

F/CDD/004 Rev.00.dt.20.03.2020

# FACULTY OF ENGINEERING AND TECHNOLOGY

# **OUTCOME BASED EDUCATION**

**Curriculum and Syllabus** 

B.Tech (Mechanical Engineering) (Full Time)

2022

DEPARTMENT OF MECHANICAL ENGINEERING B.Tech Mechanical Engineering - 2022 Regulation



# **VISION AND MISSION**

# **Department**

# Vision:

To educate, nurture and motivate the upcoming Engineering professionals with moral and ethical values to become a committed punctilious Engineers to the Nation.

## **Mission:**

M1: Providing quality education through well structured curricula supplemented with practical training, guest lectures by eminent professionals, field visits to leading industries and also in-plant training.

M2: Enhancing skills through faculty development programmes.

M3: Providing ambience for innovative projects and extra-curricular activities

M4: Equipping the department with contemporary infra-structure and the state of art R&D centre to cater to the needs of research scholars and industries

**M5:** Providing training to students in emerging areas like robotics and CAD/CAM.

M6: Nurturing students having creative ideas to adopt innovative projects which can be subsequently commercialized.



# **PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)**

- PEO1: Graduates will learn and utilize the basics of science and engineering knowledge to excel in their Industrial, Academic, Research and entrepreneurship career.
- PEO2: Graduates will contribute to the society as technically educated, ethical and responsible citizens with proven expertise.
- PEO3: Graduates will fulfil their goals with thrive to pursue lifelong learning with creativity and innovation.



# PROGRAM OUTCOMES

# **Engineering Graduates will be able to:**

**PO1: Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2: Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3: Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4: Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5: Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO6:The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7: Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.



**PO8: Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9: Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10: Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11: Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12: Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.



# **Programme Specific Outcomes**

- **PSO1**: Students will have knowledge of Mechanics of Fluids, Thermal Energy and their applications.
- **PSO2**: Students will learn to design Mechanisms and Mechanical Components.
- **PSO3:** Students will learn the various concepts of Manufacturing in Industrial scenario.
- **PSO4:** Students will be exposed to multi disciplinary subjects in Engineering field.



#### Table1: Components of Curriculum and Credit distribution for E&T Programmes

| Course                       | Description    |          |         |       | Credit     | Contact |
|------------------------------|----------------|----------|---------|-------|------------|---------|
| Component                    |                | No of    |         |       | Weight age | hours   |
|                              |                | Courses  | Credits | Total | (%)        |         |
| Basic Science                | Theory         | 6        | 22      | 28    | 17         | 240     |
| Dusie Science                | Lab            | 0        |         | 20    | 17         | 90      |
|                              | ETL            | 2        | 6       |       |            | 120     |
| Engineering Science          | Theory         | 0        |         | 03    | 1.8        | 60      |
| Engineering Science          | Lab            | 0        |         | 05    | 1.0        | 00      |
|                              | ETL            | 1        | 3       |       |            |         |
| Humanities and               | Theory         | 3        | 3       | 10    | 6.0        | 90      |
| Social Science               | Lab            | 1        | 1       | 10    | 0.0        | 30      |
|                              | ETL            | 0        | 0       |       |            |         |
| Program Core                 | Theory         | 15       | 53      | 71    | 42.8       | 720     |
|                              | Lab            | 9        | 09      |       |            | 405     |
|                              | ETL            | 3        | 09      |       |            | 180     |
| Program Electives            |                | 5        | 15      | 15    | 9.0        | 225     |
| Open Elective                | Theory         | 2        | 6       | 07    | 4.2        | 90      |
|                              | Lab            | 1        | 1       |       |            | 45      |
| Inter-disciplinary           | Theory         | 3        | 9       | 14    | 8.4        | 90      |
|                              | Lab            | 2        | 2       |       |            | 90      |
|                              | ETL            | 4        | 3       |       |            | 150     |
| Skill Component              |                | 05       | 05      | 05    | 3.0        | 150     |
| Online course                | Theory         | 1        | 1       | 1     | 0.6        | 15      |
| Internship/                  |                | 1        | 1       |       |            | 15      |
| <b>Project / Orientation</b> |                | 2        | 10      | 12    | 7.2        | 90      |
| to Entre& Project            |                | 1        | 1       |       |            | 30      |
|                              |                |          |         |       |            | 1.5     |
| Others if any                | The Indian     | 1        | 0       | 0     |            | 15      |
|                              | Constitution/E |          |         |       |            |         |
|                              | nvironmental   |          |         |       |            |         |
|                              | TOTAL          | <u> </u> | 166     | 166   | 1000/      | 2040    |
|                              | IUIAL          | 60       | 100     | 100   | 100%       | 2940    |

Note:

**Basic Science:** Mathematics, Physics and Chemistry.

**Engineering Science: Engineering Graphics, Basics of Mechanical and Civil Engineering, Basics of Electrical and Electronics Engineering,** C Programming and MS office tools, Python Programming

Humanities and Social sciences:

English, Foreign language, Environmental Studies, Management, Entrepreneurship, Indian Constitution and Indian Traditional Knowledge, Universal Human Values.

#### **Skill Component:**

Technical Skill, Soft Skill, internship.

Note:

Following categories should be available in the mapping page of each subject

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#### Table 2: Revision/modification done in syllabus content:

| S. | Course    | Course      | Concept/                       | Concept/topic added in the           | % of              |
|----|-----------|-------------|--------------------------------|--------------------------------------|-------------------|
| No | (Subject) | (Subject)   | topic if any, removed          | new curriculum                       | <b>Revision</b> / |
|    | Code      | Name        | in current Curriculum          |                                      | Modificat         |
|    |           |             |                                |                                      | ion done          |
| 1. |           |             | Unit-IV- Cetane and            | Unit-IV- Stages of combustion in     |                   |
|    |           |             | Octane numbers of fuels,       | IC engines- Knocking and             |                   |
|    | EBME22007 |             | Combustion Knocking            | Detonation- factors affecting        | 20%               |
|    | LDML22007 |             | and Detonation                 | knocking_ignition delay_factors      | 2070              |
|    |           | Thormal     | Securating Value and           | affecting ignition delay             |                   |
|    |           |             | Scavenging, valve and          | affecting fightion delay-            |                   |
|    |           | Engineering | port timing diagrams, Fuel     | Supercharging and turbo charging-    |                   |
|    |           |             | supply, Ignition, Cooling      | various types of loading devices.    |                   |
|    |           |             | and Lubrication System         |                                      |                   |
|    |           |             | Performance & Testing-         |                                      |                   |
|    |           |             | Heat balance calculations.     |                                      |                   |
| 2. | EBME22ET1 | Engineering | Unit –I & Unit-II              | Unit-I& Unit-II Combined- legal      |                   |
|    |           | Metrology   | Combined                       | metrology- Calibration -             |                   |
|    |           |             |                                | Interchangeability and selective     |                   |
|    |           |             |                                | assembly                             |                   |
|    |           |             |                                | internal and External screw threads- |                   |
|    |           |             | Unit-III changed as Unit-      | Measurements of various elements     |                   |
|    |           |             | 11: Form measurement           | of thread, Best size wire - Two and  |                   |
|    |           |             |                                | three wire method.                   |                   |
|    |           |             |                                | Gears - Constant chord method -      |                   |
|    |           |             |                                | Base tangent method.                 |                   |
|    |           |             |                                | definitions                          |                   |
|    |           |             |                                | - Measurement of Surface Texture -   | 40%               |
|    |           |             |                                | Methods - Evaluation of Surface      |                   |
|    |           |             |                                | finish.                              |                   |
|    |           |             | Unit-V: Measurement of         | UNIT V: MEASUREMENT OF               |                   |
|    |           |             | Power, Flow and                | POWER, FLOW AND                      |                   |
|    |           |             | <b>Temperature- Introduced</b> | TEMPERATURE                          |                   |
|    |           |             | as new Unit                    | Force, torque, power :-mechanical,   |                   |
|    |           |             |                                | pneumatic, hydraulic and electrical  |                   |
|    |           |             |                                | type-Flow measurement: Venturi,      |                   |
|    |           |             |                                | Tomporatura: himatallia strip        |                   |
|    |           |             |                                | pressure thermometers                |                   |
|    |           |             |                                | thermocouples. electrical            |                   |
|    |           |             |                                | resistance thermister.               |                   |
| 3  | EBME22010 | Design of   | Unit-I Content expanded.       | The following topics are newly       |                   |
|    |           | Machine     |                                | included                             |                   |
|    |           | Elements-I  |                                | UNIT- I: Design for Variable         |                   |
|    |           |             |                                | loading -Gerber line, Goodman's      |                   |
|    |           |             |                                | line, and Soderberg's Line           |                   |
|    |           |             |                                | Unit-II: Keys- different types of    | 50%               |
|    |           |             |                                | keys- Design of Keys, keyways,       |                   |
|    |           |             |                                | tailures of keys                     |                   |
| 1  |           | 1           |                                | Unit-III: Functions of springs-      |                   |



|   |           |                                     |   | applications- spring materials-<br>Belleville springs (disc) and<br>torsion Spring<br><b>Unit-IV:</b> Threaded fasteners-<br>stress in screwed threads, Bolted<br>joints including eccentric loading-<br>Welded Joints -merits and demerits<br>of welded joints, Types of welded<br>Joints, Weld symbols, Strength of<br>parallel and fillet weld, strength of<br>a welded joint, eccentrically loaded<br>Welded joints.<br><b>Unit-V:</b> Lubrication in journal<br>bearings - Types of fly wheels-<br>Design of flywheels involving<br>stresses in rim and arm |     |
|---|-----------|-------------------------------------|---|--|-----|
| 4 | EBME22ET2 | Manufacturing<br>Technology-II      | UNIT- V: POWDER<br>METALLURGY AND<br>PRECISION ENGINEERING<br>Powder metallurgy –<br>production of metal<br>powders, compaction,<br>sintering, selective laser<br>sintering, finishing of<br>sintered parts. Precision<br>machining and micro<br>machining – diamond<br>turning of parts to<br>nanometer accuracy, stereo<br>microlithography,<br>machining of micronized<br>components | UNIT- V: SMART<br>MANUFACTURING<br>Industry 4.0, Cyber Physical<br>system, IoT and Cloud computing<br>for manufacturing,<br>Digital manufacturing, Additive<br>manufacturing, Sustainable<br>manufacturing, advanced<br>simulation, Augmented reality<br><u>Lab Components</u><br>Additive manufacturing: Simple<br>components design, slicing and<br>fabrication using FDM machine  | 20% |
| 5 | EBME22011 | Heat and Mass<br>Transfer           |   | Unit-IV: Heat exchangers-<br>Classifications, parallel, counter and<br>cross flow- Fouling factors- LMTD<br>and NTU methods<br>Unit-V: <b>Basic Concepts</b><br>Equimolar counter diffusion –<br>isothermal evaporation.<br><b>Convective Mass Transfer</b><br>Sherwood number, Schmidt<br>number, Stanton number- mass<br>transfer coefficients- Laminar,<br>turbulent and Laminar-turbulent<br>conditions.   | 20% |
| 6 | EBME22013 | Design of<br>Machine<br>Elements-II | <b>Uint-V: DESIGN OF</b><br><b>SIMPLE MECHANISMS</b><br>Design of Ratchet and<br>pawl mechanism, Geneva<br>mechanism.   | The following topics are newly<br>included<br>UNIT II: Tooth stresses –Dynamic<br>effects-Fatigue strength-Factor of<br>Safety-Gear materials- Equivalent<br>number of teeth – Forces for<br>helical gears.<br>UNIT- V: CLUTCHES AND   | 30% |

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| 10     EBCS22IDX     Microprocessor<br>Architecture<br>and Embedded<br>Programming     New course has been introduced<br>Programming     100%       8     EBMA22008     Mathematics-<br>Interfigance<br>and Statistics)     New course has been introduced<br>Programming     100%       9     EBCS22IDX     Artificial<br>Intelligence<br>and Machine<br>Learning     New course has been introduced     100%       10     EBCS22IDX     Artificial<br>Intelligence<br>and Machine<br>Learning     New course has been introduced     100%       11     EBME22ET3     Artificial<br>Machine     New course has been introduced     100%       11     EBME22ET3     Virtual and<br>Achine<br>Learning Lab     New course has been introduced     100%       12     EBME22ET3     Virtual and<br>Acanceal to<br>Reality     UNIT     Included in UNIT IV<br>Flexible fuel vehicles-<br>nordications-merits and<br>demerits     20%       13     EBME22E03     Automobile<br>Engineering     Electric course has<br>been introduced     New Elective course has<br>been introduced     100%       14     EBME22E15     Design Thinking<br>and Innovation     New Elective course has<br>been introduced     Shifted from programme<br>Elective   |    |            |                         |                    | BRAKES                             |       |
|--|----|------------|-------------------------|--------------------|------------------------------------|-------|
| 10       EBCS22IDX       Microprocessor<br>Architecture<br>and Embedded<br>Programming       New course has been introduced<br>Programming       100%         8       EBMA22008       Mathematics-<br>IV (Probability<br>and Statistics)       New course has been introduced<br>Programming       100%         9       EBCS22IDX       Artificial<br>Intelligence<br>and Machine<br>Learning       New course has been introduced<br>Intelligence<br>and Machine       100%         10       EBCS22IDX       Artificial<br>Intelligence<br>and Machine       New course has been introduced<br>Intelligence       100%         11       EBME22ET3       Virual and<br>Augmented<br>Reality       New course has been introduced<br>Introduced       100%         12       EBME22ED1<br>(ELECTIVE)       Advanced IC<br>Engines       UNIT       Included in UNIT       10         13       EBME22ED3       Fleetric and<br>Hybrid vehicles       UNIT       V: RECENT<br>TRENDS       New Elective course has<br>been introduced       20%         14       EBME22ED15       Adviewed       Shifted from programme<br>Core to programme<br>Elective       Shifted from programme<br>Elective       New Elective course has<br>been introduced   |    |            |                         |                    | Design of plate clutches -Cone     |       |
| Image: Section of the section of t  |    |            |                         |                    | clutches – Centrifugal clutches-   |       |
| and Block brakes - External shoe<br>brakes - Internal expanding shoe       7     EBEC22IDX<br>Architecture<br>and Embedded<br>Programming     Microprocessor<br>Architecture<br>and Embedded<br>Programming     New course has been introduced       8     EBMA22008     Mathematics-<br>IV (Probability<br>and Statistics)     New course has been introduced     100%       9     EBCS22IDX     Artificial<br>Intelligence<br>and Machine<br>Learning     New course has been introduced     100%       10     EBCS22IDX     Artificial<br>Intelligence<br>and Machine<br>Learning     New course has been introduced     100%       11     EBME22ET3     Virual and<br>Augmented<br>Reality     New course has been introduced     100%       11     EBME22ET3     Advanced IC<br>Engines     UNIT     New course has been introduced     100%       12     EBME22E01     Advanced IC<br>Engines     UNIT     V:     RECENT     20%       13     EBME22E03     Automobile<br>Engineering     UNIT     V:     Recells-types-<br>construction and working.     New Elective course has<br>been introduced       14     EBME22E15     Design Thinking<br>and Innovation     Shifted from programme<br>core to programme<br>Elective     New Elective course has<br>been introduced     In  |    |            |                         |                    | Electromagnetic clutches. Band     |       |
| 1       EBEC22IDX       Microprocessor<br>Architecture<br>and Embedded<br>Programming       New course has been introduced         8       EBMA22008       Mathematics-<br>IV (Probability<br>and Statistics)       New course has been introduced       100%         9       EBCS22IDX       Artificial<br>Intelligence<br>and Machine<br>Learning       New course has been introduced       100%         10       EBCS22IDX       Artificial<br>Intelligence<br>and Machine       New course has been introduced       100%         11       EBME22ET3       Virtual and<br>Augmented<br>Reality       New course has been introduced       100%         12       EBME22ET3       Virtual and<br>Augmented<br>Reality       New course has been introduced       100%         12       EBME22EO1       Advanced IC<br>Engines       UNIT       IV:<br>INIT       Included in UNIT IV<br>ALTERNATIVE FUELS       Included in UNIT IV<br>Flexible fuel vehicles-<br>nodifications-merits and<br>demerits       20%         13       EBME22E02       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       New Elective course has<br>been introduced         14       EBME22E03       Automobile<br>Engineering       Shifted from programme<br>core to programme<br>elective       New Elective course has<br>been introduced   |    |            |                         |                    | and Block brakes. External shoe    |       |
| Total States     Internal expanding since       7     EBEC22IDX     Microprocessor<br>Architecture<br>and Embedded<br>Programming     New course has been introduced       8     EBMA22008     Mathematics-<br>IV (Probability<br>and Statistics)     New course has been introduced       9     EBCS22IDX     Artificial<br>Intelligence<br>and Machine<br>Learning     New course has been introduced     100%       10     EBCS22ILX     Artificial<br>Intelligence<br>and Machine     New course has been introduced     100%       11     EBME22ED1     Artificial<br>Reality     New course has been introduced     100%       11     EBME22ED1     Advanced IC<br>Reality     UNIT     New course has been introduced     100%       12     EBME22ED1     Advanced IC<br>Eggines     UNIT     V:     Included in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits     20%       13     EBME22E02     Electric and<br>Hybrid vehicles     New Elective course has<br>been introduced     20%       14     EBME22E15     Design Thinking<br>and Innovation     Shifted from programme<br>core to programme<br>Elective course has<br>been introduced     New Elective course has<br>been introduced   |    |            |                         |                    | hulter Internal expanding shoe     |       |
| 7     EBEC22IDX     Microprocessor<br>Architecture<br>and Embedded<br>Programming     New course has been introduced<br>New course has been introduced       8     EBMA22008     Mathematics-<br>IV (Probability<br>and Statistics)     New course has been introduced     100%       9     EBCS22IDX     Artificial<br>Intelligence<br>and Machine<br>Learning     New course has been introduced     100%       10     EBCS22ILX     Artificial<br>Intelligence<br>and Machine<br>Learning     New course has been introduced     100%       11     EBME22E13     Artificial<br>Machine     New course has been introduced     100%       11     EBME22E01     Artificial<br>Intelligence<br>and Machine     New course has been introduced     100%       12     EBME22E01     Advanced IC<br>(ELECTIVE)     UNIT     IV:     Included in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits     20%       13     EBME22E02     Electric and<br>Hybrid vehicles     New Elective course has<br>been introduced     New Elective course has<br>been introduced       14     EBME22E15     Design Thinking<br>and Innovation     Shifted from programme<br>Elective     New Elective course has<br>been introduced     New Elective course has<br>been introduced   |    |            |                         |                    | brakes – internai expanding shoe   |       |
| 7       EBEC22IDX       Microprocessor<br>Architecture<br>and Embedded<br>Programming       New course has been introduced         8       EBMA22008       Mathematics-<br>IV (Probability<br>and Statistics)       New course has been introduced       100%         9       EBCS22IDX       Artificial<br>Intelligence<br>and Machine<br>Learning       New course has been introduced       100%         10       EBCS22ILX       Artificial<br>Intelligence<br>and Machine       New course has been introduced       100%         11       EBME22ET3       Virtual and<br>Agumented<br>Reality       New course has been introduced       100%         12       EBME22ET3       Virtual and<br>Agumented<br>Reality       UNIT       Included in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         13       EBME22E02       Electric and<br>Hybrid vehicles       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       New course has<br>been introduced         14       EBME22E15       Design Thinking<br>and Innovation       Shifted from programme<br>Elective       Shifted from programme<br>Elective course has<br>been introduced       New Elective course has<br>been introduced   |    |            |                         |                    | brake.                             |       |
| Architecture<br>and Embedded<br>Programming       100%         8       EBMA22008       Mathematics-<br>IV (Probability<br>and Statistics)       New course has been introduced       100%         9       EBCS22IDX       Artificial<br>Intelligence<br>and Machine<br>Learning       New course has been introduced       100%         10       EBCS22ILX       Artificial<br>Intelligence<br>and Machine<br>Learning Lab       New course has been introduced       100%         11       EBME22ET3       Virtual and<br>Augmented<br>Reality       New course has been introduced       100%         12       EBME22E01       Advanced IC<br>(ELECTIVE)       UNIT       IV:<br>Reality       Included in UNIT IV<br>ALTERNATIVE FUELS       Included in UNIT IV<br>Flexible fuel vehicles-<br>- series, parallel and series,<br>parallel configuration – Design –<br>Drive train, sizing of<br>components. Fuel cells-types-<br>construction and working.         13       EBME22E02       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       New Elective course has<br>been introduced         14       EBME22E05       Automobile<br>Engineering<br>and Innovation       Shifted from programme<br>core to programme<br>Elective       Shifted from programme<br>core to programme<br>Elective         15       EBME22E15       Design Thinking<br>and Innovation       New Elective course has<br>been introduced       New Elective course has<br>been introduced   | 7  | EBEC22IDX  | Microprocessor          |                    | New course has been introduced     |       |
| and Embedded<br>Programming     100%       8     EBMA22008     Mathematics-<br>IV (Probability<br>and Statistics)     New course has been introduced       9     EBCS22IDX     Artificial<br>Intelligence<br>and Machine<br>Learning     New course has been introduced       10     EBCS22ILX     Artificial<br>Intelligence<br>and Machine<br>Learning     New course has been introduced       11     EBME22ET3     Virtual and<br>Augmented<br>Reality     New course has been introduced       11     EBME22ET3     Virtual and<br>Augmented<br>Reality     New course has been introduced     100%       12     EBME22E01     Advanced IC<br>(ELECTIVE)     UNIT     Intelligence<br>and Machine     New course has been introduced     100%       13     EBME22E02     Electric and<br>Hybrid vehicles     UNIT     V: RECENT<br>TRENDS     New Elective course has<br>been introduced     20%       13     EBME22E03     Automobile<br>Engineering     New Elective course has<br>been introduced     New Elective course has<br>been introduced       14     EBME22E105     Automobile<br>Engineering     Shifted from programme<br>Elective     Shifted from programme<br>Elective   |    |            | Architecture            |                    |                                    |       |
| Image: second statistics     Programming     Image: second statistics     New course has been introduced     100%       9     EBCS22IDX     Artificial Intelligence and Machine Learning     New course has been introduced     100%       10     EBCS22ILX     Artificial Intelligence and Machine Learning     New course has been introduced     100%       11     EBME22ET3     Virtual and Achine Learning Lab     New course has been introduced     100%       11     EBME22ET3     Virtual and Achine Learning Lab     New course has been introduced     100%       12     EBME22E01     Advanced IC     UNIT     Included in UNIT IV     20%       12     EBME22E01     Advanced IC     UNIT     Included in UNIT IV     20%       13     EBME22E02     Electric and Hybrid vehicles     New Elective course has been introduced     20%       14     EBME22E03     Automobile Engineering     New Elective course has been introduced     100%       14     EBME22E02     Electric and Hybrid vehicles     New Elective course has been introduced     10%       15     EBME22E15     Design Thinking and Innovation     New Elective course has been introduced     10%  |    |            | and Embedded            |                    |                                    | 100%  |
| 8       EBMA22008       Mathematics-<br>IV (Probability<br>and Statistics)       New course has been introduced       100%         9       EBCS22IDX       Artificial<br>Intelligence<br>and Machine<br>Learning       New course has been introduced       100%         10       EBCS22ILX       Artificial<br>Intelligence<br>and Machine<br>Learning Lab       New course has been introduced       100%         11       EBCS22ILX       Artificial<br>Intelligence<br>and Machine<br>Learning Lab       New course has been introduced       100%         11       EBME22ET3       Virtual and<br>Augmented<br>Reality       New course has been introduced       100%         12       EBME22E01       Advanced IC<br>(ELECTIVE)       UNIT       IV:<br>Engines       Included in UNIT IV<br>ALTERNATIVE FUELS       Included in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         13       EBME22E02       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       New Elective course has<br>been introduced         14       EBME22E03       Automobile<br>Engineering       Shifted from programme<br>core to programme<br>Elective       New Elective course has<br>been introduced         15       EBME22E15       Design Thinking<br>and Innovation       New Elective course has<br>been introduced       New Elective   |    |            | Programming             |                    |                                    |       |
| 1       IV (Probability<br>and Statistics)       100%         9       EBCS22IDX       Artificial<br>Intelligence<br>and Machine<br>Learning       New course has been introduced       100%         10       EBCS22ILX       Artificial<br>Intelligence<br>and Machine<br>Learning Lab       New course has been introduced       100%         11       EBME22ET3       Virtual and<br>Augmented<br>Reality       New course has been introduced       100%         12       EBME22E01       Advanced IC<br>Engines       UNIT       New course has been introduced       100%         12       EBME22E01       Advanced IC<br>Reality       UNIT       Included in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         13       EBME22E02       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       New Elective course has<br>been introduced         14       EBME22E15       Design Thinking<br>and Innovation       Shifted from programme<br>core to programme<br>Elective       Shifted from programme<br>core to programme<br>elective       New Elective course has<br>been introduced  | 8  | EBMA22008  | Mathematics-            |                    | New course has been introduced     |       |
| 9       EBCS22IDX       Artificial<br>Intelligence<br>and Machine<br>Learning       New course has been introduced       100%         10       EBCS22ILX       Artificial<br>Intelligence<br>and Machine<br>Learning       New course has been introduced       100%         11       EBCS22ILX       Artificial<br>Intelligence<br>and Machine<br>Learning Lab       New course has been introduced       100%         11       EBME22E03       Virtual and<br>Augmented<br>Reality       New course has been introduced       100%         12       EBME22E01       Advanced IC<br>Engines       UNIT       IV:<br>ALTERNATIVE FUELS       Included in UNIT       20%         13       EBME22E02       Electric and<br>Hybrid vehicles       UNIT       V:<br>RENDS       New Elective course has<br>been introduced       20%         14       EBME22E03       Automobile<br>Engineering       Electric and<br>Hybrid vehicles       Shifted from programme<br>core to programme<br>Elective       Shifted from programme<br>core to programme<br>Elective       New Elective course has<br>been introduced   | U  |            | IV (Probability         |                    |                                    | 100%  |
| 9       EBCS22IDX       Artificial<br>Intelligence<br>and Machine<br>Learning       New course has been introduced       100%         10       EBCS22ILX       Artificial<br>Intelligence<br>and Machine<br>Learning Lab       New course has been introduced       100%         11       EBME22ET3       Virtual and<br>Augmented<br>Reality       New course has been introduced       100%         12       EBME22E01<br>(ELECTIVE)       Advanced IC<br>Engines       UNIT       IV:<br>ALTERNATIVE FUELS       Included in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         13       EBME22E02       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       20%         14       EBME22E03       Automobile<br>Engineering       Shifted from programme<br>core to programme<br>Elective       Shifted from programme<br>core to programme<br>Elective       Shifted from programme<br>core to programme<br>Elective  |    |            | and Statistics)         |                    |                                    | 10070 |
| 9       EBCS22IDX       Artrictal<br>Intelligence<br>and Machine<br>Learning       New course has been introduced       100%         10       EBCS22ILX       Artificial<br>Intelligence<br>and Machine<br>Learning Lab       New course has been introduced       100%         11       EBME22ET3       Virtual and<br>Augmented<br>Reality       New course has been introduced       100%         12       EBME22E01       Advanced IC<br>(ELECTIVE)       UNIT       Included in UNIT IV<br>Engines       Included in UNIT IV<br>ALTERNATIVE FUELS       Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         13       EBME22E02       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       New Elective course has<br>been introduced         14       EBME22E15       Design Thinking<br>and Innovation       Shifted from programme<br>core to programme<br>Elective       Shifted from programme<br>core to programme<br>Elective   | 0  | EDCCOMINY  |                         |                    | Norman and the base in the days of |       |
| 10       EBCS22ILX       Artificial<br>Intelligence<br>and Machine<br>Learning       New course has been introduced       100%         10       EBCS22ILX       Artificial<br>Intelligence<br>and Machine<br>Learning Lab       New course has been introduced       100%         11       EBME22ET3       Virtual and<br>Augmented<br>Reality       New course has been introduced       100%         12       EBME22E01       Advanced IC<br>Engines       UNIT       Included in       UNIT       10         12       EBME22E01       Advanced IC<br>Engines       UNIT       V:       RECENT       Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         13       EBME22E02       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       New Elective course has<br>been introduced         14       EBME22E15       Design Thinking<br>and Innovation       New Elective course has<br>been introduced       New Elective course has<br>been introduced   | 9  | EBCS22IDX  | Artificial              |                    | New course has been introduced     | 1000/ |
| 10       EBCS22ILX       Artificial<br>Intelligence<br>and Machine<br>Learning Lab       New course has been introduced       100%         11       EBME22ET3       Virtual and<br>Augmented<br>Reality       New course has been introduced       100%         12       EBME22E01       Advanced IC<br>Engines       UNIT       IV:<br>ALTERNATIVE FUELS       Included in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         11       EBME22E01       Advanced IC<br>Engines       UNIT V: RECENT       Included in UNIT IV<br>Flexible fuel vehicles-<br>rostrics, parallel and series,<br>parallel configuration – Design –<br>Drive train, sizing of<br>components. Fuel cells-types-<br>construction and working.       20%         13       EBME22E03       Automobile<br>Engineering       New Elective course has<br>been introduced       New Elective course has<br>been introduced         14       EBME22E15       Design Thinking<br>and Innovation       Shifted from programme<br>core to programme<br>Elective       New Elective course has<br>been introduced   |    |            | Intelligence            |                    |                                    | 100%  |
| 10       EBCS22ILX       Artificial<br>Intelligence<br>and Machine<br>Learning Lab       New course has been introduced       100%         11       EBME22ET3       Virtual and<br>Augmented<br>Reality       New course has been introduced       100%         12       EBME22E01<br>(ELECTIVE)       Advanced IC<br>Engines       UNIT       INC       Included in UNIT       1V         12       EBME22E01<br>(ELECTIVE)       Advanced IC<br>Engines       UNIT       V:<br>ALTERNATIVE FUELS       Included in UNIT       20%         13       EBME22E02       Electric and<br>Hybrid vehicles       UNIT       Reality       New Elective course has<br>been introduced       100%         14       EBME22E03       Automobile<br>Engineering       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       Shifted from programme<br>core to programme<br>elective       New Elective course has<br>been introduced  |    |            | and Machine             |                    |                                    |       |
| 10       EBCS22ILX       Artificial<br>Intelligence<br>and Machine<br>Learning Lab       New course has been introduced       100%         11       EBME22ET3       Virtual and<br>Augmented<br>Reality       New course has been introduced       100%         12       EBME22E01       Advanced IC       UNIT       Included in UNIT IV       Included in UNIT IV         (ELECTIVE)       Engines       UNIT       V: RECENT<br>TRENDS       Include of the vehicles-<br>modifications-merits and<br>demerits       20%         13       EBME22E02       Electric and<br>Hybrid vehicles       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       New Elective course has<br>been introduced         14       EBME22E03       Automobile<br>Engineering       Electric and<br>Hybrid vehicles       Shifted from programme<br>core to programme<br>Elective       Shifted from programme<br>Elective       Intelligence<br>introduced         15       EBME22E15       Design Thinking<br>and Innovation       New Elective course has<br>been introduced       New Elective course has<br>been introduced       Intelligence<br>introduced   |    |            | Learning                |                    |                                    |       |
| Intelligence<br>and Machine<br>Learning LabIntelligence<br>and Machine<br>Learning Lab100%11EBME22ET3Virtual and<br>Augmented<br>RealityNew course has been introduced100%12EBME22E01<br>(ELECTIVE)Advanced IC<br>EnginesUNITIV:<br>ALTERNATIVE FUELSIncluded in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits20%12EBME22E01<br>(ELECTIVE)Advanced IC<br>EnginesUNITV:<br>RECENT<br>TRENDSIncluded in UNIT IV<br>Flexible fuel vehicles-<br>nodifications-merits and<br>demerits20%13EBME22E02Electric and<br>Hybrid vehiclesNew Elective course has<br>been introducedNew Elective course has<br>been introduced14EBME22E15Design Thinking<br>and InnovationNew Elective course has<br>been introducedShifted from programme<br>Elective15EBME22E15Design Thinking<br>and InnovationNew Elective course has<br>been introducedNew Elective course has<br>been introduced   | 10 | EBCS22ILX  | Artificial              |                    | New course has been introduced     |       |
| and Machine<br>Learning Laband Machine<br>Learning Laband Machine<br>Learning Laband Machine<br>Learning Lab11EBME22E13Virtual and<br>Augmented<br>RealityNew course has been introduced100%12EBME22E01<br>(ELECTIVE)Advanced IC<br>EnginesUNITIV:<br>ALTERNATIVE FUELSIncluded in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits20%12EBME22E01<br>(ELECTIVE)Advanced IC<br>EnginesUNITIV:<br>ALTERNATIVE FUELSFlexible fuel vehicles-<br>modifications-merits and<br>demerits20%13EBME22E02Electric and<br>Hybrid vehiclesNew Elective course has<br>been introducedNew Elective course has<br>been introduced14EBME22E03Automobile<br>EngineeringShifted from programme<br>core to programme<br>ElectiveShifted from programme<br>Elective15EBME22E15Design Thinking<br>and InnovationNew Elective course has<br>been introducedNew Elective course has<br>been introduced   |    |            | Intelligence            |                    |                                    | 100%  |
| 11       EBME22ET3       Virtual and<br>Augmented<br>Reality       New course has been introduced       100%         12       EBME22E01       Advanced IC<br>Engines       UNIT       IV:<br>ALTERNATIVE FUELS       Included in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         12       EBME22E01       Advanced IC<br>Engines       UNIT       V:<br>ALTERNATIVE FUELS       Included in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         13       EBME22E02       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       New Elective course has<br>been introduced         14       EBME22E15       Design Thinking<br>and Innovation       New Elective course has<br>been introduced       New Elective course has<br>been introduced  |    |            | and Machine             |                    |                                    |       |
| 11       EBME22ET3       Virtual and<br>Augmented<br>Reality       New course has been introduced       100%         12       EBME22E01       Advanced IC<br>(ELECTIVE)       UNIT       UNIT       IV:<br>ALTERNATIVE FUELS       Included in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         12       EBME22E01       Advanced IC<br>(ELECTIVE)       UNIT       V:<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         13       EBME22E02       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       New Elective<br>construction and working.         14       EBME22E03       Automobile<br>Engineering       Shifted from programme<br>core to programme<br>Elective       Shifted from programme<br>core to programme<br>Elective         15       EBME22E15       Design Thinking<br>and Innovation       New Elective course has<br>been introduced       New Elective course has<br>been introduced  |    |            | Learning Lab            |                    |                                    |       |
| 11       EBME22E13       Advanced Reality       New Course has been infroduced       100%         12       EBME22E01<br>(ELECTIVE)       Advanced IC<br>Engines       UNIT       IV:<br>ALTERNATIVE FUELS       Included in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         12       EBME22E01<br>(ELECTIVE)       Advanced IC<br>Engines       UNIT       V:<br>RECENT       Included in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         13       EBME22E02       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       New Elective course has<br>been introduced         14       EBME22E03       Automobile<br>Engineering       Shifted from programme<br>core to programme<br>Elective       New Elective course has<br>been introduced         15       EBME22E15       Design Thinking<br>and Innovation       New Elective course has<br>been introduced       New Elective course has<br>been introduced  | 11 | EBME22ET2  | Virtual and             |                    | New course has been introduced     | 100%  |
| 12       EBME22E01<br>(ELECTIVE)       Advanced IC<br>Engines       UNIT       IV:<br>ALTERNATIVE FUELS       Included in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         12       EBME22E01<br>(ELECTIVE)       Advanced IC<br>Engines       UNIT       IV:<br>ALTERNATIVE FUELS       Included in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         14       EBME22E03       Automobile<br>Engineering       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       Shifted from programme<br>core to programme<br>Elective         15       EBME22E15       Design Thinking<br>and Innovation       New Elective course has<br>been introduced       New Elective course has<br>been introduced   | 11 | EDME22E13  | Augmented               |                    | New course has been introduced     | 100%  |
| 12       EBME22E01<br>(ELECTIVE)       Advanced IC<br>Engines       UNIT       IV:<br>ALTERNATIVE FUELS       Included in UNIT IV<br>Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         12       EBME22E01<br>(ELECTIVE)       AUTORNATIVE FUELS       Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         UNIT       V:       RECENT<br>TRENDS       UNIT V: Hybrid electrical vehicles<br>– series, parallel and series,<br>parallel configuration – Design –<br>Drive train, sizing of<br>components. Fuel cells-types-<br>construction and working.       0         13       EBME22E02       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       New Elective course has<br>been introduced         14       EBME22E03       Automobile<br>Engineering       Shifted from programme<br>core to programme<br>Elective       New Elective course has<br>been introduced         15       EBME22E15       Design Thinking<br>and Innovation       New Elective course has<br>been introduced       New Elective   |    |            | Reality                 |                    |                                    |       |
| 12       EDME22E01       Instance ite       OTH PT.       Included in OTH PV.       20%         (ELECTIVE)       Engines       ALTERNATIVE FUELS       Flexible fuel vehicles-<br>modifications-merits and<br>demerits       20%         UNIT       V: RECENT       UNIT V: Hybrid electrical vehicles       20%         parallel configuration – Design –<br>Drive train, sizing of<br>components. Fuel cells-types-<br>construction and working.       0         13       EBME22E02       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced       0         14       EBME22E03       Automobile<br>Engineering       Shifted from programme<br>core to programme<br>Elective       New Elective course has<br>been introduced         15       EBME22E15       Design Thinking<br>and Innovation       New Elective course has<br>been introduced       1   | 12 | EBME22E01  | Advanced IC             | LINIT IV:          | Included in UNIT IV                |       |
| Image: Section of the section of th                | 14 | (FLECTIVE) | Engines                 | AI TEDNATIVE FUELS | Flavible fuel vehicles             | 20%   |
| ImponingImponingImponingImponingUNIT V: RECENT<br>TRENDSUNIT V: Hybrid electrical vehicles<br>– series, parallel and series,<br>parallel configuration – Design –<br>Drive train, sizing of<br>components. Fuel cells-types-<br>construction and working.13EBME22E02Electric and<br>Hybrid vehiclesNew Elective course has<br>been introduced14EBME22E03Automobile<br>EngineeringShifted from programme<br>core to programme<br>Elective15EBME22E15Design Thinking<br>and InnovationNew Elective course has<br>been introduced   |    | (LLLCIIVL) | Zingines                | ALTERNATIVEFUELS   | medifications manite and           | 2070  |
| Image: Construction and working.Image: Construction and working.13EBME22E02Electric and<br>Hybrid vehiclesNew Elective course has<br>been introduced14EBME22E03Automobile<br>EngineeringShifted from programme<br>Elective15EBME22E15Design Thinking<br>and InnovationNew Elective course has<br>been introduced   |    |            |                         |                    | mounications-ments and             |       |
| Image: Construction of the con |    |            |                         |                    |                                    |       |
| Image: Figure 10 and series, parallel and series, parallel configuration – Design –<br>Drive train, sizing of<br>components. Fuel cells-types-<br>construction and working.13EBME22E02Electric and<br>Hybrid vehiclesNew Elective course has<br>been introduced14EBME22E03Automobile<br>EngineeringShifted from programme<br>core to programme<br>Elective15EBME22E15Design Thinking<br>and InnovationNew Elective course has<br>been introduced   |    |            |                         | UNIT V: RECENT     | UNIT V: Hybrid electrical vehicles |       |
| Image: space of the systemImage: space of the systemImage: space of the system13EBME22E02Electric and<br>Hybrid vehiclesNew Elective course has<br>been introduced14EBME22E03Automobile<br>EngineeringShifted from programme<br>core to programme<br>Elective15EBME22E15Design Thinking<br>and InnovationNew Elective course has<br>been introduced  |    |            |                         | TRENDS             | – series, parallel and series,     |       |
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| Image: Components of the second sec |    |            |                         |                    | Drive train, sizing of             |       |
| 13EBME22E02Electric and<br>Hybrid vehiclesNew Elective course has<br>been introduced14EBME22E03Automobile<br>EngineeringShifted from programme<br>core to programme<br>Elective15EBME22E15Design Thinking<br>and InnovationNew Elective course has<br>been introduced  |    |            |                         |                    | components Fuel cells_types_       |       |
| 13EBME22E02Electric and<br>Hybrid vehiclesNew Elective course has<br>been introduced14EBME22E03Automobile<br>EngineeringShifted from programme<br>core to programme<br>Elective15EBME22E15Design Thinking<br>and InnovationNew Elective course has<br>been introduced  |    |            |                         |                    | components. I der cens-types-      |       |
| 13       EBME22E02       Electric and<br>Hybrid vehicles       New Elective course has<br>been introduced         14       EBME22E03       Automobile<br>Engineering       Shifted from programme<br>core to programme<br>Elective         15       EBME22E15       Design Thinking<br>and Innovation       New Elective course has<br>been introduced   |    |            |                         |                    | construction and working.          |       |
| 14     EBME22E03     Automobile<br>Engineering     Shifted from programme<br>core to programme<br>Elective       15     EBME22E15     Design Thinking<br>and Innovation     New Elective course has<br>been introduced   | 13 | EBME22E02  | Electric and            |                    | New Elective course has            |       |
| 14     EBME22E03     Automobile<br>Engineering     Shifted from programme<br>core to programme<br>Elective       15     EBME22E15     Design Thinking<br>and Innovation     New Elective course has<br>been introduced       EBME22E10     Additive  |    |            | Hybrid vehicles         |                    | been introduced                    |       |
| 14     EBME22E03     Automobile<br>Engineering     Shifted from programme<br>core to programme<br>Elective       15     EBME22E15     Design Thinking<br>and Innovation     New Elective course has<br>been introduced       EBME22E10     Additive  |    |            |                         |                    |                                    |       |
| Engineering     core to programme<br>Elective       15     EBME22E15       Design Thinking<br>and Innovation     New Elective course has<br>been introduced  | 14 | EBME22E03  | Automobile              |                    | Shifted from programme             |       |
| EBME22E15     Design Thinking<br>and Innovation     Elective       EDME22E10     Additive  |    |            | Engineering             |                    | core to programme                  |       |
| 15     EBME22E15     Design Thinking<br>and Innovation     New Elective course has<br>been introduced       EDME22E10     Additive   |    |            | 6                       |                    | Elective                           |       |
| Internation     Internation       EDME22E10     Additive   | 15 | EBME22E15  | Design Thinking         |                    | New Elective course has            |       |
|  |    |            | and Innovation          |                    | been introduced                    |       |
| EBNIEZ/ELY AUUUVE  |    | EBME22E10  | Additive                |                    | New Elective course has            |       |
| 16 manufacturing hoon introduced   | 16 |            | manufacturing           |                    | heen introduced                    |       |
| 10     Interference       17     EDME22E22       System     Non-Election   | 10 | EDMEODEO2  | Custom                  |                    | New Elective course has here       |       |
| 17     EDIVIEZZEZ3     System       New Elective course has been   | 1/ | EBME22E23  | System<br>Modelling and |                    | New Elective course has been       |       |
| Simulation Introduced  |    |            | Simulation              |                    | introduced                         |       |
|  | 10 |            |                         |                    | New Elective course has here       |       |
|  | 18 | EBME22E29  | Block chain             |                    | New Elective course has been       |       |
| 18     EBME22E29     Block chain     New Elective course has been  |    |            | Technology              |                    | Introduced                         |       |



# Table3: List of New courses/value added courses//life skills/Electives/interdisciplinary /courses focusing on employability/entrepreneurship/skill development

| Sl.No | New courses (Subjects)   | New<br>Courses | Value<br>added | Life skill | Electives | Inter<br>Disciplinary | Focus on<br>employability/  |
|-------|--|----------------|----------------|------------|-----------|-----------------------|-----------------------------|
|       |  |                | courses        |            |           |                       | entrepreneurs<br>hip/ skill |
|       |  |                |                |            |           |                       | development.                |
| 1     | Microprocessor Architecture and  | Yes            |                |            |           | Yes                   | Yes                         |
| 2     | Mathematics IV (Probability and  | Vac            |                |            |           |                       | Vas                         |
| 2     | Statistics)  | 105            |                |            |           |                       | 105                         |
| 3     | Artificial Intelligence and Machine<br>Learning                                | Yes            |                |            |           | Yes                   | Yes                         |
| 4     | Artificial Intelligence and Machine<br>Learning Lab                            | Yes            |                |            |           | Yes                   | Yes                         |
| 5     | Virtual and Augmented Reality  | Yes            | Yes            |            |           |                       | Yes                         |
|       | C Programming and MS office tools  | Yes            |                |            |           | Yes                   | Yes                         |
| 6     | Communicative English Lab  |                |                |            |           |                       | Yes                         |
| 7     | Python Programming   | Yes            |                |            |           | Yes                   | Yes                         |
| 8     | Technical Skill I (Internal Evaluation)  |                | Yes            | Yes        |           |                       | Yes                         |
| 9     | Soft Skill I (Career & Confidence<br>Building) (Internal Evaluation)           |                |                | Yes        |           |                       | Yes                         |
| 10    | Technical Skill II (Internal Evaluation)                                       |                | Yes            | Yes        |           |                       | Yes                         |
| 11    | Soft Skill II (Qualitative and<br>Quantitative Skills)(Internal<br>Evaluation) |                |                | Yes        |           |                       | Yes                         |
| 12    | Mini Project/In plant<br>Training/Industrial Training                          |                | Yes            | Yes        |           |                       | Yes                         |
| 13    | Technical Skill III  |                | Yes            | Yes        |           |                       | Yes                         |
| 14    | CAD/CAM Lab  |                | Yes            |            |           |                       | Yes                         |
| 15    | Design and Simulation Lab  |                | Yes            |            |           |                       | Yes                         |
| 16    | Industrial Automation  |                |                |            |           |                       | Yes                         |
| 17    | Industrial Automation Lab  |                |                |            |           |                       | Yes                         |
| 18    | Project Phase – 1  |                |                |            |           |                       |                             |
| 19    | Foreign Language (Internal<br>Evaluation)                                      |                | Yes            |            |           |                       | Yes                         |
| 20    | Project Phase – 1  |                | Yes            |            |           |                       | Yes                         |
| 21    | Electric and Hybrid vehicles   | Yes            |                |            | Yes       |                       | Yes                         |
| 22    | Design Thinking and Innovation   | Yes            |                |            | Yes       |                       | Yes                         |
| 23    | Additive manufacturing   | Yes            |                |            | Yes       |                       | Yes                         |
| 24    | System Modeling and Simulation   | Yes            |                | _          | Yes       |                       | Yes                         |
| 25    | Industry 4.0   | Yes            |                | _          | Yes       |                       | Yes                         |
| 26    | Block chain Technology   | Yes            |                |            | Yes       |                       | Yes                         |



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#### DEPARTMENT OF MECHANICAL ENGINEERING

**B.Tech. Mechanical Engineering (Full Time)** 

#### Curriculum – 2022 Regulation

#### SEMESTER I

| S.NO. | Course Code           | Course Title                                     | Ty/Lb/<br>ETL/IE | L | T/SLr | P/R | С | Category |
|-------|-----------------------|--|------------------|---|-------|-----|---|----------|
| 1     | EBEN22001             | Technical English                                | Ту               | 2 | 0/0   | 0/0 | 2 | HS       |
| 2     | EBMA22001             | Mathematics – I                                  | Ту               | 3 | 1/0   | 0/0 | 4 | BS       |
| 3     | EBPH22ET1             | Engineering Physics                              | ETL              | 2 | 0/0   | 2/0 | 3 | BS       |
| 4     | EBCH22ET1             | Engineering Chemistry                            | ETL              | 2 | 0/0   | 2/0 | 3 | BS       |
| 5     | EBEE22ET1             | Basic Electrical & Electronics<br>Engineering    | ETL              | 2 | 0/0   | 2/0 | 3 | ES       |
| 6     | EBCC22I01             | Orientation to<br>Entrepreneurship& Project lab. | IE               | 1 | 0/0   | 1/0 | 1 | ID       |
| 7     | EBCS22ET1             | C Programming and MS office tools                | ETL              | 1 | 0/0   | 2/0 | 2 | ID       |
|       | Credits Sub Total: 18 |  |                  |   |       |     |   |          |

|       | SEMESTER II |   |                  |   |       |     |   |          |  |
|-------|-------------|---|------------------|---|-------|-----|---|----------|--|
| S.NO. | Course Code | Course Title                            | Ty/Lb/<br>ETL/IE | L | T/SLr | P/R | С | Category |  |
| 1     | EBMA22003   | Mathematics – II                        | Ту               | 3 | 1/0   | 0/0 | 4 | BS       |  |
| 2     | EBPH22002   | Engineering Mechanics                   | Ту               | 3 | 0/0   | 0/0 | 3 | BS/PC    |  |
| 3     | EBCH22002   | Industrial Chemistry                    | Ту               | 3 | 0/0   | 0/0 | 3 | BS       |  |
| 4     | EBME22001   | Engineering Graphics                    | Ту               | 2 | 0/0   | 2/0 | 3 | ES/PC    |  |
| 5     | EBME22002   | Engineering Metallurgy                  | Ту               | 3 | 0/0   | 0/0 | 3 | PC       |  |
| 6     | EBCC22I02   | Communicative English Lab               | IE               | 1 | 0/0   | 1/0 | 1 | HS       |  |
| 7     | EBCS22ET2   | Python Programming                      | ETL              | 1 | 0/0   | 2/0 | 2 | ID       |  |
| 8     | EBCC22I03   | Environmental Science<br>(Audit Course) | IE               | 1 | 0/0   | 1/0 | 0 | HS       |  |

#### Credits Sub Total: 19 TOTAL CREDITS FOR I YEAR: 37

Note:

Ty/Lb/ETL/IE: Theory/Lab/Embedded Theory and lab/Internal evaluation L/T/SLr/P/R/C: Lecture/Tutorials/Supervised Learning/Practical/Research/Credit HS:Humanities and Social Science,ES:Engg.Science.BS:Basic Science,PC:Program core,PE:Program Elective,OE:Open Elective,P:Project Contraction of the second seco

|                   | SEMESTER III |   |                  |   |       |     |    |          |  |
|-------------------|--------------|---|------------------|---|-------|-----|----|----------|--|
| S.NO.             | Course Code  | Course Title  | Ty/Lb/<br>ETL/IE | L | T/SLr | P/R | С  | Category |  |
| 1                 | EBMA22005    | Mathematics –III for Mechanical and Civil Engineers     | Ту               | 3 | 1/0   | 0/0 | 4  | BS       |  |
| 2                 | EBME22003    | Engineering Thermodynamics                              | Ту               | 3 | 1/0   | 0/0 | 4  | PC       |  |
| 3                 | EBME22004    | Manufacturing Technology- I                             | Ту               | 3 | 0/0   | 0/0 | 3  | PC       |  |
| 4                 | EBCE22ID5    | Fluid Mechanics and Machinery                           | Ту               | 3 | 0/0   | 0/0 | 3  | ID       |  |
| 5                 | EBEC22ET3    | Microprocessor Architecture and<br>Embedded Programming | ETL              | 2 | 0/0   | 2/0 | 3  | ID       |  |
| 6                 | EBME22005    | Machine Drawing   | Ту               | 2 | 0/0   | 2/0 | 3  | PC       |  |
| 7                 | EBCC22ET1    | Universal human values:<br>Understanding harmony        | ETL              | 1 | 0/0   | 2/0 | 2  | ID       |  |
|                   | PRACTICALS*  |   |                  |   |       |     |    |          |  |
| 1                 | EBME22L01    | Manufacturing Technology Lab- I                         | Lb               | 0 | 0/0   | 3/0 | 1  | PC       |  |
| 2                 | EBME22L02    | Engineering Metallurgy Lab                              | Lb               | 0 | 0/0   | 3/0 | 1  | PC       |  |
| 3                 | EBCE22IL4    | Fluid Mechanics and Machinery Lab                       | Lb               | 0 | 0/0   | 3/0 | 1  | ID       |  |
| Credits Sub Total |              |   |                  |   |       |     | 25 |          |  |

| SEMESTER IV |                         |  |                  |   |           |     |   |          |
|-------------|-------------------------|--|------------------|---|-----------|-----|---|----------|
| S.NO.       | Course<br>Code          | Course Title   | Ty/Lb/<br>ETL/IE | L | T/SL<br>r | P/R | С | Category |
| 1           | EBMA22008               | Statistical and Numerical Methods  | Ту               | 3 | 1/0       | 0/0 | 4 | BS       |
| 2           | EBME22006               | Strength of Materials  | Ту               | 3 | 1/0       | 0/0 | 4 | РС       |
| 3           | EBME22007               | Mechanics of Machine-I   | Ту               | 3 | 1/0       | 0/0 | 4 | PC       |
| 4           | EBCS22ID5               | Artificial Intelligence and Machine<br>Learning                                | Ту               | 3 | 0/0       | 0/0 | 3 | ID       |
| 5           | EBME22ET2               | Engineering Metrology  | ETL              | 2 | 0/0       | 2/0 | 3 | РС       |
| 6           | EBCC22I04/<br>EBCC22I05 | The Indian Constitution/ The Indian<br>Traditional Knowledge<br>(Audit Course) | IE               | 2 | 0/0       | 0/0 | 0 | ID       |
| PRACTICALS* |                         |  |                  |   |           |     |   |          |
| 1           | EBME22L03               | Strength of Materials Lab  | Lb               | 0 | 0/0       | 3/0 | 1 | РС       |
| 2           | EBCS22IL4               | Artificial Intelligence and Machine<br>Learning Lab                            | Lb               | 0 | 0/0       | 3/0 | 1 | ID       |

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| 3 | EBME22I01            | Technical Skill I                  | IE | 0 | 0/0 | 2/0 | 1 | SC |
|---|----------------------|------------------------------------|----|---|-----|-----|---|----|
| 4 | EBCC22I06            | Soft Skill I – Employability Skill | IE | 0 | 0/0 | 2/0 | 1 | SC |
|   | Credits Sub Total 22 |                                    |    |   |     |     |   |    |

Credits

| Sub | Total |  |
|-----|-------|--|

| SEMESTER V |                |  |                  |     |           |         |   |          |
|------------|----------------|--|------------------|-----|-----------|---------|---|----------|
| S.NO.      | Course<br>Code | Course Title   | Ty/Lb/E<br>TL/IE | L   | T/S<br>Lr | P/R     | С | Category |
| 1          | EBME22008      | Thermal Engineering  | Ту               | 3   | 0/0       | 0/0     | 3 | PC       |
| 2          | EBME22009      | Mechanics of Machine-II                                      | Ту               | 3   | 1/0       | 0/0     | 4 | PC       |
| 3          | EBME22ET3      | Manufacturing Technology -II                                 | ETL              | 2   | 0/0       | 2/0     | 3 | PC       |
| 4          | EBME22EXX      | Program Elective I   | Ту               | 3   | 0/0       | 0/0     | 3 | PE       |
| 5          | EBXX22OEX      | Open Elective I  | Ту               | 3   | 0/0       | 0/0     | 3 | ID       |
| 6          | EBOL22I01      | Online course NPTEL/SWAYAM/Any<br>MOOC APPROVED BY AICTE/UGC | IE               | 1   | 0/0       | 1/0     | 1 | ID       |
|            |                | PRACTICALS*  |                  |     |           |         |   |          |
| 1          | EBME22L04      | Dynamics Lab   | Lb               | 0   | 0/0       | 3/0     | 1 | PC       |
| 2          | EBME22L05      | Thermal Engineering Lab-I                                    | Lb               | 0   | 0/0       | 3/0     | 1 | PC       |
| 3          | EBME22I02      | Technical Skill II   | IE               | 0   | 0/0       | 2/0     | 1 | SC       |
|            |                |  |                  | Cre | dits Sul  | b Total |   | 20       |

| SEMESTER VI |                |   |                  |   |           |         |   |          |
|-------------|----------------|---|------------------|---|-----------|---------|---|----------|
| S.NO.       | Course<br>Code | Course Title  | Ty/Lb/ET<br>L/IE | L | T/SLr     | P/R     | С | Category |
| 1           | EBME22010      | Heat and Mass Transfer                              | Ту               | 3 | 1/0       | 0/0     | 4 | PC       |
| 2           | EBME22011      | CAD,CAM&CIM   | Ту               | 3 | 0/0       | 0/0     | 3 | PC       |
| 3           | EBME22012      | Design of Machine Elements-I                        | Ту               | 3 | 1/0       | 0/0     | 4 | PC       |
| 4           | EBME22EXX      | Program Elective II                                 | Ту               | 3 | 0/0       | 0/0     | 3 | PE       |
| 5           | EBXX22OEX      | Open Elective II                                    | Ту               | 3 | 0/0       | 0/0     | 3 | ID       |
|             |                | PRACTICALS*   | 1                |   |           |         |   |          |
| 1           | EBME22L06      | Thermal Engineering Lab -II                         | Lb               | 0 | 0/0       | 3/0     | 1 | PC       |
| 2           | EBME22L07      | CAD/CAM Lab   | Lb               | 0 | 0/0       | 3/0     | 1 | PC       |
| 3           | EBCC22I07      | Soft Skill II-Qualitative and Quantitative<br>Skill | IE               | 0 | 0/0       | 2/0     | 1 | SC       |
| 4           | EBME22I03      | Technical Skill III                                 | IE               | 0 | 0/0       | 2/0     | 1 | SC       |
| 5           | EBME22I04      | Mini Project/Internship                             | IE               | 0 | 0/0       | 3/0     | 1 | SC       |
|             |                |   |                  | C | redits Su | b Total |   | 22       |

C: Credits L: Lecture T: Tutorial S.Lr: Supervised Learning P: Problem / Practical R: Research Ty/Lb/ETL: Theory /Lab/Embedded Theory and Lab \* Internal Evaluation

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| SEMESTER VII |           |                               |       |   |           |         |   |          |
|--------------|-----------|-------------------------------|-------|---|-----------|---------|---|----------|
| S.N          | SUBJECT   | SUBJECT NAME                  | Ty/   | L | Τ/        | P/R     | С | Category |
| О.           | CODE      |                               | Lb/   |   | S.Lr      |         |   |          |
|              |           |                               | ETL/I |   |           |         |   |          |
|              |           |                               | Ε     |   |           |         |   |          |
| 1            | EBME22013 | Industrial Automation         | Ту    | 3 | 0/0       | 0/0     | 3 | PC       |
| 2            | EBME22EXX | Program Elective III          | Ту    | 3 | 0/0       | 0/0     | 3 | PE       |
| 3            | EBME22014 | Design of Machine Elements-II | Ту    | 3 | 1/0       | 0/0     | 4 | PC       |
| 4            | EBME22015 | Finite Element Methods        | Ту    | 3 | 1/0       | 0/0     | 4 | PC       |
| 5            | EBME22ET4 | Virtual and Augmented Reality | ETL   | 2 | 0/0       | 2/0     | 3 | PC       |
|              |           | PRACTICALS*                   |       |   |           |         |   |          |
| 1            | EBXX22OL1 | Open Lab                      | Lb    | 0 | 0/0       | 3/0     | 1 | ID       |
| 2            | EBME22L08 | Design and Simulation Lab     | Lb    | 0 | 0/0       | 3/0     | 1 | PC       |
| 3            | EBME22L09 | Industrial Automation Lab     | Lb    | 0 | 0/0       | 3/0     | 1 | PC       |
| 4            | EBME22I05 | Project Phase – I             | IE    | 0 | 0/0       | 3/3     | 2 | Р        |
| 5            | EBFL22IXX | Foreign Language              | IE    | 1 | 0/0       | 1/0     | 1 | HS       |
|              |           |                               |       | C | redits Su | b Total |   | 23       |

| VIII SEMESTER |                    |                                      |        |   |      |       |   |          |
|---------------|--------------------|--------------------------------------|--------|---|------|-------|---|----------|
| S.N           | SUBJECT            | SUBJECT NAME                         | Ty/    | L | Τ/   | P/R   | С | Category |
| 0.            | CODE               |                                      | Lb/    |   | S.Lr |       |   |          |
|               |                    |                                      | ETL/IE |   |      |       |   |          |
| 1             | EBCC22ID1          | Engineering Economics and Industrial | Ту     | 3 | 0/0  | 0/0   | 3 | ID       |
|               |                    | Management                           |        |   |      |       |   |          |
| 2             | EBME22EXX          | Program Elective IV                  | Ту     | 3 | 0/0  | 0/0   | 3 | PE       |
| 3             | EBME22EXX          | Program Elective V                   | Ту     | 3 | 0/0  | 0/0   | 3 | PE       |
| PRACTICALS*   |                    |                                      |        |   |      |       |   |          |
| 1             | EBME22L10          | Project Phase – II                   | Lb     | 0 | 0/0  | 12/12 | 8 | Р        |
|               | Credits Sub Total: |                                      |        |   |      |       |   | 17       |

#### **TOTAL CREDITS: 166**

C: Credits L: Lecture T: Tutorial S.Lr: Supervised Learning P: Problem / Practical R: Research Ty/Lb/ETL: Theory /Lab/Embedded Theory and Lab \* Internal Evaluation



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|       | PROGRAM ELECTIVE –I & V |   |         |   |            |     |   |          |
|-------|-------------------------|---|---------|---|------------|-----|---|----------|
| S.NO. | SUBJECT                 | SUBJECT NAME                              | Ty/Lb   | L | Τ/         | P/R | С | Category |
|       | CODE                    | Elective: Thermal                         | /ETL/IE |   | SLr        |     |   |          |
|       |                         | Engineering                               |         |   |            |     |   |          |
| 1     | <b>EBME22E01</b>        | Advanced IC Engines                       | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 2     | <b>EBME22E02</b>        | Electric and Hybrid vehicles              | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 3     | <b>EBME22E03</b>        | Automobile Engineering                    | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 4     | <b>EBME22E04</b>        | Sustainable Energy                        | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 5     | EBME22E05               | Gas Dynamics and Jet Propulsion           | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 6     | <b>EBME22E06</b>        | Refrigeration and Air Conditioning        | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 7     | <b>EBME22E07</b>        | <b>Computational Fluid Dynamics</b>       | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 8     | <b>EBME22E08</b>        | Turbo Machines                            | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
|       |                         | PROGRAM ELECTIVE -II                      |         |   |            |     |   |          |
| S.NO. | SUBJECT                 | SUBJECT NAME                              | Ty/Lb   | L | <b>T</b> / | P/R | C | Category |
|       | CODE                    | Elective: Design Engineering              | /ETL/IE |   | SLr        |     |   |          |
| 1     | <b>EBME22E09</b>        | Mechanical Vibrations                     | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 2     | <b>EBME22E10</b>        | Design of Production Tools                | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 3     | EBME22E11               | Design of Material Handling<br>Equipments | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 4     | EBME22E12               | Applied Tribology                         | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 5     | EBME22E13               | Design for Manufacture and<br>Assembly    | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 6     | EBME22E14               | Mechanics of Fracture                     | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 7     | <b>EBME22E15</b>        | <b>Design Thinking and Innovation</b>     | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
|       | PROGRA                  | M ELECTIVE –III                           |         |   |            |     |   |          |
| S.NO. | SUBJEC                  | SUBJECT NAME                              | Ty/Lb   | L | Τ/         | P/R | C | Category |
|       | TCODE                   | Elective: Manufacturing                   | /ETL/IE |   | SLr        |     |   |          |
|       |                         | Engineering                               |         |   |            |     |   |          |
| 1     | EBME22E16               | Industrial Robotics                       | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 2     | EBME22E17               | Non-Conventional Machining<br>Techniques  | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 3     | EBME22E18               | Process planning and cost estimation      | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 4     | <b>EBME22E19</b>        | Additive manufacturing                    | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 5     | EBME22E20               | Flexible Manufacturing Systems            | Ту      | 3 | 0/0        | 0/0 | 3 | PE       |
| 6     | EBME22E21               | Powder Metallurgy                         | Ty      | 3 | 0/0        | 0/0 | 3 | PE       |
|       |                         |   |         |   |            |     |   |          |



| PROGRAM ELECTIVE –I V |                  |                                |       |   |            |     |   |          |
|-----------------------|------------------|--------------------------------|-------|---|------------|-----|---|----------|
| S.NO.                 | SUBJECT          | SUBJECT NAME                   | Ty/Lb | L | <b>T</b> / | P/R | С | Category |
|                       | CODE             | Elective: Industrial           | /ETL  |   | SLr        |     |   |          |
|                       |                  | Engineering                    |       |   |            |     |   |          |
| 1                     | EBME22E22        | Enterprise Resource Planning   | Ту    | 3 | 0/0        | 0/0 | 3 | PE       |
| 2                     | EBME22E23        | System Modeling and Simulation | Ту    | 3 | 0/0        | 0/0 | 3 | PE       |
| 3                     | EBME22E24        | Total Quality Management       | Ту    | 3 | 0/0        | 0/0 | 3 | PE       |
| 4                     | EBME22E25        | Facilities Planning and        | Ту    | 3 | 0/0        | 0/0 | 3 | PE       |
|                       |                  | Design                         |       |   |            |     |   |          |
| 5                     | EBME22E26        | Quality Engineering            | Ту    | 3 | 0/0        | 0/0 | 3 | PE       |
| 6                     | <b>EBME22E27</b> | Industry 4.0                   | Ту    | 3 | 0/0        | 0/0 | 3 | PE       |
| 7                     | EBME22E28        | Supply Chain Management        | Ту    | 3 | 0/0        | 0/0 | 3 | PE       |
| 8                     | <b>EBME22E29</b> | Block chain Technology         | Ту    | 3 | 0/0        | 0/0 | 3 | PE       |

#### **Open electives offered by the Mechanical Engineering Department to other Department Students**

|     |                  | <b>OPEN ELECTIVE-I&amp;II</b>      |        |   |     |     |   |       |
|-----|------------------|------------------------------------|--------|---|-----|-----|---|-------|
| S.N | SUBJECT          | SUBJECT NAME                       | Ty/Lb/ | L | Т/  | P/R | С | Categ |
| 0.  | CODE             |                                    | ETL    |   | SLr |     |   | ory   |
| 1   | EBME22OE1        | Industrial Engineering             | Ту     | 3 | 0/0 | 0/0 | 3 | OE    |
| 2   | <b>EBME22OE2</b> | Refrigeration and Air conditioning | Ту     | 3 | 0/0 | 0/0 | 3 | OE    |
| 3   | EBME22OE3        | Automobile Engineering             | Ту     | 3 | 0/0 | 0/0 | 3 | OE    |
| 4   | EBME22OE4        | Industrial Robotics                | Ту     | 3 | 0/0 | 0/0 | 3 | OE    |
| 5   | EBME22OE5        | Sustainable Energy                 | Ту     | 3 | 0/0 | 0/0 | 3 | OE    |
| 6   | EBME22OE6        | Composite Materials                | Ту     | 3 | 0/0 | 0/0 | 3 | OE    |
| 7   | EBME22OE7        | Industry 4.0                       | Ту     | 3 | 0/0 | 0/0 | 3 | OE    |
| 8   | <b>EBME22OE8</b> | Virtual and Augmented Reality      | Ty     | 3 | 0/0 | 0/0 | 3 | OE    |

# **Open Labs offered by the Mechanical Engineering Department to other Department Students**

|               | <u> </u>      |      | - |
|---------------|---------------|------|---|
| <b>PEN EL</b> | <b>ECTIVE</b> | LAB* |   |

|     |           | OI LIVE LECTIVE LIND        |        |   |            |     |   |          |
|-----|-----------|-----------------------------|--------|---|------------|-----|---|----------|
| S.N | SUBJECT   | SUBJECT NAME                | Ty/Lb/ | L | <b>T</b> / | P/R | С | Category |
| 0.  | CODE      |                             | ETL    |   | SLr        |     |   |          |
| 1   | EBME22OL1 | Internal Combustion Engines | Lb     | 0 | 0/0        | 3/0 | 1 | OL       |
|     |           | Lab and Steam Turbine       |        |   |            |     |   |          |
| 2   | EBME22OL2 | Computer Aided Design Lab   | Lb     | 0 | 0/0        | 3/0 | 1 | OL       |
| 3   | EBME22OL3 | Engineering Metrology Lab   | Lb     | 0 | 0/0        | 3/0 | 1 | OL       |
| 4   | EBME22OL4 | Automation Lab              | Lb     | 0 | 0/0        | 3/0 | 1 | OL       |
| 5   | EBME22OL5 | Virtual and Augmented       | Lb     | 0 | 0/0        | 3/0 | 1 | OL       |
|     |           | Reality Lab                 |        |   |            |     |   |          |

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| DEEMED TO BE UNIVERSITY                     | ****              |
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# **Open electives offered to Mechanical Engineering Students**

| COMPUTER SCIENCE AND ENGINEERING             |            |   |         |      |            |     |   |          |  |  |  |  |
|--|------------|---|---------|------|------------|-----|---|----------|--|--|--|--|
| S.NO.  | SUBJECT    | SUBJECT NAME                            | Ty/Lb   | L    | <b>T</b> / | P/R | С | Category |  |  |  |  |
|  | CODE       |   | /ETL/IE |      | SLr        |     |   |          |  |  |  |  |
| 1  | EBCS22OE1  | Cyber security & Forensics              | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 2  | EBCS22OE2  | Artificial Intelligence                 | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 3  | EBCS22OE3  | Data Base Concepts                      | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 4  | EBCS22OE4  | Software Engineering                    | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
|  | IN         | FORMATION TECHNOLOGY                    |         |      | I          |     |   |          |  |  |  |  |
| S.NO.  | SUBJECT    | SUBJECT NAME                            | Ty/Lb   | L    | <b>T</b> / | P/R | C | Category |  |  |  |  |
|  | CODE       | Elective: Design Engineering            | /ETL/IE |      | SLr        |     |   |          |  |  |  |  |
| 1  | EBIT22OE1  | Web Design                              | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 2  | EBIT22OE 2 | Digital Marketing                       | TY      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 3  | EBIT22OE3  | Cyber Security Essentials               | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 4  | EBIT22OE4  | Introduction to Multimedia              | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| ELECTRONICS AND COMMUNICATION<br>ENGINEERING |            |   |         |      |            |     |   |          |  |  |  |  |
| S.NO.  | SUBJEC     | SUBJECT NAME                            | Ty/Lb   | L    | <b>T</b> / | P/R | C | Category |  |  |  |  |
|  | TCODE      |   | /ETL/IE |      | SLr        |     |   |          |  |  |  |  |
| 1  | EBEC22OE1  | Internet of Things and its Applications | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 2  | EBEC22OE2  | Cellular Mobile communication           | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 3  | EBEC22OE3  | Satellite and its Applications          | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 4  | EBEC22OE4  | Fundamentals of Sensors                 | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 5  | EBEC22OE5  | Microprocessor Based System<br>Design   | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 6  | EBEC22OE6  | Industry 4.0 Concepts                   | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
|  | ELI        | ECTRICAL AND ELECTRONICS                | ENGINEE | RINC | r<br>T     |     |   |          |  |  |  |  |
| S.NO.  | SUBJECT    | SUBJECT NAME                            | Ty/Lb   | L    | Τ/         | P/R | C | Category |  |  |  |  |
|  | CODE       |   | /ETL/IE |      | SLr        |     |   |          |  |  |  |  |
| 1  | EBEE22OE1  | Electrical Safety for Engineers         | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 2  | EBEE22OE2  | Energy Conservation Techniques          | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 3  | EBEE22OE3  | Electric Vehicle Technology             | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 4  | EBEE22OE4  | Biomedical Instrumentation              | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 5  | EBEE22OE5  | Industrial Instrumentation              | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 6  | EBEE22OE6  | Solar Energy Conversion System          | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 7  | EBEE22OE7  | Wind Energy Conversion System           | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 8  | EBEE22OE8  | Energy Storage Technology               | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |
| 9  | EBEE22OE9  | Electrical Machines                     | Ту      | 3    | 0/0        | 0/0 | 3 | OE       |  |  |  |  |

EDUCATIONAL AND RESEARCH INSTITUTE

University with Graded Autonomy Status (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India. CIVIL ENGINEERING

| S.NO.         | SUBJECT   | SUBJECT NAME  | Ty/Lb    | L          | <b>T</b> / | P/R | C        | Category |  |  |  |  |
|---------------|-----------|---|----------|------------|------------|-----|----------|----------|--|--|--|--|
|               | CODE      | Elective: Design Engineering                              | /ETL/IE  |            | SLr        |     |          |          |  |  |  |  |
| 1             | EBCE22OE1 | Water Pollution and Its management                        | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 2             | EBCE22OE2 | Air Pollution Control                                     | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 3             | EBCE22OE3 | Green Building and Vastu Concepts                         | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 4             | EBCE22OE4 | Climate Change and Sustainable<br>Development             | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 5             | EBCE22OE5 | Intelligent Transportation Systems                        | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 6             | EBCE22OE6 | Environment, Health and Safety in Industries              | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 7             | EBCE22OE7 | Industrial Pollution Prevention and Cleaner<br>Production | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 8             | EBCE22OE8 | Fundamentals of nano science                              | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| BIOTECHNOLOGY |           |   |          |            |            |     |          |          |  |  |  |  |
| S.NO.         | SUBJEC    | SUBJECT NAME  | Ty/Lb    | L          | <b>T</b> / | P/R | C        | Category |  |  |  |  |
|               | TCODE     |   | /ETL/IE  |            | SLr        |     |          |          |  |  |  |  |
| 1             | EBBT22OE1 | Food and Nutrition  | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 2             | EBBT22OE2 | Human Physiology  | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 3             | EBBT22OE3 | Clinical Biochemistry                                     | Ty       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 4             | EBBT22OE4 | Bioprocess Principles                                     | Ty       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 5             | EBBT22OE5 | Biosensors and Biomedical Devices in<br>Diagnostics       | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 6             | EBBT22OE6 | Basic Bioinformatics                                      | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
|               |           | CHEMICAL ENGINEER   | ING      |            |            |     |          |          |  |  |  |  |
| S.NO.         | SUBJECT   | SUBJECT NAME  | Ty/Lb    | L          | <b>T</b> / | P/R | С        | Category |  |  |  |  |
|               | CODE      |   | /ETL/IE  |            | SLr        |     |          |          |  |  |  |  |
| 1             | EBCT22OE1 | Fundamentals of Nanoscience                               | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 2             | EBCT22OE2 | Electrochemical Engineering                               | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 3             | EBCT22OE3 | Alternative Fuels And Energy System                       | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 4             | EBCT22OE4 | Petrochemical Unit Processes                              | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 5             | EBCT22OE5 | Principles of Desalination Technologies                   | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 6             | EBCT22OE6 | Piping Design Engineering                                 | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
| 7             | EBCT22OE7 | E- Waste Management                                       | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |
|               |           | Dr APJ Abdul Kalam Center For                             | Research |            | 1          | 1   |          |          |  |  |  |  |
| S.NO.         | SUBJECT   | Ty/Lb   | L        | <b>T</b> / | P/R        | C   | Category |          |  |  |  |  |
|               | CODE      |   | /ETL/IE  |            | SLr        |     |          |          |  |  |  |  |
| 1             | EBMG22OE1 | Technical Entrepreneurship                                | Ту       | 3          | 0/0        | 0/0 | 3        | OE       |  |  |  |  |

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| Open Labs offered to Mechanical Engineering Students |           |                                      |                   |      |             |     |   |  |  |  |  |  |  |
|--|-----------|--------------------------------------|-------------------|------|-------------|-----|---|--|--|--|--|--|--|
| COMPUTER SCIENCE AND ENGINEERING                     |           |                                      |                   |      |             |     |   |  |  |  |  |  |  |
| S.NO.  | SUBJEC    | SUBJECT NAME                         | Ty/Lb             | L    | <b>T</b> /  | P/R | С | Category   |  |  |  |  |  |
|  | TCODE     |                                      | /ETL/IE           |      | SLr         |     |   |  |  |  |  |  |  |
| 1  | EBCS22OL1 | Artificial Intelligence Lab          | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
| 2  | EBCS22OL2 | PHP/My SQL Programming Lab           | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
| 3  | EBCS22OL3 | Database Lab                         | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
| INFORMATION TECHNOLOGY                               |           |                                      |                   |      |             |     |   |  |  |  |  |  |  |
| S.NO.  | SUBJECT   | SUBJECT NAME                         | Ty/Lb             | L    | Τ/          | P/R | С | Category   |  |  |  |  |  |
|  | CODE      |                                      | /ETL/IE           |      | SLr         |     |   |  |  |  |  |  |  |
| 1  | EBIT22OL1 | Visual Programming Lab               | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
| 2  | EBIT22OL2 | Web Design Lab                       | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
| 3  | EBIT22OL3 | Digital content creation Lab         | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
| 4  | EBIT22OL4 | Computer Network Lab                 | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
| 5  | EBIT22OL5 | PHP/My SQL Programming Lab           | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
|  | ELEC      | TRONICS AND COMMUNICATIO             | ON ENGINE         | EERI | NG          |     |   |  |  |  |  |  |  |
| S.NO.  | SUBJECT   | SUBJECT NAME                         | Tv/Lb             | L    | T/          | P/R | С | Category   |  |  |  |  |  |
| 211101   | CODE      | Elective: Design Engineering         | /ETL/IE           |      | SLr         |     |   | 95   |  |  |  |  |  |
| 1  | EBEC22OL1 | Sensors and IoT Lab                  | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
| 2  | EBEC22OL2 | Robotics Control Lab                 | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
| 3  | EBEC22OL3 | Basics of MATLAB                     | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
|  | EL        | ECTRICAL AND ELECTRONICS             | ENGINEEI          | RING | -           |     |   |  |  |  |  |  |  |
| C NO   |           |                                      |                   | T    | <b>71</b> ( | D/D |   | C (  |  |  |  |  |  |
| S.NO.  | SUBJEC    | SUBJECT NAME                         | Ty/Lb<br>/FTI /IF | L    |             | P/K | С | Category   |  |  |  |  |  |
| 1  | TCODE     | Tuono duo en Lob                     |                   | 0    | SLr         | 2/0 | 1 |  |  |  |  |  |  |
| 1  | EDEE22OLI |                                      | LU                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
| 2  | EBEE22OL2 | PLC and SCADA Lab                    | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
| 3  | EDEE220L3 |                                      | LU                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
| 4  | EBEE22OL4 | Power Electronics Lab                | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
| 5  | EBEE22OL5 | Bio Medical Instrumentation Lab      | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
| 6  | EBEE22OL6 | Electrical Machines Lab              | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
| ~  | CIV       | IL ENGINEERING                       |                   |      |             |     | ~ | a di seconda di s |  |  |  |  |  |
| S.NO.  | SUBJEC    | SUBJECT NAME                         | Ty/Lb<br>/ETL/IE  | L    | T/          | P/R | C | Category   |  |  |  |  |  |
| 1  | EBCE22OL1 | Building Drawing Practice using Auto | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |
|  | EDCE22QL2 | CADD                                 | T L               |      | 0./0        | 2/0 | 1 |  |  |  |  |  |  |
| 2  | EBCE22OL2 | Mapping Lab                          | LD                | U    | 0/0         | 3/0 |   | UL   |  |  |  |  |  |
| 3  | EBCE22OL3 | Environmental Engineering Laboratory | Lb                | 0    | 0/0         | 3/0 | 1 | OL   |  |  |  |  |  |

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|--|-------------------|
| University with Graded Autonomy Status                               |                   |
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|--|
| Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India. |
|  |

| BIOTECHNOLOGY |                 |                                   |               |   |           |     |   |          |  |  |  |  |  |
|---------------|-----------------|-----------------------------------|---------------|---|-----------|-----|---|----------|--|--|--|--|--|
| S.NO.         | SUBJECT<br>CODE | SUBJECT NAME                      | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С | Category |  |  |  |  |  |
| 1             | EBBT22OL1       | Basic Biochemistry Lab            | Lb            | 0 | 0/0       | 3/0 | 1 | OL       |  |  |  |  |  |
| 2             | EBBT22OL2       | Basic Bioprocess Lab              | Lb            | 0 | 0/0       | 3/0 | 1 | OL       |  |  |  |  |  |
| 3             | EBBT22OL3       | Basic Microbiology Lab            | Lb            | 0 | 0/0       | 3/0 | 1 | OL       |  |  |  |  |  |
| 4             | EBBT22OL4       | Basic Bioinformatics Lab          | Lb            | 0 | 0/0       | 3/0 | 1 | OL       |  |  |  |  |  |
|               |                 | CHEMICAL ENGINEERING              |               |   |           |     |   |          |  |  |  |  |  |
| S.NO.         | SUBJECT<br>CODE | SUBJECT NAME                      | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | C | Category |  |  |  |  |  |
| 1             | EBCT22OL1       | Chemical Separation Lab           | Lb            | 0 | 0/0       | 3/0 | 1 | OL       |  |  |  |  |  |
| 2             | EBCT22OL2       | Chemical Composition Analysis Lab | Lb            | 0 | 0/0       | 3/0 | 1 | OL       |  |  |  |  |  |
| 3             | EBCT22OL3       | Alternate Fuel Lab                | Lb            | 0 | 0/0       | 3/0 | 1 | OL       |  |  |  |  |  |
| 4             | EBCT22OL4       | Food Testing Laboratory           | Lb            | 0 | 0/0       | 3/0 | 1 | OL       |  |  |  |  |  |

#### **CREDIT SUMMARY**

- Semester: 1 : **18 Credits**
- Semester: 2 : **19 Credits**
- Semester: 3 : **25 Credits**
- Semester: 4 : 22 Credits
- Semester: 5 : **20 Credits**
- Semester: 6 : 22 Credits
- Semester: 7 : **23 Credits**
- Semester: 8 : **17 Credits**

#### **TOTAL CREDITS-166 Credits**



# **SEMESTER - I**



| Subject<br>Code   | Subject Subject Name :<br>Code TECHNIC  |   |        |            |             | AL EN    | GLIS    | H               |       | <b>T</b><br>] | Ty/Lb/<br>ETL/II | E    | L     | T/SI     | Lr   | P/R | C |  |
|---|---|---|--------|------------|-------------|----------|---------|-----------------|-------|---------------|------------------|------|-------|----------|------|-----|---|--|
| EBEN2   | 2001  | Pr  | erequ  | isite : ]  | Pass in     | Plus 2   | Englis  | sh              |       |               | Ту               |      | 2     | 0/0      | )    | 0/0 | 2 |  |
| C: Cred   | its, L:   | Lec   | ture,  | T: Tuto    | orial, S    | Lr: Su   | pervise | ed Lea          | rning | g, P:         | : Proble         | em / | Prac  | ctical   |      |     |   |  |
| R: Rese   | arch,   | Γy/L  | .b/ETI | L/IE: 7    | Theory      | /Lab/E   | mbedd   | led Th          | eory  | and           | l Lab/Iı         | nter | nal E | valuatio | on   |     |   |  |
| OBJEC   | TIVE  | Ś   |        |            |             |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
| To refre  | To refresh and stimulate students' English learning through Content Integrated Language Learning to have an |   |        |            |             |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
| in-depth understanding of the components of English language and its use in communication that they are |   |   |        |            |             |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
| competent in inter-personal and academic communication for a successful career.                         |   |   |        |            |             |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
| COURSE OUTCOMES (Cos)   |   |   |        |            |             |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
| Student   | s comj  | oleti   | ng thi | s cours    | se were     | able to  | )       |                 |       |               |                  |      |       |          |      |     |   |  |
| CO1   | Refresh and stimulate their English learning through Content Integrated Language Learning                   |   |        |            |             |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
| CO2   | Have an in-depth understanding of the components of English language and its use in communication.          |   |        |            |             |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
| CO3   | Stren   | Strengthen their vocabulary and syntactic knowledge for use in academic and technical |        |            |             |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
| 005   | com   | communication   |        |            |             |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
| CO4   | Learn to negotiate meaning in inter-personal and academic communication for a successful career             |   |        |            |             |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
| CO5   | Engage in organized academic and professional writing for life-long learning and research                   |   |        |            |             |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
| Mappir  | ng of (   | Cour  | rse Oı | itcom      | e with      | Progra   | m Ou    | tcome           | e (PC | )s)           |                  |      |       |          |      |     |   |  |
| Cos/PO  | s PC  | )1  | PO2    | PO3        | PO4         | PO5      | PO6     | PO7             | PO    | 80            | PO9              | PC   | 010   | PO11     | PC   | D12 |   |  |
| CO1   | 1   |   | -      | 1          | 1           | 3        | 1       | 1               | 1     | 2             | 3                |      | 3     | 1        |      | 3   |   |  |
| CO2   | -   |   | 1      | -          | 2           | 3        | 2       | 1               |       | 1             | 3                |      | 3     | -        | 3    |     |   |  |
| CO3   | 1   |   | 1      | 1          | 1           | 2        | 1       | -               |       | 2             | 3                |      | 3 1   |          | 3    |     | 3 |  |
| CO4   | 1   |   | 2      | 1          | 1           | 3        | -       | 1               |       | -             | 2                |      | 2     | 1        |      |     | 2 |  |
| CO5   | 1   |   | 2      | 1          | -           | 2        | 1       | -               |       | 1             | 3                |      | 3     | 1        |      |     | 3 |  |
| COs/PS  | Os  |   | PSO    | 1          |             | PSO2     |         |                 | PS    | 03            |                  |      | PSC   | 04       |      |     |   |  |
| CO1   |   |   |        | 3          |             |          |         |                 |       |               | 1 1              |      |       |          |      |     |   |  |
| CO2   |   |   |        | 3          |             |          |         |                 |       |               | 1                |      |       | 1        |      |     |   |  |
| CO3   |   |   |        | 3          |             |          | 2       |                 |       |               | 1                |      |       | 1        |      |     |   |  |
| CO4   |   |   |        | 3          |             |          | 2       |                 |       |               | 1                |      |       | 1        |      |     |   |  |
| CO5   |   |   |        | 3          |             |          | 2       |                 |       |               | 1                |      |       | 1        |      |     |   |  |
| 3/2/1 In  | dicate  | es St   | trengt | h Of (     | Correla     | ation, 3 | 5 – Hig | <b>gh, 2-</b> ] | Med   | ium           | n, 1- Lo         | W    |       |          |      |     |   |  |
|   | e)  |   |        |            | р           |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
|   | enc   |   |        |            | s ar<br>nce |          |         | -               | tive  |               | ary              |      | 'nt   |          |      |     |   |  |
|   | Sci   |   | ini.   |            | itie        | д        |         | ran<br>ve       | lect  |               | lini             |      | one   |          | 29]  | c f |   |  |
|   | sic.  |   | inee   | nce        | nan<br>al S | grar     | 0       | rog             | nΕ    | er            | scip             | 3    | un mp |          | ctic | oje |   |  |
|   | Ba  |   | gut    | lg<br>Scie | Hun         | rog      | Core    | P<br>ele        | Ope   | Int           | Di               | l    | Co X  |          | Pr3  | /Pr |   |  |
|   |   |   |        |            |             |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
| Ś   |   |   |        |            | *           |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
| 800   |   |   |        |            |             |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
| ate   |   |   |        |            |             |          |         |                 |       |               |                  |      |       |          |      |     |   |  |
| Ŭ   |   |   |        |            |             |          |         |                 |       |               |                  |      |       |          |      |     |   |  |

#### Subject Name : Tv/Lb/

**TECHNICAL ENGLISH** 

**Prerequisite : Pass in Plus 2 English** 

| Unit I | Vocabulary Development: |  |
|--------|-------------------------|--|

Affixes: prefixes and suffixes and word formation-synonyms and antonyms-nominal compounds, expanding using numbers and approximation - preposition, prepositional phrases, preposition + relative pronoun- adjective: degrees of comparison, formation of adjectives, irregular comparatives- Infinitive and Gerunds

ETL/IE

Ty

L

2

T/SLr

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P/R

0/0

#### Unit II Grammar

**Subject Code** 

**EBEN22001** 

Tenses- auxiliary and modal -voice: active, passive and impersonal passive - Ouestions: Wh-pattern, Yes/no questions, tag questions - adverbs and adverbial clauses- 'If' clause, 'cause and effect', 'purpose'- Concord: subjectverb agreement

#### Unit III Reading

Comprehension: extracting relevant information from the text, by skimming and scanning and inferring, identifying lexical and contextual meaning for specific information, identifying the topic sentence and its role in each paragraph, comprehension exercises - Note - making - Précis writing-instructions, suggestions and recommendations.

and formal: seeking permission to undergo practical training, letter to an editor of a newspaper complaining about

#### Unit IV Writing

#### Unit V Visual Aids in Communication

civic problems and suggesting suitable solutions

Interpretation of diagrams - tables, flow charts, pie charts and bar charts, and their use in Business reports Total no. of Periods: 30

Text book

- 1. Panorama : Content Integrated Language Learning for Engineers, Chandrasena M. Rajeswaran&R.Pushkala,, Vijay Nicole Imprints Pvt. Ltd., Chennai References
- 1. Bhatnagar & Bhatnagar, Communicative English for Engineers and Professionals, Pearson
- 2. Wren and Martin: Grammar and Composition, Chand & Co, 2006
- 3. https://learnenglish.britishcouncil.org
- 4. www.better-english.com/grammar/preposition.

## 6

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# Jumbled sentences- paragraph writing coherence devices- discourse markers. Essay writing- Letter writing, Informal

## 6

#### 26





| (All 100 21001 . 2010 Certified institution) |                                       |  |  |  |  |  |  |  |  |  |
|--|---------------------------------------|--|--|--|--|--|--|--|--|--|
| Periyar E.V.R. High Road, Madura             | avoyal, Chennai-95. Tamilnadu, India. |  |  |  |  |  |  |  |  |  |

| Subject<br>EBMA  | Code :<br>22001  | Subject Name : MATH   |  |  | IEMATI  | CS – I   | Ty/I<br>/ET  | Lb<br>L                                    | L                                       | T/<br>SLr                                | P/R                   | С                                |
|--|--|---|--|--|---|--|--|--|---|--|-----------------------|----------------------------------|
|  |  | Prerequ   | uisite : N   | None   |   |  | Ту   |  | 3                                       | 1/0                                      | 0/0                   | 4                                |
| L : Lectur<br>T/L/ETL :  | re T : T<br>Theory /   | utorial S<br>Lab / Er   | SLr : S<br>nbeddeo   | upervis<br>d Theor   | ed Learı<br>y and La  | ning P :<br>b  | Proje  | ct R :                                     | Resea                                   | rch C:                                   | Credits               |                                  |
| OBJECTT<br>•<br>•<br>•<br>•<br>•<br>•<br>•<br>•<br>•<br>•<br>•<br>•<br>• | VES :<br>Apply th<br>Use the<br>Identify :<br>Understa<br>Apply th<br>OUTCOM<br>Mompleting<br>Find the<br>Transfor<br>Find ex<br>into rea<br>Apply k<br>Minima | e Basic con<br>Basic con<br>and solve<br>ind the Ba<br>e Basic co<br><b>MES (Cos</b><br>the course<br>the course<br>e summati<br>rm a no<br>mation.<br>pansion co<br>l and imag<br>cnowledge<br>of the gi | oncepts :<br>acepts in<br>problem<br>asic concepts :<br>s) : (3 -<br>e were a<br>ion of th<br>n - di<br>of trigon<br>ginary p<br>e and co<br>ven func- | in Algeb<br>Matrice<br>as in Tri<br>cepts in I<br>in Funct<br>5)<br>ble to<br>e given s<br>agonal<br>ometric<br>arts.<br>oncepts i | ora<br>gonometr<br>Differenti<br>ions of Se<br>series of t<br>matrix i<br>function<br>n finding | y<br>ation<br>everal va<br>binomial<br>nto an<br>into an<br>the deri | riables<br>, expone<br>equival<br>infinite<br>vative o | ential &<br>lent di<br>series a<br>f given | logarit<br>agonal<br>nd to s<br>functio | hmic<br>matrix<br>eparate a<br>on and to | using or<br>a complex | thogonal<br>function<br>maxima / |
| CO5<br>Monning o   | Evaluat<br>f Course  | Outcom  | $\frac{1}{1}$  | Program  |   |  | $\frac{1}{1}$  | lima oi                                    | a funct                                 | ion of sev                               | veral varia           | bles.                            |
| COs/POs  | PO1  | PO2   | PO3  | PO4  |   | PO6  | )<br>PO7   | PO8  | PO9                                     | PO10                                     | PO11                  | PO12                             |
| 003/103  |  | 102   | 105  | 104  | 105   | 100  | 107  | 100  | 107                                     | 1010                                     | 1011                  | 1012                             |
| CO1  | 3  | 3   |  |  | 2   | 2  |  |  | 3                                       | 3  |                       | 3                                |
| CO2  | 3  | 3   |  |  | 3   | 1  |  |  |   |  |                       | 3                                |
| CO3  | 3  | 3   |  |  | 2   | -  |  |  | 2                                       | 3  |                       | 1                                |
| CO4  | 3  | 3   |  |  | 1   |  |  |  | 2                                       | 3  |                       | 2                                |
| CO5  | 3  | 3   |  |  |   | 2  |  |  | 2                                       | 2  |                       | 3                                |
| 3/2/1 Indica   | tes Stren  | gth Of Co   | orrelatio  | on, 3 – I  | High, 2- N  | /ledium  | , 1- Low   | 7  |   |  |                       | _                                |
| Category   | <ul><li>▲ Basic Science</li></ul>  | Engineering<br>Science  | Humanities and   | social Science   | Program<br>Core   | Program<br>elective  | Open Elective  |  | Inter<br>Disciplinary                   | Skill Component                          |                       | Practical /Project               |

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| Subject Code :<br>EBMA22001 | Subject Name : MATHEMATICS – I | Ty/Lb<br>/ETL | L | T/<br>SLr | P/R | С |
|-----------------------------|--------------------------------|---------------|---|-----------|-----|---|
|                             | Prerequisite : None            | Ту            | 3 | 1/0       | 0/0 | 4 |
|                             |                                |               |   |           |     |   |

#### UNIT I ALGEBRA

Binomial, Exponential, Logarithmic Series (without proof of theorems) – Problems on Summation, Approximation and Coefficients.

#### UNIT II MATRICES

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values – Cayley - Hamilton theorem(without proof) – Orthogonal reduction of a symmetric matrix to Diagonal form.

#### UNIT III TRIGONOMETRY

Expansions of Sin n $\theta$ , Cos n $\theta$  in powers of Sin $\theta$  and Cos $\theta$  – Expansion of Tan n $\theta$  – Expansions of Sin<sup>n</sup> $\theta$  and Cos<sup>n</sup> $\theta$  in terms of Sines and Cosines of multiples of  $\theta$  – Hyperbolic functions – Separation into real and imaginary parts.

#### UNIT IV DIFFERENTIATION

Basic concepts of Differentiation – Elementary differentiation methods – Parametric functions – Implicit function –Leibnitz theorem(without proof) – Maxima and Minima – Points of inflection.

#### UNIT V FUNCTIONS OF SEVERAL VARIABLES

DUCA

Partial derivatives – Total differential – Differentiation of implicit functions – Taylor's expansion – Maxima and Minima by Lagrange's Method of undetermined multipliers – Jacobians.

#### Total no. of periods: 60

12

12

12

12

12

#### **Text & Reference Books**:

1) Kreyszig E., Advanced Engineering Mathematics (10<sup>th</sup> ed.), John Wiley & Sons, (2011).

- 2) Grewal B.S., *Higher Engineering Mathematics*, Khanna Publishers, (2012).
- **3**) John Bird, *Basic Engineering Mathematics* (5<sup>th</sup> ed.), Elsevier Ltd, (2010).
- 4) Veerarajan T., Engineering Mathematics (for first year), Tata McGraw Hill Publishing Co., (2008).
- **5)** P.Kandasamy, K.Thilagavathy and K. Gunavathy, *Engineering Mathematics Vol. I (4<sup>th</sup> Revised ed.)*, S.Chand& Co., Publishers, New Delhi (2000).
- 6) John Bird, Higher Engineering Mathematics (5<sup>th</sup> ed.), Elsevier Ltd, (2006).





| Subject<br>EBPH22 | Code<br>2ET1 |   | Subject Name :ENGINEERING PHY |               |   |  |                | YSI         | CS      | Ty/<br>ET | Lb/<br>L | L       | T/<br>SLr | P/R       | С       |
|-------------------|--------------|---|-------------------------------|---------------|---|--|----------------|-------------|---------|-----------|----------|---------|-----------|-----------|---------|
|                   |              | -   | Prerequ                       | isite :H      | ligher <b>S</b>                           | Sec. Phys  | ics            |             |         | ET        | Ĺ        | 2       | 0/0       | 2/0       | 3       |
| C: Cred           | its, L: Leo  | cture.                                      | T: Tuto                       | rial, S       | Lr: Su                                    | pervised   | Lear           | ning        | . P:    | Proble    | em / Pra | actical |           |           | l       |
| R: Resea          | arch, Ty/I   | b/E   | ΓL/IE: Τ                      | heory         | /Lab/E                                    | mbedded  | d The          | ory         | and     | Lab/In    | nternal  | Evaluat | ion       |           |         |
| OBJEC             | <b>FIVES</b> |   |                               |               |   |  |                |             |         |           |          |         |           |           |         |
| •                 | • Outlin     | e the                                       | relation                      | betwe         | en Scie                                   | ence, En   | ginee          | ring        | & 7     | Fechno    | ology.   |         |           |           |         |
| •                 | Demo         | nstrat                                      | te compo                      | etency        | in unde                                   | erstandir  | ng bas         | sic c       | once    | epts.     |          |         |           |           |         |
| •                 | • Apply      | fund  | amental                       | laws c        | of Phys                                   | ics in Er  | iginee         | ering       | g & '   | Techn     | ology.   |         |           |           |         |
| •                 | • To ide     | ntify                                       | & solve                       | proble        | ems usi                                   | ng phys  | ics co         | nce         | pts.    |           |          |         |           |           |         |
| •                 | Produc       | ce a  | nd pres                       | sent a        | ctivitie                                  | es assoc   | ciated         | W           | ith     | the o     | course   | throug  | h effe    | ctive te  | chnical |
|                   | comm         | unica                                       | tion                          |               |   |  |                |             |         |           |          |         |           |           |         |
| COURS             | E OUTCO      | OME   | S (Cos)                       |               |   |  |                |             |         |           |          |         |           |           |         |
| Students          | completin    | g this                                      | course v                      | vere ab       | le to                                     |  |                |             |         |           |          |         |           |           |         |
| CO1               | Demonst      | trate                                       | compete                       | ncy in        | unders                                    | tanding  | basic          | con         | cept    | ts.       |          |         |           |           |         |
| CO2               | Utilize s    | cient<br>and                                | ific met                      | hods fo       | or form                                   | al investion investigation in the second s | tigati<br>nowl | ons<br>edge | & (<br> | demon     | strate c | ompete  | ncy wi    | th experi | mental  |
| CO3               | Identify     | and r                                       | rovide s                      |               | is for e                                  | ngineeri   | ng nr          | oble        | ems     |           |          |         |           |           |         |
| CO4               | Relate th    | e tec                                       | hnical co                     | oncent        | $\frac{10}{10} \frac{10}{2} \frac{10}{2}$ | $\frac{11}{10}$ to day   | life ar        | nd to       | nns.    | actical   | situatio | ns      |           |           |         |
| CO5               | Think an     | alvti                                       | cally to i                    | internr       | $\frac{1}{2}$                             | ents   |                | iu ii       | ) pre   | uctical   | Situatio | /113.   |           |           |         |
| Manning           | of Cours     | f Course Outcome with Program Outcome (POs) |                               |               |   |  |                |             |         |           |          |         |           |           |         |
| Cos/POs           | PO1          | PO2   | PO3                           | PO4           | PO5                                       | PO6  | <u>PO7</u>     | /<br>PC     | )8      | PO9       | PO10     | PO11    | PO12      |           |         |
| CO1               | 3            | 3   | 1                             | 2             | 2   | 2  | 1              |             |         | 1         | 2        | 1011    | 1012      | 1         |         |
| CO2               | 3            | 3   | 2                             | 2             | 2   | 2  | 1              |             |         | 2         | 2        | 1       |           | 1         |         |
| CO3               | 3            | 3   | 3                             | 2             | 2   | 2  | 1              | 1           | L       | 1         | 2        | 1       |           | 2         |         |
| CO4               | 3            | 3   | 2                             | 2             | 1   | 2  | 2              | 1           | L       | 2         | 2        | 1       |           | 2         |         |
| CO5               | 3            | 3   | 2                             | 1             | 1   | 2  | 1              | 2           | 2       | 1         | 2        | 1       |           | 1         |         |
| COs/PSOs          | PSO1         |   |                               | PSO           | PSO                                       | PSO  |                |             |         |           |          |         |           |           |         |
| 0.01              | _            |   |                               | 2             | 3   | 4  |                |             |         |           |          |         |           |           |         |
| <u>CO1</u>        |              | 3   |                               | 2             | 1   | 1  |                |             |         |           |          |         |           |           |         |
| C02               |              | 3   |                               | 2             | 1   | 1  |                |             |         |           |          |         |           |           |         |
| $CO_4$            |              | 3   |                               | $\frac{2}{2}$ | 1   | 1  |                |             |         |           |          |         |           |           |         |
| C04               |              | 3   |                               | $\frac{2}{2}$ | 1   | 1  |                |             |         |           |          |         |           |           |         |
| 3/2/1 Ind         | licates Str  | engtl                                       | h Of Cor                      | relatio       | n. 3 – F                                  | ligh. 2- N   | Aediu          | m. 1        | 1- Lo   | OW        |          |         |           |           |         |
|                   |              |   |                               | al            |   |  |                |             |         |           |          |         |           |           |         |
|                   |              |   |                               | soci          |   | ive  |                |             | Ŋ       |           | It       |         | t         |           |         |
|                   | e            |   |                               | s pr          |   | ect  |                |             | ina     |           | ner      |         | ojec      |           |         |
| ~                 | enc          |   | 50                            | s ai          | ore                                       | n el   | hive           |             | lqi     |           | odu      |         | Pr        |           |         |
| ory               | Sci          |   | arin .                        | itie          | u C                                       | ran  | lec            |             | Disc    |           | Jon      |         | cal       |           |         |
| teg               | sic          |   | nce                           | nani          |   | rog  | Ц              |             | εrΓ     |           | II C     |         | ctic      |           |         |
| Ca                | Ba           |   | ingi                          | lum           |   | L L  | Jue            | 2           | Inte    |           | Ski      |         | Pra       |           |         |
|                   | √            | /   | ЦS                            | ы<br>П        |   |  |                |             |         |           | +        |         |           |           |         |
|                   |              |   |                               |               |   |  |                |             |         |           |          |         |           |           |         |
|                   |              |   |                               |               |   |  |                |             |         |           | 1        |         |           |           |         |
|                   |              |   |                               |               |   |  |                |             |         |           | 1        |         |           |           |         |
|                   |              |   |                               |               |   |  |                |             |         |           | 1        |         |           |           |         |
|                   |              |   |                               |               |   |  |                |             |         |           |          |         |           |           |         |



| Subject Code<br>EBPH22ET1 | Subject Name : ENGINEERING PHYSICS | Ty/Lb<br>/ETL | L | T/<br>SLr | P/R | С |
|---------------------------|------------------------------------|---------------|---|-----------|-----|---|
|                           | Prerequisite : Higher Sec. Physics | ETL           | 2 | 0/0       | 2/0 | 3 |

#### UNIT I PROPERTIES OF MATTER

Elasticity - stress, strain and Hook's law - Poisson's ratio - three moduli of elasticity - twisting couple on a wire – Shafts – Solid & Hollow Shafts – Bending moment – Youngs Modulus Determination -I form of girders. viscosity - flow of liquid through a narrow tube: Poiseuille's law - Ostwald's viscometer – Lubrication

#### Lab Component – 1. Torsional Pendulum – Determination of Rigidity Modulus 2. Coefficient of Viscosity determination using Poiseuille's Method

#### UNIT II ACOUSTICS & ULTRASONICS

Fundamentals of acoustics - reverberation- reverberation time - factors affecting acoustics. Ultrasonics -Production of ultrasonic waves - detection of ultrasonic waves - acoustic grating - application of ultrasonic waves.

Lab Component – 3. Ultrasonic Velocity Determination

#### UNIT III WAVE OPTICS

Huygen's principle - interference of light – wave front splitting and amplitude – air wedge - Newton's rings - Michelson interferometer and its applications - Fraunhofer diffraction from a single slit - diffraction grating

#### Lab Component – 4. Spectrometer – Grating UNIT IV LASER

Laser principle and characteristics - amplification of light by population inversion - properties of laser beams: monochromaticity, coherence, directionality and brightness - different types of lasers - Ruby laser-Nd-YAG laser-He-Ne laser-CO<sub>2</sub> laser - semiconductor laser - applications of lasers in science, engineering and medicine.

Lab Component – 5. Determination of Wavelength of the given Laser source

#### UNIT V FIBER OPTIC COMMUNICATION

Total Internal Reflection – Propagation of Light in Optical Fibers – Numerical aperture and Acceptance Angle – Types of Optical Fibers (material, refractive index, mode) – Fiber Optical Communication system (Block diagram) – Attenuation–Transmitter, Receiver, Dispersion, Modulation/Demodulation Advantages of Fiber Optical Communication System – IMT, PMT, Wavelength Modulated & Polarization Modulated Sensors – Endoscope Applications.

#### Lab Component – 6. Determination of Numerical Aperture of Optical Fiber

#### Total No of Periods: 45

#### **TEXT BOOKS**

- 1. Brijlal, M. N. Avadhanulu & N. Subrahmanyam, Text Book of Optics, S. Chand Publications, 25<sup>th</sup> edition, 2012
- 2. R. Murugeshan, Electricity and Magnetism, S.Chand Publications, 10<sup>th</sup> edition, 2017
- 3. R. Murugeshan & Kiruthiga Sivaprasath, Modern Physics, S.Chand Publications, 2016

#### **REFERENCE BOOKS**

- 1. Dr. Senthil Kumar Engineering Physics I VRB Publishers, 2016
- 2. N Subrahmanyam & Brijlal, Waves and Oscillations, Vikas Publications, New Delhi, 1988
- 3. N Subrahmanyam & Brijlal, Properties of Matter, S. Chand Co., New Delhi, 1982
- 4. N Subrahmanyam & Brijlal, Text book of Optics, S. Chand Co., New Delhi, 1989
- 5. R. Murugeshan, Electricity and Magnetism, S. Chand & Co., New Delhi, 1995
- 6. Thygarajan K & Ajay Ghatak, Laser Theory and Applications, Macmillan, New Delhi, 1981

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| EDUCATIONAL AND RESEARCH INSTITUTE (   | NAAC  |
|--|---|
| University with Graded Autonomy Status |   |
| 109 × 10                               | EDUCATIONAL AND RESEARCH INSTITUTE (<br>DEEMED TO BE UNIVERSITY<br>University with Graded Autonomy Status |

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| Subject (<br>EBCH22 | Code<br>ET1 | Su  | ıbject      | Name I     | ENGIN                | EERIN        | G CH     | EMIS          | ΓRY       | Ty/Lb/<br>ETL | L          | T/S        | Lr     | P/R  | С |
|---------------------|-------------|---|-------------|------------|----------------------|--------------|----------|---------------|-----------|---------------|------------|------------|--------|------|---|
|                     |             | Pre   | ereaui      | site :Hi   | gher Se              | c. Chen      | nistrv   |               |           | ETL           | 2          | 0/         | 0      | 2/0  | 3 |
| C: Credi            | ts. L: L    | ectu  | re. T       | : Tutori   | al. SLr              | : Super      | vised    | Learn         | ing. P:   | Problem       | 1 / Prac   | tical      |        | _, . |   |
| R: Resea            | urch. Ty    | /Lb   | /ETL        | /IE: Th    | eorv /L              | ab/Emb       | edded    | l Theo        | rv and    | Lab/Inte      | ernal Ev   | valuatio   | n      |      |   |
| OBJECT              | TIVES       |   |             | -          | - J ·                |              |          |               | <b>J</b>  |               |            |            |        |      |   |
| Т                   | o deduce    | e pra                                       | ctical a    | pplicatio  | on of the            | oretical c   | oncepts  | 5             |           |               |            |            |        |      |   |
| Т                   | 'o provid   | le and                                      | d insigl    | ht into fu | ndamen               | tal concep   | ots of c | hemica        | l thermo  | dynamics      |            |            |        |      |   |
| Т                   | 'o articul  | ate tł                                      | he wate     | er treatm  | ent meth             | ods          |          |               |           |               |            |            |        |      |   |
| Т                   | 'o impart   | the l                                       | knowle      | edge in el | lectrical            | conducta     | nce and  | 1 EMF         |           |               |            |            |        |      |   |
| 1                   | o create    | awar  | reness a    | about the  | moderr               | Nano co      | mposit   | es alon       | g with c  | oncepts of    | polyme     | rs         |        |      |   |
| 1                   | o introdi   | uce a                                       | inalytic    | al tools i | for chara            | cterizatio   | on techi | nques.        |           |               |            |            |        |      |   |
| COURS               | E OUT       | CON   | MES (       | Cos)       |                      |              |          |               |           |               |            |            |        |      |   |
| Students            | complet     | ing   | this co     | ourse we   | re able              | to           |          |               |           |               |            |            |        |      |   |
| CO1                 | Apply r     | eleva                                       | ant inst    | rumenta    | tion tech            | iniques to   | solve    | comple        | x proble  | ms            |            |            |        |      |   |
| CO2                 | Recall t    | the fu                                      | undame      | entals and | d demon              | strate by    | unders   | tanding       | the first | principle     | s of Engi  | ineering   | scien  | ces. |   |
| CO3                 | Examin      | e the                                       | e appro     | priate teo | chniques             | to interp    | ret data | a to pro      | vide vali | d conclus     | ion        |            |        |      |   |
| <b>CO4</b>          | Demon       | strate                                      | e the co    | ollaborati | ion of sc            | ience and    | l Engin  | eering t      | o recogi  | nize the ne   | eed for li | fe long le | earniı | ıg.  |   |
| CO5                 | Analyse     | e the                                       | impact      | t of conte | extual kr            | nowledge     | to acce  | ess the l     | nealth ar | nd society    | issues.    |            |        |      |   |
| Mapping             | g of Cou    | f Course Outcome with Program Outcome (POs) |             |            |                      |              |          |               |           |               |            |            |        |      |   |
| Cos/POs             | PO1         | P   | <b>PO</b> 2 | PO3        | PO4                  | PO5          | PO6      | PO7           | PO8       | PO9           | PO10       | PO11       | PO     | 12   |   |
| CO1                 | 3           |   |             | 3          | 3                    | 3            |          |               |           | 2             |            |            |        |      |   |
| CO2                 | 3           |   | 3           |            |                      |              | 3        |               |           |               |            |            |        | 3    |   |
| CO3                 | 3           |   |             | 2          | 3                    |              |          |               |           |               |            |            |        |      |   |
| CO4                 | 3           |   | 3           |            | 3                    |              |          |               | 3         |               |            |            |        | 3    |   |
| CO5                 | 3           |   |             |            |                      |              | 2        | 3             | 2         |               |            |            |        | 3    |   |
| COs/PSOs            | PSO         | 1 P   | PSO2        | PSO3       | PSO4                 | PSO5         |          |               | •         |               |            | •          |        |      |   |
| CO1                 | 3           |   |             | 3          | 3                    |              |          |               |           |               |            |            |        |      |   |
| CO2                 | 3           |   |             | 2          | 3                    |              |          |               |           |               |            |            |        |      |   |
| CO3                 | 3           |   |             | 3          | 3                    |              |          |               |           |               |            |            |        |      |   |
| CO4                 | 3           |   |             | 3          | 3                    |              |          |               |           |               |            |            |        |      |   |
| CO5                 | 3           |   |             | 3          | 3                    |              |          |               |           |               |            |            |        |      |   |
| 3/2/1 Ind           | icates S    | Strer                                       | ngth O      | of Corre   | elation,             | 3 – Hig      | h, 2- N  | <b>Iediur</b> | n, 1- L   | OW            |            |            |        |      |   |
|                     |             |   |             |            | , í                  |              |          |               |           |               | ıt         |            |        |      |   |
|                     | ė           |   |             |            | р                    |              |          |               | N.        |               | neı        |            |        |      |   |
|                     | enc         |   |             |            | s ar<br>nce          |              |          |               |           | ary           | odı        |            |        |      |   |
| ory                 | Scie        |   | rin         | ce         | tie:<br>cie          | _            | ran      | e c           | מרו       | lina          | on         |            | [0]    | t f  |   |
| ege                 | ic S        |   | nee         | ien        | ani<br>1 S           | ran          | 120      | b it i        | 5         | r<br>cip]     | 1 C        |            |        | ojec |   |
| Cat                 | 3as         |   | lgi         | Sc         | um<br>cia            | 1 <u>3</u> 0 | Pr Pr    | elec          | har       | nte<br>Disc   | škil       |            | Prof   | Prc  |   |
| <u> </u>            |             | /   | Ē           | ад         | H <sub>1</sub><br>so | L d          | 5        | ŢĊ            | )         |               |            |            |        | - /  |   |
|                     | · ·         | ·   |             |            |                      |              |          |               |           |               |            |            |        |      |   |
|                     |             |   |             |            |                      |              |          |               |           |               |            |            |        |      |   |

(An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code :<br>EBCH22ET1 | Subject Name : ENGINEERING CHEMISTRY | Ty/Lb<br>/ETL | L | T/<br>SLr | P/R | С |
|-----------------------------|--------------------------------------|---------------|---|-----------|-----|---|
|                             | Prerequisite : None                  | ETL           | 2 | 0/0       | 2/0 | 3 |

#### UNIT -I CHEMICAL THERMODYNAMICS

EDUCAT

Introduction, Terminology in thermodynamics –System, Surrounding, State and Path functions, Extensive and intensive properties. Laws of thermodynamics – I and II laws-Need for the II law. Enthalpy, Entropy, Gibbs free energy, Helmholtz free energy - Spontaneity and its criteria. Maxwell relations, Gibbs -Helmholtz equation (relating E & A) and (relating H & G).

#### **UNIT -II TECHNOLOGY OF WATER**

Water quality parameters – Definition and expression. Analysis of water – alkalinity, hardness and its determination (EDTA method only). Boiler feed water and Boiler Troubles-Scales and sludges, Caustic embrittlement, Priming and Foaming and Boiler corrosion. Water softening processes – Internal conditioning, external conditioning – Demineralization methods. Desalination processes-RO and Electrodialysis.

#### Lab Component-1. Analyze the water quality parameters for the given water sample. UNIT -III ANALYTICAL AND CHARACTERIZATION TECHNIQUES 9

Chromatographic techniques – column, thin layer and paper. Instrumentation-working with block diagram- UV-Visible Spectroscopy, IR Spectroscopy, Scanning electron microscope, Transmission electron microscope.

#### Lab Component-2.Determination of Rf values of various components using thin layer chromatography.

3. Compute and interpret the structures of the given molecules using Chem Draw.

#### UNIT – IV ELECTROCHEMISTRY

Conductance – Types of conductance and its Measurement. Electrodes and electrode potential, Nernst equation – EMF measurement and its applications-Electrochemical series- Types of electrodes- Reference electrodes-Standard

hydrogen electrode- Saturated calomel electrode-Determination of P<sup>H</sup> using these electrode.

#### Lab Component-4. Studies on acid-base conductometric titration.

5. Determination of redox potentials using potentiometry

#### UNIT -VPOLYMERS AND NANO COMPOSITES

Polymers-Introduction-Monomers – Functionality – Degree of polymerization-Tacticity. Classification- Plastics – Thermoplastics and thermosetting plastics, Compounding of plastics – Compression moulding, injection moulding and extrusion processes. Nano composites:particulates, clay and carbon nano tubes.Graphene nano composites and its applications.

#### Lab Component-6.Polymeric analysis using capillary viscometer

#### References

1. Jain & Jain Engineering Chemistry 17th Edition, Dhanpat Rai Publishing Company

- 2. Vasant R. Gowariker, N. V. Viswanathan, Jayadev Sreedhar, Polymer Science, New Age International, 1986
- 3. B.K. Sharma, Polymer Chemistry, Goel Publishing House
- 4. Y. R. Sharma , *Elementary Organic Spectroscopy*, S. Chand& Company Ltd.

5. N.Krishnamurthy, K.Jeyasubramanian, P.Vallinayagam, Applied Chemistry, Tata McGraw-Hill Publishing Company Limited, 1999.

6. Chichester, polymer-clay-nano composites, Johnwiley (2000)

#### Total No. of periods: 45

9

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| Subject Code<br>EBEE22ET1 | e Sub<br>ELF   | ject N<br>ECTRO   | ct Name :BASIC ELECTRICAL AND<br>TRONICS ENGINEERING |               |            |        |                   |                 |              | Ty/Lb/<br>ETL | ' L                | T/SLr     | P/F           | ł     | С        |
|---------------------------|--|---|--|---------------|------------|--------|-------------------|-----------------|--------------|---------------|--------------------|-----------|---------------|-------|----------|
|                           | Pre  | requis  | ite : No   | one           |            |        |                   |                 |              | ETL           | 2                  | 0/0       | 2/0           | )     | 3        |
| C: Credits, L             | L: Lectu   | re, T:  | Tutori   | ial, SL       | r: Supe    | rvise  | ed L              | earnin          | g, P:        | Proble        | m / P              | ractical  |               |       |          |
| R: Research,              | Ty/Lb  | /ETL/   | IE: Th   | eory /I       | Lab/Eml    | bedd   | led ]             | Theory          | and          | Lab/In        | terna              | Evaluat   | tion          |       |          |
| OBJECTIVE                 | ES   |   |  |               |            |        |                   | •               |              |               |                    |           |               |       |          |
| Unde                      | erstand  | the co  | ncepts   | of circ       | cuit elen  | nent   | s, ci             | rcuit l         | aws a        | and cou       | pled               | circuits. |               |       |          |
| Gain                      | inform   | ation   | on mea   | asurem        | ent of e   | lectr  | rical             | paran           | neter        | S.            | -                  |           |               |       |          |
| Acqu                      | ire kno  | wledg   | e on c   | onvent        | tional &   | non    | -con              | ventio          | onal e       | nergy         | produ              | ction.    |               |       |          |
| • Ident                   | ifv basi   | ic theo   | retical  | princi        | ples bel   | nind   | the               | worki           | ng of        | mode          | n ele              | ctronic g | adgets.       |       |          |
| • Demo                    | onstrate   | e digit   | al elec  | tronic        | circuits   | and    | asse              | emble           | simp         | le devi       | ces.               | 2         | 0             |       |          |
| COURSE OU                 | UTCON  | <b>IES</b> (0   | Cos)   |               |            |        |                   |                 | <u>siiip</u> | 10 00 11      |                    |           |               |       |          |
| Students com              | pleting t  | this co   | urse we  | ere able      | to         |        |                   |                 |              |               |                    |           |               |       |          |
| CO1 0                     | Comput   | e the e   | lectric  | circuit       | paramete   | ers fo | or sir            | nple p          | roblei       | ns            |                    |           |               |       |          |
| CO2 I                     | Elaborat   | te the c  | concept  | s of Ele      | ectrical r | nach   | ines              | and m           | easur        | ement p       | rincip             | les       |               |       |          |
| CO3 1                     | ldentify   | conve   | entiona  | 1 and         | Non-cor    | vent   | tiona             | l Elec          | trical       | power         | Gen                | eration,  | Transmis      | ssion | and      |
| I                         | Distribu   | tion  |  |               |            |        |                   |                 |              |               |                    |           |               |       |          |
| <b>CO4</b>                | Analyze  | the w   | orking   | princip       | les and c  | hara   | cteri             | stics o         | f anal       | og elec       | tronic             | devices   |               |       |          |
| CO5 1                     | Underst  | rstand basics of digital electronics and solving problems and design combinational circuits |  |               |            |        |                   |                 |              |               |                    |           |               |       |          |
| Mapping of C              | Course   | Outco   | me wit   | h Prog        | ram Ou     | tcon   | ne (F             | <u>POs)</u>     | -            |               |                    |           |               |       |          |
| Cos/POs                   | PO1  | PO2   | PO3  | PO4           | PO5        | PC     | 06                | PO7             | PO8          | PO9           | PO                 | 10        | PO11          | PO1   | 12       |
| COI                       | 3  | 3   | 3  | 3             |            |        |                   |                 |              |               |                    |           | 2             |       | <u>l</u> |
| CO2                       | 3  | 3   | 3  | 2             | 2          |        |                   | 2               |              |               | -                  |           | 2             |       | 1        |
| <u>CO3</u>                | 3  | 2   | 3  | 2             | 3          |        |                   | $\frac{2}{2}$   |              | 2             |                    |           | 2             |       | 1<br>1   |
| C04                       | 3  | $\frac{2}{2}$   | 3  | $\frac{2}{2}$ | 3          |        |                   | Z               |              | 2             | _                  |           | $\frac{2}{2}$ |       | 1<br>1   |
| CO <sub>5</sub> /PSOs     | PSO1   | 2   | <br>PSO2   | 2             | PSO3       | PSC    | $\overline{a}$    | PSO5            |              | 2             |                    |           | 2             |       | 1        |
| CO1                       | 3  |   | 1502   |               | 1505       | 150    |                   | 1505            |              |               |                    |           |               |       |          |
| CO2                       | 3  |   |  |               |            |        |                   |                 |              |               |                    |           |               |       |          |
| CO3                       | 3  |   |  |               |            |        |                   |                 |              |               |                    |           |               |       |          |
| CO4                       | 3  |   |  |               |            |        |                   |                 |              |               |                    |           |               |       |          |
| CO5                       | 3  |   |  |               |            |        |                   |                 |              |               |                    |           |               |       |          |
| 3/2/1 Indicate            | es Stren   | gth O   | f Corr   | elation       | , 3 – Hig  | gh, 2  | - Me              | edium,          | 1- L         | DW            |                    |           |               |       |          |
|                           |  |   |  |               |            |        |                   |                 |              | >             |                    |           |               |       |          |
| Category                  | Basic Science<br>Engineering<br>Science<br>Humanities and<br>social Science<br>Program<br>Core<br>Program<br>elective<br>Open Elective |   |  |               |            | -      | Inter Disciplinar | Skill Component |              |               | Practical /Project |           |               |       |          |
|                           |  |   | ~  |               |            |        |                   |                 |              |               |                    |           |               |       |          |

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| Subject Code :<br>EBEE22ET1 | Subject Name : BASIC ELECTRICAL<br>AND ELECTRONICS ENGINEERING | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|-----------------------------|--|---------------|---|-----------|-----|---|
|                             | Prerequisite : None  | ETL           | 2 | 0/0       | 2/0 | 3 |

#### UNIT I ELECTRIC CIRCUITS

Electrical Quantities – Ohms Law – Kirchhoff's Law – Series and Parallel Connections – Current Division and Voltage Division Rule - Source Transformation – Wye (Y) – Delta ( $\Delta$ ) , Delta ( $\Delta$ ) – Wye (Y) Transformation – Rectangular to Polar and Polar to Rectangular

#### Lab Components – Measurement of Electrical Quantities

EDUCATIO

#### UNIT II MACHINES & MEASURING INSTRUMENTS

Construction & Principle of Operation of DC motor & DC Generator – EMF equation of Generator – Torque Equation of Motor – Construction & Principle of operation of Transformer –Operating principles and Types of measuring instruments – Moving coil, Moving iron – Principle of Energy meter

Lab Component – Measurement of Energy Using energy meter

#### UNIT III BASICS OF POWER SYSTEM

Generation of Electric Power (Thermal, Hydro, Wind and Solar) – Basic structure of Power system – Types of Transmission & Distribution Schemes – Representation of Substation.

Lab Component – Residential house wiring Stair case wiring

#### UNIT IV ELECTRON DEVICES

Semiconductor Materials: Silicon and Germanium – PN Junction Diode, Zener Diode – Characteristics and Applications – Bipolar Junction Transistor - JFET, SCR, MOSFET, IGBT –Characteristics and Applications – Operating principle - Rectifiers and Inverters

Lab Component – Resistor colour coding -Resistance Measurement

#### UNIT V DIGITAL SYSTEM

Number System – Binary, Decimal, Octal, Hexadecimal – Binary Addition, Subtraction, Multiplication & Division – Boolean Algebra – Reduction of Boolean Expressions – Logic Gates - De-Morgan's Theorem - Adder – Subtractor Lab Component - Soldering practice

#### **Logic Gates**

#### **Total no of Periods : 45**

#### **TEXT BOOKS:**

- 1. D P Kothari, I J Nagrath, 2017, Basic Electrical Engineering, Second Edition, Tata McGraw-Hill Publisher
- 2. A.K. Sawhney, 2015 A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai & CO publisher
- 3. B.L. Theraja, A.K. Theraja, Text Book of Electrical Technology: Volume 3: Transmission, Distribution and Utilization, S. Chand publisher
- 4. Morris Mano, M, 2016 Digital Logic and Computer Design, Prentice Hall of India
- 5. Millman and Halkias 2015, Electronic Devices and Circuits, Tata McGraw Hill

#### **REFERENCE BOOKS:**

1. R. Muthusubramanian, S. Salivahanan, K A Muraleedharan, Basic Electrical, Electronics and Computer Engineering, Second Edition, Tata McGraw-Hill publisher



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| EDUCATIONAL AND RESEARCH INSTITUTE          | A A A A A A A A A A A A A A A A A A A |
|---|---------------------------------------|
| University with Graded Autonomy Status      |                                       |
| (An ISO 21001 : 2018 Certified Institution) |                                       |

| Subject Code<br>EBCC22I01 | è             | Sub<br>ENT  | ject N    | ame :            | ORIENT                        | ATION '<br>& PROJI | TO<br>ECT  | Ty<br>E        | /Lb/<br>TL/IE | L            | T/SI               | r P      | /R        | C       |
|---------------------------|---------------|---|-----------|------------------|-------------------------------|--------------------|------------|----------------|---------------|--------------|--------------------|----------|-----------|---------|
|                           |               | LAI   | B         |                  |                               |                    |            |                |               |              |                    |          |           |         |
|                           |               | Pre   | requis    | ite : N          | one                           |                    |            |                | IE            | 1            | 0/0                | 1        | /0        | 1       |
| C: Credits, L             | L: Lect       | ture,   | T: Tu     | torial,          | SLr: S                        | upervise           | ed Learn   | ing, I         | P: Probl      | em / P       | Practical          | •        |           |         |
| R: Research,              | Ty/L          | b/E'l   | L/IE:     | Theor            | y /Lab/l                      | Embedd             | led Theo   | ry an          | d Lab/I       | nterna       | l Evalu            | ation    |           |         |
| OBJECTIVE                 | LS .          | 1 1   |           |                  | 1. т                          |                    |            |                | • 1• • 1      | 1 .          |                    | C 1 1    | 1         |         |
| • Unde                    | erstanc       | 1 hov   | v entre   | eprene           | urship E                      |                    | on transfo | orms           | individ       | uals in      | ito succ           | essful I | eade      | ers.    |
| • Ident                   | ify inc       | divid   | ual po    | tentia           | l &S ha                       | ve caree           | er dreams  | 5              |               |              |                    |          |           |         |
| • Unde                    | erstand       | l diff  | erence    | e betw           | een idea                      | as & op            | portuniti  | es             |               |              |                    |          |           |         |
| • Ident                   | ify co        | mpor  | nents a   | & crea           | ate actio                     | n plan.            |            |                |               |              |                    |          |           |         |
| • Use b                   | orainst       | tormi   | ing in    | a grou           | ip to gei                     | nerate ic          | leas.      |                |               |              |                    |          |           |         |
| COURSE OU                 | JTCO          | MES   | G (Cos)   |                  | 11.                           |                    |            |                |               |              |                    |          |           |         |
| Students com              | pleting       | g this  | course    | were             | able to                       |                    | -1-11:44   |                | ! 1           | • • •        |                    |          |           |         |
|                           | Deve          | elop  | a Busi    | ness I           | $\sin \alpha$ i               | nprove             | ability to | ) reco         | ognize c      | busine       | ss oppo            | riunity  |           |         |
| CO2                       | Do a          | u self  | -analy    | sis to           | build an                      | entrep             | reneurial  | care           | er.           |              |                    |          |           |         |
| CO3                       | Artic         | iculate an effective elevator pitch.  |           |                  |                               |                    |            |                |               |              |                    |          |           |         |
| CO4                       | Anal          | nalyze the local market environment & demonstrate the ability to find an attractive |           |                  |                               |                    |            |                |               |              |                    |          |           |         |
|                           | mark          | arket   |           |                  |                               |                    |            |                |               |              |                    |          |           |         |
| CO5                       | Iden          | tify t  | he req    | uired            | skills fo                     | or entrep          | oreneursh  | nip &          | develop       | р            |                    |          |           |         |
| Mapping of (              | Course        | e Out   | tcome     | with F           | rogram                        | Outcon             | ne (POs)   |                |               |              |                    |          |           |         |
| Cos/POs                   | PO            | D1  | PO2       | PO3              | PO4                           | PO5                | PO6 I      | PO7            | PO8           | PO9          | PO10               | PO11     | PC        | )12     |
| CO1                       |               |   | 2         | 2                | 3                             | 2                  | 2          | 2              |               | 2            | 2                  | 2        |           | 1       |
| CO2                       |               | 3   | 2         |                  | 3                             | 2                  | 3          | 2              | 3             | 3            | 3                  | 2        |           | 2       |
| CO3                       |               |   | 2         | 2                | 2                             | 2                  | 3          |                | 3             | 3            | 3                  | 2        |           |         |
| C04                       |               |   | 2<br>2    | $\frac{2}{2}$    | 2                             | $\frac{2}{2}$      | 2          | 3              | 3             | 2            | 2                  | 3        |           | 1       |
| COs/PSOs                  | P             | SO1   |           | $\frac{2}{D2 P}$ | 2SO3                          | PSO4               | 2          | 5              | 5             | 2            | 2                  | 5        |           | 1       |
| CO1                       |               | 2   | 15.       | 21               | 3                             | 1501               |            |                |               |              |                    |          |           |         |
| CO2                       |               | 2   |           |                  | 3                             |                    |            |                |               |              |                    |          |           |         |
| CO3                       |               | 2   |           |                  | 3                             |                    |            |                |               |              |                    |          |           |         |
| CO4                       |               | 2   |           |                  | 3                             |                    |            |                |               |              |                    |          |           |         |
| CO5                       |               | 2   |           |                  | 3                             |                    |            |                |               |              |                    |          |           |         |
| 3/2/1 Indicate            | es Stre       | ength   | Of Co     | orrelat          | tion, 3 –                     | High, 2            | - Mediun   | <b>n, 1-</b> ] | Low           |              |                    |          |           |         |
| Category                  | Docto Colonoo | Basic ocience   | Ingineeri | lg<br>Science    | Humanities and social Science | Program            | Program    | Jnen Elective  | Inter         | Disciplinary | Skill<br>Component |          | Duration1 | Project |
|                           |               |   |           |                  |                               |                    | -          |                | <u> </u>      |              |                    | ✓        |           |         |



| Subject Code :<br>EBCC22I01 | Subject Name : ORIENTATION TO<br>ENTREPRENEURSHIP | Ty/Lb<br>/ETL/IE | L | T/<br>SLr | P/R | С |
|-----------------------------|---|------------------|---|-----------|-----|---|
|                             | Prerequisite : None                               | IE               | 1 | 0/0       | 1/0 | 1 |

#### UNIT I CHARACTERISTICS OF A SUCCESSFUL ENTREPRENEUR

Introduction to entrepreneurship education – Myths about entrepreneurship – How has entrepreneurship changed the country – Dream it. Do it - Idea planes - Some success stories – Global Legends – Identify your own heroes –

#### UNITII ENTREPRENEURIAL STYLE

Entrepreneurial styles – Introduction, concept & Different types - Barrier to Communication – Body language speaks louder than words

#### UNIT III DESIGN THINKING

Introduction to Design thinking – Myth busters – Design thinking Process - Customer profiling – Wowing your customer – Personal selling – concept & process – show & tell concept – Introduction to the concept of Elevator Pitch

#### UNIT IV RISK MANAGEMENT

Introduction to risk taking & Resilience – Managing risks (Learning from failures, Myth Buster) – Understanding risks through risk takers – Why do I do? – what do I do?

#### UNIT V PROJECT

How to choose a topic – basic skill sets necessary to take up a project – creating a prototype – Pitch your project – Project presentation.

Total No. of Periods: 15



| Subject Code:    | C         | PROGR                    | AMMING        | AND N    | AS OFF     | FICE TO          | OOLS      | Т        | y/Lb/     | L     | Т/      | <b>P</b> / | R           | С  |
|------------------|-----------|--------------------------|---------------|----------|------------|------------------|-----------|----------|-----------|-------|---------|------------|-------------|----|
| EBCS22ET1        |           |                          |               |          |            |                  |           |          | ETL       |       | S.Lr    |            |             |    |
|                  | Prereq    | uisite: Nil              |               |          |            |                  |           |          | ETL       | 1     | 0/0     | 2/         | 0           | 2  |
| C: Credits, L: I | Lecture   | , T: Tuto                | rial, SLr: S  | Superv   | ised Le    | arning,          | P: Prob   | olem / F | Practica  | 1     |         |            |             |    |
| R: Research, T   | y/Lb/E    | TL/IE: T                 | heory /Lab    | /Embe    | dded T     | heory a          | nd Lab/   | Interna  | ıl Evalu  | ation | l       |            |             |    |
| OBJECTIVES       | :         | •                        |               |          |            |                  |           |          |           |       |         |            |             |    |
| The student sh   | ould be   | made to:                 |               |          |            |                  |           |          |           |       |         |            |             |    |
| • learn a p      | oblem s   | ming lang                | uage.         |          |            |                  |           |          |           |       |         |            |             |    |
| • leaffi pro     | ograms    | in C and t               | o solve the   | nrohlen  | ns         |                  |           |          |           |       |         |            |             |    |
| • familiar       | ize the s | students in              | preparation   | n of doc | uments     | and pres         | sentation | ns with  | office a  | itoma | tion to | ols.       |             |    |
| COURSE OUT       | COME      | $\frac{1}{S(COs)}$ :     | After Com     | pleting  | the cou    | irse, the        | e studen  | t can b  | e able to | 0     |         | 015.       |             |    |
| CO1              | Under     | stand and                | trace the ex  | ecution  | of prog    | rams wr          | ritten in | C langu  | age.      |       |         |            |             |    |
| CO2              | Write     | the C code               | e for a giver | n algori | thm.       |                  |           |          |           |       |         |            |             |    |
| CO3              | Apply     | Arrays an                | nd Function   | s conce  | pts to v   | write Pro        | ograms    |          |           |       |         |            |             |    |
| CO4              | Apply     | Structure                | s and point   | ers con  | cepts for  | r writing        | , Prograi | ms       |           |       |         |            |             |    |
| CO5              | To per    | form docu                | imentation .  | accour   | nting op   | erations         | and pre   | sentatio | n skills  |       |         |            |             |    |
| Mapping of Co    | urse Oi   | itcomes w                | ith Progra    | m Oute   | comes (    | POs)             | DOT       | DOP      | DOD       | DOI   |         | 11         | <b>D</b> O1 | 2  |
| COS/POS          | POI       | POZ                      | POS           | PO4      | POS        | PUo              | P07       | PUð      | P09       | PUI   |         | <u>л</u>   | PUI         | .4 |
|                  | 2         | 2                        | 2             | 2        | 1          | 1                | 1         | 1        | 1         | 1     |         | 2          | 2           | 2  |
| CO2              | 2         | 2                        | 2             | 2        | 1          | 1                | 1         | 1        | 1         | 1     |         | 2          | 2           | 2  |
| CO3              | 2         | 2                        | 3             | 2        | 1          | 1                | 1         | 1        | 1         | 1     |         | 3          | 2           | 2  |
| CO4              | 2         | 2                        | 3             | 3        | 1          | 1                | 1         | 1        | 1         | 1     |         | 3          | 2           | 2  |
| CO5              | 1         | 1                        | 1             | 1        | 1          | 1                | 0         | 0        | 2         | 3     |         | 2          | (           | )  |
|                  |           | DC01                     |               |          | DCOA       |                  |           | DCO      |           |       |         | DCO        |             |    |
| CUs/PSUs         |           | PS01                     |               |          | PS02       |                  |           | P503     | )         |       |         | P504       | ŧ           |    |
| CO1              |           | 1                        |               |          | 1          |                  |           | 2        |           |       |         | 2          |             |    |
| CO2              |           | 1                        |               |          | 1          |                  |           | 2        |           |       |         | 2          |             |    |
| CO3              |           | 1                        |               |          | 1          |                  |           | 2        |           |       |         | 2          |             |    |
| <u>CO4</u>       |           | 1                        |               |          | 1          |                  |           | 2        |           |       |         | 2          |             |    |
| CO5              | C4        | 1<br>• • • • • • • • • • |               | TT: - L  | 1<br>2 Mai | l <sup>1</sup> 1 | T         | 2        |           |       |         | 2          |             |    |
| 3/2/1 Indicates  | Strengt   | n Of Cor                 | relation, 3 - | - Hign,  | 2- Meo     | iium, 1-         | LOW       | 1        | 1         | _     |         |            |             |    |
|                  |           |                          |               |          |            |                  |           |          |           |       |         |            |             |    |
|                  |           |                          |               |          |            |                  |           |          |           |       |         |            |             |    |
|                  |           | e                        | cial          |          | a          |                  |           |          |           |       |         |            |             |    |
|                  |           | ien                      | soc           |          | tiv        |                  | ary       | ent      | ect       |       |         |            |             |    |
|                  | Jce       | Sc                       | and           | e        | elec       | ve               | olin      | one      | roj       |       |         |            |             |    |
|                  | cier      | ing                      | ies           | Co       | am         | sctiv            | scil      | duid     | ll /F     |       |         |            |             |    |
|                  | c S       | leer<br>ce               | anit          | am       | ngra       | Ele              | Di        | I CC     | tica      |       |         |            |             |    |
| ry               | 3asi      | ngin<br>tien             | um:<br>ien    | ogr      | Pr(        | pen              | nter      | Kill     | rac       |       |         |            |             |    |
| ego              | щ         | Er                       | Hi<br>Sc      | Pr       |            | Ō                | н<br>,    |          | щ         |       |         |            |             |    |
| Cat              |           |                          |               |          |            |                  | <b>✓</b>  |          |           |       |         |            |             |    |
| -                |           |                          |               |          |            |                  |           |          |           |       |         |            |             |    |

B.Tech Mechanical Engineering - 2022 Regulation

University with Graded Autonomy Status (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95, Tamilnadu, India.

| Subject Code: | C PROGRAMMING AND MS OFFICE TOOLS | Ty/Lb/ | L | Τ/   | P/R | С |
|---------------|-----------------------------------|--------|---|------|-----|---|
| FRCS22FT1     |                                   | ETL    |   | S.Lr |     |   |
|               | Prerequisite: Nil                 | ETL    | 1 | 0/0  | 2/0 | 2 |

#### UNIT I INTRODUCTION

Basic Structure of C programme- Constants, Variables and data types, Keywords, Identifiers- Operators and expressions- executing a C Program

#### UNIT II DECISION MAKING STATEMENTS AND LOOPING STATEMENTS

Decision making with if statement, Simple if statement, else-if statement, Nesting if-else statement, The else if ladder, The switch statement, The goto statement, The while statement, The do while statement, The for statement, jumps in loops

#### UNIT III ARRAYS AND FUNCTIONS

Introduction to Arrays- One dimensional arrays, Two dimensional array, and Multidimensional array- Introduction to Functions- calling a function, category of functions- arguments with return values, argument with no return values-parameter passing Mechanism: Call by Value and Call by Reference. Recursion.

#### **UNIT IV STRUCTURES& POINTERS**

Structures definition, giving values to members, Structure initialization, comparison of structure variables, Structure within structures, Understanding pointers, accessing the address of the variable, declaring and initializing pointer, accessing a variable through its pointer and arrays

#### **UNIT V MS-OFFICE**

Introduction to MS-Word- Menus- Introduction to MS-Excel: features of MS- Excel, spread sheet/worksheet, parts of MS-excel window, functions in excel sheet, chart, Introduction to MS-Power point

#### **Total No. of Periods: 30**

#### **TEXT BOOKS:**

- 1. E.Balaguruswamy, Programming in ANSI C
- 2. Padma Reddy ,Computer Concepts & 'C' Programming
- 3. ShobhaHangirke,Computer Application For Business List of Experiments : C PROGRAMMING
- 1. Find the factorial of a given positive number using function.
- 2. Calculate X raised to y using function.
- 3. Find GCD and LCM of two given integer numbers using function.
- 4. Find the sum of N natural numbers using function.
- 5. Book information using Structure.
- 6. Student information using Structure.
- 7. Print the address of a variable and its value using Pointer
- 8. Find area and perimeter of a circle
- 9. Check whether the given number is palindrome or not
- 10. Check whether the given number is prime or not
- 11. Calculate sum of the digits of the given number
- 12. Display Fibonacci series up to N terms
- 13. Check whether a given character is alphabetic, numeric or special character
- 14. Count vowels and consonants in a given string

# 15. Find product of two matrices **MS-OFFICE**

- 16. Preparing a news letter:
- 17. To prepare a newsletter with borders, two columns text, header and footer and inserting a graphic image and page layout.
- 18. Creating and editing the table
- 19. Printing envelopes and mail merge.
- 20. Using formulas and functions: To prepare a Worksheet showing the monthly sales of a company in different branch offices
- 21. Prepare a Statement for displaying Result of 10 students in 5 subjects



6

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# **SEMESTER II**



|                         | JOI . ZOIO Celtine  | a mananon)                |
|-------------------------|---------------------|---------------------------|
| erivar E.V.R. High Road | , Maduravoval, Chen | nai-95. Tamilnadu, India. |

| Subject Code:<br>EBMA22003 | Su   | bject Na  | ame : M     | MATIC      |            |                | Ty/I<br>E | Lb/<br>TL      | ]       | Ĺ           | T/<br>S.Lr    | P/F      | 2   | С    |     |            |
|----------------------------|--|---|-------------|------------|------------|----------------|-----------|----------------|---------|-------------|---------------|----------|-----|------|-----|------------|
|                            | D  |   |             |            | 1          | 1              |           |                | -       |             |               | 2        | 1/0 | 0/0  |     | -          |
| C. Cradita I. I            | Pre  | erequisit   | e: Higne    | r second   | ary Mat    | nematic        | :S        | D. D.,         |         | <u>y</u>    |               | <b>3</b> | 1/0 | 0/0  |     | 4          |
| C: Creans, L: I            |  | 2, 1: 1u  | ional, S    | Lr: Su     | pervised   | 1 Learn        | ing, i    | P: Pr          |         | 1 / Pra     |               | 11<br>   |     |      |     |            |
| R: Research, T             | y/Lb/E                                       | L1L/IE:   | Theory      | /Lab/E     | mbedde     | d Theo         | ry ar     | nd La          | ib/Inte | rnal .      | Evalu         | atio     | n   |      |     |            |
| OBJECTIVES                 | :  |   |             |            |            |                |           |                |         |             |               |          |     |      |     |            |
| The student sh             | ould b                                       | e made 1  | <b>:0:</b>  |            |            |                |           |                |         |             |               |          |     |      |     |            |
| To be able to unde         | erstand l                                    | basic con   | cepts in i  | ntegratio  | n          |                |           |                |         |             |               |          |     |      |     |            |
| To understand the          | concep                                       | in ordina   | uple inte   | grais      | ations     |                |           |                |         |             |               |          |     |      |     |            |
| To be able to appl         | v conce                                      | concepts of analytical geometry   |             |            |            |                |           |                |         |             |               |          |     |      |     |            |
| To be able to upp          | erstand the basic concept of vector calculus |   |             |            |            |                |           |                |         |             |               |          |     |      |     |            |
| COURSE OUT                 | COMES (COs):                                 |   |             |            |            |                |           |                |         |             |               |          |     |      |     |            |
| CO1                        | Int  | UMES (COs):<br>Integrate the given function by using methods of integration and to find the area under curve and the volume |             |            |            |                |           |                |         |             |               |          |     |      | ame |            |
|                            | of   | of a solid by revaluation   |             |            |            |                |           |                |         |             |               |          |     |      |     |            |
| CO2                        | Ev   | aluate the  | multiple    | integral   | s /area/vo | lume an        | d to ch   | hange          | the or  | ler of      | integra       | ation    |     |      |     |            |
| CO3                        | Ap   | bly concepts in Ordinary Differential equations and to solveeulers differential equation                                    |             |            |            |                |           |                |         |             |               |          |     |      |     |            |
| CO4                        | Fir  | d equation  | n of plar   | es, lines  | and sphe   | re and s       | hortes    | t dista        | ance be | tween       | skew          | lines    |     |      |     |            |
| C05                        | Ve   | rifv greer  | stokes/s    | gauss div  | ergence t  | neorem         |           |                |         |             |               |          |     |      |     |            |
| Manning of Cor             | urse O                                       | utcomes   | with P      | rogram     | Outcom     | es (PO         | s)        |                |         |             |               |          |     |      |     |            |
| COs/POs                    | PO1  | PO2   | PO3         | PO4        | PO5        | PO6            | <br>P     | 07             | PO8     | Р           | 79            | PO       | 10  | PO11 | PO  | 12         |
| CO1                        | 3  | 3   | 2           | 2          | 2          | 2              | -         | 1              | 2       |             | 2             |          | 2   | 1    |     | 3          |
| CO2                        | 3  | 3   | 1           | 2          | 2          | 3              |           | 2              | 2       |             | 3             |          | 3   | 2    |     | 2          |
| CO3                        | 3  | 3   | 1           | 2          | 2          | 3              |           | 1              | 1       |             | 3             |          | 3   | 2    |     | 2          |
| CO4                        | 3  | 3   | 2           | 2          | 1          | 2              |           | 2              | 2       |             | 2             |          | 3   | 2    |     | 2          |
| CO5                        | 3  | 3   | 1           | 2          | 2          | 2              |           | 2              | 1       |             | 2             |          | 3   | 1    |     | <u>-</u> 2 |
| COs / PSOs                 | 5  | PSO1  | 1           |            | –<br>PS    | $\frac{1}{02}$ |           | Ī              | -       | PSC         | <u>-</u>      |          |     | PS   | 14  |            |
| 00371505                   |  | 1001  | L           |            | 10         | 02             |           |                |         | 150         |               |          |     | 10   | 74  |            |
| CO1                        |  | 3   |             |            | 2          | 2              |           |                |         | 1           |               |          |     | 2    |     |            |
| CO2                        |  | 3   |             |            | 2          | 2              |           |                |         | 1           |               |          |     | 2    |     |            |
| CO3                        |  | 3   |             |            | 2          | 2              |           |                |         | 1           |               |          |     | 2    |     |            |
| CO4                        |  | 3   |             |            | 2          | 2              |           |                |         | 1           |               |          |     | 2    |     |            |
| CO5                        |  | 3   |             |            | 2          | 2              |           |                |         | 1           |               |          |     | 2    |     |            |
| 3/2/1 Indicates            | Streng                                       | th Of Co  | orrelatio   | on, 3 – I  | High, 2-   | Mediur         | n, 1-     | Low            |         |             |               |          |     |      |     |            |
|                            |  |   | T S         |            |            | _              |           |                |         | . 11        |               |          |     |      |     |            |
|                            | ces  | 50  | and         | Jre        |            | N PO           | 5         |                |         | ps /<br>Ski |               |          |     |      |     | 1          |
| <i>y</i>                   | ien  | ing   | ecti s lies |            |            |                |           |                |         | shi         | $\mathbf{ls}$ |          |     |      |     | 1          |
| goi                        | Sc   | lee1  | mit<br>I S  | am         | am         | Ves<br>F1,     |           | cal            | t       | erne        | ikil          |          |     |      |     | 1          |
| ate                        | sic  | gin   | ma<br>cial  | en len len |            |                |           |                | jec     | Int(<br>sch | ft S          |          |     |      |     | 1          |
| Ŭ                          | Ba   | En<br>Sci   | Hu<br>Soc   | Prc        | Prc        | <u>ă</u>       | 2         | $\Pr_{\Sigma}$ | Pr(     | Ē           | So            |          |     |      |     |            |
|                            |  |   |             |            |            |                |           |                |         |             |               |          |     |      |     |            |
|                            |  |   |             |            |            |                |           |                |         |             |               |          |     |      |     | l.         |

### (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code :<br>EBMA22003 | Subject Name : MATHEMATICS – II | Ty/Lb<br>/ETL | L | T/<br>SLr | P/R | С |
|-----------------------------|---------------------------------|---------------|---|-----------|-----|---|
|                             | Prerequisite : None             | Ту            | 3 | 1/0       | 0/0 | 4 |

### **1. INTEGRATION**

Basic concepts of Integration – Methods of Integration– Integration by substitution – Integration by parts – Definite integrals– Properties of definite integrals – Problems on finding Area and Volume using single integrals (simple problems).

### 2. MULTIPLE INTEGRALS

Double integral in Cartesian and Polar Co-ordinates – Change of order of integration – Triple integral in Cartesian Co-ordinates – Spherical Polar Co-ordinates – Change of variables (simple problems).

### **3. ORDINARY DIFFERENTIAL EQUATIONS**

First order differential equations – Second and higher order linear differential equations with constant coefficients and with RHS of the form:  $e^{ax}$ ,  $x^n$ , Sin ax, Cos ax,  $e^{ax}f(x)$ , x f(x) where f(x) is Sin bx or Cos bx – Differential equations with variable coefficients (Euler's form) (simple problems).

### 4. THREE DIMENSIONAL ANALYTICAL GEOMETRY

Direction Cosines and Ratios – Equation of a straight line – Angle between two lines – Equation of a plane – Coplanar lines – Shortest distance between skew lines – Sphere – Tangent plane.

### **5. VECTOR CALCULUS**

Scalar and Vector functions – Differentiation – Gradient, Divergence and Curl – Directional derivatives – Irrotational and Solenoidal fields– Line, Surface and Volume integrals – Green's, Stoke's and Gauss divergence theorems (statement only) – Verification.

### Total no. of Periods: 60

### **Reference Books:**

- 1) Kreyszig E., Advanced Engineering Mathematics (10<sup>th</sup> ed.), John Wiley & Sons, (2011).
- 2) Grewal B.S., *Higher Engineering Mathematics*, Khanna Publishers, (2012).
- 3) John Bird, *Basic Engineering Mathematics* (5<sup>th</sup> ed.), Elsevier Ltd, (2010).
- 4) Veerarajan T., Engineering Mathematics (for first year), Tata McGraw Hill Publishing Co., (2008).
- 5) P.Kandasamy, K.Thilagavathy and K. Gunavathy, *Engineering Mathematics Vol. I* (4<sup>th</sup> *Revised ed.*), S.Chand& Co., Publishers, New Delhi (2000).
- 6) John Bird, *Higher Engineering Mathematics* (5<sup>th</sup> ed.), Elsevier Ltd, (2006).



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| EDUCATIONAL AND RESEARCH INSTITUTE          | South At B |
|---|------------|
| DEEMED TO BE UNIVERSITY                     | ****       |
| University with Graded Autonomy Status      |            |
| (An ISO 21001 : 2018 Certified Institution) |            |

| Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India. |         |           |   |             |              |           |         |            |           |             |            |      |     |    |  |  |
|--|---------|-----------|---|-------------|--------------|-----------|---------|------------|-----------|-------------|------------|------|-----|----|--|--|
| Subject  | Code    | Su        | bject Na  | me: E       | NGINEER      | ING MI    | ECHA    | NICS       |           | Ty/Lb/      | L          | Τ/   | P/R | С  |  |  |
| EBPH2  | 2002    |           | (   | FORAU       | IO, MECH, V  |           |         | 11(5)      |           | ETL         |            | SLr  |     |    |  |  |
|  | 2002    | Pr        | erequisi  | te: Engi    | neering Ph   | ysics     |         |            |           | Ту          | 3          | 0/0  | 0/0 | 3  |  |  |
| L : Lectu  | ure T : | Tutoria   | 1 SLr :   | Supervi     | sed Learnir  | ng P:P    | roject  | R : Rese   | earch C:  | Credits     |            |      |     |    |  |  |
| T/L/ETL  | . : The | ory/Lab   | /Embedd   | ded Theo    | ory and Lab  | 1         |         |            |           |             |            |      |     |    |  |  |
| <b>OBJEC</b>   | TIVE    | :         |   |             |              |           |         |            |           |             |            |      |     |    |  |  |
|  | • Ba    | isic prin | ciples of   | stress, s   | train and el | astic cor | istants |            |           |             |            |      |     |    |  |  |
|  | • To    | o draw sl | floction  | e and be    | nding mom    | ent diag  | ram     |            |           |             |            |      |     |    |  |  |
|  | • 10    | ) IIIu ue | COURSE OUTCOMES (COs) : ( 3- 5)   |             |              |           |         |            |           |             |            |      |     |    |  |  |
| CO1  |         | Articul   | rticulate a strong foundation in understanding kinematics & Kinetics          |             |              |           |         |            |           |             |            |      |     |    |  |  |
|  |         |           | lentify and use the fundamentals of mechanics, static and dynamic equilibrium |             |              |           |         |            |           |             |            |      |     |    |  |  |
| CO2  | -       | Identify  | and use   | e the fu    | ndamental    | s of mee  | chanic  | es, static | c and $d$ | ynamic eq   | uilibriu   | m    |     |    |  |  |
| CO3  |         | Enhanc    | e the pr  | oblem s     | olving skil  | mics      |         |            |           |             |            |      |     |    |  |  |
| CO4  |         | Develo    | evelop analytical skills to identify different types of motion                |             |              |           |         |            |           |             |            |      |     |    |  |  |
| CO5  |         | Articula  | ate mod   | els to ac   | quire know   | wledge    | on ma   | athemat    | ical, an  | alytical sk | tills      |      |     |    |  |  |
|  |         |           | Mapping of Course Outcomes with Program Outcomes (POs)                        |             |              |           |         |            |           |             |            |      |     |    |  |  |
| Cos/Pos  |         | PO1       | PO2   | PO3         | PO4          | PO5       | PO6     | PO7        | PO8       | PO9         | ,,<br>PO10 | PO11 | PO  | 12 |  |  |
| CO1  |         | 3         | 3   | 2           | 2            | 2         | 1       | 1          | 100       |             | 2          | 1011 |     | 1  |  |  |
| CO2  |         | 3         | 3   | 1           | 2            | 2         | 1       | 1          |           | 1           | 2          |      |     | 1  |  |  |
| CO3  |         | 3         | 3   | 3           | 3            | 2         | 2       | 2          | 1         |             | 2          | 1    |     | 1  |  |  |
| CO4  |         | 3         | 3   | 3           | 3            | 2         | 2       | 1          | 1         | 3           | 2          | 1 1  |     |    |  |  |
| CO5  |         | 3         | 2   | 2           | 2            | 2         | 1       | 1          | 1         | 2           | 2          | 1    |     | 1  |  |  |
| Cos / PS   | SOs     | PS        | 501   | P           | <b>SO2</b>   | PS        | 03      | PS         | 504       |             |            |      |     |    |  |  |
| CO1  |         |           | 3   |             | 3            | 1         |         |            | 2         |             |            |      |     |    |  |  |
| CO2  |         |           | 3   |             | 3            | 1         |         |            | 2         |             |            |      |     |    |  |  |
| CO3  |         |           | 3   |             | 3            | 1         |         |            | 2         |             |            |      |     |    |  |  |
| CO4  |         |           | 3   |             | 3            | 1         |         |            | 2         |             |            |      |     |    |  |  |
| CO5  |         |           | 3   |             | 3            | 1         |         |            | 2         |             |            |      |     |    |  |  |
| 3/2/1 indi   | icates  | Strengt   | h of Cor  | relation    | a 3- High,   | 2- Medi   | ium, 1  | -Low       | <u> </u>  |             |            |      |     |    |  |  |
|  |         |           |   |             |              |           |         |            |           |             |            |      |     |    |  |  |
|  |         |           |   |             |              |           |         |            |           |             |            |      |     |    |  |  |
|  |         |           | lce   | cial        |              | e         |         | ~          |           |             |            |      |     |    |  |  |
|  |         |           | cier  | l so        |              | ctiv      |         | nary       | ent       | ject        |            |      |     |    |  |  |
|  |         | nce       | Š   | anc         | ore          | ele       | ve      | iplir      | noq       | Pro         |            |      |     |    |  |  |
|  | ry      | Scie      | ring  | ties        | CC           | ram       | lecti   | lisci      | om        | al /        |            |      |     |    |  |  |
|  | ego     | sic 5     | nee   | nce         | ,ran         | rogi      | n El    | er D       | II C      | ctic        |            |      |     |    |  |  |
|  | Cat     | Ba        | Ingi  | Hun<br>Scie | rog          | P.        | Dpe     | Int        | Ski       | Pra         |            |      |     |    |  |  |
|  |         |           |   |             |              |           |         |            |           |             |            | 1    |     |    |  |  |
|  |         |           |   |             |              |           |         |            |           |             |            |      |     |    |  |  |
|  |         |           |   |             |              |           |         |            |           |             |            |      |     |    |  |  |
|  |         |           |   |             |              |           |         |            |           |             |            |      | 1   |    |  |  |

### (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code: | Subject Name : ENGINEERING MECHANICS | Ty/Lb/ | L | Τ/  | P/R | С |
|---------------|--------------------------------------|--------|---|-----|-----|---|
| EDD1122002    |                                      | ETL    |   | SLr |     |   |
| EBPH22002     | Prerequisite: Engineering Physics    | Ту     | 3 | 0/0 | 0/0 | 3 |

### UNIT I STATICS OF PARTICLE

Introduction – units and Dimensions – Laws of mechanics – concurrent forces in a plane-resolution and Composition of forces – equilibrium of the particle-resultant force. Forces in space – Equilibrium of a particle in space – Rigid body - Moments and couples -moment of a force about a point and about an axis – Equilibrium of rigid bodies

### UNIT II PROPERTIES OF SURFACE AND SOLIDS

EDUCAT

Determination of Area and volume – Determination and derivation of First moment of area (Centroid), Second moment of area (Moment of Inertia) geometrical area Mass moment of inertia and polar moment of inertia.Principal moments of inertia of plane areas

### **UNIT IIIFRICTION**

Introduction – Laws of Dry Friction – Coefficient of friction – friction of a body lying on an inclined plane. Application of friction-Ladder friction-Wedge friction-Screw friction.

### UNITIVDYNAMICS OF PARTICLES

KINEMATICS: Displacement, Velocity-Constant and variable Acceleration, their relationship – linear and curvilinear motion- Projectile motion, relative motion.

KINETICS: Linear and Curvilinear motion- Impulse and Momentum, Impact-collision of Elastic bodies. Newton's law-D'Alemberts principle.

### UNITV DYNAMICS OF RIGID BODIES

KINEMATICS: Introduction-Rotation-Linear and Angular Velocity as well as acceleration. General plane motion-Absolute and Relative velocity in plane motion.

KINETICS: Relation between Translatory and Rotary motion of the body-Work energy equation of particles –D'Alemberts principle.

### TEXT BOOKS & REFERENCE BOOKS

- 1) R.S.Khurmi. (2008), "A Textbook of Engineering Mechanics", S.Chand& co Ltd.
- 2) S.Rajasekaran et.al. (2009), "*Fundamentals of Engineering Mechanics*", Vikas Publishing House Pvt Ltd., 3<sup>rd</sup> Edition.
- 3) Arthur.P.Boresi,Richard.J.Schmidt, "Engineering Mechanics : Statics & Dynamics", Thomson Brooks/Cole,Chennai.
- 4) Palanichamy M.S, Nagan.S, (2001), "Engineering Mechanics Statics and Dynamics" Tata Mc Graw Hill.
- 5) Beer & Johnson et.al, (2010) "Vector Mechanics for Engineers (Statics and Dynamics)", Tata Mc Graw Hill



### Total No. of Periods: 45

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| Subject Coc    | le  | S   | ubject ]            | Name :   | INDUS      | TRIAI   | 4       |       | 7     | Ty/Lb  | / I      |           | T/S  | SLr        | P/I    | 2    | С |
|----------------|---|---|---------------------|----------|------------|---------|---------|-------|-------|--------|----------|-----------|------|------------|--------|------|---|
| EBCH2200       | 02  | C   | HEMI                | 5181     |            |         |         |       |       | EIL    |          |           |      |            |        |      |   |
|                |   | P   | erequi              | site :Er | ngg. Che   | emistry |         |       | r     | Ty     | 3        | ;         | 0    | /0         | 0/0    |      | 3 |
| C: Credits,    | L:  | Lectur  | e, T: T             | utoria   | l, SLr:    | Superv  | vised L | earn  | ing,  | P: Pro | oblem    | / Pr      | acti | cal        |        |      |   |
| R: Researc     | h, 7  | Гу/Lb/F   | TL/IE               | E: Theo  | ory /La    | b/Embe  | edded ' | Theo  | ry a  | and La | b/Inter  | nal       | Eva  | luati      | on     |      |   |
| OBJECTIV       | VES   | 5   |                     |          | •          |         |         |       |       |        |          |           |      |            |        |      |   |
| OBJECTIV       | ES  | :   |                     |          |            |         |         |       |       |        |          |           |      |            |        |      |   |
| 1.Tounderst    | stand and apply the basic concepts of fuels and combustion in automobiles.  |   |                     |          |            |         |         |       |       |        |          |           |      |            |        |      |   |
| 2. To analyz   | ze the moisture and protein in food through physical and chemical methods.<br>t the industrial development aiming at job creators.                              |   |                     |          |            |         |         |       |       |        |          |           |      |            |        |      |   |
| 4.To detect a  | o detect the industrial development aiming at job creators.<br>o demonstrate the operations of pulp and paper Industry.   |   |                     |          |            |         |         |       |       |        |          |           |      |            |        |      |   |
| 5. To illustra | emonstrate the operations of pulp and paper industry.         llustrate the fundamentals of industrial wastewater treatment.         DEF OUTCOMES (Constrained) |   |                     |          |            |         |         |       |       |        |          |           |      |            |        |      |   |
| COURSE (       | E OUTCOMES (Cos)  |   |                     |          |            |         |         |       |       |        |          |           |      |            |        |      |   |
| Students co    | mpleting this course were able to   |   |                     |          |            |         |         |       |       |        |          |           |      |            |        |      |   |
| CO1            | Re  | Reproduce the understanding of industry oriented chemical science   |                     |          |            |         |         |       |       |        |          |           |      |            |        |      |   |
| CO2            | Ar<br>pr  | nalyze the solutions for industrybased problems for sustainable development following rofessional ethics. |                     |          |            |         |         |       |       |        |          |           |      | owing      |        |      |   |
| CO3            | Âŗ  | pply appropriate techniques for industrial development as a resource of life long learning.               |                     |          |            |         |         |       |       |        |          |           |      |            |        |      |   |
| <b>CO4</b>     | De  | Develop the reasoning nature by the knowledge acquired to assess the health and safety issues.            |                     |          |            |         |         |       |       |        |          |           |      |            |        |      |   |
| CO5            | De  | Describe the tools used to apply the engineering knowledge  |                     |          |            |         |         |       |       |        |          |           |      |            |        |      |   |
| Mapping of     | f Co  | ourse O   | utcom               | e with   | Progra     | m Out   | come (l | POs)  |       |        |          |           |      |            |        |      |   |
| Cos/POs        |   | PO1   | PO2                 | PO3      | PO4        | PO5     | PO6     | PO    | 7 ]   | PO8    | PO9      | PC        | 010  | PO1        | 1 1    | PO12 | 2 |
| CO1            |   | 3   | 3                   | -        |            |         |         | 3     |       |        |          |           |      |            |        |      |   |
| CO2            |   | 3   |                     | 3        | 3          |         |         |       |       |        |          |           |      |            |        |      | 3 |
| <u>CO3</u>     |   | 3   |                     | 2        |            |         | 2       | 3     | _     | 2      |          |           |      |            | _      |      | 3 |
| CO4            |   | 3   |                     | 3        |            | 2       |         | 2     |       | 3      |          |           |      |            |        |      | 2 |
| COS/PSOs       |   | 3   | DCO                 | 1        |            |         |         | 3     | 1     | DSO2   |          |           | DSC  | 74         |        |      | 3 |
| CO1            |   |   | P50                 | 1        |            | P302    |         |       |       | P305   | 2        |           | P30  | <b>J</b> 4 | 2      |      |   |
| $CO^2$         |   |   |                     | 3        |            |         |         |       |       |        | 3        |           |      |            | 3      |      |   |
| CO3            |   |   |                     | 3        |            |         |         |       |       |        | <u>२</u> |           |      |            | 3<br>3 |      |   |
| CO4            |   |   |                     | 3        |            |         |         |       |       |        | 3        |           |      |            | 3      |      |   |
| CO5            |   |   |                     | 3        |            |         |         |       |       |        | 3        |           |      |            | 3      |      |   |
| 3/2/1 Indica   | ates  | Streng  | th Of (             | Correla  | ation, 3   | – High  | , 2- M  | ediur | n, 1- | - Low  |          |           |      |            | -      |      |   |
|                | T   |   |                     |          | Ч          |         |         |       |       |        |          |           |      |            | Ī      |      |   |
|                |   |   |                     |          | cie        |         | ve      |       |       | Y      |          |           |      |            |        | L.   |   |
|                |   |   |                     |          | d sc       |         | cti     |       |       | nar    |          |           | len  |            |        | je:  |   |
|                |   | nce   | br                  | \        | an         | ore     | ele     |       | ive   | ipli   |          |           | Iod  |            |        | Pro  |   |
| Ŋ              |   | cie   | om   isci   am   CC |          |            |         |         | al /  |       |        |          |           |      |            |        |      |   |
| 080            |   | ic  | Jee                 | Ice      | ani<br>Ice | am      | 190     | c     | Ξ     | r D    |          |           |      |            | ctic   |      |   |
| Cate           |   | 3as   | ıgi                 | cier     | um<br>xien | 1g0     | P.      |       | pen   | nte    |          | Skil Srac |      |            | Prac   |      |   |
| <u> </u>       | -+  |   | Ē                   | Š        | Ϋ́Η        | P1      |         |       | Ō     |        |          |           | • 1  |            |        | Η    |   |
|                |   | v   |                     |          |            |         |         |       |       |        |          |           |      |            |        |      |   |
|                |   |   |                     |          |            |         |         |       |       |        |          |           |      |            |        |      |   |
|                |   |   |                     |          |            |         |         |       |       |        |          |           |      |            |        |      |   |

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| Subject Code<br>EBCH22002 | Subject Name : INDUSTRIAL CHEMISTRY  | Ty/Lb/<br>ETL | L | T/SLr | P/R | С |
|---------------------------|--------------------------------------|---------------|---|-------|-----|---|
|                           | Prerequisite : Engineering Chemistry | Ту            | 2 | 0/1   | 0/0 | 3 |

### **UNIT - 1 FUELS & COMBUSTION**

Fuels - classification, calorific value, GCV, NCV, Solid fuels-coal - varieties and ranking, analysis -Proximate Carbonisation of coal, Coke -manufacture, Beehive coke oven method, Otto Hoffmann method - recovering by products - Liquid fuels - petrol -refining-cracking- thermal & catalytic, Synthetic petrol - Hydrogenation of coal (Fischer Tropsch Process and Bergius process) – Polymerization, Knocking properties of Gasoline –octane number, cetane number - Ignition lag, Leaded petrol, Reforming, Gaseous fuels- manufacture and uses Combustion - Flue gas analysis – Orsatapparatus. Alternative fuel-Electric vehicles

### **UNIT2 FOOD ANALYSIS**

Food analysis-Introduction. Moisture Analysis-Introduction-Moisture content of foods-Sample collection and handling-Forms of water in foods- Distillation procedure-Reflux distillation with immiscible solvent,-Physical methods-Direct method-Hydrometer, -Refractometry -Chemical method-Karl Fischer titration- Protein analysis-Kjeldahl method-Dumas combustion method.

### UNIT – 3 APPLICATIONS IN PAPER INDUSTRY

EDUCAT

Introduction-Manufacture of pulp-Mechanical process-Chemical process-Beating, Refining, Filling, Sizing and Colouring-Manufacture of paper-Calendering-Bagasse utilization in paper industry. 9

### **UNIT - 4 BUSINESS CHEMICALS**

Toiletry formulations-Soaps and detergent, shampoo, Shaving cream, production. Preparation of cosmeticsmoisturizing cream, talcum powder, Nail enamel, Lipstick. Disinfectantsphenyl, hand sanitizer,bleach,causticsoda,naphthalene balls production.

### **UNIT - 5 INDUSTRIAL WASTES AND TREATMENT PROCESS**

Introduction-Characteristics of industrial waste-Types of industrial wastes-Solid industrial wastes-Principles of industrial waste treatment-Treatment and disposal of industrial waste-Sanitary-Chemical analysis of industrial effluents or sewage-Method of treating industrial sludge.

### References

- 1. Rama Rao Nadendla, Principles of Organic Medicinal Chemistry, New Age International (P) Limited, Publishers.
- 2. H.D.Belitz, W.Grosch, P.Schieberle, Food Chemistry Springer
- 3. Industrial chemistry by B.K.Sharma, KrisnaPrakashan Media(P) Ltd, Publishers.
- 4. Industrial Chemistry C. S. Unnithan, T. Jayachandran & P. Udhayakala, Sree Lakshmi Publications 2010
- 5. John A.Tyrell, Fundamentals of Industrial Chemistry, , Wiley.
- 6. Ernest M. Flick, Cosmetic and Toiletry Formulations, 2<sup>nd</sup> Edition, Volume 8, Noyes Publications, William Andrew Publishing, LLC.

**Total No. of Periods: 45** 

Q



| Subject Coo     | le   | Subj  | ject N  | ame :        | ENGIN    | EERIN       | G GR            | APHI  | ICS   |       | Ty/Lb/<br>ETL | L    | T        | /SLr       | P/R | C    |  |  |
|-----------------|--|---|---------|--------------|----------|-------------|-----------------|-------|-------|-------|---------------|------|----------|------------|-----|------|--|--|
| <b>EBME2200</b> | 1  | Prer  | requis  | ite : N      | one      |             |                 |       |       |       | Ту            | 2    |          | 0/0        | 2/0 | 3    |  |  |
| C: Credits,     | L: L   | ecture  | e, T: 7 | Futoria      | ıl, SLr: | Super       | rvised          | Lea   | rnin  | g, P: | Problem       | / P1 | actio    | cal        |     |      |  |  |
| R: Research     | n, Ty  | /Lb/E   | ETL/I   | E: The       | ory /La  | ıb/Emt      | bedde           | d Th  | eory  | and   | Lab/Inter     | mal  | Eva      | luatio     | n   |      |  |  |
| OBJECTIV        | ES   |   |         |              | ·        |             |                 |       |       |       |               |      |          |            |     |      |  |  |
| • To a          | acqui  | re kn   | owled   | dge in       | geome    | trical d    | rawin           | g.    |       |       |               |      |          |            |     |      |  |  |
| • To (          | I<br>NVDO  | a tha   | atud    | onto in      | compu    | itor oid    | ad dr           | oftin | a     |       |               |      |          |            |     |      |  |  |
|                 | To expose the students in computer aided drafting. COURSE OUTCOMES (Cos)                         |   |         |              |          |             |                 |       |       |       |               |      |          |            |     |      |  |  |
| Students cor    | COURSE OUTCOMES (Cos) Students completing this course were able to                               |   |         |              |          |             |                 |       |       |       |               |      |          |            |     |      |  |  |
| CO1             | Utilize the concept of Engineering Graphics Techniques to draft letters, Numbers,                |   |         |              |          |             |                 |       |       |       |               |      |          |            |     |      |  |  |
| 001             | Dimensioning in Indian Standards   |   |         |              |          |             |                 |       |       |       |               |      |          |            |     |      |  |  |
| CO2             | Demonstrate the drafting practice visualization and projection skills useful for conveying ideas |   |         |              |          |             |                 |       |       |       |               |      |          |            |     |      |  |  |
|                 | in en  | gineer  | ring a  | pplicati     | ons.     |             |                 |       | I     | 5     |               |      |          |            | - ( | -    |  |  |
| CO3             | Ident  | Identify basic sketching techniques of engineering equipments |         |              |          |             |                 |       |       |       |               |      |          |            |     |      |  |  |
| <b>CO4</b>      | Demonstrate the projections of Points, Lines, Planes and Solids. And                             |   |         |              |          |             |                 |       |       |       |               |      |          |            |     |      |  |  |
| CO5             | Draw the sectional view of simple building drawing.  |   |         |              |          |             |                 |       |       |       |               |      |          |            |     |      |  |  |
| Mapping of      | of Course Outcome with Program Outcome (POs)   |   |         |              |          |             |                 |       |       |       |               |      |          |            |     |      |  |  |
| Cos/POs         | P  | O1 1  | PO2     | PO3          | PO4      | PO5         | PO6             | PO    | D7    | PO8   | PO9           | PO   | D10      | PO1        | 1 F | PO12 |  |  |
| CO1             | 3  |   | 3       | 3            | 2        | 2           | 2               |       |       |       | 3             | 3    |          |            | 3   |      |  |  |
| CO2             | 3  |   | 3       | 3            | 2        | 2           | 2               |       |       |       | 3             | 3    |          |            | 3   |      |  |  |
| CO3             | 3  |   | 3       | 3            | 1        |             | 2               |       |       |       | 2             | 2    |          |            | 2   |      |  |  |
| CO4             | 3  |   | 3       | 2            | 2        | _           | 3               |       |       | 2     | 3             | 3    |          |            | 3   |      |  |  |
| CO5             | 3  |   | 3       | 3            | 2        | 3           | 1               |       |       | 2     | 3             | 3    |          | <u> </u>   | 3   |      |  |  |
|                 |  |   | PSO     | 1            |          | PSO2        |                 |       | P     | SO3   |               |      | PSG      | <b>J</b> 4 |     |      |  |  |
| COI             |  |   |         |              |          |             | 2               |       |       |       |               |      |          |            |     |      |  |  |
| C02             |  |   |         |              |          |             | 2               |       | _     |       |               |      |          |            |     |      |  |  |
| CO3             |  |   |         |              |          |             | 2               |       | _     |       |               |      |          |            |     |      |  |  |
| C04             |  |   |         |              |          |             | 2               |       |       |       |               |      |          |            |     |      |  |  |
| 2/2/1 Indian    | tos S  | trong   | th Of   | Correl       | lation ' | 3 Uia       | <br>h ? ≀       | Mod:  | um    | 1_ T  | 111           |      |          |            |     |      |  |  |
|                 | 105 3  | u eng   |         | Corre        | auvii,   | <u>- mg</u> | <b>11, 2-</b> 1 | vieul | ulli, | 1-10  | J VV          |      |          |            |     |      |  |  |
|                 |  |   |         |              | ial      |             |                 |       |       |       |               |      |          |            |     |      |  |  |
|                 |  |   |         |              | soc      |             |                 | ПVС   |       |       | пу            |      | nt       |            |     | ç    |  |  |
|                 |  | e   |         |              | pu       | 0           |                 | i ac  | a)    |       |               |      | one      |            |     | oje  |  |  |
|                 | npor cip   |   |         |              |          |             | /Pt             |       |       |       |               |      |          |            |     |      |  |  |
| ory             | τ.<br>Σ  | 2C  | erii    | 0            | itie     | n C         |                 | al al | llec  |       |               |      | CO<br>CO |            |     | cal  |  |  |
| teg             |  | sic   | ine     | ince         | nan      | grai        |                 | Ĩ     | пE    | -     |               |      |          |            |     | acti |  |  |
| Ca              | É  | Ъа  | gu      | cie          | Hun      | rog         |                 | 4     | )pe   |       |               |      | Pr:      |            |     |      |  |  |
|                 |  |   |         | $\checkmark$ | цN       |             | ✓               |       | U     |       |               | +    |          |            |     |      |  |  |
|                 |  |   |         |              |          |             |                 |       |       |       |               |      |          |            |     |      |  |  |
|                 |  |   |         |              |          |             |                 |       |       |       |               |      |          |            |     |      |  |  |

47

| Projection of points and straight lines located in the first quadrant - Determination     | ion of true lengths and true   |
|---|--------------------------------|
| inclinations - projection of polygonal surface and circular lamina in simple position onl | ly.                            |
| UNIT II PROJECTION OF SOLIDS  | 10                             |
| Projection of simple solids like prism, pyramid, cylinder and cone in simple position     |                                |
| Sectioning of above solids in simple vertical position by cutting plane inclined to any o | one of the reference plane and |
| perpendicular to the other.   | -                              |
| UNIT III DEVELOPMMENT OF SURFACES   | 9                              |
| Development of lateral surfaces of simple and truncated solids - prisms, pyramids, cylin  | nders, and cones.              |
| UNIT IVISOMETRIC PROJECTION   | 9                              |
| Principles of isometric projection – isometric scale – isometric projections of simple    | solids, like prisms pyramids,  |
| cylinders and cones.  |                                |
| UNIT V ORTHOGRAPHICS PROJECTIONS  | 8                              |
| Orthographic projection of simple machine parts – missing views                           |                                |
| BUILDING DRAWING  | 7                              |
| Building components – front, Top and sectional view of a security shed.                   |                                |
| (Basic Auto CAD commands to be taught- not for Examinations)                              |                                |
| Total No. of  | Periods: 60                    |

Note: First angle projection to be followed.

**TEXT BOOKS** 

1.

2.

3.

4.

**Subject Code** 

**EBME22001** 

Introduction to drawing, importance and areas of applications - BIS standards - IS: 10711 - 2001 : Technical products Documentation - Size and layout of drawing sheets - IS 9606 - 2001: Technical products Documentation -Lettering - IS 10714 & SP 46 - 2003: Dimensioning of Technical Drawings - IS : 15021 - 2001 : Technical drawings – Projections Methods – drawing Instruments, Lettering Practice – Line types and dimensioning – Border lines, lines title blocks Construction of polygons - conic sections - Ellipse, Parabola, Hyperbola and cycloids. UNIT IPROJECTION OF POINTS, LINES AND PLANE SURFACES 12 ue

### **CONCEPTS AND CONVENTIONS (Not for examination)**

**Prerequisite : None** 

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Subject Name : ENGINEERING GRAPHICS

Bhatt, N.D. and Panchal, V.M. (2014) Engineering Drawing Charotar Publishing House

Gopalakrishnan, K.R. (2014) Engineering Drawing (Vol.I& II Combined) Subhas Stores, Bangalore.

Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.



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| Subject Code<br>EBME22002 | : Su                  | bject Na  | ame : EN   | GINEE        | RING N                     | <b>IETAL</b> | LURG                               | Y           | Ty/Lb/   | L         | T/<br>SI r | P/R | C      |  |  |  |
|---------------------------|-----------------------|---|------------|--------------|----------------------------|--------------|------------------------------------|-------------|----------|-----------|------------|-----|--------|--|--|--|
|                           | Pro                   | ereauisi  | te: -      |              |                            |              |                                    |             |          | 3         |            | 0/0 | 3      |  |  |  |
| L : Lecture T :           | Tutoria               | I SLr:  | Supervise  | ed Learr     | ning P:                    | Project      | R : Rese                           | earch C:    | Credits  | C         | 0/0        | 0/0 |        |  |  |  |
| T/L/ETL : The             | eory/Lab              | /Embed  | ded Theor  | y and L      | ab                         | 5            |                                    |             |          |           |            |     |        |  |  |  |
| OBJECTIVE                 | :                     |   |            |              |                            |              |                                    |             |          |           |            |     |        |  |  |  |
| • To und                  | derstand              | differen  | t material | s and th     | eir meta                   | llurgica     | l propert                          | ies.        |          |           |            |     |        |  |  |  |
| COUNCE OF                 | TCOM                  |   |            |              |                            |              |                                    |             |          |           |            |     |        |  |  |  |
| COURSE OU                 | TCOM                  | ES (CO  | (3-5)      | ) Studei     | nts will                   | be able      | to                                 |             | 1 2)     |           |            |     |        |  |  |  |
|                           |                       | mprehend the properties and applications of ferrous and non ferrous metals (Level 2)          |            |              |                            |              |                                    |             |          |           |            |     |        |  |  |  |
| CO2 0                     | Compret               | iend the  | propertie  | s and ap     | plicatio                   | rous and     | s and non terrous metals (Level 2) |             |          |           |            |     |        |  |  |  |
| CO3                       | Demonst               | ration a  | bout phase | e diagra     | $\frac{\text{ms and }}{1}$ | g the fun    | damenta                            | uls of Heat | treatme  | nt (Level | 3)         | . 1 |        |  |  |  |
| CO4                       | Analyzin<br>Loval I   | analyzing and comparing the mechanisms behind deformation strengthening and fail $(aval I A)$ |            |              |                            |              |                                    |             |          |           |            |     | netals |  |  |  |
| CO5                       | Level L<br>Evaluation | Level L4)   |            |              |                            |              |                                    |             |          |           |            |     |        |  |  |  |
| Manning of C              | Course O              | valuation and selection of metals, with herars <b>Automes</b> ( <b>Pos</b> )                  |            |              |                            |              |                                    |             |          |           |            |     |        |  |  |  |
| Cos/Pos                   | PO1                   | PO2   | PO3        | PO4          | PO5                        | PO6          | /<br>PO7                           | PO8         | PO9      | PO10      | PO11       | PO  | 12     |  |  |  |
| CO1                       | 2                     | 2   | 2          | 2            | 1                          | 1            | -                                  | 1           | 1        | 1         |            |     | 1      |  |  |  |
| CO2                       | 2                     | 1   | 2          | 1            | -                          | 2            | 2                                  | 2           | 2        | 1         | -          |     | 1      |  |  |  |
| CO3                       | 3                     | 3   | 3          | 3            | 2                          | 3            | 3                                  | 2           | 3        | 2         | _          |     | 1      |  |  |  |
| CO4                       | 3                     | 3   | 3          | 3            | 3                          | 3            | 3                                  | 2           | 3        | 2         | -          |     | 1      |  |  |  |
| CO5                       | 2                     | 3   | 2          | 2            | 2                          | 2            | 2                                  | 2           | 2        | 2         | 2          |     | 1      |  |  |  |
| Cos / PSOs                | PS                    | 01  | PSC        | )2           | PS                         | 503          | PS                                 | <b>SO4</b>  |          |           |            |     |        |  |  |  |
| CO1                       | ]                     | l   | 2          |              |                            | 1            |                                    | 1           |          |           |            |     |        |  |  |  |
| CO2                       |                       | 2   | 2          |              |                            | 2            |                                    | 1           |          |           |            |     |        |  |  |  |
| CO3                       |                       | 3   | 2          |              |                            | 3            |                                    | 2           |          |           |            |     |        |  |  |  |
| CO4                       | 3                     | 3   | 2          |              |                            | 3            |                                    | 3           |          |           |            |     |        |  |  |  |
| CO5                       | 2                     | 2   | 2          |              |                            | 2            |                                    | 2           |          |           |            |     |        |  |  |  |
| 3/2/1 indicates           | Strengt               | h of Co   | rrelation  | 3- Hig       | h, 2- M                    | edium,       | 1-Low                              |             |          |           |            |     |        |  |  |  |
|                           |                       |   |            |              |                            |              |                                    |             |          |           |            |     |        |  |  |  |
|                           |                       |   | _          |              |                            |              |                                    |             |          |           |            |     |        |  |  |  |
|                           |                       |   | cia        |              | e                          |              | ~                                  |             |          |           |            |     |        |  |  |  |
|                           |                       |   | so         |              | ctiv                       |              | lary                               | ent         | ect      |           |            |     |        |  |  |  |
| ory                       | lce                   |   | and        | e            | elec                       | /e           | olin                               | one         | roj      |           |            |     |        |  |  |  |
| teg                       | cier                  | ing   | es         | Co           | n<br>B                     | ctiv         | scif                               | du          | 17       |           |            |     |        |  |  |  |
| Ca                        | S                     | eeri.   | niti<br>če | E            | gra                        | Ele          | Di                                 | C           | ica      |           |            |     |        |  |  |  |
|                           | asic                  | gine  | ma<br>enc  | gre          | Pro                        | en           | iter                               | kill        | act      |           |            |     |        |  |  |  |
|                           | B                     | En;<br>Sci  | Hu<br>Sci  | Prc          |                            | Op           | In                                 | S           | <u> </u> |           |            |     |        |  |  |  |
|                           |                       |   |            | $\checkmark$ |                            |              |                                    |             |          |           |            |     |        |  |  |  |
|                           |                       |   |            |              |                            |              |                                    |             |          |           |            |     |        |  |  |  |

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| Subject Code: | Subject Name : ENGINEERING METALLURGY | Ty/Lb/ | L | Τ/  | P/R | С |
|---------------|---------------------------------------|--------|---|-----|-----|---|
| EDMEAAAA      |                                       | ETL    |   | SLr |     |   |
| EBME22002     | Prerequisite:                         | Ту     | 3 | 0/0 | 0/0 | 3 |

### UNIT- I: CRYSTALLOGRAPHY AND STRENGTHENING MECHANISMS

Crystalline and amorphous solids - UNIT- cell and primitive cell - Miller indices BCC, FCC and HCP crystal structures and their packing factors –Crystallization- Crystal defects - Effect of crystal imperfections in mechanical properties-Dislocations- strengthening mechanisms for the improvement of mechanical properties.

### **UNIT- II: FERROUS AND NON FERROUS METALS**

DUCAT

Significance of Phase diagram-(Eutectic and Eutectoid alloy system)-Equilibrium and Non- Equilibrium cooling-Allotrophy of Iron-iron carbon phase diagram.

Classification of Steels and Cast Iron-Microstructure of Iron and Steel- Cast Irons - Grey, White malleable, spheroidal –Effect of alloying elements on steel - stainless and tool steels. Copper and Copper alloys - Brass, Bronze and Cupronickel –Aluminum and Al-Cu alloy

### UNIT- III: HEAT TREATMENT AND TESTING

Definition - Classification of heat treatment process - Purpose of heat treatment -Principles (fundamentals) of heat treatment - Annealing –Re-crystallization- Normalizing - Hardening-TTT-CCT Cooling curves- Tempering - Interrupted quenching - Testing of materials - Destructive testing - Tensile, Compression, Hardness, Impact, Torsion, Fatigue. Non-destructive testing - Visual inspection, Hammer test, Radiography, Ultrasonic inspection.

### **UNIT- IV: FAILURE MODES AND ITS PREVENTIONS**

Plastic deformation-Fracture - Mechanism of brittle fracture (Griffith's theory) and ductile fracture -Difference between brittle and ductile fractures - Fatigue failure and its prevention - Creep - different stages in creep curve - Factors affecting creep resistant materials -Mechanism of creep fracture.

### **UNIT- V: NON METALLIC AND NEWER MATERIALS**

Types, Properties and Application: Polymers, Ceramics and Metal matrix Composites –Super alloys, Nanomaterials- carbon and metal based materials, Smart materials and their properties

### TEXT BOOKS

- 1) Avner, (1997) "Introduction to Physical Metallurgy", McGraw Hill International Book., second edition.
- 2) Williams D Callister, (2007) *"Material Science and Engineering"*, Wiley India Pvt Ltd, Revised Indian Edition.

### REFERENCES

- 1) Raghavan, V., (2006) "Materials Science and Engineering", Prentice Hall of India Pvt., Ltd.," 5 th edition.
- 2) Muralidhara. M.K. (1998) "Material science and Process", Danpat Rai Publishing.
- 3) Nayak, S.P., (1985) "Engineering Metallurgy and Material Science", Character Publishing House, Anand, India.
- 4) Van Vlack, (1970) "Material Science for Engineers", Addison Wesley, 10985,
- 5) Arumugam, M., (1997) "Material Science", Anuradha Publishers.
- 6) O.P. Kanna (1999) "Material Science and Metallurgy", Prentice Hall of India Pvt., Ltd.

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**Total No. of Periods: 45** 



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|--|---|--|--------|----------------|---------------|----------|-----------|----------|--------|---------|--------|-----------------|-----------------|----------|--------------------|-------|
| C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical         R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation         OBJECTIVES         • To engage students in meaningful oral English communication and organized academic and professional reading and writing for a successful career.         COURSE COUTCOMES (Cos)         Students completing this course were able to         CO1       Engage in meaningful oral communication in English with writing as a scaffolding activity.         CO2       Have an in-depth understanding of the components of English language and its use in oral communication.         CO3       Strengthen their vocabulary and syntactic knowledge for use in academic and technical communication         CO4       Learn to negotiate meaning in inter-personal and academic communication for a successful career.         CO5       Engage in organized academic and professional writing for life-long learning and research         Mapping of Course Outcome with Program Outcome (POs)       Cool 1         CO3       1       1       3       2       1       1       3       3       1       2         CO3       PO1       PO2       PO6       PO7       PO8       PO9       PO10       PO11       PO12         CO3       1       1       1       2       3       1       2       2  |   |  | P      | rerequi        | site :Pa      | ss in Pl | lus 2 En  | glish    |        |         |        | IE              | 1               | 0/0      | 1/0                | 1     |
| R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation         OBJECTIVES         • To engage students in meaningful oral English communication and organized academic and professional reading and writing for a successful career.         COURSE OUTCOMES (Cos)         Students course were able to         CO1       Engage in meaningful oral communication in English with writing as a scatfolding activity.         CO2       Have an in-depth understanding of the components of English language and its use in oral communication.         CO3       Strengthen their vocabulary and syntactic knowledge for use in academic and technical communication         CO4       Learn to negotiate meaning in inter-personal and academic communication for a successful career.         CO5       Engage in organized academic and professional writing for life-long learning and research         Mapping of Course Outcome with Program Outcome (POS)         Co3       1       1       3       2       1       1       3       1       2         Co4       1       1       1       3       1       2       3       1       2         Co5       PO1       PO2       PO3       PO4       PO5       PO6       PO7       PO8       PO10       PO11   | C: Cred   | its, L   | : Lec  | cture, T       | Γ: Tuto       | orial, S | Lr: Su    | pervise  | ed Le  | arnin   | g, F   | P: Probler      | m / Prac        | ctical   |                    |       |
| OBJECTIVES           • To engage students in meaningful oral English communication and organized academic an professional reading and writing for a successful career.           COURSE OUTCOMES (Cos)           Students completing this course were able to           CO1         Engage in meaningful oral communication in English with writing as a scaffolding activity.           CO2         Have an in-depth understanding of the components of English language and its use in oral communication           CO3         Strengthen their vocabulary and syntactic knowledge for use in academic and technical communication           CO4         Learn to negotiate meaning in inter-personal and academic communication for a successful career.           Co5         Engage in organized academic and professional writing for life-long learning and research           Mapping of Course Outcome with Program Outcome (POs)           CO3         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12           CO3         1         1         1         2         3         1         2         2         -         3         1         2           CO4         2         1         -         2         3         1         2   | R: Rese   | arch,  | Ty/L   | b/ETI          | L/IE: T       | Theory   | /Lab/E    | mbedd    | led T  | heory   | an     | d Lab/Int       | ternal E        | valuatio | n                  |       |
| To engage students in meaningful oral English communication and organized academic and professional reading and writing for a successful career. COURSE OUTCOMES (Cos) Students completing this course were able to CO1 Engage in meaningful oral communication in English with writing as a scaffolding activity. CO2 Have an in-depth understanding of the components of English language and its use in oral communication. CO3 Strengthen their vocabulary and syntactic knowledge for use in academic and technical communication CO4 Learn to negotiate meaning in inter-personal and academic communication for a successful career. CO5 Engage in organized academic and professional writing for life-long learning and research Mapping of Course Outcome with Program Outcome (POs) Cos/PO8 PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 CO1 1 - 1 1 3 2 1 1 1 3 3 1 - 2 3 3 1 2 2 Co3 CO4 2 1 1 1 3 3 3 1 2 3 3 1 2 2 3 3 1 2 2 Co3 CO5 - 1 1 1 2 3 1 1 2 3 3 1 2 2 3 3 1 1 2 2 CO3 CO5 - 1 1 1 2 3 1 1 2 2 3 1 1 1 2 2 3 CO5 - 1 1 1 2 2 3 1 1 2 CO3 CO4 2 C CO1 CO2 2 C CO4 CO1 CO2 C 2 C CO4 CO1 CO2 C CO4 C CO1 CO3 C Correlation, 3 - High, 2 - Medium, 1 - CO3 CO3 C CO4 C CO1 CO3 C CO4 C CO1 C CO4 C CO1 C CO4 C CO4 C CO1 C CO4 C C C C   | <b>OBJEC</b>  | ΓΙΥΕ   | S      |                |               | -        |           |          |        |         |        |                 |                 |          |                    |       |
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| COURSE COURSE (COS)         Students completing this course were able to         CO1       Engage in meaningful oral communication in English with writing as a scaffolding activity.         CO2       Have an in-depth understanding of the components of English language and its use in oral communication         CO3       Strengthen their vocabulary and syntactic knowledge for use in academic and technical communication         CO4       Learn to negotiate meaning in inter-personal and academic communication for a successful career.         Mapping of Course Outcome with Program Outcome (POS)         Cos/POS       PO1       PO2       PO8       PO9       PO10       PO11       PO12         CO4       1       1       1       2       2         CO4       1       1       2       2       2         CO4       1       1       2       2       2       2       2       2       2       2       2       2       2 <td>1</td> <td>profes</td> <td>siona</td> <td>al readi</td> <td>ng and</td> <td>writing</td> <td>for a su</td> <td>uccessf</td> <td>ul cai</td> <td>eer.</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>  | 1   | profes   | siona  | al readi       | ng and        | writing  | for a su  | uccessf  | ul cai | eer.    |        |                 |                 |          |                    |       |
| Students completing this course were able to         CO1       Engage in meaningful oral communication in English with writing as a scaffolding activity.         CO2       Have an in-depth understanding of the components of English language and its use in oral communication.         CO3       Strengthen their vocabulary and syntactic knowledge for use in academic and technical communication         CO4       Learn to negotiate meaning in inter-personal and academic communication for a successful career.         CO5       Engage in organized academic and professional writing for life-long learning and research         Mapping of Course Outcome with Program Outcome (PO3)         Cos/POs       PO1       PO12         CO3       1       1       2       1       1         CO4       PO1       PO12         Cos/PO3       PO4       PO5       PO6       PO1       PO12         CO4       1       1       2       2       1       1         Co3       PO1        PO1 <t< td=""><td>COURS</td><td>E OU</td><td>TCC</td><td>OMES</td><td>(Cos)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>   | COURS   | E OU   | TCC    | OMES           | (Cos)         |          |           |          |        |         |        |                 |                 |          |                    |       |
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| CO2       2       1       1       1       3       3       1       2       3       3       1       2         CO3       1       1       1       1       2       1       -       2       3       3       1       2         CO3       1       1       1       2       1       2       3       3       1       2         CO4       1       -       2       3       1       2       1       2       2       -       3         CO5       -       1       1       2       3       1       1       -       3       1       1       2         CO3       PSO1       PSO2       PSO3       PSO4       -       2       3       1       1       2         CO3       2       2       1       1       2       1       1       2       1       2         CO3       2       2       1       1       2       1       1       1       2       1       1         CO4       2       1       1       1       1       1       2       1       1       1       1       <  | CO1   |  | 1      | -              | 1             | 1        | 3         | 2        | 1      |         | 1      | 3               | 3               | -        | 3                  |       |
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| CO4       1       -       -       2       3       1       2       1       2       2       -       3         CO5       -       1       1       2       3       1       1       -       3       1       1       2       2       -       3         COS/PSOs       PSOI       PSOI       PSO2       PSO3       PSO3       PSO4         CO1       2       2       1       2       1       2       2       1         CO2       2       1       2       1       2       1       2       2       1         CO3       2       1       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1 <t< td=""><td><u>CO3</u></td><td></td><td>1</td><td>I</td><td>1</td><td>1</td><td>2</td><td>1</td><td>-</td><td>4</td><td>2</td><td>3</td><td>3</td><td>l</td><td>3</td><td></td></t<>  | <u>CO3</u>  |  | 1      | I              | 1             | 1        | 2         | 1        | -      | 4       | 2      | 3               | 3               | l        | 3                  |       |
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| Control     LSO1     LSO1     LSO2     LSO3     LSO4       Col     2     1     1     1       CO3     2     1     1       CO3     2     1     1       CO4     2     1     1       CO5     2     1     1       J2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low     1       Jacticical Variation     And social       Inter Discriptionary     N       Variationary     Variationary  | COS/PSOs  |  | -      |                | 1             | 2        |           | 1        | 1      |         | -      | 3               |                 | 1        | Z                  |       |
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| Cotegory<br>3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Tom<br>Program consistenting<br>Science<br>Program consistenting<br>Science<br>Program consistenting<br>Program consiste   | CO4   |  |        |                | 2             |          |           |          |        |         |        | 1               |                 |          |                    |       |
| Category<br>Category<br>Category<br>Category<br>Basic Science<br>Basic Science<br>Science<br>Program Core<br>Program cor | CO5   |  |        |                | 2             |          |           |          |        |         |        | 1               |                 |          |                    |       |
| Category<br>Basic Science<br>Engineering<br>Science<br>Program Core<br>Program elective<br>Inter Disciplinary<br>Practical /Project  | 3/2/1 Inc   | licate   | s Str  | ength          | Of Co         | relatio  | n, 3 – I  | ligh, 2- | - Mee  | lium,   | 1- I   | Low             |                 |          |                    |       |
|  | Category<br>Basic Science<br>Engineering<br>Science<br>Program Core<br>Program core<br>Program elective<br>Inter Disciplinary |  |        |                |               |          |           |          |        |         |        |                 | Skill Component |          | Practical /Project |       |

| Subject Code          | Subject Name : COMMUNICATIVE                           | Ty/Lb/        | L         | T/SLr       | P/R         | C        |
|-----------------------|--|---------------|-----------|-------------|-------------|----------|
| EDCC22102             | ENGLISH LAB<br>Prerequisite Pass in Plus 2 English     |               | 1         | 0/0         | 1/0         | 1        |
|                       | The quisite if ass in Thus 2 Elignsh                   | 112           | 1         | 0/0         | 1/0         | 1        |
| UNIT I LISTENI        | NG   |               |           |             | 3           |          |
| Authentic audios a    | nd videos  |               |           |             |             |          |
| Prescribed Book: I    | English Pronunciation in use – Mark Hancock,           |               |           |             |             |          |
| UNIT IISPEAKI         | NG   |               |           |             | 3           |          |
| Individual- Solo:     | Self introduction, Describing, anchoring, welcome      | address, vo   | te of tha | unks,       |             |          |
| Pair & Group: Ro      | ole play- formal -informal, narrating stories, film re | view, analy   | zing ne   | wspaper h   | eadings a   | nd       |
| reports, interpretin  | g Advertisement pamphlets                              |               |           |             |             |          |
| Group discussion      | , mock interviews, formal presentation, power poin     | t presentati  | on        |             |             |          |
| Prescribed Book: J    | U.C. Richards with J. Hull &S.Proctor, Interchange,    | , Cambridge   | e Unive   | rsity Press | s, 2015.    |          |
| UNIT III READI        | NG   |               |           |             | 3           |          |
| Extensive, focused    | l reading,   |               |           |             |             |          |
| Strategies for effect | ctive reading - Reading comprehensions – Note mal      | king- summ    | arizing   | paraphra    | sing, Rev   | iew      |
| Suggested reading     | : Short stories, news paper reports, film reviews      |               |           |             |             |          |
| UNIT IV WRITH         | NG   |               |           |             | 3           |          |
| Extensive writing     | practices – note taking, Cognitive and meta cognitiv   | ve strategie  | s to incu | ilcate a se | ense of org | ganizing |
| ideas into coherent   | t sentences and paragraphs, Formal letters, Business   | s letters. Re | sume w    | ith coveri  | ng letter   |          |
| UNIT VNON VE          | RBAL COMMUNICATION/ CHARTS, DIAGE                      | RAMS ANI      | ) TABI    | Æ           | 3           |          |
| Interpretation of cl  | harts Flow chart, pie chart, bar diagram, table, tree  | diagram, etc  | с.        |             |             |          |
|                       |  |               | Total 1   | No. of Pei  | riods: 15   |          |

(An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

ISTITUTE

### **Text Book**

- 1. J. C. Richards with J. Hull &S.Proctor, Interchange, Level 2, Cambridge University Press, 2021.
- 2. M. Chandrasena Rajeswaran&R.Pushkala, English Communication Lab Work book **Reference Book**
- 1. Hancock, Mark, English Pronunciation in Use; Cambridge Univ. Press, 2013.

EDUCATIO

2. Dutt, K, Rajeevan, G & Prakash, CLN 2008, *A Course on Communication Skills*, 1st edn, Cambridge University Press, Chennai



| Subject         | PYTHON PROGRAMMINGT / L/LT /P/ RCFTISIr  |  |                       |           |          |          |           |                   |            |           |              |           |          |  |
|-----------------|--|--|-----------------------|-----------|----------|----------|-----------|-------------------|------------|-----------|--------------|-----------|----------|--|
| Code:           |  |  |                       |           |          |          | Ľ         |                   |            | S.Lr      |              |           |          |  |
| EBC522E12       | Prerequ  | uisite:  | C Pro                 | gramn     | ning an  | d MS     |           | ΕΓL               | 1          | 0/0       | 2/           | 0         | 2        |  |
|                 |  |  | . • 1                 | CT (      | ~        | • 1 7    | <u> </u>  |                   |            |           | • 1          |           |          |  |
| C: Credits, L:  |  | e, 1: 1u   | itorial,              | SLr: S    | Superv   | 1sed L   | earnin    | g, P: Pro         | blem       | / Pract   | ical         |           |          |  |
| R: Research,    | Ty/Lb/E  | $\frac{1 L/1E}{1}$                                       | I neoi                | y/Lab     | /Embe    | adea I   | heory     | and Lab           | /Inter     | rnal Ev   | aluation     |           |          |  |
| OBJECTIVE       | The stud   | dent sho   | build be              | made t    | 0:       |          | 1.1       |                   |            |           | 1            |           |          |  |
| • De            | evelop a t   | basic un   | derstar               | iding of  | t progra | amming   | g and t   | he Python         | prog       | rammın    | g language   | 2         |          |  |
| • W             | rite progr   | ams in   | Python                | to solv   | e real v | vorld p  | roblem    | 18                |            |           |              | •         |          |  |
| • Se            | e the va   | alue of  | t progr               | amming    | gin a    | variety  | of of     | lifferent         | discip     | olines,es | specially a  | as it re  | lates in |  |
| COURSE OU       | TCOME  | <u>.</u><br>S (CO)                                       | $s) \cdot Afta$       | er Com    | nleting  | the co   | urse. 1   | the stude         | nt car     | ı be abl  | e to         |           |          |  |
| COL             | Remem  | ber the  | svntax                | and set   | nantics  | of pytl  | non pro   | orammin           | σ land     |           |              |           |          |  |
| CO2             | Underst  | and hor  | w funct               | ional a   | nd oper  | ations a | are to l  | e utilized        | 5 14115    | Suuge     |              |           |          |  |
| CO3             | Applyth  | and no   | monto                 | progra    | mmina    | constr   | uote lil  |                   |            | ndition   | llogia lo    | oping on  | d        |  |
| 003             | function   | is to bu   | uild bas              | ic progra | rams     | consu    |           |                   | -s, co     | liuluona  | u logic, loc | oping, an | .u       |  |
| CO4             | design of  | object-o   | riented               | l progra  | ms wit   | h Pytho  | on class  | ses               |            |           |              |           |          |  |
| CO5             | Apply t  | Apply the knowledge to solve various real world problems |                       |           |          |          |           |                   |            |           |              |           |          |  |
| Mapping of C    | ourse Ou   | rse Outcomes with Program Outcomes (POs)                 |                       |           |          |          |           |                   |            |           |              |           |          |  |
| COs/POs         | PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12 |  |                       |           |          |          |           |                   |            |           |              |           |          |  |
| CO1             | 3  | 3  | 3                     | 2         | 2        | 1        | 1         | 1                 |            | 1         | 0            | 1         | 1        |  |
| CO2             | 3  | 2  | 2                     | 2         | 2        | 1        | 1         | 1                 |            | 1         | 0            | 1         | 1        |  |
| CO3             | 3  | 2  | 2                     | 2         | 2        | 1        | 1         | 1                 |            | 1         | 0            | 1         | 1        |  |
| CO4             | 3  | 3  | 3                     | 2         | 2        | 1        | 2         | 0                 |            | 2         | 0            | 2         | 2        |  |
| CO5             | 3  | 3  | 3                     | 3         | 2        | 1        | 2         | 0                 |            | 2         | 0            | 2         | 2        |  |
|                 |  |  |                       |           |          |          |           |                   |            |           |              |           |          |  |
| COs / PSOs      | PS   | <b>SO1</b>   |                       | PS        | 02       |          |           | PSO3              |            |           | PS           | 04        |          |  |
|                 |  |  |                       |           |          |          |           |                   |            |           |              |           |          |  |
| CO1             |  | 1  |                       |           | 1        |          |           | 2                 |            |           |              | 2         |          |  |
| CO2             |  | 1  |                       |           | 1        |          |           | 2                 |            |           |              | 2         |          |  |
| CO3             |  | 1  |                       |           | 1        |          |           | 2                 |            |           |              | 2         |          |  |
| CO4             |  | 1  |                       |           | 1        |          |           | 2                 |            |           |              | 2         |          |  |
| CO5             | 1 1 2 2  |  |                       |           |          |          |           |                   |            |           |              |           |          |  |
| 3/2/1 indicates | Strengt  | h of Co  | orrelati              | ion 3-    | High, 2  | 2- Med   | ium, 1    | , 1-Low           |            |           |              |           |          |  |
| Å               | ciences<br>ring<br>s<br>s<br>s<br>ciences<br>b<br>Core<br>ical Skill<br>lls  |  |                       |           |          |          |           |                   |            |           |              |           |          |  |
| Categor         | Basic Sci  | Engineer<br>Sciences                                     | Humaniti<br>Social So | Program   | Program  | Open Ele | Practical | Intern<br>Technic | Soft Skill |           |              |           |          |  |
|                 |  | ✓  |                       |           |          |          |           |                   |            |           |              |           |          |  |

### PYTHON PROGRAMMING T/L/ETL T/S.Lr L

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# office tools

Prerequisite: C Programming and MS

### **UNIT I: INTRODUCTION** History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

### **UNIT II: TYPES, OPERATORS AND EXPRESSIONS**

Types - Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while, break, continue, pass.

### **UNIT III: FUNCTIONS**

EBCS22ET2

Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variablelength arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables.

### **UNIT IV:LISTS, TUPLES, DICTIONARIES**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

### **UNIT V: OBJECT ORIENTED PROGRAMMING OOP IN PYTHON**

Classes, 'self variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding.

Total No. of Hours: 45

### **TEXT BOOKS:**

- 1. Python Programming: A Modern Approach, VamsiKurama, Pearson.
- 2. Think Python: How to Think Like a Computer Scientist", 2nd editionUpdated for Python 3, Shroff/O'Reilly Publishers, Allen B. Downey
- 3. Learning Python, Mark Lutz, Orielly.

### **REFERENCE BOOKS:**

1. Core Python Programming, W.Chun, Pearson.

2.Introduction to Python, Kenneth A. Lambert, Cengage.





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| Subject | Code:  | :             | Subjec       | t Name           | : EN            | VIRON     | IMEN'       | TAI       |          | Ту      | / <b>Lb</b> / | L          | T/SL    | P/R        | С         |
|---------|--|---------------|--------------|------------------|-----------------|-----------|-------------|-----------|----------|---------|---------------|------------|---------|------------|-----------|
| EBCC2   | 2103   |               | SCIEN        | CE (Au           | ıdit            | course)   |             |           |          | E       | ſL            |            | r       |            |           |
|         |  |               | Prereg       | uisite:          | Engi            | neering   | Chem        | istr      | y        |         | IE            | 1          | 0/0     | 0/0        | NC        |
| C: Cred | its, L: I  | Lectur        | e, T: Tut    | orial, Sl        | Lr: S           | Supervise | ed Lea      | rnin      | g, P     | : Probl | em / P        | ractica    | ıl      | •          |           |
| R: Rese | arch, T  | y/Lb/]        | ETL/IE: '    | Theory /         | /Lab/           | Embedd    | led The     | eory      | and      | l Lab/I | nterna        | l Evalı    | uation  |            |           |
| OBJEC   |  | S:            |              |                  |                 |           | . –         |           |          |         |               |            |         |            |           |
| • '     | Fo acqu  | uire ki       | nowledge     | of the I         | Envii           | onment    | and Ec      | cosy      | sten     | 1 & Bi  | odiver        | sity       |         |            |           |
| •       | To acqu  | uire ki       | nowledge     | of the c         | liffei          | ent type  | es of Er    | 1V1ro     | onm      | ental p | ollutio       | on         |         |            |           |
| •       | To knov  | w moi         | re about I   | Natural 1        | Reso            | urces     | .1 17       |           |          |         |               |            |         |            |           |
| •       | To gain  | unde          | rstanding    | ; of soci        | al 188          | ues and   | the En      | iviro     | onme     | ent     |               |            |         |            |           |
| •       | To attai   | in fam        | illiarity of | t human          | pop             | ulation a | and En      | viro      | nme      | ent     |               |            |         |            |           |
| COURS   | SE OU  | TCO<br>loting | MES (CO      | <b>Js): (3</b> - | -5)             | to        |             |           |          |         |               |            |         |            |           |
| Student | Know about Environment and Ecosystem & Biodiversity  |               |              |                  |                 |           |             |           |          |         |               |            |         |            |           |
| CO1     | Know about Environment and Ecosystem & Biodiversity  |               |              |                  |                 |           |             |           |          |         |               |            |         |            |           |
| CO2     | Comprehend air, water, Soil, Marine, Noise, Thermal and Nuclear Pollutions and Solid Waste         |               |              |                  |                 |           |             |           |          |         |               |            |         |            |           |
|         | management and identify the importance of natural resources like forest, water, and food resources |               |              |                  |                 |           |             |           |          |         |               |            |         |            |           |
| CO3     | Discover water conservation and watershed management   |               |              |                  |                 |           |             |           |          |         |               |            |         |            |           |
| CO4     | Identi   | ify its       | s probler    | ns and           | con             | cerns cl  | imate       | cha       | nge,     | globa   | al war        | ming,      | acid ra | ain, ozo   | one layer |
|         | deple  | tion e        | tc.,         |                  |                 |           |             |           |          |         |               |            |         |            |           |
| CO5     | Expla  | ain far       | nily welf    | are prog         | grami           | nes and   | role of     | f inf     | orma     | ation t | echnol        | ogy in     | human   | health     | and       |
|         | envire   | onmei         | nt           |                  |                 |           |             |           |          |         |               |            |         |            |           |
| M       | apping   | g of C        | ourse Oi     | itcomes          | wit             | 1 Progra  | am Ou       | itcoi     | mes      | (POs)   |               |            |         |            |           |
| COs/POs | s P  | PO1           | PO2          | PO3              | PO <sub>2</sub> | PO5       | PO6         | PO        | 7        | PO8     |               | PO9        | PO10    | PO11       | PO12      |
| CO1     |  |               |              |                  |                 |           | 2           | 3         | 3        | 2       |               |            |         |            | 1         |
| CO2     |  |               |              |                  |                 |           | 2           | 3         | 3        |         |               |            | 2       |            | 1         |
| CO3     |  |               |              |                  |                 |           | 2           | 3         | 3        | 2       |               |            |         |            | 1         |
| CO4     |  |               |              |                  |                 | _         | 2           | 1         | 5<br>>   | 2       |               |            | 2       |            | 1         |
| 3/2     | 2/1 indi/  | cates (       | Strength (   | of Corre         | latio           | n 3. Hid  | <br>ah 2_ N | s<br>Indi | )<br>ium | 1-I ou  | 7             |            | 2       |            | 1         |
| 514     | 3/2/1 Indicates Strength of Correlation 5- High, 2- Medium, 1-Low                                  |               |              |                  |                 |           |             |           |          |         |               |            |         |            |           |
|         | es   |               | es           | &<br>ces         |                 | d)        |             |           | 'es      |         |               |            |         | ills       |           |
|         | enc  |               | enc          | es d             |                 | core      |             |           | ctiv     |         |               |            |         | os/<br>Sk  | S         |
| ory     | Sci     Sci       Sci     Sci       Sci     Sci       Skii     Sci                                 |               |              |                  |                 |           |             |           |          |         |               |            |         |            |           |
| teg     | sic  |               | 50           | uma<br>cial      |                 | ngra      | ogra        |           | en       |         |               | actio      |         | ern<br>chn | ft S      |
| Ca      | Ba   |               | En           | Hu<br>So         |                 | Pr(       | Prc         |           | Op       |         |               | Pr;<br>Pr( |         | Int        | So        |
|         |  |               |              | √                |                 |           |             |           |          |         |               |            |         |            |           |
|         |  |               |              |                  |                 |           |             |           |          |         |               |            |         |            |           |



Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code:<br>EBCC22I03 | Subject Name: ENVIRONMENTAL<br>SCIENCE | Ty/Lb/<br>ETL      | L | T/SL<br>r | P/R | С  |
|----------------------------|--|--------------------|---|-----------|-----|----|
|                            | Prerequisite: Engineering Chemistry    | AUDIT<br>COURSE-IE | 1 | 0/0       | 0/0 | NC |

### **UNIT I ENVIRONMENT AND ECOSYSTEM**

Definition, Scope and Importance of environment – need for public awareness – concept, structure and function of an ecosystem - producers, consumers and decomposers - energy flow in the ecosystem. Biodiversity at national and local levels - India

### UNIT II ENVIRONMENT POLLUTION

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Nuclear hazards (g) E-Wastes and causes, effects and control measures

### UNIT III NATURAL RESOURCES

Forest resources: Use and over-exploitation, deforestation. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems.

### UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns climate change, global warming, acid rain, ozone layer depletion, nuclear accidents ,central and state pollution control boards- Public awareness.

### UNIT V HUMAN POPULATION AND THE ENVIRONMENT

Population growth, variation among nations – population explosion, environment and human health – human rights - value education - HIV/AIDS - women and child welfare - role of information technology in environment and human health

### (A) AWARENESS ACTIVITIES:

i) small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste

- ii) Slogan making event
- iii) Poster making event

iv) Cycle rally

v) Lectures from experts

### **(B) ACTUAL ACTIVITIES:**

i) Plantation

- ii) Gifting a tree to see its full growth
- iii) Cleanliness drive
- iv) Drive for segregation of waste
- v) To live some big environmentalist for a week or so to understand his work
- vi) To work in kitchen garden for mess
- vii) To know about the different varieties of plants
- viii) Shutting down the fans and ACs of the campus for an hour or so

### **Text Books**

- 1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
- 2. Benny Joseph, 'Environmental Science and Engineering', Tata McGrawHill, NewDelhi, (2006).

### **R**eferences

- 1. Vairamani, S. and Dr. K. Sankaran. Elements of Environmental and Health Science. Karaikudi: KPSV Publications, 5<sup>th</sup> Edition, July, 2013.
- 2. If thikarudeen, Etal, Environmental Studies, Sooraj Publications, 2005.
- 3. R.Murugesan, Environmental Studies, Millennium Publishers and Distributors, 2<sup>nd</sup> Edition, July, 2009.



# **SEMESTER III**



| Subject Code:   | Sub  | ject Na                                 | me : Mat     | themati   | cs III fo  | or Mech   | anical   |         | Ty/Lb/        | L      | <b>T</b> / | P/F        | 2            | С     |
|-----------------|--|---|--------------|-----------|------------|-----------|----------|---------|---------------|--------|------------|------------|--------------|-------|
| EBMA22005       |  | and C                                   | lvil Engi    | neers     |            |           |          |         | ETL/IE        |        | SLı        | r          |              |       |
|                 | Pre  | requisit                                | e: Mathe     | ematics   | I & II     |           |          |         | Ту            | 3      | 1/0        | 0/         | 0            | 4     |
| L : Lecture T : | Tutoria  | l SLr:                                  | Supervis     | ed Learr  | ning P:    | Project   | R : Rese | arch C  | : Credits     |        |            |            |              |       |
| T/L/ETL : The   | ory/Lab  | /Embed                                  | ded Theor    | y and L   | ab         |           |          |         |               |        |            |            |              |       |
| OBJECTIVE       | S: The s   | tudent w                                | vill learn   |           |            |           |          |         |               |        |            |            |              |       |
| Basic           | mathem   | atical to                               | ols and t    | echnique  | es which   | n empha   | size the | devel   | opment of     | rigoro | us log     | gical thin | king         | and   |
| • Theory        | v and an   | s.<br>plication                         | ns of parti  | al differ | ential ea  | nuation   | its appl | ication | s Fourier s   | series | transf     | forms and  | Lar          | place |
| transfo         | ormation   | ).                                      | is of pure   |           |            | 1,        | no uppi  |         | s, 1 ourrer . | ,,     |            |            | - <b>_</b> F |       |
| COURSE OUT      | COME   | S (COs                                  | ):(3-5)      | The stu   | dents w    | ill be al | ole to   |         |               |        |            |            |              |       |
| CO1             | Understa   | and the co                              | oncepts of I | Partial D | ifferentia | l equatio | ns       |         |               |        |            |            |              |       |
| CO2             | Determi  | ne the Fo                               | ourier serie | s solutio | ns         |           |          |         |               |        |            |            |              |       |
| CO3             | Apply th   | e concep                                | ts of PDE    | in Wave   | and Heat   | problem   | IS       |         |               |        |            |            |              |       |
| CO4             | Apply L  | aplace tra                              | insforms ir  | n Enginee | ering prol | olems     |          |         |               |        |            |            |              |       |
| CO5             | Apply Fo   | ourier tra                              | nsforms in   | Enginee   | ring prob  | lems      |          |         |               |        |            |            |              |       |
| Mapping of Co   | urse Oi  | se Outcomes with Program Outcomes (POs) |              |           |            |           |          |         |               |        |            |            |              |       |
| COs/POs         | PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12 |   |              |           |            |           |          |         |               |        |            |            | )12          |       |
| CO1             | 3  | 2                                       | 2            | 3         | 3          | 1         | 1        | 2       | 2             | 1      |            | 1          |              | 2     |
| CO2             | 2  | 2                                       | 1            | 3         | 1          | 2         | 1        | 2       | 3             | 1      |            | 1          |              | 2     |
| CO3             | 3  | 2                                       | 1            | 3         | 2          | 3         | 2        | 1       | 1             | 2      |            | 1          |              | 3     |
| CO4             | 3  | 2                                       | 1            | 2         | 1          | 3         | 2        | 1       | 1             | 1      |            | 1          |              | 2     |
| CO5             | 3  | 3                                       | 1            | 2         | 1          | 2         | 2        | 1       | 1             | 2      |            | 2          |              | 3     |
| COs / PSOs      | PS   | 01                                      | PSG          | 02        | PS         | 603       | PS       | 504     |               |        |            |            |              |       |
| CO1             |  | 2                                       | 1            | 1         |            | 1         |          | 3       |               |        |            |            |              |       |
| CO2             |  | 2                                       | ]            | 1         |            | 1         |          | 3       |               |        |            |            |              |       |
| CO3             |  | 2                                       | 1            | 1         |            | 1         |          | 3       |               |        |            |            |              |       |
| CO4             |  | 2                                       | ]            | 1         |            | 1         |          | 3       |               |        |            |            |              |       |
| CO5             | <u> </u>   | 2                                       | ]            |           |            | 1         |          | 3       |               |        |            |            |              |       |
| 3/2/1 indicates | Strengt  | h of Coi                                | relation     | 3- Hig    | h, 2- Me   | edium,    | I-Low    |         |               |        |            |            | r            |       |
|                 |  |   | I            |           |            |           |          |         |               |        |            |            |              |       |
|                 |  |   | oci          |           | ive        | Ŋ         | It       | t       |               |        |            |            |              |       |
| ory             | ce   |   | s pu         | a)        | lect       | Ð         | lina     |         |               |        |            |            |              |       |
| ateg            | iene   | ng                                      | es a         | Core      | m e        | ctiv      | scip     | du      | 4/            |        |            |            |              |       |
| ü               | c Sc   | eeri<br>ce                              | miti<br>ce   | am (      | gra        | Ele       | Dis      | Ů.      | иса           |        |            |            |              |       |
|                 | <b>3</b> asi   | ngin<br>tiene                           | uma<br>tieno | ogra      | Pro        | ben       | nter     | kill    | rac           |        |            |            |              |       |
|                 | H ./   | Er<br>Sc                                | Hı<br>Sc     | Pr        |            | Ō         | Π        |         | 4             |        |            |            |              |       |
|                 | v  |   |              |           |            |           |          |         |               |        |            |            |              |       |
|                 |  |   |              |           |            |           |          |         |               |        |            |            |              |       |
|                 |  |   |              |           |            |           |          |         |               |        |            |            |              |       |

### 2018 Certified Institution

| Subject Code:<br>EBMA22005 | Subject Name : Mathematics III for Mechanical<br>and Civil Engineers | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|----------------------------|--|---------------|---|-----------|-----|---|
|                            | Prerequisite: Mathematics I & II                                     | Ту            | 3 | 1/0       | 0/0 | 4 |

### **UNIT- I: PARTIAL DIFFERENTIAL EQUATIONS**

Formation of PDE by eliminating arbitrary constants and eliminating arbitrary functions – Solutions of standard types of first order equations – Lagrange's equation – Linear partial differential equations of second and higher order with constant coefficients.

### **UNIT- II: FOURIER SERIES**

Dirichlet's conditions – General Fourier series – Half range Sine & Cosine series – Complex form of Fourier series - Parseval's identity - Harmonic Analysis.

### **UNIT- III: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**

Classification of second order linear partial differential equations – Solutions of one dimensional wave equation, one-dimensional heat equation - Steady state solution of two dimensional heat equations (Cartesian coordinates only) - Fourier series solutions.

### **UNIT-IV: LAPLACE TRANSFORMS**

Transforms of simple functions – Properties of Transforms – Inverse Transforms – Transforms of Derivatives and Integrals - Periodic functions - Initial and final value theorems - Convolution theorem - Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients and Linear simultaneous differential equations of first order with constant coefficients.

### **UNIT- V: FOURIER TRANSFORMS**

Statement of Fourier integral theorem - Fourier transform pairs - Fourier Sine and Cosine transforms -Properties – Transforms of simple functions – Convolution theorem – Parseval's theorem.

### **TEXT BOOKS**

- 1) Veerarajan T. (2007), Engineering Mathematics (for first year), Tata McGrawHill Publishing Co.,
- 2) Veerarajan T. (2005), Engineering Mathematics (for semester III), Tata McGraw Hill Publishing Co.,

### REFERENCES

- 1) Singaravelu (2009), Transforms and Partial Differential Equations, Meenakshi Agency.
- 2) Kreyszig E. (2011), Advanced Engineering Mathematics (9<sup>th</sup> ed.), John Wiley & Sons.
- 3) Grewal B.S. (2012), Higher Engineering Mathematics, Khanna Publishers.

**Total No. of Periods** 

### 12

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: 60



| Subject Code  | :: Subject Name : ENGINEERING<br>THERMODYNAMICS<br>Distribution Distribution |  |               |              |          |                |          |               |             |          |        |     |   |  |  |
|---------------|--|--|---------------|--------------|----------|----------------|----------|---------------|-------------|----------|--------|-----|---|--|--|
| EBME22003     | Pro  | erequisi   | te: Engin     | eering       | Physics  |                |          |               | Tv          | 3        | 1/0    | 0/0 | 4 |  |  |
| L : Lecture T | : Tutoria  | l SLr:   | : Supervis    | ed Lear      | ning P:  | Practica       | al R:R   | esearch       | C: Credits  | 11       |        |     |   |  |  |
| T/L/ETL : The | eory/Lab   | /Embedo  | ded Theor     | y and La     | ab       |                |          |               |             |          |        |     |   |  |  |
| OBJECTIVE     | : OBJE   | <b>CTIVE:</b>  | The stud      | lents wi     | ll learn |                |          |               |             |          |        |     |   |  |  |
| • The funda   | mentals  | of therm   | odynamic      | s and th     | ermodyı  | namic re       | lations  |               |             |          |        |     |   |  |  |
| • Properties  | of Stean   | n and its  | application   | ons.         |          |                |          |               |             |          |        |     |   |  |  |
| • Different   | thermody   | ynamic c   | cycles        |              |          |                |          |               |             |          |        |     |   |  |  |
| COURSE OU     | JTCOM  | ES (CO   | s): The s     | tudents      | will be  | able to        |          |               |             |          |        |     |   |  |  |
| CO1           | Unders   | stand the  | e basic co    | oncepts      | and law  | vs of the      | ermody   | namics        | .(Level 18  | &2)      |        |     |   |  |  |
| CO2           | Apply  | the first  | and seco      | ond law      | of them  | modyna         | mics to  | the en        | gineering   | processe | es and |     |   |  |  |
|               | devices  | s.(Level   | 3)            |              |          |                |          |               |             |          |        |     |   |  |  |
| CO3           | Unders   | stand the  | e concept     | s of ent     | ropy an  | id its en      | gineeri  | ng appl       | lications.( | Level 2) |        |     |   |  |  |
| CO4           | Apply  | the prop   | perties of    | pure su      | ibstance | es in vai      | rious ap | plication     | ons. (Lev   | el 3)    |        |     |   |  |  |
| CO5           | Analyz   | halyze the thermal performance of various power cycles.(Level 4)   |               |              |          |                |          |               |             |          |        |     |   |  |  |
| CO6           | Unders   | nderstand and apply the various thermodynamics relations in the engineering processes.(Level   |               |              |          |                |          |               |             |          |        |     |   |  |  |
|               | 2&3).  | &3).   |               |              |          |                |          |               |             |          |        |     |   |  |  |
| Mapping of C  | Course O   | se Outcomes with Program Outcomes (POs)  |               |              |          |                |          |               |             |          |        |     |   |  |  |
| COs/POs       | PO1  | PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12   |               |              |          |                |          |               |             |          |        |     |   |  |  |
| CO1           | 3  | 3  | 2             | 2            | 1        | 1              | 2        | 1             | 1           | 2        | -      |     | 3 |  |  |
| CO2           | 3  | 3  | 2             | 3            | 1        | 1              | 2        | 1             | 2           | 2        | -      |     | 2 |  |  |
| CO3           | 3  | 3  | 3             | 3            | 1        | 1              | 2        | 1             | 1           | 2        | -      |     | 2 |  |  |
| CO4           | 3  | 3  | 3             | 3            | 1        | 1              | 2        | 1             | 2           | 2        | -      |     | 2 |  |  |
| CO5           | 3  | 3  | 3             | 3            | 2        | 1              | 3        | 1             | 2           | 2        | -      |     | 3 |  |  |
| CO6           | 3  | 3  | 3             | 3            |          |                | 2        |               | 2           | 2        | -      |     | 2 |  |  |
| COs / PSOs    | PS   | 201  |               | <b>)</b> 2   | PS       | $\frac{03}{2}$ | PS       | 204           |             |          |        | +   |   |  |  |
|               |  | <u> </u>   | 2             |              |          | 2              |          | <u> </u>      |             |          |        |     |   |  |  |
| $CO_2$        |  | 2  | $\frac{2}{2}$ |              |          | 2              |          | $\frac{2}{2}$ |             |          |        | +   |   |  |  |
| C04           |  | 3  | 2             |              |          | 2              |          | 2             |             |          |        | -   |   |  |  |
| C05           |  | 3  | 2             |              |          | 2              |          | $\frac{2}{2}$ |             |          |        |     |   |  |  |
| CO6           |  | 3  | 2             |              |          | 2              |          | 2             |             |          |        |     |   |  |  |
| 3/2/1 indicat | es Strei   | ngth of  | Correlat      | ion:         | 3- High  | , 2- Me        | dium,    | 1-Low         |             |          |        |     |   |  |  |
|               |  |  | al            |              |          |                |          |               |             |          |        | Τ   |   |  |  |
| Category      | Basic Science  | Basic Science         Engineering         Engineering         Science         Humanities and soci.         Science         Program Core         Program Core         Inter Disciplinary         Skill Component         Practical /Project |               |              |          |                |          |               |             |          |        |     |   |  |  |
|               |  |  |               | $\checkmark$ |          |                |          |               |             |          |        |     |   |  |  |

### (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code: | Subject Name : ENGINEERING<br>THERMODYNAMICS | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|---------------|--|---------------|---|-----------|-----|---|
| EDWIE22003    | Prerequisite: Engineering Physics            | Ту            | 3 | 1/0       | 0/0 | 4 |

### UNIT- I: BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS

Thermodynamics systems, Concepts of continuum, Thermodynamic properties, Equilibrium, Process, Cycle, Work, Heat, Temperature, and Zeroth law of thermo dynamics. First law of thermodynamics– Applications to closed and open systems, Internal energy, Specific heats, Enthalpy, Steady flow conditions.

### UNIT- II: SECOND LAW OF THERMODYNAMICS

EDUCA

Statements, Reversibility, Causes of irreversibility, Carnot cycle, Reversed Carnot cycle, Heat engines, Refrigerators, Heat pumps. Clausius inequality, Concept of Entropy, Principles of increase of entropy, Carnot theorem, Available energy, Availability, Introduction to exergy.

### **UNIT- III: WORKING FLUIDS**

Thermodynamic properties of pure substance, Property diagrams. PVT surface of water and other substances, calculation of properties. Applications of First law and second law analysis using tables and charts.

Properties of ideal and real gases, Equation of state, Gas laws. Van der-waal's equation of state, Compressibility. Daltons law of partial pressures, Internal Energy, enthalpy, Specific heat and molecular weight of gas mixtures.

### **UNIT- IV: POWER CYCLES**

Gas power cycles - Carnot, Otto, Diesel, Dual, Brayton Cycles. Vapour Power Cycles – Rankine, Modified Rankine, Reheat, Ideal Regenerative cycle.

### **UNIT- V: THERMODYNAMIC RELATIONS**

Exact differentials, Maxwell relations, Tds relations, Difference and ratio of Heat Capacities, Energy Equation, Clausius - Clapeyron equations, Joule-Thomson coefficient.

### Total No. of Periods : 60

**Note:** Standard and approved Steam Table, Mollier Chart are permitted in examination. **TEXT BOOKS** 

- 1) P.K.Nag, (2014) "Engineering Thermodynamics" (Fifth Edition), Tata McGraw Hill Education Publishing Company Ltd., New Delhi.
- 2) Yunus A.Cengel, (2014) "Thermodynamics-An Engineering. Approach", Tata McGraw Hill Education, 8<sup>th</sup> edition.

### REFERENCES

- 1) Spalding & Cole, (1973) "Engineering Thermodynamics", ELBS, 6<sup>th</sup> edition.
- 2) J.P.Holman, (2011) "Thermodynamics", McGraw Hill 109095, 10<sup>th</sup> edition,
- 3) Van Wylen & Sonntag, (1998) "Fundamentals of Classical Thermodynamics", Wiley Eastern, 5<sup>th</sup> Edition.
- 4) Rogers & Mathew, (1992) "Engineering Thermodynamics", Adison Wesley 1090909, 4<sup>th</sup> edition.
- 5) Michael Saad, (1966) "Thermodynamics", Prentice Hall 109097.



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| Subject    | Cod    | e: Sub  | oject Na  | me: MAN           | UFAC      | <b>FURIN</b>   | G TECH    | INOLO                  | GY - I     | Ty/Lb/E       | 1        | T/<br>SIr | P/ C  |  |  |  |
|------------|--------|---|---|-------------------|-----------|----------------|-----------|------------------------|------------|---------------|----------|-----------|-------|--|--|--|
| EBME2      | 2004   | PI  | rerequis  | ite: NIL          |           |                |           |                        |            | Ту            |          | 0/0       | 0/0 3 |  |  |  |
| L : Lect   | ure T  | : Tutori                                      | al S Li   | : : Supervi       | ised Lea  | rning P        | : Practic | cal R:R                | Research   | C: Credits    |          |           | ľ     |  |  |  |
| Ty/Lb/E    | TL:    | Theory/                                       | Lab/Em  | bedded Th         | neory and | d Lab          |           |                        |            |               |          |           |       |  |  |  |
| OBJEC      | TIVI   | ES: The                                       | purpose   | e of study        | is to     | 6              |           | c                      |            |               |          |           |       |  |  |  |
|            | •      | Impart<br>Select                              | the appr  | dge in var        | ious mai  | ring pro       | ing proc  | esses foi<br>ed on the | r metals a | and plastics  |          |           |       |  |  |  |
| COURS      | SE O   | UTCON   | AES (CO   | <b>Ds</b> ) : The | student   | will be        | able to   |                        | e appnea   |               |          |           |       |  |  |  |
| CO1        | Ur     | nderstan                                      | d the var   | ious man          | ufacturir | ng proce       | sses for  | metals. (              | (Level 2)  |               |          |           |       |  |  |  |
| CO2        | De     | emonstra                                      | ate the op  | peration of       | f various | s manufa       | acturing  | processe               | es (Level  | 3)            |          |           |       |  |  |  |
| CO3        | Ex     | pose to                                       | advance   | d methods         | s of man  | ufacturi       | ng (Leve  | el 2)                  |            |               |          |           |       |  |  |  |
| CO4        | Re     | comme   | nd the su   | itable ma         | nufactur  | ing proc       | ess depe  | ending of              | n the req  | uirement(Lev  | vel 4)   |           |       |  |  |  |
| CO5        | De     | escribe t                                     | he manu   | facturing         | of plasti | c compo        | onents/Pr | oducts a               | and their  | applications. | (Leve    | 1 3)      |       |  |  |  |
| Mappin     | g of ( | f Course Outcomes with Program Outcomes (POs) |   |                   |           |                |           |                        |            |               |          |           |       |  |  |  |
| Cos/Pos    |        | PO1   | PO2   | PO3               | PO4       | PO5            | PO6       | PO7                    | PO8        | PO9           | PO<br>10 | PO11      | PO12  |  |  |  |
| CO1        |        | 3   | 2   | 1                 | -         | 2              | 3         | 2                      | 3          | 3             | 3        | 2         | 2     |  |  |  |
| CO2        |        | 3   | 3     2     1     -     2     3     2     3     3     2     2 |                   |           |                |           |                        |            |               |          |           |       |  |  |  |
| CO3        |        | 3   | 2   | 1                 | -         | 2              | 3         | 2                      | 3          | 3             | 3        | 2         | 2     |  |  |  |
| CO4        |        | 3   | 2   | 1                 | -         | 2              | 3         | 2                      | 3          | 3             | 3        | 2         | 2     |  |  |  |
| CO5        |        | 3   | 2   | 1                 | -         | 2              | 3         | 3                      | 3          | 3             | 3        | 2         | 2     |  |  |  |
| Cos / PSC  | )s     | PS  | 01  | PSC               | )2        | PS             | 03        | PS                     | 604        |               |          |           |       |  |  |  |
| CO1        |        |   | 3   | 3                 |           |                | 3         |                        | 2          |               |          |           |       |  |  |  |
| CO2        |        | •   | 3   | 3                 |           | •              | 3         |                        | 2          |               |          |           |       |  |  |  |
| CO3        |        | •   | 3   | 3                 |           | •              | 3         |                        | 2          |               |          |           |       |  |  |  |
| CO4        |        |   | 3   | 3                 |           |                | 3         |                        | 2          |               |          |           |       |  |  |  |
| CO5        |        | ź   | 3   | 3                 |           | -              | 3         |                        | 2          |               |          |           |       |  |  |  |
| 3/2/1 indi | cates  | Streng  | th of Co  | rrelation         | 3- Hi     | gh, 2- M       | ledium,   | 1-Low                  |            |               |          |           |       |  |  |  |
|            |        | ence  |   | s and<br>ince     |           | u              | tive      | ary                    | ant        |               |          |           |       |  |  |  |
|            |        | ic Sci  | Jee   | anitie<br>l Scie  | am        | ogran<br>xtive | Elec      | r<br>Xiplin            | l<br>npone | tical<br>ject |          |           |       |  |  |  |
|            | gory   | Bass Bass Bass Bass Bass Bass Bass Bass       |   |                   |           |                |           |                        |            |               |          |           |       |  |  |  |
|            | Cate   |   |   |                   | <b>v</b>  |                |           |                        |            |               |          |           |       |  |  |  |
|            |        |   |   |                   | •         |                |           |                        |            |               |          |           |       |  |  |  |
|            |        |   |   |                   |           |                |           |                        |            |               |          |           |       |  |  |  |
|            |        |   |   |                   |           |                |           |                        |            |               |          |           |       |  |  |  |

### (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code:<br>EBME22004 | Subject Name : MANUFACTURING TECHNOLOGY - I | Ty/Lb<br>/ETL | L | T/<br>SLr | P/R | С |
|----------------------------|---|---------------|---|-----------|-----|---|
|                            | Prerequisite: NIL                           | Ту            | 3 | 0/0       | 0/0 | 3 |

### **UNIT- I: METAL CASTING PROCESSES**

EDUCA

Introduction to Pattern making - Moulding sand - Melting furnaces - Special casting processes - Shell, Investment, Die casting, Full mould process - Defects in casting. Computers in casting processes.

### **UNIT- II: METAL FORMING PROCESSES**

Cold and hot working - Forging, Rolling, Extrusion, Drawing. . Introduction to sheet metal forming processes. High energy rate forming - Explosive forming, Electro-hydraulic, Electro magnetic forming, Dynapac machine, petro forge machines. Super plastic forming

### UNIT- III: METAL JOINING PROCESSES

Classification - Arc Welding –Sheet metal arc welding, Gas metal welding- - Submerged Arc, TIG, MIG, -Resistance welding -Electrode types – Specification- Special Types - Laser, Electron beam, Plasma Arc, Ultrasonic, Electro slag, Explosive welding and Friction welding - Thermit welding –inspection of welding-Defects in weld- Brazing and soldering

### **UNIT- IV: METAL CUTTING PROCESSES**

Lathe: Specification - Types - Mechanisms - Operations - Calculations - Capstan and turret lathe - Tooling with examples - Copy turning lathe. Drilling: Specification - Types - Feed Mechanism - Operations - Drill tool nomenclature - Mounting – Reamer and tap tools - Calculations.

### **UNIT- V: PROCESSING OF PLASTIC MATERIALS**

Types of Plastics - Types of moulding - Compression moulding - Transfer molding - Injection molding - Blow Moulding - Rota moulding - Film and sheet forming - Thermo forming - Reinforced plastic - Laminated plastics.

### **Total No. of Periods : 45**

### TEXT BOOKS

- 1) Sharma P.C. (2008), "A Text Book of Production Technology", S.Chand & Company Ltd., New Delhi.
- 2) Serope Kalpakjian (2013), "*Manufacturing Engineering and Technology*", Addison-wesley Pub.Co ,7<sup>th</sup> edition.

### REFERENCES

- 1) Rao P.N. (2007), "Manufacturing Technology Foundry Forging & Welding", Tata McGraw Hill Publishing Co., New Delhi, 2<sup>nd</sup> edition.
- 2) R.K. Jain, (2001) "Production Technology", Khanna publisher.
- 3) O.P. Khanna, (1993), "Welding Technology", Dhanpat Rai & sons.
- 4) S. K. Hajra Choudry, S. K. Bose, (2010) "Elements of Workshop Technology -Volume I & II". Media promoters.



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| Subject Cod   | e: S          | ıbject Na              | ame : FL                         | UID MI<br>M    | ECHAN<br>A CHIN  | ICS AN                 | ND                 |                 | Ty/Lb/<br>ETL      | L         | T/<br>SLr | P/R   | C     |
|---------------|---------------|------------------------|----------------------------------|----------------|------------------|------------------------|--------------------|-----------------|--------------------|-----------|-----------|-------|-------|
| EBCE22ID5     | 5 P           | rereauisi              | te: Engir                        | neering        | Physics          | <u>ER 1</u><br>s & Mat | hematic            | rs              | Tv                 | 3         | 0/0       | 0/0   | 3     |
| L : Lecture T | : Tutori      | al SLr                 | : Supervis                       | ed Lear        | ning P:          | Practic                | al R : R           | esearch         | C: Credits         |           | 0/0       | 0/0   | U     |
| T/L/ETL : Th  | neory/La      | b/Embed                | ded Theor                        | y and L        | ab               |                        |                    |                 |                    |           |           |       |       |
| OBJECTIV      | E: The s      | tudents                | will learn                       |                |                  |                        |                    |                 |                    |           |           |       |       |
| • The b       | basic pro     | perties of             | f fluids.                        |                |                  |                        |                    |                 |                    |           |           |       |       |
| • Flow        | behavio       | ur in vari             | ious sectio                      | ons with       | basic eq         | luations               |                    |                 |                    |           |           |       |       |
| Worl          | king prir     | ciples of              | hydraulic                        | pumps a        | and turb         | ines                   |                    |                 |                    |           |           |       |       |
| COURSE O      | UTCON         | IES (CO                | s): The s                        | tudents        | will be          | able to                |                    |                 |                    |           |           |       |       |
| CO1           | Underst       | and the v              | arious pro                       | perties (      | of fluids        | .(Level                | 1&2)               |                 |                    |           |           |       |       |
| CO2           | Apply t       | he basic o             | concepts o                       | f fluid f      | low beh          | aviour ii              | n various          | s sectio        | ns and solv        | e simple  | problems  | (Lev  | el 3) |
| CO3           | Analyse       | the beha               | viours of                        | fluid flo      | w throu          | gh circu               | lar cond           | uits(L          | evel <b>4</b> )    |           |           |       |       |
| CO4           | Acquire       | the know               | vledge of                        | construc       | tion and         | l workin               | g princi           | ples of         | hydraulic t        | urbines a | nd pumps  | s(Lev | el 2) |
| CO5           | Analyz        | the perf               | ormance o                        | of hydrau      | ulic turb        | ines and               | pumps.             | (Level          | 4)                 |           |           |       |       |
| Mapping of    | Course        | Outcome                | s with Pr                        | ogram          | Outcom           | es (POs                | ;):                |                 |                    |           |           |       |       |
| COs/POs       | PO1           | PO2                    | PO3                              | PO4            | PO5              | PO6                    | PO7                | PO8             | PO9                | PO10      | PO11      | PC    | )12   |
| CO1           | 3             | 1                      | 2                                | 2              | 2                | 2                      | 2                  | 2               | 1                  | 2         | -         |       | 3     |
| CO2           | 3             | 3                      | 3                                | 3              | 2                | 2                      | 2                  | 2               | 1                  | 3         | -         |       | 2     |
| CO3           | 3             | 3                      | 2                                | 2              | 2                | 2                      | 2                  | 2               | 1                  | 3         | -         |       | 2     |
| CO4           | 3             | 2                      | 3                                | 2              | 2                | 2                      | 2                  | 2               | 1                  | 2         | -         |       | 3     |
| CO5           | 3             | 2                      | 3                                | 2              | 2                | 2                      | 2                  | 2               | 1                  | 3         | -         |       | 1     |
| COs / PSOs    | Р             | SO1                    | PSC                              | 02             | PS               | 03                     | PS                 | 604             |                    |           |           |       |       |
| CO1           |               | 3                      | 2                                |                | 4                | 2                      |                    | 2               |                    |           |           |       |       |
| CO2           |               | 3                      | 2                                |                |                  | 2                      |                    | 2               |                    |           |           |       |       |
| CO3           |               | 3                      | 2                                |                |                  | 2                      |                    | 2               |                    |           |           |       |       |
| CO4           |               | 3                      | 2                                |                | 4                | 2                      |                    | 2               |                    |           |           |       |       |
| CO5           | Ct.           | 3                      | 2                                |                |                  | 2                      | 1 1                | 2               |                    |           |           |       |       |
| 3/2/1 indicat | es Stren      | gth of Co              | orrelation                       | 1: <b>3-</b> H | ligh, 2- 1       | Vlediun                | 1, I-Lov           | V               |                    |           | 1         |       |       |
| Category      | Basic Science | Engineering<br>Science | Humanities and social<br>Science | Program Core   | Program elective | Open Elective          | Inter Disciplinary | Skill Component | Practical /Project |           |           |       |       |
|               |               |                        |                                  |                |                  |                        |                    |                 |                    |           |           |       |       |



| Subject Code: | Subject Name : FLUID MECHANICS AND<br>MACHINERY | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|---------------|---|---------------|---|-----------|-----|---|
| EDCE22ID5     | Prerequisite: Engineering Physics               | Ту            | 3 | 0/0       | 0/0 | 3 |

### **UNIT- I: PROPERTIES OF FLUIDS**

UNIT-s & Dimensions, Properties of fluids – density, specific Gravity, specific weight, viscosity. Surface tension and Capillarity, Compressibility & Bulk modulus, Vapour pressure, Measurement of pressure- Manometers, Mechanical gauges.

### UNIT- II: FLUID FLOW CONCEPTS AND BASIC EQUATIONS

Flow Characteristics, Concepts of System and Control Volume, Continuity, Energy equation- Euler equation- Bernoulli equation, Impulse momentum equation-applications.

### **UNIT- III: FLOW THROUGH CIRCULAR CONDUITS**

Laminar flow through circular tubes – Boundary layer thickness -Darcy equation on pipe roughness – Friction factor – Minor losses – Flow through pipes in series and in parallel, Equivalent pipes.

### **UNIT- IV: HYDRAULIC TURBINES**

Impact of free jets-work done and efficiency calculation, Classification of hydraulic turbines, Elementary working principles of Pelton, Francis, Kaplan turbine, Work done, Governing of turbines, Draft tube, Specific Speed.

### **UNIT- V: HYDRAULIC PUMPS**

Reciprocating pumps : Classification, Working, Single acting and Double acting, Slip, Indicator diagram, Air vessels. Centrifugal pumps :Classification, Components, Working, Velocity triangles, Losses & Efficiency of a centrifugal pump, Pumps in series & parallel, Specific speed, Separation, Cavitations, Priming.

### **TEXT BOOKS**

### Total No. of Periods : 45

- 1) Bansal S.K. (2012) "Fluid Mechanics and Hydraulic Machines", Laxmi Publications (P) Ltd., New Delhi.
- 2) R.K.Rajput. (1998) "Fluid Mechanics and Hydraulic Machines", S.Chand & Company Ltd., New Delhi.

### REFERENCES

- 1) L.Kumar. (2002), "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi.
- 2) Roberson J.A. & Crowe C.T. (2001), "Engineering Fluid Mechanics", M/s Jaico Publishing Co., 9<sup>th</sup> edition
- 3) Streeter V.L. and Wylie E.B. (1983), "Fluid Mechanics", McGraw Hill.
- 4) Ramamirtham S. (1988), "Fluid Mechanics, Hydraulics and Fluid Machines", Dhanpat Rai & Sons, Delhi.
- 5) Yunus.A.Cengel, Robert H.Turner., "Thermal-Fluid Sciences", Tata McGraw Hill.

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| Subject Co<br>EBEC22E | de:<br>ГЗ | Su<br>AF      | bject Na<br>RCHITE     | ame : M<br>ECTURI                | ICROP<br>E AND I    | ROCES<br>EMBEI      | SSOR<br>DDED S       | YSTEN              | IS              | T / L/<br>ETL      | L     | T/SL    | r P/H   | Ł     | C    |
|-----------------------|-----------|---------------|------------------------|----------------------------------|---------------------|---------------------|----------------------|--------------------|-----------------|--------------------|-------|---------|---------|-------|------|
|                       |           | Pre           | erequisite             | e: Basic                         | Electric            | al and E            | Electroni            | cs Engir           | neering         | ETL                | 2     | 0/      | 0 2     | 2/0   | 3    |
| L : Lecture           | T : Tu    | loria         | I SLr:                 | Supervis                         | sed Lear            | rning P             | : Project            | t R : Re           | search C        | C: Credits         |       |         | •       |       |      |
| T/L/ETL : 7           | Theory.   | /Lab          | /Embedd                | led Theo                         | ory and l           | Lab                 |                      |                    |                 |                    |       |         |         |       |      |
| OBJECTI               | VES :     |               |                        |                                  |                     |                     |                      |                    |                 |                    |       |         |         |       |      |
| •                     | To stu    | ıdy           | the arch               | itecture                         | , addres            | ssing m             | odes an              | d assen            | nbly lev        | el progra          | amm   | ing of  | microp  | roces | sor. |
| •                     | To un     | ders          | stand the              | e concep                         | ots of d            | ifferent            | periphe              | erals and          | d their a       | pplicati           | ons   |         |         |       |      |
| •                     | To lea    | arn t         | he funct               | tions of<br>dament:              | 8051 n<br>als of ei | nicrocor<br>mbedde  | ntroller.<br>d Syste | ems                |                 |                    |       |         |         |       |      |
| COURSE                | OUTC      | OM            | ES (CO                 | s): The                          | studen              | ts will b           | e able to            | 0                  |                 |                    |       |         |         |       |      |
| CO1                   | Write     | asse          | embly la               | nguage p                         | orogram             | in 8085             | and 808              | 36 and u           | nderstan        | d the des          | ign o | f proce | essors. |       |      |
| CO2                   | Show      | thei          | r ability              | to interf                        | ace peri            | pherals v           | with mic             | croproce           | ssors           |                    |       |         |         |       |      |
| CO3                   | To le     | arn ti        | he functi              | ions of 8                        | 051 mic             | rocontro            | oller                |                    |                 |                    |       |         |         |       |      |
| CO4                   | Unde      | rstan         | nd the fur             | ndament                          | als of er           | nbedded             | l system             |                    |                 |                    |       |         |         |       |      |
| CO5                   | Demo      | onstr         | ate the a              | pplicatio                        | ons of en           | nbedded             | system.              | •                  |                 |                    |       |         |         |       |      |
| Mapping of            | f Cour    | se O          | outcome                | s with P                         | rogram              | Outcor              | nes (PO              | s)                 |                 |                    |       |         |         |       |      |
| COs/POs               | РО        | 1             | PO2                    | PO3                              | PO4                 | PO5                 | PO6                  | PO7                | PO8             | PO9                | PO    | 010     | PO11    | P     | 012  |
| CO1                   | 3         |               | 1                      | 3                                | 1                   | 1                   | 3                    | 2                  | 2               | 1                  | 2     | 2       | 3       |       | 3    |
| CO2                   | 3         |               | 1                      | 3                                | 1                   | 1                   | 3                    | 2                  | 2               | 1                  | 2     | 2       | 3       |       | 3    |
| CO3                   | 3         |               | 1                      | 3                                | 1                   | 1                   | 3                    | 2                  | 2               | 1                  | 2     | 2       | 3       |       | 3    |
| CO4                   | 3         |               | 1                      | 3                                | 1                   | 1                   | 3                    | 2                  | 2               | 1                  | 2     | 2       | 3       |       | 3    |
| CO5                   | 3         | Dao           | 3                      | 3                                | 3                   | 3                   | 3                    | 3                  | 2               | 3                  | 3     | \$      | 3       |       | 3    |
| COs /<br>PSOs         |           | PSO           | 01                     | PS                               | 02                  | PS                  | 03                   | PS                 | 04              |                    |       |         |         |       |      |
| CO1                   |           |               |                        |                                  |                     | 1                   | 1                    |                    | 3               |                    |       |         |         |       |      |
| CO2                   |           |               |                        |                                  |                     | 1                   | 1                    |                    | 3               |                    |       |         |         |       |      |
| CO3                   |           |               |                        |                                  |                     | 1                   | 1                    |                    | 3               |                    |       |         |         |       |      |
| CO4                   |           |               |                        |                                  |                     | 1                   | 1                    |                    | 3               |                    |       |         |         |       |      |
| CO5                   |           |               |                        |                                  |                     | 1                   | 1                    |                    | 3               |                    |       |         |         |       |      |
| 3/2/1 indica          | ates St   | reng          | th of Co               | orrelatio                        | n 3- H              | ligh, 2-            | Mediun               | n, 1-Lov           | V               | 1                  | 1     |         |         | 1     |      |
| itegory               |           | Basic Science | Engineering<br>Science | Humanities and<br>social Science | Program Core        | Program<br>elective | Open Elective        | Inter Disciplinary | Skill Component | Practical /Project |       |         |         |       |      |
| C                     |           |               |                        |                                  |                     |                     |                      | <b>√</b>           |                 |                    |       |         |         |       |      |

### ARCHITECTURE AND EMBEDDED SYSTEMS Prerequisite: Basic Electrical and Electronics Engineering

### UNIT I INTEL 8 BIT, 16 BIT MICROPROCESSORS

Internal Architecture of 8085 and 8086 microprocessor – Instruction set – Addressing modes – 8085 interrupts – Timing diagram – Assembly level programming

Lab Component: ALPs on 8085, 8086 microprocessor for arithmetic operations.

Subject Name : MICROPROCESSOR

### UNIT II PERIPHERAL INTERFACING

Subject Code:

EBEC22ET3

USART (8251) – Programmable interval timer (8353/8254) programmable peripheral interface (8255)Programmable DMA controller (8257) – Programmable Interrupt controller (8259) – Keyboard display interface (8279) – ADC/DAC interfacing

Lab Component: ALPs on interfacing 8085/8086 with interfacing units like 8255, 8259, 8279, ADC/DAC units.

### UNIT III 8051 MICROCONTROLLER

8051 Microcontroller hardware and Architecture –I/O pins, Ports and circuits–Counters and Timers-Serial Data I/O – Interrupts - 8051 Instruction set – Addressing Modes –Assembly Language Programming. **Lab Component**: ALPs using 8051 microcontroller for arithmetic operations and interfacing like timers/counters, Serial I/O.

### UNIT -IV EMBEDDED SYSTEM FUNDAMENTALS

## Introduction, Characteristics of embedded systems and challenges in system design –Design issues in embedded real-time systems, critical performance issues in embedded real-time systems.

### UNIT V SENSOR INTERFACING WITH ARDUINO

Basics of hardware design and functions of basic passive components-sensors and actuators- Arduino code - library file for sensor interfacing-construction of basic applications using laboratory tools. **Lab Component**: Programs in Arduino like LED Blinking, Reading Analog Voltage, Pushbutton Debounce, Reading a Potentiometer value etc.

### **Total Number of Periods: 45**

### Text books:

Krishna Kant, "Microprocessors and Microcontrollers, Architecture, programming and system design using 8
 R.S. Gaonkar, "Microprocessor Architecture Programming and Application, with 8085", Wiley Eastern Ltd., New Delhi, 2013.

3. David E. Simon, "An Embedded Software Primer", Pearson education, 1999

### **References:**

Kenneth J. Ayala, "The 8086 Microprocessor: Programming & Interfacing the PC", Delmar Publishers, 2007.
 Arnold S. Berger, "Embedded Systems Design- an Introduction to Processes, Tools & Techniques", CMP books, 2002

3. https://www.arduino.cc/en/software



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| Subject Code:<br>EBME22005 | Subjec           | et Name   | : MACI                         | HINE D         | RAWIN            | IG            |                    | T / L/<br>ETL   | L                  | T /<br>S.Lr | P/ R        | C    |  |
|----------------------------|------------------|---|--------------------------------|----------------|------------------|---------------|--------------------|-----------------|--------------------|-------------|-------------|------|--|
|                            | Prerec           | quisite: ]  | Basic Er                       | ngineeri       | ng Grap          | ohics         |                    | Ту              | 2                  | 0/0         | 2/0         | 3    |  |
| L : Lecture T : Tu         | utorial          | S Lr : S  | upervise                       | d Learni       | ng P:F           | Practical     | R : Res            | earch           | C: Cred            | its         |             |      |  |
| T/L/ETL : Theory           | y/Lab/Ei         | nbedded   | Theory                         | and Lat        | )                |               |                    |                 |                    |             |             |      |  |
| <b>OBJECTIVES:</b>         | The pur          | pose of   | study is                       | to impai       | t knowle         | edge in f     | fundame            | ntals of        | machin             | e drawing   | g and asse  | mbly |  |
| drawings.                  |                  |   |                                |                |                  |               |                    |                 |                    |             |             |      |  |
| COURSE OUTO                | COMES            | ( <b>COs</b> ) :  | The stu                        | ident w        | ill be ab        | le to         |                    |                 |                    |             |             |      |  |
| CO1                        | Unders           | stand the   | code of                        | practice       | e and BI         | S specifi     | ication o          | f basic r       | nachine            | elements    | s. (Level 2 | 2)   |  |
| CO2                        | Apply<br>manufa  | the fund  | amental<br>(Level 3            | s of mac<br>3) | hine dra         | wing lik      | te fits, li        | mits and        | toleran            | ce analys   | is in       |      |  |
| CO3                        | Assem<br>jack et | ble the v<br>c.(Level   | various n<br>6)                | nachine        | parts of         | IC Engiı      | ne comp            | onents, '       | Fail sto           | ck, Cotter  | Joint, Sc   | rew  |  |
| CO4                        | Sketch           | ketch the isometric view and orthographic view of various machine parts . (Level 3) |                                |                |                  |               |                    |                 |                    |             |             |      |  |
| CO5                        | Employ           | y CAD t   | ools to c                      | convert p      | oart draw        | ving into     | orthogr            | aphic vi        | ews. (L            | evel 3)     |             |      |  |
| Mapping of Cou             | rse Out          | Outcomes with Program Outcomes (POs)  |                                |                |                  |               |                    |                 |                    |             |             |      |  |
| Cos/Pos                    | PO1              | PO2   | PO3                            | PO4            | PO5              | PO6           | PO7                | PO8             | PO9                | PO10        | PO11        | PO12 |  |
| CO1                        | 3                | -   | -                              | -              | -                | 2             | 2                  | -               | 3                  | 3           | 1           | 2    |  |
| CO2                        | 3                | -   | -                              | -              | -                | 2             | 2                  | -               | 3                  | 3           | 1           | 2    |  |
| CO3                        | 3                | -   | 2                              | -              | 3                | 2             | 2                  | -               | 3                  | 3           | 1           | 3    |  |
| CO4                        | 3                | -   | 2                              | -              | 3                | 2             | 2                  | -               | 3                  | 3           | 1           | 3    |  |
| CO5                        | 3                | -   | 2                              | -              | 3                | 2             | 2                  | -               | 3                  | 3           | 1           | 3    |  |
| Cos / PSOs                 | PS               | 01  | PS                             | 02             | PS               | 03            | PS                 | 04              |                    |             |             |      |  |
| CO1                        |                  | 3   | 2                              | 2              |                  | 3             |                    | 2               |                    |             |             |      |  |
| CO2                        |                  | 3   | 2                              | 2              | -                | 3             |                    | 2               |                    |             |             |      |  |
| CO3                        |                  | 3   | 2                              | 2              |                  | 3             |                    | 2               |                    |             |             |      |  |
| CO4                        |                  | 3   | 2                              | 2              |                  | 3             |                    | 2               |                    |             |             |      |  |
| CO5                        |                  | 3   | 2                              | 2              |                  | 3             |                    | 2               |                    |             |             |      |  |
| 3/2/1 indicates S          | trength          | of Corr   | elation                        | 3- Hig         | h, 2- Me         | edium, 1      | l-Low              |                 |                    |             | 1           |      |  |
|                            |                  |   | al                             |                |                  |               |                    |                 |                    |             |             |      |  |
| Category                   | Basic Science    | Engineering<br>Science  | Humanities and soci<br>Science | Program Core   | Program elective | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |             |             |      |  |
|                            |                  |   |                                | ~              |                  |               |                    |                 |                    |             |             |      |  |



| (An ISO 21001 : 2018 Certified Institution)                          |  |
|--|--|
| Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India. |  |

| Subject Code: | Subject Name : MACHINE DRAWING     | Ty/Lb/ | L | Τ/  | P/R | С |
|---------------|------------------------------------|--------|---|-----|-----|---|
| EDME22005     |                                    | ETL    |   | SLr |     |   |
| EBME22005     | Prerequisite: Engineering Graphics | Ту     | 2 | 0/0 | 2/0 | 3 |

### **UNIT-I-DRAWING STANDARDS**

Code of practice for Engineering Drawing, BIS specifications -Welding symbols, riveted joints, keys, andfasteners - Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc.

### **UNIT- II - INTRODUCTION TO MACHINE DRAWING**

Fundamentals of machine drawing: Geometric Dimensioning - Limits, fits, Tolerances - Types -Tolerance Analysis. Isometric to Orthographic conversion of Part drawings and vice versa, Assembly Drawings - Manual drawing.

### **UNIT- III - PREPARATION OF ASSEMBLY MODELS**

Preparing the assembly views (with minimum four components) of various industrial oriented equipments.(E.g. Piston and connection rod, Coupling and shafts, Plummer block, Tail stock, Cotter Joint, Knuckle Joint, Universal Joint and Screw Jack)

### **UNIT- IV - PREPARATION OF PART MODELS USING MODELING SOFTWARE** 6

Preparing isometric view of various industrial oriented machine components - Selection of machine components from software library - Conversion of part drawing into orthographic views. (Drafting)

(UNIT-s I, II and III should be practiced by drafting equipment- UNIT- IV to be practiced by CAD software)

Total No. of Periods: 45

### **TEXT BOOK:**

1. N. D. Bhatt and V. M. Panchal, "Machine Drawing", Charotar Publishing House, Anand, Gujarat, India. 2004.

### **REFERENCE:**

1. K R Gopalakrishnan, "Machine drawing", Subhas Stores, Bangalore. 2007



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| Subject Code:<br>EBCC22ET1 | Su<br>Un | bject<br>derstan                                     | Name<br>ding Har  | : Ur<br>mony        | niversal             | alues:               | T / L/<br>ETL/<br>IE | L       | T /<br>S.Lr        | <b>P/ R</b> | C            |        |        |
|----------------------------|----------|--|-------------------|---------------------|----------------------|----------------------|----------------------|---------|--------------------|-------------|--------------|--------|--------|
|                            | Pro      | erequisi   | te:               |                     |                      |                      |                      |         | ETL                | 1           | 0/0          | 2/0    | 2      |
| L : Lecture T :            | Tutoria  | l S Lr   | : Supervis        | ed Lear             | ning P:              | Project              | R : Rese             | earch C | Credits            |             |              |        |        |
| T/L/ETL : The              | ory/Lab  | /Embed   | ded Theor         | y and L             | ab                   |                      |                      |         |                    |             |              |        |        |
| <b>OBJECTIVE:</b>          | :        |  |                   |                     |                      |                      |                      |         |                    |             |              |        |        |
| •                          | Develo   | pment  | of a h            | olistic             | perspe               | ctive l              | based of             | on sel  | f- explor          | ation       | about        |        |        |
| •                          | themse   | elves (h)  | uman bei          | ng), fai<br>velopin | nily, so<br>o clarit | $c_1 ety ar  x of t$ | id natur<br>he hari  | e/exist | ence.<br>in the hu | ıman h      | eing fai     | nilv   |        |
|                            | society  | and na   | ture/exis         | tence               | 5 cluin              | y) 01 (              | ine nun              | inony   | in the nu          | innun 0     | enig, iu     | iiiiy, |        |
| •                          | Strengt  | hening   | of self-re        | eflection           | n.                   |                      |                      |         |                    |             |              |        |        |
| •                          | Develo   | pment  | of comm           | itment              | and cou              | rage to              | act.                 |         |                    |             |              |        |        |
| COURSE OU                  | TCOM     | ES (CO   | s) : ( 3- 5)      | : The st            | tudents              | will be a            | able to              |         |                    |             |              |        |        |
| CO1                        | Relate   | self and   | surround          | ings and            | l identif            | y respon             | sibility i           | in life |                    |             |              |        |        |
| CO2                        | Assoc    | iate hum   | an relatio        | nship ar            | nd nature            | e to hand            | lle probl            | ems and | l provide s        | ustainał    | ole solutio  | ns     |        |
| CO3                        | Develo   | op critic  | al ability a      | and enga            | age in re            | flective             | and inde             | ependen | t Thinking         |             |              |        |        |
| CO4                        | Show     | commiti  | nent towa         | rds und             | erstandiı            | ng of val            | lues                 |         |                    |             |              |        |        |
| CO5                        | Apply    | oply Human values in day to day setting in real life |                   |                     |                      |                      |                      |         |                    |             |              |        |        |
| Mapping of Co              | urse Ot  | itcomes  | with Pro          | gram O              | utcome               | s (POs)              |                      | DOG     | DOA                | DO10        | <b>D</b> 011 | DO     | 10     |
| COs/POs                    | PO1      | PO2  | PO3               | PO4                 | PO5                  | PO6                  | PO7                  | PO8     | PO9                | PO10        | PO11         | PO     | 12     |
|                            |          |  | 1                 |                     | -                    | 2                    | 1                    | 1       | 1                  |             |              |        | 2      |
| CO2                        |          |  | 2                 | 2                   |                      | 2                    | 3                    | 1       | 1                  | 2           |              |        | 2      |
| CO3                        |          |  | 1                 | 1                   |                      | <u> </u>             | 1                    | 2       |                    |             |              |        | 3      |
| C04                        |          |  | <u> </u>          |                     | 1                    | 1                    | 1<br>1               | 3       | 1                  | 1           |              |        | 3<br>2 |
| $CO_{\rm S}$               | DS       | 01   |                   | 22                  | DS                   | <u><u></u></u>       |                      | <u></u> | I<br>DSO5          | 1           |              |        | 3      |
| $CO_1$                     | rs       | 2  |                   | J2                  | PS                   | 2                    | r.                   | 504     | P305               |             |              |        |        |
|                            |          | ,<br>,   | 2                 |                     |                      | 3                    |                      |         |                    |             |              |        |        |
| CO2                        |          | 2<br>2   | 2                 |                     |                      | <u>.</u>             |                      |         |                    |             |              |        |        |
| CO4                        |          | 3  | 1                 |                     |                      | 2                    |                      |         |                    |             |              |        |        |
| CO5                        |          | 2  | 2                 |                     |                      | <u>-</u><br>1        |                      |         |                    |             |              |        |        |
| 3/2/1 indicates            | Streng   | th of Co   | orrelation        | 3- Hi               | gh, 2- M             | ledium,              | 1-Low                |         |                    |             |              |        |        |
|                            |          |  |                   |                     |                      |                      |                      |         |                    |             |              |        |        |
|                            | 0        |  | d social          |                     | ective               |                      | nary                 | lent    | ject               |             |              |        |        |
| gory                       | Science  | ring   | ties an           | 1 Core              | ram ele              | ective               | iscipli              | ompor   | al /Pro            |             |              |        |        |
| Cate                       | Basic !  | Enginee<br>Science                                   | Humani<br>Science | Progran             | Prog                 | Dpen El              | Inter <b>E</b>       | Skill C | Practic            |             |              |        |        |
|                            |          |  |                   |                     |                      |                      | <b>√</b>             |         |                    |             |              |        |        |



| Subject Code: | Subject Name UNIVERSAL HUMAN VALUES | T / L/ | L | T /  | <b>P/ R</b> | С |
|---------------|-------------------------------------|--------|---|------|-------------|---|
|               |                                     | ETL/IE |   | S.Lr |             |   |
| EBCC22E11     | Prerequisite:                       | ETL    | 1 | 0/0  | 2/0         | 2 |

### **OBJECTIVE:**

- 1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
- 2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- 3. Strengthening of self-reflection.
- 4. Development of commitment and courage to act.

# **UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**

- 1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
- 2. Self-Exploration–what is it? Its content and process; 'Natural Acceptance'andExperientialValidation-astheprocessforself-exploration.
- 3. Continuous Happiness and Prosperity-A look at basic Human Aspirations
- 4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority.
- 5. UnderstandingHappinessandProsperitycorrectly-Acriticalappraisalof the current scenario
- 6. Method to fulfill the above human aspirations: understanding and living in at various levels of harmony

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

### UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!

- 1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.
- 2. Understanding the needs of Self ('I') and 'Body' happiness and physical facility.
- 3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
- 4. Understanding the characteristics and activities of 'I' and harmony in 'I'.
- 5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
- 6. Programs to ensure Sanyam and Health.

# Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life.

# Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

# UNIT 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

- 1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; trust and Respect as the foundational values of relationship
- 2. Understanding the meaning of Trust; Difference between intention and competence
- 3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship



- 4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
- 5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family,real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal valuein relationships. Discuss with scenarios. Elicit examples from students' lives.

### UNIT 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

- 1. Understanding the harmony in the Nature
- 2. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature.
- 3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.
- 4. Holistic perception of harmony at all levels of existence.
- 5. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

### **UNIT 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics**

- 1. Natural acceptance of human values
- 2. Definitiveness of Ethical Human Conduct
- 3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- 4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- 5. Case studies of typical holistic technologies, management models and production systems
- 6. Strategy for transition from the present state to Universal Human Order:
  - a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
  - b. At the level of society: as mutually enriching institutions and organizations
- 7. Sum up.

# Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. Todiscuss the conduct as an engineer or scientist etc.

- Text Books
- 1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

### **REFERENCE BOOKS**

- 1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
- 2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
- 3. The Story of Stuff (Book).
- 4. The Story of My Experiments with Truth by Mohandas Karamchand Gandhi.
- 5. Small is Beautiful E. F Schumacher.
- 6. Slow is Beautiful Cecile Andrews
- 7. Economy of Permanence J C Kumarappa
- 8. Bharat Mein Angreji Raj PanditSunderlal
- 9. Rediscovering India by Dharampal
- 10. Hind Swaraj or Indian Home Rule by Mohandas K. Gandhi

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| L · Locture T   | · Tutori |                    |                                    |                     | - 1            |            |            |           | ETL         |             | SLr       |       |   |  |  |
|-----------------|----------|--------------------|------------------------------------|---------------------|----------------|------------|------------|-----------|-------------|-------------|-----------|-------|---|--|--|
| I · Locturo T · | · Tutori |                    | Prerec                             | uisite:             | Manufa         | cturing    | Techno     | ology - I | Lb          | 0           | 0/0       | 3/0   | 1 |  |  |
| T/L/ETL : The   | eory/La  | al S Lr<br>b/Embec | : Supervi<br>lded Theo             | sed Lea<br>ry and I | rning P<br>Lab | : Practic  | al R : F   | Research  | C: Credits  | 5           |           |       |   |  |  |
| OBJECTIVE       | S: The   | student            | will learn                         |                     |                |            |            |           |             |             |           |       |   |  |  |
| •               | To imp   | art pract          | tical expos                        | sure and            | skill in       | metal cu   | itting pr  | ocesses o | of Lathe ar | nd Drillin  | g machin  | e.    |   |  |  |
| COURSE OU       | JTCOM    | IES (CO            | Ds) : The                          | Student             | s will be      | e able to  | •          |           |             |             |           |       |   |  |  |
| CO1             | 1        | Understa           | and the op                         | erations            | of basic       | metal c    | utting p   | rocess m  | achines (L  | level 2)    |           |       |   |  |  |
| CO2             | 1        | Acquire            | skill in ba                        | sic oper            | ations in      | n metal c  | utting p   | rocess m  | achines (L  | Level 4)    |           |       |   |  |  |
| СОЗ             | ]        | Practical          | skill in se                        | etting me           | echanisn       | n and pr   | ocess pa   | rameters  | for specif  | fic operat  | ions (Lev | el 4) |   |  |  |
| CO4             | 1        | Understa           | and and pr                         | epare th            | e mould        | s based    | on the n   | eed (Lev  | rel 3)      |             |           |       |   |  |  |
| CO5             | ]        | Practical          | skill in w                         | elding o            | peration       | ns (Leve   | l 4)       |           |             |             |           |       |   |  |  |
| Mapping of C    | Course   | Outcom             | tcomes with Program Outcomes (POs) |                     |                |            |            |           |             |             |           |       |   |  |  |
| Cos/Pos 1       | PO1      | PO2                | PO3                                | PO4                 | PO5            | <b>PO6</b> | <b>PO7</b> | PO8       | PO9         | <b>PO10</b> | PO11      | PO12  | 2 |  |  |
| CO1             | 3        | 3                  | -                                  | -                   | -              | 2          | 2          | 2         | 3           | 2           | 2         | 2     | 2 |  |  |
| CO2             | 3        | 3                  | -                                  | -                   | -              | 2          | 2          | 2         | 3           | 2           | 2         | 2     | 2 |  |  |
| CO3             | 3        | 3                  | -                                  | -                   | -              | 2          | 2          | 2         | 3           | 2           | 2         | 2     |   |  |  |
| CO4             | 3        | 3                  | -                                  | -                   | -              | 2          | 2          | 2         | 3           | 2           | 2         | 2     |   |  |  |
| CO5             | 3        | 3                  | -                                  | -                   | -              | 2          | 2          | 2         | 3           | 2           | 2         | 2     | 2 |  |  |
| Cos / PSOs      | PSC      | 01                 | PSC                                | )2                  | PS             | 03         | PS         | 504       |             |             |           |       |   |  |  |
| CO1             | 3        |                    | 3                                  |                     |                | 2          |            | 2         |             |             |           |       |   |  |  |
| CO2             | 3        |                    | 3                                  |                     | 2              | 2          |            | 2         |             |             |           |       |   |  |  |
| CO3             | 3        |                    | 3                                  |                     | 2              | 2          |            | 2         |             |             |           |       |   |  |  |
| CO4             | 3        |                    | 3                                  |                     |                | 2          |            | 2         |             |             |           |       |   |  |  |
| CO5             | 3        |                    | 3                                  |                     |                | 2          |            | 2         |             |             |           |       |   |  |  |
| 3/2/1 indicates | Strengt  | th of Co           | rrelation                          | 3- Hig              | gh, 2- M       | edium,     | 1-Low      |           |             |             |           |       |   |  |  |
|                 |          |                    | al                                 |                     |                |            |            |           |             |             |           |       |   |  |  |
|                 |          |                    | soci                               |                     | iive           |            | ury        | nt        | ct          |             |           |       |   |  |  |
|                 | ce       |                    | pun                                | e                   | lect           | e          | lina       | one       | roje        |             |           |       |   |  |  |
| ~               | cien     | ing                | es a                               | Cor                 | m e            | ctiv       | scip       | duu       | 1 /P        |             |           |       |   |  |  |
| gory            | c S      | leer.<br>ce        | uniti<br>ce                        | am                  | ogra           | Ele        | Di         | Co        | tica        |             |           |       |   |  |  |
| ate             | Basi     | ngin<br>cien       | uma                                | 1g0.                | Pro            | pen        | Inter      | Skill     | Prac        |             |           |       |   |  |  |
|                 | -        | ы<br>Х<br>Е        | Η<br>Sc                            | _P_                 |                | 0          | -          |           |             |             |           |       |   |  |  |
|                 |          |                    |                                    | ÷                   |                |            |            |           |             |             |           |       |   |  |  |
|                 |          |                    |                                    |                     |                |            |            |           |             |             |           |       |   |  |  |
|                 |          |                    |                                    |                     |                |            |            |           |             |             |           |       |   |  |  |



|               | Feriyar E.v.K. filgh koau, Maduravoyai, Chennai-95. Taminia | au, maia. |   |        |     |   |
|---------------|---|-----------|---|--------|-----|---|
| Subject Code: | Name: MANUFACTURING TECHNOLOGYLAB - I                       | Ty/Lb/    | L | T/ SLr | P/R | С |
| EBME22L01     |   | ETL/IE    |   |        |     |   |
|               | Prerequisite: Manufacturing Technology - I                  | Lb        | 0 | 0/0    | 3/0 | 1 |

### LIST OF EXPERIMENTS:

### LATHE PRACTICE

- 1) Step turning
- 2) Taper turning
- 3) Thread cutting
- 4) Eccentric turning

### DRILLING PRACTICE

- 1) Drilling
- 2) Reaming
- 3) Tapping.

### FOUNDRY

1) Study of tools and equipments.

2) Preparation of Green sand moulds for Flange, Gear, V-grooved pulley, T & L Pipes

### WELDING

1) Study of tools and equipments.

2) Electric arc welding exercises – lap joint – Butt joint – Fillet joint – Tee joint.

3) Gas welding and gas cutting – Template cutting.

Total No. of Periods: 45



|                                 |           |               | Periyar E.  | V.R. High R  | oad, Madu  | ravoyal, C | hennai-95     | . Tamilna                   | du, India.  |        |      |            |     |  |  |  |
|---------------------------------|-----------|---------------|-------------|--------------|------------|------------|---------------|-----------------------------|-------------|--------|------|------------|-----|--|--|--|
| Subject Code:                   | Su        | bject N       | ame : E     | NGINE        | ERING      | META       | LLUR          | GY                          | Ty/Lb/      | L      | Τ/   | P/R        | С   |  |  |  |
| EBME22L02                       | LA        | В             |             |              |            |            |               |                             | ETL         |        | SLr  |            |     |  |  |  |
|                                 | Pr        | erequisi      | te: Engin   | eering N     | Aetallur   | gy         |               |                             | Lb          | 0      | 0/0  | 3/0        | 1   |  |  |  |
| L : Lecture T :                 | Tutorial  | SLr :         | Supervise   | ed Learn     | ing P:     | Project 1  | R : Rese      | arch C:                     | Credits     |        |      | . <u> </u> |     |  |  |  |
| T/L/ETL : The                   | ory/Lab   | /Embedo       | led Theor   | y and La     | ıb         |            |               |                             |             |        |      |            |     |  |  |  |
| OBJECTIVE:                      | :         |               |             |              |            |            |               |                             |             |        |      |            |     |  |  |  |
| • To imp                        | oart knov | vledge a      | nd skill al | oout mic     | rostructi  | ure and h  | neat trea     | tment p                     | rocesses    |        |      |            |     |  |  |  |
| • Experi                        | mental r  | nethods       | of finding  | g mechar     | nical prop | perties o  | f materi      | als                         |             |        |      |            |     |  |  |  |
| •                               |           |               |             |              |            |            |               |                             |             |        |      |            |     |  |  |  |
|                                 |           | CC            | OURSE C     | UTCO         | MES (C     | Os):(3     | <b>3- 5</b> ) |                             |             |        |      |            |     |  |  |  |
| CO1                             | Unders    | tand the      | basic con   | cept of s    | specimer   | n prepara  | ation for     | micros                      | tructure an | alysis |      |            |     |  |  |  |
| CO2                             | Descrit   | be the Ti     | me tempe    | rature tr    | ansform    | ation dia  | ıgram (T      | m (TTT) of different metals |             |        |      |            |     |  |  |  |
| CO3                             | Analys    | e the mi      | icrostructu | are of n     | on ferro   | us mate    | erials        |                             |             |        |      |            |     |  |  |  |
| CO4                             | Analys    | e the mi      | icrostructu | are of fe    | errous m   | naterials  |               |                             |             |        |      |            |     |  |  |  |
| CO5                             | Determ    | ine the l     | nardness c  | of differe   | ent mate   | rials      |               |                             |             |        |      |            |     |  |  |  |
|                                 |           | Ma            | apping of   | Course       | Outcon     | nes with   | Progra        | m Out                       | comes (Pos  | s)     |      |            |     |  |  |  |
| Cos/Pos                         | PO1       | PO2           | PO3         | PO4          | PO5        | PO6        | <b>PO7</b>    | PO8                         | PO9         | PO10   | PO11 | PO         | )12 |  |  |  |
| CO1                             | 1         |               | 3           |              |            |            |               |                             | 2           |        |      |            | 3   |  |  |  |
| CO2                             | 1         |               | 3           |              |            |            |               |                             | 2           |        |      |            | 3   |  |  |  |
| CO3                             | 1         |               | 3           |              |            |            |               |                             | 2           |        |      |            | 3   |  |  |  |
| CO4                             | 1         |               | 3           |              | -          |            |               |                             | 2           |        |      |            | 3   |  |  |  |
| CO5                             | 1         |               | 3           |              |            |            | -             |                             | 2           |        |      |            | 3   |  |  |  |
| Cos / PSOs                      | PS        | 1             | PS          | 02           | PS         | <u>303</u> | P             | 504                         | PS05        |        |      | _          |     |  |  |  |
|                                 |           | 1             | 2           |              |            | 3          |               |                             |             |        |      |            |     |  |  |  |
| CO2                             |           | <u> </u><br>1 |             | <u>.</u>     |            | 3          |               |                             |             |        |      |            |     |  |  |  |
| CO3                             |           | 1<br>1        | 2           | 2<br>)       |            | <u> </u>   |               |                             |             |        |      | _          |     |  |  |  |
| C04                             | -         | 1<br>1        | 2           | ,<br>,       |            | 3          |               |                             |             |        |      | _          |     |  |  |  |
| $\frac{CO3}{3/2/1}$ indicates 9 | Strengtl  | 1<br>h of Cor | relation    | '<br>3. Hiał | 2- Me      | <u> </u>   | .Low          |                             |             |        |      |            |     |  |  |  |
| 5/2/1 malcates                  | Strengt   |               |             | J- Ingi      | l, 2- 1110 |            |               |                             |             |        |      |            |     |  |  |  |
|                                 |           |               | nce         |              |            |            |               |                             |             |        |      |            |     |  |  |  |
|                                 |           |               | Scie        |              |            |            |               |                             |             |        |      |            |     |  |  |  |
|                                 |           | e             | ial 5       |              |            |            |               |                             |             |        |      |            |     |  |  |  |
| <b>&gt;</b>                     |           | ienc          | soc         |              | tive       |            | ary           | nt                          | ct          |        |      |            |     |  |  |  |
| gory                            | ce        | Sci           | nud         | e            | lec        | e          | lina          | one                         | roje        |        |      |            |     |  |  |  |
| ateg                            | cien      | ing           | es a        | Cor          | m e        | ctiv       | scip          | duu                         | 1/P         |        |      |            |     |  |  |  |
| Ŭ                               | c S(      | leer          | uniti       | am           | gra        | Ele        | Di            | Co                          | tica        |        |      |            |     |  |  |  |
|                                 | 3asi      | ngin          | um.         | ogr          | Prc        | pen        | nter          | skill                       | rac         |        |      |            |     |  |  |  |
|                                 | H         | Ē             | Η           | Pr           |            | Ō          |               |                             |             |        |      | _          |     |  |  |  |
|                                 |           |               |             | ×            |            |            |               |                             | Ň           |        |      |            |     |  |  |  |
|                                 |           |               |             |              |            |            |               |                             |             |        |      |            |     |  |  |  |


| Subject Code: | Subject Name : ENGINEERING METALLURGY<br>LAB | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|---------------|--|---------------|---|-----------|-----|---|
|               | Prerequisite: Engineering Metallurgy         | Lb            | 0 | 0/0       | 3/0 | 1 |

### ENGINEERING METALLURGY LAB

#### STUDY EXPERIMENTS

- **1.** Introduction to metallurgy
- 2. Specimen preparation
- **3.** Metallurgical microscope
- 4. Iron carbon system
- 5. Time temperature transformation diagram (TTT)

# MICROSTRUCTURE ANALYSIS

- 1. Brass
- 2. Copper
- 3. Gray cast-iron
- **4.** Malleable cast-iron
- 5. Nodular iron
- 6. Mild-steel, Stainless-steel and High speed steel

#### HEAT TREATMENT PROCESS

- **1.** Jominey quench test
- 2. Hardness of steel



| Subject Code    | : Su<br>M | bject<br>ACHIN         | Name<br>ERY LAI                                  | : FLU<br>B      | J <b>ID N</b>   | ЛЕСНА              | NICS           | AND      | Ty/Lb/<br>ETL     | L           | T/<br>SLr | P/R    | C      |
|-----------------|-----------|------------------------|--|-----------------|-----------------|--------------------|----------------|----------|-------------------|-------------|-----------|--------|--------|
| EBCE221L4       | Pr        | ereauisi               | te: Fluid  | Mecha           | nics and        | l Machi            | nerv           |          | Lb                | 0           | 0/0       | 3/0    | 1      |
| L : Lecture T : | Tutoria   | al SLr:                | Supervis   | ed Learr        | ning P:         | Project            | R : Rese       | arch C:  | Credits           |             |           |        |        |
| T/L/ETL : The   | eorv/Lał  | o/Embed                | ded Theor  | v and L         | ab              | U                  |                |          |                   |             |           |        |        |
| OBJECTIVE       | S. The    | otudont v              | will loorn                                       | ·) ·····        |                 |                    |                |          |                   |             |           |        |        |
| • Differ        | ent Met   | hods of f              | low meas   | urement         | s               |                    |                |          |                   |             |           |        |        |
| To stu          | dy the c  | haracter               | istics of h                                      | ydraulic        | pumps.          |                    |                |          |                   |             |           |        |        |
| • To stu        | dy the c  | haracteri              | istics of h                                      | ,<br>ydraulic   | turbines        | 5.                 |                |          |                   |             |           |        |        |
|                 | maar      |                        |  |                 |                 |                    |                |          |                   |             |           |        |        |
| COURSE OU       | TCOM      | IES (CO                | s):  |                 | 1:00            |                    |                |          |                   |             |           |        |        |
|                 |           | otormin                | the con  | tioiont of t    | f discha        |                    |                |          |                   |             |           |        |        |
| $CO_2$          |           | Determin               | e the friet                                      | ion foot        | or for the      | irge of C          | Jinice al      | ia veni  | unmeter           |             |           |        |        |
| C04             | <u> </u>  | )raw and               | e ule met<br>l analyze                           | the ner         | formanc         | e pipes<br>e chara | cteristics     | Clirves  | of iet n          | limn dear   | r numn r  | ecipro | cating |
| 04              | p         | umps an                | ps   |                 | cteristica      |                    | or jet p       | ump, gea | r pump, i         | cerpro      | cating    |        |        |
| CO5             | Í         | Draw and               | aw and analyze the performance characteristics c |                 |                 |                    |                |          | of hydrau         | ilic turbin | es        |        |        |
| Mapping of C    | Course (  | Outcome                | es with Pr                                       | ogram (         | Outcom          | es (Pos)           |                |          |                   |             | -         |        |        |
| Cos/Pos         | PO1       | PO2                    | PO3  | PO4             | PO5             | PO6                | <b>PO7</b>     | PO8      | PO9               | PO10        | PO11      | PO     | 12     |
|                 | 3         | 2                      | 2  | 2               |                 | 2                  | 1              |          | 1                 |             |           |        |        |
| C02             | 3         | 1                      | 1  | 2               |                 |                    | 1              | 2        | 1                 |             |           |        |        |
| CO4             | 4         | 3                      | 1  | 2               |                 | 2                  | 1              | 2        |                   |             |           |        |        |
| C05             |           | 3                      |  | 2               |                 | 2                  |                | 2        |                   |             |           |        |        |
| Cos / PSOs      | PS        | 501                    | PSC  | $\overline{)2}$ | PS              |                    | PS             | 504      |                   |             |           |        |        |
| CO1             |           | 3                      |  |                 |                 | 2                  |                |          |                   |             |           |        |        |
| CO2             |           | 3                      |  |                 |                 | 2                  |                |          |                   |             |           |        |        |
| CO3             |           | 2                      |  |                 |                 | 3                  |                |          |                   |             |           |        |        |
| CO4             |           | 3                      | 2  |                 |                 | 2                  |                | 3        |                   |             |           |        |        |
| CO5             |           | 3                      | 2  |                 |                 | 2                  |                | 3        |                   |             |           |        |        |
|                 |           | <u>3/2/1 i</u>         | ndicates <b>S</b>                                | Strengtl        | <u>ı of Cor</u> | relatior           | 1 <u>3- Hi</u> | gh, 2- N | <b>Iedium</b> , 1 | l-Low       |           | -      |        |
|                 |           |                        |  |                 |                 |                    |                |          |                   |             |           |        |        |
|                 |           |                        | al   |                 |                 |                    |                |          |                   |             |           |        |        |
|                 |           |                        | oci  |                 | ive             |                    | Ŋ              | It       | t                 |             |           |        |        |
| ŝ               | e         |                        | s pr   |                 | lect            | 0                  | ina            | ner      | ojec              |             |           |        |        |
| 081             | ienc      | ല്പ                    | ss an  | Core            | n el            | tive               | cipl           | npc      | /Pr               |             |           |        |        |
| Cat             | Sci       | erii<br>e              | nitie<br>e                                       | m (             | graı            | Elec               | Dis            | Cor      | ical              |             |           |        |        |
|                 | asic      | gine                   | mar<br>enc                                       | gra             | Pro             | en I               | ter            | cill     | acti              |             |           |        |        |
|                 | B         | En <sub>{</sub><br>Sci | Hu<br>Sci  | Pro             |                 | Op                 | In             | SI       | P1                |             |           |        |        |
|                 |           |                        |  |                 |                 |                    | ✓              |          | $\checkmark$      |             |           |        |        |
|                 |           |                        |  |                 |                 |                    |                |          |                   |             |           |        |        |



| Subject Code:<br>EBCE22IL4 | Subject Name : FLUID MECHANICS AND<br>MACHINERY LAB | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|----------------------------|---|---------------|---|-----------|-----|---|
|                            | Prerequisite: Fluid Mechanics and Machinery         | Lb            | 0 | 0/0       | 3/0 | 1 |

### LIST OF EXPERIMENTS:

- 1. Determination of coefficient of discharge of given orifice meter
- 2. Determination of coefficient of discharge of given venturimeter,
- 3. Determination of coefficient of discharge of given mouthpiece.
- 4. Determination of friction factor of given set of pipes
- 5. Performance test and drawing the characteristics curves of centrifugal pump
- 6. Performance test and drawing the characteristics curves of reciprocating pump
- 7. Performance test and drawing the characteristics curves of jet pump
- 8. Performance test and drawing the characteristics curves of gear pump
- 9. Experiments to draw the characteristic curves of pelton wheel.
- 10. Experiments to draw the characteristic curves of Francis turbine.



# **SEMESTER IV**

| EDUCATIONAL AND RESEARCH INSTITUTE<br>DEEMED TO BE UNIVERSITY<br>University with Graded Autonomy Status | AC * |
|---|------|
|---|------|

(An ISO 21001 : 2018 Certified Institution)

| Link H2Dots         Intervise         E1L         S.L f           Precequisite: First year Engineering Mathematics         Ty         3         1/0         0/0         4           L: Lecture T: Tutorial         S.L f: Supervised Learning P: Project R: Research C: Credits         Ty         3         1/0         0/0         4           L: Lecture T: Tutorial         S.L f: Supervised Learning P: Project R: Research C: Credits         Ty         3         1/0         0/0         4           DiffectTVFS:         The student should be made to:         To be able to apply the concepts in Statistics         To understand the concepts in Numerical methods         To be able to apply the concepts in Autoriations.         To understand the concepts in Interpolation           CO1         Analyze Statistical dat         CO2         Understand the concepts in Interpolation         Tot able to solve Algebraic and Transcendental equations.           CO3         Understand the concepts in Numerical methods         CO4         Solve algebraic and Transcendental copations         CO5           CO4         Solve algebraic and Transcendental copations         CO5         Apply Interpolation concepts         Tot al 1         2         1         2         1         2         2         3         3         1         1         2         2         2         3         3   | Subject Code                            | Subj     | ect Nam                                 | e :STA                   | TISTIC    | AL A   | ND NU                               | UMER   | RIC  | AL    |      | Ty/I    | ∠b/  | L        | T/   | P/R  | С  |
|--|---|----------|---|--------------------------|-----------|--|-------------------------------------|--------|------|-------|------|---------|------|----------|------|------|----|
| Note: Try         a         1/0         0/0         4           Prerequisite: First year Engineering Mathematics         Ty J. 1/0         0/0         4           L: Lecture T: Tutorial         Supervised Learning P: Project R: Research C: Credits           TheoryLab/Embedded Theory and Lab           OBJECTIVES :           TheoryLab/Embedded Theory and Lab           OBJECTIVES :           To deable apply theoroperios in Statistics           To understand the concepts in Probability theory           COURSE OUTCOMES (COS): The Students will be able to           COURSE OUTCOMES (COS): The Students will be able to           COURSE OUTCOMES (COS): The Students will be able to           CO1         Anyplinterproduction concepts           Mapping of Course Outcomes with Program Outcomes (POS)           COs?         PO         PO1         PO11         PO PO2         PO           Cos?         PO         PO11         PO         PO PO1         PO           Cos?   | EDWIA22000                              | (FO      | R MEC                                   | ,<br>HANIC               | AL AN     | D CI   | VIL EN                              | NGINH  | EER  | RS)   |      | E       | L    |          | 5.Lr |      |    |
| Prorequisite: First year Engineering Mathematics         Ty         3         1/0         0/0         4           L: Lecture T: Tutorial S.L: Supervised Learning P: Project R: Research C: Credits<br>Ty/Lb/ETL: Theory/Lab/Embedded Theory and Lab         000000000000000000000000000000000000  |   | ``       |   |                          |           |  |                                     |        |      | ,     |      |         |      |          |      |      |    |
| L: Lecture T: Turorial S.Lr: Supervised Learning P: Project R: Research C: Credits Ty/LoFET: Theory/LabEmbedded Theory and Lab OBJECTIVES: The student should be made to: To be able to apply the concepts in Numerical methods To materiand the concepts in Numerical methods To be able to solve Algebraic and Transcendental equations. To understand the concepts in Numerical methods To be able to solve Algebraic and Transcendental equations. To understand the concepts in Numerical methods CO1 Analyze Statistical data CO2 Understand the concepts in Numerical methods CO3 Understand the concepts in Numerical methods CO4 Solve algebraic and Transcendental equations. CO5 Apply Interpolation concepts Mapping of Course Outcomes with Program Outcomes (POS) CO5 PO PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO PO11 PO12 CO1 3 3 3 2 2 3 1 1 1 1 1 2 2 1 2 3 CO3 2 3 1 1 3 2 2 1 3 1 1 2 2 3 3 1 1 2 2 3 3 1 1 2 2 3 3 1 1 2 2 3 3 1 1 2 2 3 3 1 1 2 2 3 3 1 1 2 2 3 3 1 1 2 2 3 3 1 1 2 2 3 3 1 1 2 2 2 3 3 1 1 1 2 2 2 2  |   | Prere    | equisite:                               | First ye                 | ar Engir  | ieerin   | g Math                              | ematic | s    |       |      | Т       | у    | 3        | 1/0  | 0/0  | 4  |
| TyrLbrETL : Theory Lab/Embedded Theory and Lab         OBJECTIVES :         The student should be made to:         To be able to apply the concepts in Statistics         To understand the concepts in Numerical methods         To be able to solve Algebraic and Transcendental equations .         To Understand the concepts in Interpolation         COURSE OUTCOMES (COS) : The Students will be able to         CO3       Understand the concepts in Numerical methods         CO4       Solve algebraic and Transcendental equations .         CO4       Solve algebraic and Transcendental equations         CO3       POP       POP       POP       POP         CO4       Solve algebraic and Transcendental equations         CO4       Solve algebraic and Transcendental equations         CO4       Solve algebraic and Transcendental equations         CO4       PO       PO       PO11       PO12         CO5       A       1       1       1       2       2         <  | L : Lecture T : T                       | lutoria  | al S.Lr                                 | : Super                  | vised Le  | arnin  | $\mathbf{g} \mathbf{P}: \mathbf{P}$ | roject | R :  | Resea | arch | C: Cree | dits |          |      |      |    |
| OBJECTIVES :         The student should be made to:         To be able to apply the concepts in Numerical methods         To understand the concepts in Numerical methods         COURSE OUTCOMES (COs) : The Students will be able to         COURSE OUTCOMES (COs) : The Students will be able to         COURSE OUTCOMES (COs) : The Students will be able to         CO2         Understand probability theory         CO3         CO4         Solve algebraic and Transcendental equations         CO4         Solve algebraic and Transcendental equations         CO4         Solve algebraic and Transcendental equations         CO5         Apply Interpolation concepts         Mapping of Course Outcomes with Program Outcomes (POs)         CO3       2       3       1       1       2       2       2         CO4       2       3       1       1       2       2       3         CO4       PO2       PO3       PO4       PO5       PO6       PO7       PO8       PO9       PO       PO11       PO12   | Ty/Lb/ETL : Th                          | eory/I   | _ab/Emb                                 | bedded 7                 | Theory a  | nd La  | ıb                                  |        |      |       |      |         |      |          |      |      |    |
| The student should be made to:         To be able to apply the concepts in Numerical methods         To understand the concepts in Numerical methods         To anderstand the concepts in Interpolation         COURSE OUTCOMES (COS) : The Students will be able to         CO1       Analyze Statistical data         CO2       Understand the concepts in Numerical methods         CO3       Outlets will be able to         CO3       Understand the concepts in Numerical methods         CO4       Solve algebraic and Transcendental equations         CO4       PO2       PO3       PO6       PO7       PO8       PO11       PO12         COs/POS       PO       PO11       PO         COs/POS       PO       PO11 </td <td>OBJECTIVES</td> <td>:</td> <td>_</td> <td></td>  | OBJECTIVES                              | :        | _                                       |                          |           |  |                                     |        |      |       |      |         |      |          |      |      |    |
| 10 be table to apply the concepts in Substrict         To understand the concepts in Numerical methods         10 be able to solve Algebraic and Transcendental equations .         10 understand the concepts in Interpolation         COURSE COUTCOMES (COs): The Students will be able to         COURSE COUTCOMES (COs): The Students will be able to         COU         COURES (COs): The Students will be able to         CO3         Understand the concepts in Numerical methods         CO4         CO4         Statistical data         CO5         Apply Interpolation concepts         Mapping of Course Outcomes with Program Outcomes (POs)         CO3         CO4       PO4       PO5       PO6       PO7       PO8       PO9       PO11       PO12         CO3       2       1       1       2       2       1       2       2       3         CO4       PO2       PO4       PO5       PO6       PO7       PO8       PO9       PO11       PO12         CO3       2       1       1       2       2       3       <   | The student sh                          | ould I   | be made                                 | e to:                    | •         |  |                                     |        |      |       |      |         |      |          |      |      |    |
| To understand the concepts in Numerical methods:         To understand the concepts in Numerical methods:         CO2         Understand the concepts in Numerical methods:         CO2         Understand the concepts in Numerical methods:         CO2         Understand probability theory         CO3         Understand probability theory         CO3         Understand probability theory         CO3         CO4         Solve algebraic and Transcendental equations :         CO4         Solve algebraic and Transcendental equations :         CO4         CO4         CO3       PO4       PO5       PO6       PO7       PO8       PO9       PO       PO11       PO12         CO3       1       1       2       2       1       3         CO3       PO4       PO5       PO6       PO7       PO8       PO9       PO       PO11       PO12         CO3       1       1       2       3       1       1 <t< td=""><td>To be able to appl<br/>To understand the</td><td>ly the c</td><td>oncepts in Pro-</td><td>in Statisti<br/>obability</td><td>lCS</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>  | To be able to appl<br>To understand the | ly the c | oncepts in Pro-                         | in Statisti<br>obability | lCS       |  |                                     |        |      |       |      |         |      |          |      |      |    |
| $ \begin{array}{c c c c c c c c c c c c c c c c c c c $  | To understand the                       | conce    | concepts in Numerical methods           |                          |           |  |                                     |        |      |       |      |         |      |          |      |      |    |
| $ \begin{array}{c c c c c c c c c c c c c c c c c c c $  | To be able to solv                      | e Alge   | Algebraic and Transcendental equations. |                          |           |  |                                     |        |      |       |      |         |      |          |      |      |    |
| $ \begin{array}{c c c c c c c c c c c c c c c c c c c $  | To understand the                       | conce    | pts in Int                              | erpolatio                | n         | 1  |                                     |        |      |       |      |         |      |          |      |      |    |
| CO1       Analyze Statistical data         CO2       Understand probability theory         CO3       Understand probability theory         CO3       Understand probability theory         CO3       Understand probability theory         CO4       Solve algebraic and Transcendental equations         COs/POS       PO       PO1       PO1       PO1       PO8       PO9       PO       PO11       PO12         COs/POS       PO11       1       2         COs/POS       PO1       PO8       PO9       PO       PO1       PO1       PO12       2         COs/POS       PO11       1       2       2         CO1       3       3       1       1       2         CO3       2       1       1       2       2       2  | COURSE OUT                              | COM      | IES (CC                                 | <b>()</b> : The          | e Studer  | ts wi  | ll be al                            | ble to |      |       |      |         |      |          |      |      |    |
| CO2         Understand probability theory           CO3         Understand the concepts in Numerical methods           CO4         Solve algebraic and Transcendental equations           CO5         Apply Interpolation concepts         PO         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO         PO11         PO12           CO3         1         3         2         2         3         1         1         1         2         2         1         3           CO3         2         3         1         3         2         2         1         1         2         2         1         3           CO4         2         3         1         2         2         3         3         1         1         2         2         3           CO4         2         3         1         1         1         3         3         1         1         2         2         3           CO4         2         3         1         1         2         3         1         1         2         2         2         2           CO5         3         2   | CO1                                     | Anal     | yze Statis                              | stical dat               | a         |  |                                     |        |      |       |      |         |      |          |      |      |    |
| $ \begin{array}{c c c c c c c c c c c c c c c c c c c $  | CO2                                     | Unde     | erstand pi                              | robability               | theory    |  |                                     |        |      |       |      |         |      |          |      |      |    |
| CO4         Solve algebraic and Transcendental equations           CO5         Apply Interpolation concepts           Mapping of Course Outcomes with Program Outcomes (POs)         COS         PO0         PO1         PO1 <th< td=""><td>CO3</td><td>Unde</td><td>erstand th</td><td>e concep</td><td>ts in Nun</td><td>nerica</td><td>l method</td><td>ds</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>  | CO3                                     | Unde     | erstand th                              | e concep                 | ts in Nun | nerica   | l method                            | ds     |      |       |      |         |      |          |      |      |    |
| Apply Interpolation concepts           Mapping of Course Outcomes with Program Outcomes (POs)         PO         PO         PO         PO         PO1         PO12           COS/POs         PO         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO         PO11         PO12           CO1         3         3         2         2         3         1         1         1         2         2         1         3           CO2         3         3         1         2         2         3         3         1         1         2         2         3         3           CO3         2         3         1         1         2         3         3         1         1         2         2         3         3         1         1         2         1         2         2         3         1         1         2         2         2         3         1         1         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2 <td>CO4</td> <td>Solve</td> <td>e algebrai</td> <td>ic and Tr</td> <td>anscende</td> <td>ntal e</td> <td>quations</td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>   | CO4                                     | Solve    | e algebrai                              | ic and Tr                | anscende  | ntal e   | quations                            | 3      |      |       |      |         |      |          |      |      |    |
| $\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$   | CO5                                     | Appl     | y Interpo                               | lation co                | ncepts    |  |                                     |        |      |       |      |         |      |          |      |      |    |
| $ \begin{array}{c c c c c c c c c c c c c c c c c c c $  | Mapping of Co                           | urse (   | Dutcom                                  | es with ]                | Progran   | n Out  | tcomes                              | (POs)  |      |       |      |         |      |          |      |      |    |
| CO1       3       3       2       2       3       1       1       1       2       2       1       3         CO2       3       3       1       3       2       2       1       1       1       2       2       1       3         CO3       2       3       1       2       2       3       3       1       1       2       1       2       2       3         CO3       2       3       1       1       1       3       3       1       1       2       2       3         CO4       2       3       1       1       1       3       3       1       1       2       2       2       3         CO4       2       3       1       1       2       3       1       1       2       2       2       3         CO5       3       2       1       3       1       2       2       2       2       3       1       1       2       2       2       3         CO4       Co5       3       2       1       1       2       1       1       2       2  | COs/POs                                 | PO<br>1  | PO2                                     | PO3                      | PO4       | PO   | 5 P                                 | 06     | PC   | 07    | PC   | )8      | PO9  | PO<br>10 | PO11 | PO   | 12 |
| CO2       3       3       1       3       2       2       1       1       2       1       2       2         CO3       2       3       1       2       2       3       3       1       1       2       2       3         CO4       2       3       1       1       1       3       3       1       1       2       2       3         CO4       2       3       1       1       1       3       3       1       1       2       1       2       1       2       1       2       3       1       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       2       1       2       1       2       1       2       1       1       2       2       1       1       1       2       1       1       1       2       1       1       1       1       1       1       1       1       1       1       1       1       1       1  | CO1                                     | 3        | 3                                       | 2                        | 2         | 3  | ;                                   | 1      |      | 1     |      | 1       | 2    | 2        | 1    |      | 3  |
| CO3       2       3       1       2       2       3       3       1       1       2       2       3         CO4       2       3       1       1       1       3       3       1       1       2       2       3         CO4       2       3       1       1       1       3       3       1       1       2       2       1       2       2       1       2       2       2       2       2       2       2       3       1       1       1       2       2       1       2       2       1       2 <th< td=""><td>CO2</td><td>3</td><td>3</td><td>1</td><td>3</td><td>2</td><td>2</td><td>2</td><td></td><td>1</td><td></td><td>1</td><td>2</td><td>1</td><td>2</td><td></td><td>2</td></th<>   | CO2                                     | 3        | 3                                       | 1                        | 3         | 2  | 2                                   | 2      |      | 1     |      | 1       | 2    | 1        | 2    |      | 2  |
| CO4       2       3       1       1       1       3       3       1       1       2       1       2         CO5       3       2       1       3       1       2       3       1       1       2       1       2       3       1       1       2       2       2       2       3       1       1       2       1       2       2       2       2       2       2       2       2       2       2       2       2       2       3       1       1       2       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1 </td <td>CO3</td> <td>2</td> <td>3</td> <td>1</td> <td>2</td> <td>2</td> <td>2</td> <td>3</td> <td></td> <td>3</td> <td></td> <td>1</td> <td>1</td> <td>2</td> <td>2</td> <td></td> <td>3</td>   | CO3                                     | 2        | 3                                       | 1                        | 2         | 2  | 2                                   | 3      |      | 3     |      | 1       | 1    | 2        | 2    |      | 3  |
| CO5       3       2       1       3       1       2       3       1       1       2       2       2         CO5       3       2       1       3       1       2       3       1       1       2       2       2         CO5       PSO1       PSO2       PSO2       PSO3       PSO4         CO1       CO1       CO2       CO2       CO3       CO3       CO4       CO4       CO4       CO4       CO5       Co1       CO3       Co1       CO4       CO4 <td>CO4</td> <td>2</td> <td>3</td> <td>1</td> <td>1</td> <td>1</td> <td></td> <td>3</td> <td></td> <td>3</td> <td></td> <td>1</td> <td>1</td> <td>2</td> <td>1</td> <td></td> <td>2</td>  | CO4                                     | 2        | 3                                       | 1                        | 1         | 1  |                                     | 3      |      | 3     |      | 1       | 1    | 2        | 1    |      | 2  |
| COs / PSOs     PSO1     PSO2     PSO3     PSO4       C01   | CO5                                     | 3        | 2                                       | 1                        | 3         | 1  |                                     | 2      |      | 3     |      | 1       | 1    | 2        | 2    |      | 2  |
| COs / PSOs     PSO1     PSO2     PSO3     PSO4       C01   |   |          |   |                          |           |  |                                     |        |      |       |      |         |      |          |      |      |    |
| CO1     Image: Colored color   | COs / PSOs                              |          | PSO1                                    | L                        |           | PS   | 02                                  |        |      |       |      | PSO3    |      |          | F    | PSO4 |    |
| CO2     CO3     Co3       CO4     Engineering       CO5     Basic Science       J2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low         Basic Science       Science       Basic Science       Science       Basic Science       Basic Science       Science       Still Component       Program clective       Practical /Project  | CO1                                     |          |   |                          |           |  |                                     |        |      |       |      |         |      |          |      |      |    |
| CO3       CO3       CO3         CO4       Endineering       Basic Science         J2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low       Program elective       Science         Basic Science       Science       Science       Science         Science       Program elective       Program elective       Science         Program elective       Program elective       Science       Science         Still Component       Still Component       Science       Science       Science   | CO2                                     |          |   |                          |           |  |                                     |        |      |       |      |         |      |          |      |      |    |
| CO4       Co4         Co5       Description       3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low         J/2/1 Indicates Strength of Correlation       Basic Science       Basic Science         Image: Science       Program core       Science       N         Image: Strength of Corelation       Program core       N       N   | CO3                                     |          |   |                          |           |  |                                     |        |      |       |      |         |      |          |      |      |    |
| Cote<br>Strength Of Correlation, 3 – High, 2- Medium, 1- Low<br>Engineering<br>Basic Science<br>Basic Sc | CO4                                     |          |   |                          |           |  |                                     |        |      |       |      |         |      |          |      |      |    |
| 3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- From         Category       Basic Science       Basic Science         Program Core       Program Core       Science       Basic Science         Program Core       Program Core       Science       Science         Project       Program Core       Program Core       V         Project       Projective       Projective       V         Project       Projective       V       V <t< td=""><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>  | CO5                                     |          |   |                          |           |  |                                     |        |      |       |      |         |      |          |      |      |    |
| Category         Abasic Science         Abasic Science         Engineering         Engineering         Science         Program Core         Program Core         Inter Disciplinary         Inter Disciplinary         Practical /Project  | 3/2/1 Indicates                         | Stren    | gth Of (                                | Correlat                 | tion, 3 – | High   | 1, 2- Me                            | edium, | , 1- | Low   |      |         |      | -        |      | [    |    |
| Category<br>Basic Science<br>Basic Science<br>Engineering<br>Science<br>Program elective<br>Program elective<br>Inter Disciplinary<br>Skill Component<br>Practical /Project  |   |          |   |                          |           |  |                                     |        |      |       |      |         |      |          |      |      |    |
| Category Category Category Category Category Basic Science Basic Science Brogram Core Program clectiv Program electiv Skill Component Skill Component Practical /Project   |   |          |   | ocia                     |           |  | /e                                  |        |      | >     |      |         |      |          |      |      |    |
| Category Category Category Category Basic Science Engineering Science Program cle Program cle Inter Disciplii Inter Disciplii Practical /Proj  |   |          |   | 1 sc                     |           |  | ctiv                                |        |      | nar.  |      | ent     | ject |          |      |      |    |
| Category   |   | Jce      |   | anc                      | d H       | 2  | ele                                 | ve     |      | plir  |      | uoc     | roj  |          |      |      |    |
| Categ  | ory                                     | ciel     | ing                                     | es                       |           | ctiv   |                                     |        |      |       |      | łu      | 1 /F |          |      |      |    |
| Ca<br>Engine<br>Science<br>Progre<br>Skill<br>Skill  | teg                                     | Š        | eer                                     | niti e                   | e 5       | Ele  |                                     |        |      |       |      | č       | ica  |          |      |      |    |
| B     B     C     B     C       P     P     P     P     P  | Ca                                      | asic     | gine                                    | enc                      | enc       | Pro Jagra Ja |                                     |        |      |       |      |         |      |          |      |      |    |
|  |   | B        | Eng                                     | Sci<br>Hui               | Sci       | Pro Pro  |                                     |        |      |       |      | S       | Pr   |          |      |      |    |
|  |   | ,        |   |                          |           |  |                                     |        |      |       |      |         |      |          |      |      |    |
|  |   |          |   |                          |           |  |                                     |        |      |       |      |         |      |          |      |      |    |
|  |   |          |   |                          |           |  |                                     |        |      |       |      |         |      |          |      |      |    |

#### An ISO 21001 : 2018 Certified Institution Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code<br>EBMA22008 | Subject Name :<br>STATISTICAL AND NUMERICAL METHODS<br>(FOR MECHANICAL AND CIVIL ENGINEERS) | Ty/Lb/<br>ETL | L | T/<br>S.Lr | P/R | С |
|---------------------------|---|---------------|---|------------|-----|---|
|                           | Prerequisite: First year Engineering Mathematics  | Ту            | 3 | 1/0        | 0/0 | 4 |
|                           |   |               |   |            |     |   |

#### UNIT I **BASICS OF STATISTICS**

Variables – Uni-variate Data – Frequency Distribution – Measures of Central Tendency – Mean – Median – Mode - Quartiles - Measures of Dispersion - The Range - Quartile Deviation - Standard Deviation - Relative Measures of Dispersion - Coefficient of Variation - Quartile Coefficient of Variation.

#### UNIT II PROBABILITY AND RANDOM VARIABLE

EDUCAT

Axioms of Probability – Conditional probability – Total probability – Baye's Theorem – Random variable – Probability mass function – Probability density function – Properties – Moments (Definition and simple problems).

### UNIT III BASICS OF NUMERICAL METHODS

Curve fitting-Method of group averages-Principle of least square-Method of moments-Finite differences-Operators (Forward, Backward & Shifting) -Relationship between the operators.

#### **UNIT IV** SOLUTION OF EQUATIONS

Solution of Algebraic and Transcendental equations - Method of false position - Iteration method - Newton-Raphson method - Solution of Linear system of equations - Gauss Elimination method - Gauss-Jordan method - Iterative methods - Gauss-Jacobi method - Gauss-Seidel method - Matrix Inversion by Gauss-Jordan method. UNIT V **INTERPOLATION** 12

Newton forward and backward differences - Central differences - Stirling's and Bessel's formulae - Interpolation with Newton's divided differences – Lagrange's method.

#### Total no. of hrs: 60

# **Text Books:**

# **Reference Books:**

1) Veerarajan T., *Probability, Statistics and, Random Processes*, Tata McGraw Hill Publishing Co., (2008).

- 2) Singaravelu, Probability and Random Processes, Meenakshi Agency, (2017).
- 3) Gupta S.C., Kapoor V.K., Fundamentals of Mathematical Statistics, S.Chand& Co., (2007).
- 4) Veerarajan T., *Numerical Methods*, Tata McGraw Hill Publishing Co., (2005).
- 5) Sastry S.S., Introductory Methods of Numerical Analysis, Prentice Hall of India, (2003).
- Kandasamy P., Thilagavathy, Gunavathy K., Numerical Methods (Vol.IV), S.Chand& Co., (2008). 6)



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| Subjec     | ct Cod         | e:         | Subject<br>MATEI | Name :<br>RIALS             | STF           | RENGT    | TH OF       |                       |         | Ty/Lb/<br>ETL |          |     | T/<br>SLr | P/R | С        |  |
|------------|----------------|------------|------------------|-----------------------------|---------------|----------|-------------|-----------------------|---------|---------------|----------|-----|-----------|-----|----------|--|
| EBME       | E <b>22006</b> | 5          |                  |                             |               |          |             |                       |         |               |          |     |           |     |          |  |
|            |                |            | Prerequ          | isite: Ei                   | igine         | ering N  | Aechan      | ics                   |         | Ту            | 3        |     | 1/0       | 0/0 | 4        |  |
| L : Leo    | cture T        | : Tuto     | rial SL          | : Super                     | vised         | Learni   | ng P:       | Practical             | R : R   | esearch (     | C: Credi | ts  |           |     |          |  |
| T/L/E7     | $\Gamma L: Th$ | neory/L    | .ab/Embe         | dded Th                     | eory a        | and Lal  | b           |                       |         |               |          |     |           |     |          |  |
| OBJE       | CTIV           | E: The     | e student        | will lea                    | rn            |          |             |                       |         |               |          |     |           |     |          |  |
|            | • E            | Basic p    | rinciples        | of stress                   | strai         | n and e  | lastic c    | onstants              |         |               |          |     |           |     |          |  |
|            | • 1            | To drav    | shear fo         | orce and                    | bendi         | ng mor   | nent dia    | agrams                |         |               |          |     |           |     |          |  |
| COUT       |                | o find (   | leflection       | $\mathbf{O}$ of bean        | 15            | 1 4      | <u></u>     | .1.4.                 |         |               |          |     |           |     |          |  |
| COUR       | (SE U          | UICO       | MES (C           | Os): If                     | dent w        | III de a | die to      |                       |         |               |          |     |           |     |          |  |
| CO1        |                | Under      | stand the        | concept                     | s of m        | nechani  | cs of sc    | s of solids (Level 2) |         |               |          |     |           |     |          |  |
| CO2        |                | Analy      | ze the str       | resses involved due to      |               |          | differe     | nt types              | of load | ling (Lev     | vel 4)   |     |           |     |          |  |
| CO3        |                | Apply      | the diffe        | rent theo                   | ries o        | of mech  | anics (I    | Level 3)              |         |               |          |     |           |     |          |  |
| CO4        |                | Derive     | the expr         | ession fo                   | or def        | lection  | and ber     | nding mo              | oment   | (Level 4)     |          |     |           |     |          |  |
| CO5        |                | Use m      | athematio        | hematical approach to analy |               |          |             | tresses i             | nvolve  | d (Level      | 4)       |     |           |     |          |  |
|            |                |            | Μ                | apping                      | of Co         | ourse O  | utcom       | es with l             | Progra  | m Outc        | omes (P  | Os) |           |     |          |  |
| Cos/P      | OS             | <b>PO1</b> | PO2              | PO3                         | PO3 PO4       |          |             | PO6                   | PO7     | ' <b>PO8</b>  | PO9      | )   | PO10      | PO  | 1 PO12   |  |
| CO1        |                | 3          | 3                | 3                           |               | 2        | 3           | 2                     | 2       | 2             | 3        |     | 3         | 2   | 2        |  |
| CO2        |                | 3          | 3                | 3                           |               | 2        | 3           | 2                     | 2       | 2             | 3        |     | 3         | 2   | 2        |  |
| <u>CO3</u> |                | 3          | 3                | 3                           |               | 2        | 3           | 2                     | 2       | 2             | 3        |     | 3         | 2   | 2        |  |
| C04        |                | 3          | 3                | 3                           |               | 2        | 3           | 2                     | 2       | 2             | 3        |     | 3         | 2   | 2        |  |
| Cos/I      | DSOg           | J<br>D     | <u> </u>         | 3                           |               | <u></u>  | <b>PSO3</b> |                       |         | <u> </u>      | 3        |     | 3         |     | <u>∠</u> |  |
| C01        | 1 505          | 1          | 3                |                             | 3             | <i>.</i> | <u>PS03</u> |                       |         | 2             |          |     |           |     |          |  |
| CO2        |                |            | 3                |                             | $\frac{3}{3}$ |          |             | 2                     |         | 2             |          |     |           |     |          |  |
| CO3        |                |            | 3                |                             | 3             |          |             | 2                     |         | 2             |          |     |           |     |          |  |
| CO4        |                |            | 3                |                             | 3             |          |             | 2                     |         | 2             |          |     |           |     |          |  |
| CO5        |                |            | 3                |                             | 3             |          |             | 2                     |         | 2             |          |     |           |     |          |  |
| 3/2/1 i    | ndicat         | es Stre    | ngth of          | Correla                     | ion           | 3- Hig   | gh, 2- M    | ledium,               | 1-Low   | 7             |          |     | <u>.</u>  |     |          |  |
|            |                |            | al               |                             |               |          |             |                       |         |               |          |     |           |     |          |  |
|            |                |            | oci              |                             |               | ive      |             | IJ                    | It      | t             |          |     |           |     |          |  |
|            | e              |            | s pu             |                             |               | ect      |             | ina                   | ner     | ojec          |          |     |           |     |          |  |
|            | enc            | b          | s al             | Ore                         |               | n el     | tive        | cipl                  | odu     | /Pr           |          |     |           |     |          |  |
|            | Sci            | enir       | itie             |                             |               | ran      | lec         | Disc                  | Con     | cal           |          |     |           |     |          |  |
|            | sic            | ine        | nce              | nce                         | rogr          |          |             | er I                  | ill (   | acti          |          |     |           |     |          |  |
|            | Ba             | Eng        | Scie<br>Hun      | Scie                        | Progi         |          | Ope         | Int                   | Sk      | Pra           |          |     |           |     |          |  |
|            |                |            |                  |                             |               | ~~       |             |                       |         |               |          |     |           |     |          |  |
|            |                |            |                  |                             |               |          |             |                       |         |               |          |     |           |     |          |  |
|            |                |            |                  |                             |               |          |             |                       |         |               |          |     |           |     |          |  |
|            |                |            |                  |                             |               |          |             |                       |         |               |          |     |           |     |          |  |
|            |                |            |                  |                             |               |          |             |                       |         |               |          |     |           |     |          |  |

#### (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India

| Subject Code:<br>EBME22006 | Subject Name : STRENGTH OF MATERIALS | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|----------------------------|--------------------------------------|---------------|---|-----------|-----|---|
|                            | Prerequisite: Engineering Mechanics  | Ту            | 3 | 1/0       | 0/0 | 4 |

### **UNIT- I: STRESS, STRAIN AND DEFORMATION OF SOLIDS**

EDUCAT

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants and their relationship – strain energy due to axial load – stress due to suddenly applied load and impact load.

# UNIT- II: BEAMS - LOADS AND STRESSES

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported beams and Overhanging beams Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stress distribution in beams of different sections.

# UNIT- III: TORSION OF SHAFTS AND SPRINGS

Theory of pure torsion- Torsion of circular and hollow shafts –Stepped shafts – Composite shaft – Stress due to combined bending and torsion. Type of springs - Stiffness- Springs in series-Springs in parallel - Stresses and deflections in helical springs and leaf springs – Design of helical springs- design of buffer Springs - leaf springs.

# **UNIT- IV: DEFLECTION OF BEAMS**

Double integration method- Macaulay's Method- Area Moment Theorems for Computations of slope and deflection in Beams. Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.

# **UNIT- V: ANALYSIS OF STRESSES IN TWO DIMENSIONS**

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point-Stress as Tension. Stresses on inclined plane – Principal planes and Principal stresses – Mohr's circle for biaxial stresses – Maximum shear stress - Strain energy and Strain Energy Density.

# **Total No. of Periods: 60**

# **TEXT BOOKS**

- 1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 2010.
- 2. S.Ramamruthum and R. Narayan, "Strength of Materials", Dhanpat Rai & Sons,

# **REFERENCES:**

- 1. Beer F. P. and Johnston R, (2002) "Mechanics of Materials", McGraw-Hill Book Co, Third Edition
- 2. Egor P. Popov, "Engineering Mechanics of Solids", Prentice Hall of India, New Delhi.



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#### D G EDUCATIONAL AND RESEARCH INSTITUTE DEE MED TO BE UNIVERSITY University with Graded Autonomy Status (An ISO 21001 : 2018 Certified Institution)

| Subject<br>Code: |         | Sub  | ject     | Nam      | ne: M   | ECH     |        | CS (     | <b>)F M</b> A | ACH    | INE         | S-I                               | T / I<br>ETL |        | L         | T/<br>Lr | S.     | P/ R | C        |
|------------------|---------|--|----------|----------|---------|---------|--------|----------|---------------|--------|-------------|-----------------------------------|--------------|--------|-----------|----------|--------|------|----------|
| EBME22           | 007     | Pre  | req      | uisite   | e: Eng  | neer    | ring N | Mech     | nanics        |        |             |                                   | Т            | у      | 3         | 1        | /0     | 0/0  | 4        |
| L : Lecture      | е Т : Т | [<br>[utori  | al       | S Lr     | : Supe  | vise    | d Lea  | rnin     | g P:I         | Practi | cal         | R : Re                            | esearch      | C: C   | Credits   |          |        |      | <u> </u> |
| T/L/ETL :        | Theo    | ry/La  | b/Er     | nbed     | ded Th  | eory    | and l  | Lab      |               |        |             |                                   |              |        |           |          |        |      |          |
| OBJECT           | IVES    | : The  | pur      | pose     | of stuc | ly is t | to un  | derst    | and ar        | nd app | ply tl      | ne diff                           | ferent c     | once   | pts of n  | necha    | nics.  |      |          |
| COURSE           | OUT     | COM  | 1ES      | (CO      | s): T   | he stu  | uden   | t wil    | l be al       | ble to | )           |                                   |              |        |           |          |        |      |          |
| CO1              | U       | Inders   | tand     | l the f  | fundan  | enta    | l con  | cepts    | s of me       | echan  | ism         | and their applications. (Level 2) |              |        |           |          |        |      |          |
| CO2              | Α       | nalyz  | e the    | e diff   | erent l | nks o   | of a n | nech     | anism         | . (Lev | /el 4]      | )                                 |              |        |           |          |        |      |          |
| CO3              | D       | raw t  | he di    | isplac   | cement  | , velo  | ocity  | and      | accele        | ratior | 1 for       | differ                            | ent me       | chani  | sms. (I   | Level    | 3)     |      |          |
| CO4              | C       | ompa   | re th    | ne dif   | ferent  | ypes    | of ri  | gid t    | ransm         | issior | ı sys       | tems a                            | and the      | ir app | olication | ns. (L   | evel 3 | 3)   |          |
| CO5              | Il      | lustrate the various frictions in machine drives. (Lev |          |          |         |         |        | vel 3)   |               |        |             |                                   |              |        |           |          |        |      |          |
| Mapping          | of Co   | urse   | Out      | come     | es with | Prog    | gram   | l Out    | tcome         | s (PC  | <b>)</b> s) |                                   |              |        |           |          |        |      |          |
| Cos/Pos          | P       | 01   | PO       | 02       | PO3     | P       | 04     | PO       | 5   P         | 06     | PC          | 07                                | PO8          | PO     | 9   PO    | D10      | PO     | 11   | PO12     |
| CO1              |         | 3  |          | 3        | 2       |         | 2      | -        |               | 1      |             | 1                                 | -            | 1      |           | 2        | 1      |      | 2        |
| CO2              |         | 3  |          | 3        | 2       | 2 3     |        |          |               | 1      |             | 1                                 | -            | 1      |           | 2        | 1      |      | 2        |
| CO3              |         | 3  |          | 3        | 2       |         | 3      | 2        |               | 1      |             | 1                                 | -            | 1      |           | 2        | 1      |      | 2        |
| CO4              |         | 3  |          | 3        | 2       |         | 3      | 2        |               | 1      |             | 1                                 | -            | 1      |           | 2        | 1      |      | 2        |
| CO5              |         | 3  |          | 3        | 2       |         | 2      | 2        |               | 1      |             | 1                                 | -            | 1      |           | 2        | 1      |      | 2        |
| Cos / PSC        | s       | PS   | 01       |          | P       | SO2     |        | PSO3 PS  |               |        |             | PSC                               | )4           |        |           |          |        |      |          |
| CO1              |         | ,  | 3        |          |         | 2       |        | 2        |               |        |             | 2                                 |              |        |           |          |        |      |          |
| CO2              |         | ,  | 3        |          |         | 2       |        |          | 2             |        |             | 2                                 |              |        |           |          |        |      |          |
| CO3              |         |  | 3        |          |         | 2       |        |          | 2             |        |             | 2                                 |              |        |           |          |        |      |          |
| CO4              |         |  | 3        |          |         | 2       |        |          | 2             |        |             | 2                                 |              |        |           |          |        |      |          |
| CO5              |         |  | 3        |          |         | 2       |        |          | 2             |        |             | 2                                 |              |        |           |          |        |      |          |
| 3/2/1 indi       | cates   | Stren  | gth      | of Co    | orrelat | ion     | 3- E   | High,    | , 2- M        | ediur  | n, 1-       | Low                               |              |        |           |          |        |      |          |
|                  |         |  |          |          |         |         |        |          |               |        |             |                                   |              |        |           |          |        |      |          |
|                  |         |  |          | cial     |         |         | e      | <b>)</b> |               |        |             |                                   |              |        |           |          |        |      |          |
|                  |         |  |          | l so     |         |         | ctiv   |          |               | hary   | •           | ent                               | ect          |        |           |          |        |      |          |
|                  | nce     | 5  |          | anc      |         | ore     | ele    | 3        | ve            | ildi   |             | pon                               | Proj         |        |           |          |        |      |          |
|                  | Scie    | Ling   | ,        | ties     |         | L Col   |        |          | lecti         | isci   |             | om                                | al /         |        |           |          |        |      |          |
|                  | sic (   | nee  | nce      | iani     | nce     | gram    |        |          | пE            | er D   |             | ПС                                | ctic         |        |           |          |        |      |          |
|                  | Ba      | ignE   | Scie     | Ium      | Scie    | Progr   |        |          | Dpe           | Inte   |             | Ski                               | Pra          |        |           |          |        |      |          |
|                  |         |  | <u> </u> | <u> </u> |         |         |        |          |               |        |             |                                   | 1            |        |           |          |        |      |          |
|                  |         |  |          |          |         |         |        |          |               |        |             |                                   |              |        |           |          |        |      |          |
|                  |         |  |          |          |         |         |        | 1        |               |        |             |                                   |              |        |           |          |        |      |          |

#### (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| ubject mame . MILCHANICS OF MACHINES -1                      | Ty/Lb/   | L  | Τ/   | P/R  | С  |
|--|--|--|--|--|--|
|  | ETL  |  | SLr  |  |  |
| rerequisite: Engineering Mechanics, Strength of<br>Iaterials | Ту   | 3  | 1/0  | 0/0  | 4  |
| re<br>Ia   | requisite: Engineering Mechanics, Strength of<br>terials | requisite: Engineering Mechanics, Strength of Ty | requisite: Engineering Mechanics, Strength of Ty 3 | requisite: Engineering Mechanics, Strength of Ty 3 1/0 | requisite: Engineering Mechanics, Strength of Ty 3 1/0 0/0 |

### UNIT I BASICS OF MECHANISMS

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle.

# UNIT II KINEMATIC ANALYSIS OF MECHANISMS

EDUCAT

Displacement, velocity and acceleration analysis of simple mechanisms –Velocity and acceleration polygons – analytical method and Kliens construction . Coincident points – Coriolis component of Acceleration.

# UNIT III KINEMATICS OF CAM MECHANISMS

Classification of cams and followers – Terminology and definitions – Displacement diagrams –Uniform velocity, uniform acceleration and retardation, simple harmonic motions – Derivatives of follower motions – Layout of plate cam profiles.

# UNIT IV GEARS AND GEAR TRAINS

Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions–Gear tooth action – contact ratio – Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains – Speed ratio, train value – Parallel axis gear trains – Simple Epicyclic Gear Trains.

## UNIT V FRICTION IN MACHINE ELEMENTS

Bearings and lubrication – Pivot and collar bearings, Friction clutches – Belt and rope drives – Friction in brakes- Shoe brakes, Band brakes and band and block brakes-braking torque.

# **Total No. of Periods: 60**

# **TEXT BOOKS:**

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 3rd Edition, Oxford University Press, 2009.

2. Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw-Hill, 2009.

3. Khurmi R. S, (2012) "Theory of Machines", S.Chand Publications,.

# REFERENCES

1) Thomas Bevan, (2005) "Theory of Machines", CBS Publishers and Distributors, 5<sup>th</sup> Edition.

2) Shigley J.E and Uicker J.J., (1995) "Theory of Machines and Mechanisms", McGraw Hill Inc.

3) Rattan S.S., (2009) "Theory of Machines", Tata McGraw Hill Publishing Company Ltd., New Delhi.

4) Dr.V.P.Singh. (2005) "Theory of Machines", Dhanpat Rai and Co Private Limited.



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| Subject Code   | : S<br>N      | Subject Na<br>MACHINI  | ect Name : ARTIFICIAL INTELLIGENCE A<br>CHINE LEARNING |              |                  |               |                    |                 | Ty / Lb/<br>ETL        | L           | T/<br>S.Lr   | P/ R   | C      |  |  |
|----------------|---------------|------------------------|--|--------------|------------------|---------------|--------------------|-----------------|------------------------|-------------|--------------|--------|--------|--|--|
| FRCS22ID5      | I             | Prerequisi             | te: Mathe  | ematics      |                  |               |                    |                 | Ту                     | 3           | 0/0          | 0/0    | 3      |  |  |
| L : Lecture T  | : Tuto        | rial SLr :             | Supervis   | ed Lear      | ning P:          | Project       | R : Res            | earch C         | C: Credits             |             |              |        |        |  |  |
| Ty/Lb/ETL : 7  | Гheory        | //Lab/Emb              | edded Th   | eory and     | l Lab            |               |                    |                 |                        |             |              |        |        |  |  |
| OBJECTIVE      | 2:            |                        |  |              |                  |               |                    |                 |                        |             |              |        |        |  |  |
| • Study        | the co        | oncepts of             | Artificial   | Intellige    | ence.            |               |                    |                 |                        |             |              |        |        |  |  |
| • Learn        | the m         | ethods of s            | solving pr   | oblems       | using A          | rtificial     | Intellige          | nce.            |                        |             |              |        |        |  |  |
| Introd         | luce th       | e concepts             | of Exper   | t Systen     | ns and m         | achine        | earning            |                 |                        |             |              |        |        |  |  |
| COURSE OU      | JTCO          | MES (CO                | s): Stud   | ents will    |                  |               | 1.1                |                 | s AI search algorithms |             |              |        |        |  |  |
|                |               | A nulve lin            | ly knowledge representation, reasoning, and ma         |              |                  |               |                    |                 | s Al search algorithms |             |              |        |        |  |  |
| 02             |               | problems               | roblems in terms of data management                    |              |                  |               |                    | mach            | ine learni             | ng tech     | iiques t     | o rear | -world |  |  |
| CO3            |               | Analyse th             | analyse the statistical data for decision making       |              |                  |               |                    |                 |                        |             |              |        |        |  |  |
| CO4            |               | Describe               | escribe the concepts in machine learning               |              |                  |               |                    |                 |                        |             |              |        |        |  |  |
| CO5            |               | Apply kno              | owledge o  | of AI in 1   | obotics          |               |                    |                 |                        |             |              |        |        |  |  |
| Mapping of (   | Course        | e Outcome              | es with Pr   | ogram        | Outcom           | nes (POs      | s)                 |                 |                        |             |              |        |        |  |  |
| COs/POs        | PO1           | PO2                    | PO3  | PO4          | PO5              | PO6           | <b>PO7</b>         | <b>PO8</b>      | PO9                    | <b>PO10</b> | <b>PO1</b> 2 | l PO   | 012    |  |  |
| CO1            | 3             | 3                      | 3  | 3            | 2                | 3             | 2                  | 2               | 3                      | 3           | 3            |        | 3      |  |  |
| C02            | 3             | 3                      | 3  | 3            | 2                | 3             | 2                  | 2               | 3                      | 3           | 3            |        | 3      |  |  |
| 005            | 3             | 3                      | 3  | 3            | 1                | 3             | 2                  | 2               | 3                      | 2           | 3            |        | 3      |  |  |
| CO4            | 3             | 3                      | 3  | 3            | 1                | 3             | 2                  | 2               | 3                      | 2           | 3            |        | 3      |  |  |
| CO5            | 3             | 3                      | 3  | 3            | 1                | 3             | 2                  | 2               | 3                      | 2           | 3            |        | 3      |  |  |
| COs / PSOs     | PSC           | 01                     | PSO2   |              | PSO3             |               | PSO4               |                 |                        |             |              |        |        |  |  |
|                |               |                        |  |              |                  |               |                    | 3               |                        |             |              |        |        |  |  |
| C02            |               |                        |  |              |                  |               |                    | <u> </u>        |                        |             |              |        |        |  |  |
| CO4            |               |                        |  |              |                  |               |                    | 3               |                        |             |              |        |        |  |  |
| CO5            |               |                        |  |              |                  |               |                    | 3               |                        |             |              |        |        |  |  |
| 3/2/1 indicate | s Stre        | ength of Co            | orrelatio  | n 3- Hi      | gh, 2- N         | Iedium        | , 1-Low            | -               | <u> </u>               |             |              |        |        |  |  |
|                |               | Ĭ                      |  |              |                  |               |                    |                 |                        |             |              |        |        |  |  |
| Category       | Basic Science | Engineering<br>Science | Humanities and social<br>Science                       | Program Core | Program elective | Open Elective | Inter Disciplinary | Skill Component | Practical /Project     |             |              |        |        |  |  |
|                |               |                        |  |              |                  |               | •                  |                 |                        |             |              |        |        |  |  |

# **UNIT 1: INTRODUCTION OF AI AND ML**

Introduction to data science and AI&ML: Data Science AI & ML, Use Cases in Business and Scope, Scientific Method, Modeling Concepts, CRISP-DM Method, Statistical analysis: Initial Data Analysis, probability, R essentials: Commands and Syntax, Packages and Libraries, Introduction to Data Types, Data Structures in R - Vectors, Matrices, Arrays, Lists, Factors, Data Frames, Importing and Exporting Data, Control structures and Functions.

# **UNIT 2: DATA MANAGEMENT**

Data Acquisition, Data Pre-Processing And Preparation, Data Quality And Transformation, Handling Text Data, Principle Of Big Data, Big Data Framework-Hadoop, Spark, Nosql.

# **UNIT 3: STATISTICAL DECISION MAKING**

Data Visualization, Sampling And Estimation, Inferential Statistics, Linear Regression, Non Linear Regression.

# **UNIT 4: MACHINE LEARNING**

Foundation for ML, Clustering, Classification: Naïve bayes classifier, K-Nearest neighbors, support vector machine, decision tree, ensembles methods, Association rule mining.

# **UNIT 5 : AI IN ROBOTICS**

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics

#### Total No. of Periods: 45

#### **TEXT BOOKS:**

1. Micheal Negnevitsky, "Artificial Intelligence: A guide to Intelligent Systems", Harlow: Addison-Wesley, 2005.

# **REFERENCES:**

1. Nils J. Nilsson, "Introduction to Machine Learning", 2005. 2. Pang-Ning Tan, Michael Steinbach., Introduction to Data Mining, Pearson, 2019.

|           | Periyar E.v.k. high koad, Maduravoyal, Chennal-95. Taminad | iu, india. |   |      |             |   |
|-----------|--|------------|---|------|-------------|---|
| Subject   | Subject Name : ARTIFICIAL INTELLIGENCE AND                 | Ty / Lb/   | L | T /  | <b>P/ R</b> | 1 |
| Code:     | MACHINE LEARNING   | ETL        |   | S.Lr |             | l |
|           | Prerequisite: Mathematics                                  | Ту         | 3 | 0/0  | 0/0         | 1 |
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# DUCA 2018 Certified Institution

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| EDUCATIONAL AND RESEARCH INSTITUTE          | Solution At State |
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| DEEMED TO BE UNIVERSITY                     | ****              |
| University with Graded Autonomy Status      |                   |
| (An ISO 21001 : 2018 Certified Institution) |                   |

| Subject Code:      |          | Subject    | Name: E     | NGINE     | ERING      | METR     | OLOG        | Y          | Ty/Lb/       | L          | <b>T</b> / | P/R    | С  |
|--------------------|----------|------------|-------------|-----------|------------|----------|-------------|------------|--------------|------------|------------|--------|----|
| EBME22ET2          |          |            |             |           |            |          |             |            | ETL          |            | SLr        |        |    |
|                    | Prer     | equisite   | : Enginee   | ring Phy  | ysics      |          |             |            | ETL          | 2          | 0/0        | 2/0    | 3  |
| L : Lecture T :    | Tutoria  | l S Lr     | : Supervis  | ed Learr  | ning P:    | Project  |             |            |              |            |            |        |    |
| T/L/ETL : The      | ory/Lab  | /Embedo    | ded Theor   | y and La  | ıb         |          |             |            |              |            |            |        |    |
| OBJECTIVES         | S: The s | student v  | vill learn  |           | _          | _        |             |            | _            |            |            |        |    |
| • Te               | chnique  | of meas    | surement u  | sing dif  | ferent ty  | pes of p | recision    | measuri    | ng instru    | nments     |            |        |    |
| OURSE OUT          | COME     | S (COs)    | :           |           |            |          |             |            |              |            |            |        |    |
| CO1                | Un       | derstand   | d the funda | amentals  | of preci   | ision me | easureme    | ents ( Le  | evel 2)      |            |            |        |    |
| CO2                | Ga       | in theore  | etical and  | practical | l knowle   | edge abo | out the lin | near and   | l angular i  | measureme  | ents (Leve | 13)    |    |
| CO3                | De       | monstra    | te the diff | erent typ | bes of for | rm meas  | suremen     | ts (Leve   | 13)          |            |            |        |    |
| CO4                | Sel      | lect the a | appropriate | e precisi | on meas    | uring in | strumen     | t based of | on the cor   | nponent di | awing (Le  | evel 4 | )  |
| CO5                | Ex       | posed to   | the recen   | t advanc  | ement ii   | n metrol | ogy (Le     | vel 2)     |              |            |            |        |    |
| Mapping of Co      | ourse O  | outcome    | s with Pro  | ogram C   | Jutcome    | es (POs) |             |            | <b>D</b> 0 0 |            |            |        |    |
| Cos/Pos            | PO1      | PO2        | PO3         | PO4       | PO5        | PO6      | PO7         | PO8        | PO9          | PO10       | P011       | PO     | 12 |
| COI                | 3        | 2          | 2           | -         | 3          | 3        | 2           | 2          | 3            | 2          | 2          |        | 2  |
| CO2                | 3        | 2          | 2           | -         | 3          | 3        | 2           | 2          | 3            | 2          | 2          |        | 2  |
| CO3                | 3        | 2          | 2           | -         | 3          | 3        | 2           | 2          | 3            | 2          | 2          |        | 2  |
| CO4                | 3        | 2          | 2           | -         | 3          | 3        | 2           | 2          | 3            | 2          | 2          |        | 2  |
| CO5                | 3        | 2          | 2           | -         | 3          | 3        | 2           | 2          | 3            | 2          | 2          |        | 2  |
| Cos / PSOs         | PS       | 01         | PSC         | 02        | PS         | 03       | PS          | 504        |              |            |            |        |    |
| CO1                | ,        | 3          | 3           |           | 2          | 2        |             | 2          |              |            |            |        |    |
| CO2                |          | 3          | 3           |           |            | 2        |             | 3          |              |            |            |        |    |
| CO3                | •        | 3          | 3           |           |            | 2        |             | 3          |              |            |            |        |    |
| CO4                | ,        | 3          | 3           |           |            | 2        |             | 3          |              |            |            |        |    |
| CO5                | ,        | 3          | 3           |           |            | 2        |             | 3          |              |            |            |        |    |
| 3/2/1 indicates \$ | Strengt  | h of Cor   | relation    | 3- High   | n, 2- Me   | dium, 1  | -Low        | . <u></u>  |              |            | -          |        |    |
|                    |          |            |             |           |            |          |             |            |              |            |            |        |    |
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|                    |          |            | l Sc        |           |            |          |             |            |              |            |            |        |    |
|                    |          | JCe        | cia         |           | 'e         |          |             |            |              |            |            |        |    |
| ory                |          | ciel       | d sc        |           | ctiv       |          | nary        | lent       | ject         |            |            |        |    |
| tego               | ence     | S<br>S     | ano         | ore       | ele        | ive      | ipli        | por        | Pro          |            |            |        |    |
| Cai                | Scie     | lini       | ties        | Ŭ         | ram        | lect     | Disc        | Jom        | al/          |            |            |        |    |
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|                    | Ba       | Bug        | Hun         | Prof      | Ч          | Ope      | Int         | Sk         | Prí          |            |            |        |    |
|                    |          |            |             |           |            | Ĭ        | 1           |            |              |            |            |        |    |
|                    |          |            |             | ✓         |            |          |             |            |              |            |            |        |    |
|                    |          |            |             |           |            |          |             |            |              |            |            |        |    |

#### An ISO 21001 : 2018 Certified Institution Perivar E.V.R. High Road, Maduravoval, Chennai-95, Tamilnadu, India.

| Subject Code: | Subject Name : ENGINEERING METROLOGY | Ty/Lb/<br>ETL | L | T/<br>SLr | P/<br>R | С |
|---------------|--------------------------------------|---------------|---|-----------|---------|---|
| EBME22ET2     | Prerequisite: Engineering Physics    | ETL           | 2 | 0/0       | 2/0     | 3 |

#### **UNIT- I: INTRODUCTION TO METROGY**

Basic concepts-Need for measurement - legal metrology-Precision and Accuracy - Reliability - Errors in Measurements - Types - Causes- Calibration - Interchangeability and selective assembly

Linear and angular measurements- Measurement of Engineering Components: Comparators- types--Mechanical, Optical, Electrical, electronics and pneumatic - Slip Gauges - Limit Gauges - Auto Collimator - Angle Decker - Alignment Telescope - Sine Bar - Bevel Protractor.

### LAB COMPONENTS:

1. Angular Measurement using Sine Bar, Slip Gauge and Dial Gauge,

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- 2. Measurement of Dimensions using Vernier Height Gauge
- 3. Measurement of Dimensions using Vernier Depth Micrometer
- 4. Angular Measurement using Vernier Height Gauge and Sine Bar
- 5.Angular measurement using Bevel Protractor
- 6.Calibration of Dial Gauge using Slip Gauge

7.Flatness of given work piece using Autocollimator

#### **UNIT- II: FORM MEASUREMENTS**

Measurement of Screw Thread - internal and External screw threads- Measurements of various elements of thread - Best size wire - Two and three wire method.

Gears - Measurements of various elements - Constant chord method - Base tangent method.

Surface Finish: Surface topography definitions - Measurement of Surface Texture - Methods - Evaluation of Surface finish.

#### Lab Components:

1. Measurement of Gear Nomenclature using Gear Tooth Vernier 2. Thread Measurement using Profile Projector

#### **UNIT- III: LASER METROLOGY**

Precision instrument based on Laser: Use of Lasers - Principle - Laser Interferometer - Application in Linear and Angular measurements - Testing of machine tools using Laser Interferometer.

#### **UNIT- IV: ADVANCES IN METROLOGY**

Co-ordinate Measuring Machine (CMM) - Constructional features - Types - Applications of CMM - CNC applications - Computer Aided Inspection (CAI) - Machine Vision - Applications in Metrology. Lab Components: 1. Measurement of Dimensions using Tool Makers Microscope

#### **UNIT V: MEASUREMENT OF POWER, FLOW AND TEMPERATURE**

Force, torque, power :-mechanical, pneumatic, hydraulic and electrical type-Flow measurement: Venturi, orifice, Rotameters, pitot tube – Temperature: bimetallic strip, pressure thermometers, thermocouples, electrical resistance thermister..

#### **TEXT BOOK**

1)

# R.K. Jain, (1994) "Engineering Metrology", Khanna publishers, 109094.

# REFERENCES

- I.C. Gupta, "A TEXT BOOK of Engineering Metrology", Dhanpat Rai & sons, 109096. 1)
- 2) G.N. Galyer and C.R. Shotbolt, "Metrology for Engineers", ELBS edition, 109090.
- Thomas "Engineering Metrology", Butthinson & co, 10984. 3)

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(An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Co           | de:   |               | Subject CONS           | et Nai<br>STITUTIC               | ne :<br>N (Audi | THI<br>t course  | E IN                | IDIAN              | Ty/L            | b/                 | L   | T/        | P/R      | C     |
|----------------------|---|---------------|------------------------|----------------------------------|-----------------|------------------|---------------------|--------------------|-----------------|--------------------|-----|-----------|----------|-------|
| EBCC22I0             | C22I04 Prerequisite: NIL  |               |                        |                                  |                 |                  |                     |                    | TE              | 2                  |     | 0/0       | 0        |       |
|                      |   |               | Prerec                 | juisite: N                       | IL.             |                  |                     |                    | IE              |                    | 2   | U/U       | U/U      | U     |
| L : Lecture          | T : T   | utorial       | SLr :                  | Supervise                        | d Learnin       | g P : P          | roject R            | : Resea            | rch C:          |                    |     |           |          |       |
| Credits T/L/         | ETL   | : Theor       | y/Lab/E                | mbedded 'I                       | heory and       | l Lab            |                     |                    |                 |                    |     |           |          |       |
| OBJECT               | VE:   | de en e       |                        | of the high                      |                 |                  | .f. I., d:          | Constitu           | 4               |                    |     |           |          |       |
| • 10<br>• To         | To provide an overview of the history of the making of Indian Const |               |                        |                                  |                 |                  |                     |                    | luion           |                    |     |           |          |       |
| • 10<br>• To         | Knox  | v the fu      | ndament                | al rights d                      | buties and      | the direct       | tive prind          | rinles of          | i.<br>state no  | licy               |     |           |          |       |
| • To                 | unde  | rstand fl     | he functi              | onality of                       | the legisl      | ature th         | e execut            | ive and f          | he indic        | iarv               |     |           |          |       |
| COURSE               | OUT   |               | S (COs)                | (3-5)                            | the legist      |                  | <u>e enecut</u>     | ive una t          | lie juure       | iui y              |     |           |          |       |
| The Studen           | ts wil  | ll be abl     | e to                   | . ( )                            |                 |                  |                     |                    |                 |                    |     |           |          |       |
| CO1                  | Und   | lerstand      | the histo              | ory of mak                       | ing of Ind      | ian Cons         | titution            |                    |                 |                    |     |           |          |       |
| CO2                  | Und   | lerstand      | the prea               | mble and                         | the basic s     | tructures        | of the C            | onstitutio         | on              |                    |     |           |          |       |
| CO3                  | Des   | cribe th      | e fundan               | nental righ                      | ts, duties a    | and the d        | irective p          | orinciples         | s of state      | e policy           | y   |           |          |       |
| CO4                  | Des   | cribe th      | e Emerg                | ency powe                        | rs of the g     | overnme          | ent                 |                    |                 |                    |     |           |          |       |
| CO5                  | Und   | lerstand      | the Spe                | cial Provis                      | sions for J     | ammu an          | d Kashn             | nir, Nagal         | land and        | l Other            | Reg | gions and | d Amendr | nents |
| Mapping o            | of Course Outcomes with Program Outcomes (POs)                      |               |                        |                                  |                 |                  |                     |                    |                 |                    |     |           |          |       |
| COs/POs              | PO  | 01            | PO2                    | PO3                              | PO4             | PO5              | PO6                 | PO7                | PO8             | PO9                |     | PO10      | PO11     | PO1 2 |
| CO1                  |   |               |                        |                                  |                 |                  | 3                   | 1                  | 1               | 1                  |     | 1         |          |       |
| CO2                  |   |               |                        |                                  |                 |                  | 3                   | 1                  | 1               | 1                  |     | 1         |          |       |
| CO3                  |   |               |                        |                                  |                 |                  | 3                   | 1                  | 1               | 2                  |     | 1         |          |       |
| CO4                  |   |               |                        |                                  |                 |                  | 3                   | 1                  | 1               | 2                  |     | 1         |          |       |
| CO5                  | _   |               |                        |                                  |                 |                  | 3                   | 1                  | 1               | 2                  |     | 1         |          |       |
| COs /<br>PSOs        |   | PSO           | 01                     | PS                               | 02              | PS               | 503                 |                    |                 |                    |     |           |          |       |
| CO1                  |   | 1             |                        |                                  | 1               |                  | 2                   |                    |                 |                    |     |           |          |       |
| CO2                  | _   | 1             |                        |                                  | 1               |                  | 2                   |                    |                 |                    |     |           |          |       |
| <u>CO3</u>           |   | 1             |                        |                                  | 1               |                  | 2                   |                    |                 |                    |     |           |          |       |
| CO4<br>CO5           |   | 1             |                        |                                  | 1<br>1          |                  | 2                   |                    |                 |                    |     |           |          |       |
| 203<br>3/2/1 indicat | tes St  | renoth        | of Corr                | elation 3                        | 1<br>- High 2-  | Medium           | <u>-</u><br>n 1-Low | 7                  |                 |                    |     |           |          |       |
|                      |   | n engul       |                        |                                  |                 |                  | <br>                |                    |                 |                    |     |           |          |       |
| Category             |   | Basic Science | Engineering<br>Science | Humanities and social<br>Science | Program Core    | Program elective | Open Elective       | Inter Disciplinary | Skill Component | Practical /Project |     |           |          |       |
|                      |   |               |                        |                                  |                 |                  |                     | <b>√</b>           |                 |                    |     |           |          |       |



| Subject Code: | Subject Name : THE INDIAN<br>CONSTITUTION (Audit course) | Ty/Lb/<br>ETL/IE | L     | T/<br>SLr | P/R    | C |
|---------------|--|------------------|-------|-----------|--------|---|
| EBCC22104     | Prerequisite: NIL  | IE               | 2     | 0/0       | 0/0    | 0 |
| UNIT 1        |  |                  | •     |           | 3      | • |
| The Histo     | ry of the Making of Indian Constitution, Prear           | nble and the     | e Bas | ic Struct | tures  |   |
| UNIT 2        |  |                  |       |           | 3      |   |
| Fundame       | ntal Rights and Duties , Directive Principles of         | f State Polic    | у     |           |        |   |
| UNIT 3        |  |                  |       |           | 3      |   |
| Legislatu     | re, Executive and Judiciary                              |                  |       |           |        |   |
| UNIT 4        | -  |                  |       |           | 3      |   |
| Emergeno      | cy Powers  |                  |       |           |        |   |
| UNIT 5        | -  |                  |       |           | 3      |   |
| Special P     | rovisions for Jammu and Kashmir, Nagaland a              | nd Other Re      | egion | s. Amen   | dments |   |

Total No. of Periods: 15

# **TEXT BOOKS:**

1. D D Basu, Introduction to the Constitution of India, 20th Edn., Lexisnexis Butter worths, 2012.

# **REFERENCE BOOKS:**

1. Rajeev Bhargava (ed), Ethics and Politics of the Indian Constitution, OxfordUniversity

Press, New Delhi, 2008.

2. Granville Austin, The Indian Constitution: Cornerstone of a Nation, Oxford UniversityPress, Oxford, 1966.

 Zoya Hassan, E. Sridharan and R. Sudarshan (eds), India's Living Constitution: Ideas, Practices, Controversies, Permanent Black, New Delhi, 2002
 Subhash C. Kashyap, Our Constitution, National Book Trust, New Delhi, 2011.



| Subject              | t Code        | e: S            | Subject Na      | ame: THE          | INDIAN '    | <b>FRADITI</b>                | ONAL         |             | Ty/L       | b L        | Τ/              | <b>P</b> / | R     | С   |
|----------------------|---------------|-----------------|-----------------|-------------------|-------------|-------------------------------|--------------|-------------|------------|------------|-----------------|------------|-------|-----|
| EBCC2                | 22105         | I               | KNOWLE          | EDGE (Aud         | it course   | e)                            |              |             | /ETL       | ./         | SLı             | •          |       | I   |
|                      |               |                 |                 |                   |             |                               |              |             | IE         |            |                 |            |       | 1   |
|                      |               | I               | Prerequisi      | te: NIL           |             |                               |              |             | IF         | 2 2        | 0/0             | 0/0        |       | 0   |
| L : Lect             | ure T         | : Tut           | orial SL        | r : Supervised    | Learning    | P: Project                    | R : Resea    | arch C: Cre | dits       | •          |                 |            |       |     |
| T/L/ET               | L : Th        | neory/          | Lab/Embe        | edded Theory      | and Lab     |                               |              |             |            |            |                 |            |       |     |
| OBJEC                | TIVE          | E:              | ( 1.1 D         | 1 • 1             | 101         | 10 11                         | 1. 75 1      | 177         | 1 1        | <b>G</b> ( |                 |            |       |     |
| •                    | Tou           | inders          | stand the P     | re- colonial a    | nd Colonia  | al Period, In<br>Aditional Pr | ndian I rad  | itional Kno | wledge     | System     | TV .            |            |       |     |
| •                    | To K          | Know            | the Histor      | v of Physics a    | and Chemi   | strv. Tradit                  | tional Art a | and Archite | cture an   | d Vastu    | sy<br>Shashtra, | Astronor   | nv an | d   |
|                      | Ast           | trolog          | sy size         | .jj               |             |                               |              |             |            |            | ,               |            |       |     |
| •                    | To u          | inders          | stand the C     | Drigin of Math    | nematics, A | viation Te                    | chnology i   | n Ancient   | India, Cr  | afts and   | Trade in        | Ancient l  | India |     |
| COUR                 | SE OU         |                 | OMES (C         | Os): (3-5)        |             |                               |              |             |            |            |                 |            |       |     |
| CO1                  | Unde          | will t          | d the Pre-      | colonial and      | Colonial P  | eriod Indi                    | an Traditio  | nal Knowl   | edge Svs   | stem       |                 |            |       |     |
|                      | Desc          | rihe            | the Traditi     | ional Medicin     | e Traditio  | nal Produc                    | tion and C   | onstruction | Techno     | logy       |                 |            |       |     |
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|                      | Astro         | erstan<br>ology | u the histo     | bry of Physics    | s and Chen  | instry, 1rac                  | intional Ar  | i and Archi | lecture a  | uia vasti  | u Snashtra      | i, Astron  | omy a | u10 |
|                      | 1 10110       | 51055           |                 |                   |             |                               |              |             |            |            |                 |            |       |     |
| CO4                  | Unde          | erstan          | d the Orig      | in of Mathem      | atics, Avia | tion Techr                    | nology in A  | Ancient Ind | ia, Crafts | s and Tra  | ade in An       | cient Indi | a     |     |
| CO5                  | Unde          | erstan          | d the TK        | S and the C       | ontempo     | rary Wor                      | ld, India    | n union a   | nd IT F    | Revolut    | tion            |            |       |     |
| Mappir               | ng of (       | Cour            | se Outcon       | nes with Prog     | gram Outo   | comes (PO                     | s)           |             |            |            |                 |            |       |     |
| COs/PO               | Os F          | <b>?0</b>       | PO2             | PO3               | PO4         | PO5                           | PO6          | PO7         | PO8        | PO9        | PO10            | PO11       | PO    | 12  |
| CO1                  |               | -               | 3               | 3                 | 1           |                               | 2            |             |            |            | 2               |            | 1     |     |
| CO2                  |               |                 | 3               | 3                 | 1           |                               | 2            |             |            |            | 2               |            | 1     |     |
| <u>CO3</u>           |               |                 | 3               | 3                 | 1           |                               | 2            |             |            |            | 2               |            | 1     |     |
| CO4<br>CO5           |               |                 | 3               | 3                 | 1           |                               | 2            |             |            |            | $\frac{2}{2}$   |            | 1     |     |
| $\frac{COS}{COS}$    |               | Р               | <u>5</u><br>SO1 | PSO               | 2           | PS                            | 03           | PSC         | )4         |            | 2               |            | 1     |     |
| PSOs                 |               |                 |                 | 1                 |             | -~                            |              |             |            |            |                 |            |       |     |
| CO1                  |               | 1               |                 | 1                 |             | 2                             |              |             |            |            |                 |            |       |     |
| CO2                  |               | 1               |                 | 1                 |             | 2                             |              |             |            |            |                 |            |       |     |
| CO3                  |               | 1               |                 | 1                 |             | 2                             |              |             |            |            |                 |            |       |     |
| CO4                  |               | 1               |                 | 1                 |             | 2                             |              |             |            |            |                 |            |       |     |
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| 3/2/11               | luica         | ites 5          | trengtn         | of Correlati      | оп 5- п     | gn, 2- Me                     |              |             | 1          | -          |                 |            |       |     |
|                      |               |                 |                 |                   |             |                               |              | ry          | at         | 5          |                 |            |       |     |
|                      | e             |                 |                 | e a               |             |                               | n            | lina        | nei        | oje        |                 |            |       |     |
|                      | iena          |                 | Jg              | ence              | Core        | n                             | tive         | cipl        | npc        | /Pr        |                 |            |       |     |
|                      | Sci           |                 | erii<br>e       | nitie<br>Scie     | u C         | grat                          | Ilec         | Dis         | Cor        | cal        |                 |            |       |     |
|                      | Isic          |                 | ține<br>ence    | nar<br>ial S      | grai        | Prog                          | sn E         | ter ]       | ill (      | acti       |                 |            |       |     |
|                      | $\mathbf{Ba}$ |                 | Eng<br>Sci6     | Hui<br>soci       | Pro         | ele                           | Opé          | In          | Sk         | Pr         |                 |            |       |     |
|                      |               |                 |                 |                   |             |                               |              | ✓           |            |            |                 |            |       |     |
|                      |               |                 |                 |                   |             |                               |              |             |            |            |                 |            |       |     |
| X                    |               |                 |                 |                   |             |                               |              |             |            |            |                 |            |       |     |
| JOF                  |               |                 |                 |                   |             |                               |              |             |            |            |                 |            |       |     |
| TEC                  |               |                 |                 |                   |             |                               |              |             |            |            |                 |            |       |     |
| CA'                  |               |                 |                 |                   |             |                               |              |             |            |            |                 |            |       |     |
| -                    |               |                 |                 |                   | B.Tech Ma   | chanical I                    | Ingineerin   | g - 2022 Re | gulation   | 1          |                 |            |       | 91  |

B.Tech Mechanical Engineering - 2022 Regulation

| Subject Code:<br>EBCC22I05 | Subject Name : THE INDIAN TRADITIONAL<br>KNOWLEDGE (Audit course) | Ty/Lb<br>/ETL/<br>IE | L | T/<br>SLr | P/R | C |
|----------------------------|---|----------------------|---|-----------|-----|---|
|                            | Prerequisite: NIL   | IE                   | 2 | 0/0       | 0/0 | 0 |

# UNIT I

Historical Background: TKS During the Pre- colonial and Colonial Period, Indian Traditional Knowledge System

# UNIT II

Traditional Medicine, Traditional Production and Construction Technology

# **UNIT III**

History of Physics and Chemistry, Traditional Art and Architecture and Vastu Shashtra, Astronomy and Astrology

# UNIT IV

Origin of Mathematics, Aviation Technology in Ancient India, Crafts and Trade in Ancient India

# UNIT V

TKS and the Contemporary World, TKS and the Indian Union, TKS and IT Revolution.

# Total No. of Periods: 15

# **TEXT BOOKS:**

1. Amit Jha (2009), Traditional knowledge system in india, 1<sup>st</sup> Edition, Delhi University (North Campus)

2. Dr.A.K.Ghosh (2011), Traditional Knowledge of Household Products



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| Subject Code     | e: Su<br>LA             | bject N<br>AB       | ame : S                       | TREN             | GTH O                 | F MA               | FERIAI             | LS              | Ty/Lb/<br>ETL      | L            | T/<br>SLr | P/R | C        |
|------------------|-------------------------|---------------------|-------------------------------|------------------|-----------------------|--------------------|--------------------|-----------------|--------------------|--------------|-----------|-----|----------|
|                  | Pre                     | erequisi            | te: Engin                     | eering N         | Aetallur              | gy                 |                    |                 | Lb                 | 0            | 0/0       | 3/0 | 1        |
| L : Lecture T    | : Tutorial              | SLr :               | Supervise                     | ed Learn         | ing P:                | Project            | R : Rese           | earch (         | C: Credits         |              |           |     | <u>.</u> |
| T/L/ETL : Th     | eory/Lab                | /Embedd             | led Theory                    | y and La         | ıb                    |                    |                    |                 |                    |              |           |     |          |
| OBJECTIVE        | C:                      |                     |                               |                  |                       |                    |                    |                 |                    |              |           |     |          |
| To de     To tes | termine t<br>st the har | he mech<br>dness of | anical pro                    | perties of OPPER | of steel read and Alu | od using<br>minium | g Univers          | sal test        | ing machir         | ne           |           |     |          |
| COURSE OU        | JTCOM                   | ES (COs             | s): The st                    | udent w          | vill be at            | ole to             | L arral (2)        |                 |                    |              |           |     |          |
|                  | Determ                  | and the s           | stress strai                  | n diagra         | m of ste              | el rod. (          | Level 2)           |                 |                    |              |           |     |          |
| 002              | Determ                  | me the r            | iaruness u                    | esting of        | Steel, C              | opper a            | na Alun            | iinium          |                    |              |           |     |          |
| CO3              | Estimate                | e the Spr           | ing consta                    | ant, unde        | er Tensio             | on and C           | ompress            | sion            |                    |              |           |     |          |
| CO4              | Estimat                 | e the not           | ch toughn                     | ess of st        | eel using             | g Izod in          | mpact te           | sting n         | nachine            |              |           |     |          |
| CO5              | Study th                | ne mecha            | unical prop                   | perties of       | f Steel a             | nd Cast            | iron spe           | cimen           | using Univ         | versal testi | ng machin | ne. |          |
| Mapping of C     | ourse Ou                | tcomes              | with Prog                     | gram O           | utcomes               | (Pos)              |                    |                 |                    |              |           |     |          |
| Cos/Pos          | PO1                     | PO2                 | PO3                           | PO4              | PO5                   | <b>PO6</b>         | <b>PO7</b>         | PO8             | PO9                | <b>PO10</b>  | PO11      | PO  | 12       |
| CO1              | 3                       | 3                   | 2                             | 2                | 2                     | 2                  | 2                  | 2               | 3                  | 3            | 2         |     | 2        |
| CO2              | 3                       | 3                   | 2                             | 2                | 2                     | 2                  | 2                  | 2               | 3                  | 3            | 2         |     | 2        |
| CO3              | 3                       | 3                   | 2                             | 2                | 2                     | 2                  | 2                  | 2               | 3                  | 3            | 2         |     | 2        |
| CO4              | 3                       | 3                   | 2                             | 2                | 2                     | 2                  | 2                  | 2               | 3                  | 3            | 2         |     | 2        |
| CO5              | 3                       | 3                   | 2                             | 2                | 2                     | 2                  | 2                  | 2               | 3                  | 3            | 2         |     | 2        |
| Cos / PSOs       | PS                      | 501                 | PSO                           | 02               | PS                    | 03                 | PS                 | 504             |                    |              |           |     |          |
| CO1              |                         | 3                   | 3                             |                  |                       | 2                  | 2                  |                 |                    |              |           |     |          |
| CO2              | -                       | 3                   | 3                             |                  | 4                     | 2                  | 2                  |                 |                    |              |           |     |          |
| CO3              |                         | 3                   | 3                             |                  |                       | 2                  | 2                  |                 |                    |              |           |     |          |
| CO4              |                         | 3                   | 3                             |                  |                       | 2                  | 2                  |                 |                    |              |           |     |          |
| CO5              |                         | 3                   | 3                             |                  |                       | 2                  | 2                  |                 |                    |              |           |     |          |
| 3/2/1 indicates  | Strengt                 | h of Cor            | relation                      | 3- High          | n, 2- Mee             | dium, 1            | Low                |                 |                    |              |           |     |          |
| Category         | Basic Science           | Engineering Science | Humanities and social Science | Program Core     | Program elective      | Open Elective      | Inter Disciplinary | Skill Component | Practical /Project |              |           |     |          |
|                  |                         |                     |                               |                  |                       |                    |                    |                 |                    |              |           |     |          |

B.Tech Mechanical Engineering - 2022 Regulation



| Subject Code:<br>EBME22L03 | Subject Name : STRENGTH OF MATERIALS<br>LAB | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|----------------------------|---|---------------|---|-----------|-----|---|
|                            | Prerequisite: Engineering Metallurgy        | Lb            | 0 | 0/0       | 3/0 | 1 |

# LIST OF EXPERIMENTS:

- 1. Evaluation of Engineering Stress/strain diagram on steel rod.
- 2. Determination of mechanical properties of steel and cast iron using Universal testing machine
- 3. Hardness values of Steel, Copper and Aluminium using Brinell hardness machines
- 4. Hardness values of Steel, Copper and Aluminium using Rockwell machine
- 5. Deflection Test on mild steel and Aluminium beam Verification of Maxwell theorem
- 6. Estimation of Spring constant, under Tension and Compression
- 7. Determination of notch toughness of steel using Izod impact testing machine
- 8. Torsion test on metal specimen by using Torsion Testing Machine.

| EDUCATIONAL AND RESEARCH INSTITUTE          | A + + + + |
|---|-----------|
| University with Graded Autonomy Status      |           |
| (An ISO 21001 : 2018 Certified Institution) |           |

Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code  | : Sul<br>M   | bject Na<br>ACHINI  | ame : AR<br>E LEARN              | AND            | Ty / Lb/<br>ETL  | L             | T/<br>S.Lr         | <b>P/ R</b>     | C                  |             |              |         |            |  |
|---|--|---|----------------------------------|----------------|------------------|---------------|--------------------|-----------------|--------------------|-------------|--------------|---------|------------|--|
| EBCS22IL4   | Pro<br>M   | erequisi<br>ACHIN   | te: ART<br>E LEARN               | IFICIA<br>NING | L INT            | ELLIG         | ENCE               | AND             | Lb                 | 0           | 0/0          | 3/0     | 1          |  |
| L : Lecture T :   | Tutoria  | l SLr   | Supervis                         | ed Lear        | ning P:          | Project       | R : Res            | earch C         | C: Credits         | 11          |              |         |            |  |
| Ty/Lb/ETL : T   | Theory/I   | _ab/Emb   | edded Th                         | eory and       | l Lab            |               |                    |                 |                    |             |              |         |            |  |
| OBJECTIVE   | :  |   |                                  |                |                  |               |                    |                 |                    |             |              |         |            |  |
| • Study   | the cond   | cepts of  | Artificial                       | Intellige      | ence.            |               |                    |                 |                    |             |              |         |            |  |
| • Learn   | the met  | hods of s   | solving pr                       | oblems         | using A          | rtificial     | Intellige          | nce.            |                    |             |              |         |            |  |
| • Introd  | uce the  | concepts  | of Exper                         | t Systen       | ns and m         | achine l      | earning            |                 |                    |             |              |         |            |  |
| COURSE OU   | COURSE OUTCOMES (COs) : Students will able to:                                   |   |                                  |                |                  |               |                    |                 |                    |             |              |         |            |  |
| CO1 Write a R program to merge two given lists into one list, given matrix into one list. |  |   |                                  |                |                  |               |                    |                 |                    |             |              |         |            |  |
| CO2   | Demo   | onstrate  | the work                         | ing of t       | he decis         | sion tree     | e based            | ID3 al          | gorithm            |             |              |         |            |  |
| CO3   | Write  | a progr   | am to im                         | plemen         | t the na         | ïve Bay       | vesian c           | lassifie        | r for a san        | nple trai   | ining da     | ita set |            |  |
| <u>CO4</u>  | Apple  | $\frac{1}{2}$ as a .C   | SV IIIe.                         | o olucto       | r a sot          | of data (     | stored             |                 | V filo             |             |              |         |            |  |
| C04   | Apply  | Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set using |                                  |                |                  |               |                    |                 |                    |             |              |         |            |  |
|   | Java/Python ML library.  |   |                                  |                |                  |               |                    |                 |                    |             |              |         |            |  |
| Monning of C  | Java/Python ML library.<br>Apping of Course Outcomes with Program Outcomes (POs) |   |                                  |                |                  |               |                    |                 |                    |             |              |         |            |  |
|   |  |   |                                  |                |                  | PO6           | 9<br>PO7           | POS             | PO0                | <b>PO10</b> | <b>Ρ</b> Ω11 | 1 D/    | <b>D12</b> |  |
| CO1   | 3  | 3   | 3                                | 3              | 2                | 3             | 2                  | 2               | 3                  | 3           | 3            |         | 3          |  |
| CO2   | 3  | 3   | 3                                | 3              | 2                | 3             | 2                  | 2               | 3                  | 3           | 3            |         | 3          |  |
| CO3   | 3  | 3   | 3                                | 3              | 1                | 3             | 2                  | 2               | 3                  | 2           | 3            |         | 3          |  |
| CO4   | 3  | 3   | 3                                | 3              | 1                | 3             | 2                  | 2               | 3                  | 2           | 3            |         | 3          |  |
| CO5   | 3  | 3   | 3                                | 3              | 1                | 3             | 2                  | 2               | 3                  | 2           | 3            |         | 3          |  |
| COs / PSOs  | PSO1   | 5   | PSO2                             | 5              | PSO3             | 5             | 2<br>PSO4          | -               | 5                  | -           |              |         | 5          |  |
| CO1   | 1501   |   | 1504                             |                | 1505             |               | 1004               | 3               |                    |             |              |         |            |  |
| CO2   |  |   |                                  |                |                  |               |                    | 3               |                    |             |              |         |            |  |
| CO3   |  |   |                                  |                |                  |               |                    | 3               |                    |             |              |         |            |  |
| CO4   |  |   |                                  |                |                  |               |                    | 3               |                    |             |              |         |            |  |
| CO5   |  |   |                                  |                |                  |               |                    | 3               |                    |             |              |         |            |  |
| 3/2/1 indicates   | s Strens   | gth of C  | orrelation                       | n <b>3-</b> Hi | gh, 2- N         | ledium.       | 1-Low              |                 | L                  |             |              |         |            |  |
|   | c  |   |                                  |                | Í                |               |                    |                 |                    |             |              |         |            |  |
| Category  | Basic Science  | Engineering<br>Science  | Humanities and social<br>Science | Program Core   | Program elective | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |             |              |         |            |  |
|   |  |   |                                  |                |                  |               | $\checkmark$       |                 | ✓                  |             |              |         |            |  |



| Subject Code:<br>EBCS22IL4 | Subject Name : ARTIFICIAL INTELLIGENCE AND<br>MACHINE LEARNING LAB | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|----------------------------|--|---------------|---|-----------|-----|---|
|                            | Prerequisite: Artificial Intelligence and Machine Learning         | Lb            | 0 | 0/0       | 3/0 | 1 |

- 1. Write a R program to list containing a vector, a matrix and a list and give names to the elements in the list.
- 2. Write a R program to merge two given lists into one list.
- 3. Write a R program to convert a given matrix to a list.
- 4. Write a program to demonstrate the working of the decision tree based ID3 algorithm.
- 5. Write a program to implement the naïve Bayesian classifier for a sample training data set Stored as a .CSV file.
- 6. Apply EM algorithm to cluster a set of data stored in a .CSV file.

7. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set.



| Subject Code: | Subject Name: TECHNICAL SKILL-I                | Ty/Lb/ | L | Τ/  | P/R | С |
|---------------|--|--------|---|-----|-----|---|
| FBMF22101     |  | ETL/IE |   | SLr |     |   |
| EDNIE22101    | Pre requisite: All subjects studied up to date | IE     | 0 | 0/0 | 2/0 | 1 |

Students should acquire skill in the domain/inter disciplinary area from government/private training centers/industries /University for a minimum period of 15 calendar days. The training can be through off line, online or mixed mode. Students are supposed to prepare Technical skill report at the end of the training and submit the report along with the certificate in proof of the training, during the viva voce examination conducted by the examiners duly appointed by the head of the department



| Subject Code:                          | Subj  | ect Name   | : SOFT SI                         | KILLS I            | -EMPLY   | ABILI     | TY SKIL   | L Ty/      | Lb/            | L         | Τ/         | P/R     | С     |  |  |
|--|---|--|-----------------------------------|--------------------|--|-----------|-----------|------------|----------------|-----------|------------|---------|-------|--|--|
| EBCC22I06                              |   |  |                                   |                    |  |           |           | ETI        | L/IE           |           | SLr        |         |       |  |  |
|  | Pre r                                       | equisite:  | None                              |                    |  |           |           | I          | IE 0 0/0 2/0 1 |           |            |         |       |  |  |
| L : Lecture T : Tu<br>T/L/ETL : Theory | itorial<br>y/Lab/E                          | S Lr : Suj<br>mbedded  | pervised Le<br>Theory and         | earning I<br>d Lab | P : Projec   | t R:Res   | search C: | Credits    |                |           |            |         |       |  |  |
| OBJECTIVES:                            | The stu                                     | dent will  |                                   |                    |  |           |           |            |                |           |            |         |       |  |  |
| • To                                   | create a                                    | awarenes   | s in stude                        | nts, varı          | ous top  | compan    | les helpi | ng them    | improve th     | neir skil | l set matr | x, lead | ıng   |  |  |
| • To 1                                 | heln sti                                    | udents be  | e aware of                        | various            | technia  | ues of c  | andidate  | recruitm   | ent and he     | eln them  | prepare    | CV's at | nd    |  |  |
| resu                                   | ime.  |  |                                   | vano as            | teening  |           | anaraato  | 10010101   |                | np thom   | propure    | e v b u | 14    |  |  |
| • To ]                                 | help stu                                    | udent ho   | w to face                         | various t          | types of   | interviev | w, prepa  | ring for H | HR, techni     | cal inter | views.     |         |       |  |  |
| • To                                   | help stu                                    | udents in  | nprove the                        | eir verba          | l reading  | g, narrat | ion and p | presentat  | ion skills ł   | by perfo  | rms vario  | us moc  | k     |  |  |
| sess                                   | sions.                                      |  |                                   |                    |  |           |           |            |                |           |            |         |       |  |  |
| COURSE OUT                             | COMES                                       | <b>5 (COs) :</b>   |                                   |                    |  |           |           |            |                |           |            |         |       |  |  |
| CO1                                    | В   | Be aware of various top companies leading to improvement in skills amongst them. |                                   |                    |  |           |           |            |                |           |            |         |       |  |  |
| CO2                                    | В   | Be aware   | of vario                          | us cand            | idate re   | cruitme   | ent techr | niques li  | ke group       | discuss   | sion, inte | rviews  | s and |  |  |
|  | b   | e able to  | able to prepare CV's and resumes. |                    |  |           |           |            |                |           |            |         |       |  |  |
| CO3                                    | P   | repare f   | or differe                        | ent type           | s of inte  | erviews   | and be    | prepareo   | 1 for HR       | and tecl  | hnical in  | terviev | vs.   |  |  |
| CO4                                    | lı  | mprove   | their verb                        | oal, wri           | tten and   | other s   | kills by  | perform    | ning mock      | x sessio  | ns.        |         |       |  |  |
| CO5                                    | P   | articipa   | tion of gr                        | oup dis            | cussion  | and ap    | titude te | ests       |                |           |            |         |       |  |  |
| Mapping of Cou                         | Course Outcomes with Program Outcomes (POs) |  |                                   |                    |  |           |           |            |                |           |            |         |       |  |  |
| Cos/Pos                                | PO1   | PO2  | PO3                               | PO4                | PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12 |           |           |            |                |           |            |         |       |  |  |
| CO1                                    | 1   | 1  | 1                                 | 1                  | 1  | 2         | 2         | 3          | 2              | 3         | 2          |         | 3     |  |  |
| CO2                                    | 1   | 1  | 1                                 | 1                  | 1  | 2         | 2         | 3          | 2              | 3         | 2          |         | 3     |  |  |
| CO3                                    | 1   | 1  | 1                                 | 1                  | 1  | 2         | 2         | 3          | 2              | 3         | 2          |         | 3     |  |  |
| CO4                                    | 1   | 1  | 1                                 | 1                  | 1  | 2         | 2         | 3          | 2              | 3         | 2          |         | 3     |  |  |
| CO5                                    | 1   | 1  | 1                                 | 1                  | 1  | 2         | 2         | 3          | 2              | 3         | 2          |         | 3     |  |  |
| Cos / PSOs                             | PS  | 501  | PS(                               | )2                 | PS   | <u> </u>  | 2<br>PS   | 504        | 2              |           |            |         | 5     |  |  |
| CO1                                    |   |  |                                   |                    |  |           |           |            |                |           |            |         |       |  |  |
| CO2                                    |   |  |                                   |                    |  |           |           |            |                |           |            |         |       |  |  |
| CO3                                    |   |  |                                   |                    |  |           |           |            |                |           |            |         |       |  |  |
| CO4                                    |   |  |                                   |                    |  |           |           |            |                |           |            | _       |       |  |  |
| CO5                                    |   |  |                                   |                    |  |           |           |            |                |           |            | _       |       |  |  |
| 3/2/1 indicates S                      | trengt                                      | h of Cor   | relation                          | 3- Higł            | 1, 2- Me   | dium, 1   | -Low      |            |                |           |            |         |       |  |  |
|  | _   |  |                                   |                    |  |           |           |            |                |           |            |         |       |  |  |
|  |   |  | cial                              |                    | e  |           |           |            |                |           |            |         |       |  |  |
|  |   |  | l so                              |                    | ctiv   |           | lary      | ent        | ect            |           |            |         |       |  |  |
| ory                                    | nce   | 50   | and                               | ore                | ele  | ve        | plir      | hon        | Proj           |           |            |         |       |  |  |
| tego                                   | Scie  | ring   | ties                              | CC                 | am   | ecti      | isci      | om         | al //          |           |            |         |       |  |  |
| Ca                                     | sic (                                       | inee   | nani<br>nce                       | ran                | rogı   | n El      | er D      | ПC         | ctic           |           |            |         |       |  |  |
|  | Bat   | Ingi   | Hum                               | rog                | L L  | Dpei      | Inte      | Ski        | Pra            |           |            |         |       |  |  |
|  |   | ШХ   |                                   |                    | 1  |           | 1         | ✓          |                |           |            |         |       |  |  |
|  |   |  |                                   |                    |  |           |           |            |                |           |            |         |       |  |  |



| Subject Code: | Subject Name : SOFT SKILLS I-EMPLYABILITY | Ty/Lb/ | L | Τ/  | P/R | С |
|---------------|---|--------|---|-----|-----|---|
| EBCC22106     | SKILL                                     | ETL/IE |   | SLr |     |   |
|               | Prerequisite: None                        | IE     | 0 | 0/0 | 2/0 | 1 |

# UNIT I

Creation of awareness of top companies / improving skill set matrix / Development of positive frame of mind / Creation of self-awareness.

# **UNIT II**

Group discussions / Do's and don'ts - handling group discussions / what evaluators look for interpersonal relationships / Preparation of Curriculum Vitae / Resume.

# UNIT III

Interview – awareness of facing questions – Do's and don'ts of personal interview / group interview, enabling students to prepare for different proce3dures such as HR interviews and Technical Interviews / self-introductions. 6

# **UNIT IV**

Verbal aptitude, Reading comprehension / narration / presentation / Mock Interviews. UNIT V

Practical session on Group Discussion and written tests on vocabulary and reading comprehension Practical component P : Include case studies / application scenarios

**Research component R : Future trends / research areas / Comparative Analysis** 

**Total No of Periods: 30** 

6



# **SEMESTER V**



| Subject C | Code:  | Subjec              | t Name<br>TH | me :<br>ΓHERMAL ENGINEERING |           |  |          |               |             | L          | T/<br>SLr | P/R       | C         |
|-----------|--|---------------------|--------------|-----------------------------|-----------|--|----------|---------------|-------------|------------|-----------|-----------|-----------|
| EBME22    | 008  | Prere               | auisite:     | Engine                      | ering [   | Therm                                      | odvnai   | mics          | Ty          | 3          | 0/0       | 0/0       | 3         |
| L.·Lectur | e T · Tutori   | ial SL:             | r · Supe     | rvised I                    | earning   | $\mathbf{p} \mathbf{P} \cdot \mathbf{P}_1$ | ractical | R · Rese      | arch C· C   | redits     | 0/0       | 0/0       | 5         |
| T/L/ETL : | Theory/La  | ıb/Embe             | edded T      | heory ar                    | nd Lab    | 5 1 . 1 1                                  | lucticu  | 1 IV. IVOS    |             | realts     |           |           |           |
| OBJECT    | IVE: The s   | student             | will lea     | rn                          |           |  |          |               |             |            |           |           |           |
| • To      | o integrate  | the cond            | cepts. la    | ws and                      | method    | lologies                                   | s from   | the first c   | ourse in th | nermodvr   | amics in  | to the an | alvsis of |
| c         | yclic proce  | ss.                 | 1,           |                             |           | 0  |          |               |             |            |           |           | <b>,</b>  |
| • To<br>T | o apply the<br>urbines.                                | thermo              | dynami       | c conce                     | pts into  | o variou                                   | us ther  | mal appli     | cations lik | e, IC eng  | gines Ste | am turbi  | nes, Gas  |
| COURSE    |  | AES (C              | Os): T       | The stud                    | lent wi   | ll be al                                   | ole to   |               |             |            |           |           |           |
| CO1       | Demonstra  | ate the v           | vorking      | princip                     | les of st | eam ge                                     | enerato  | rs, conder    | sers and r  | ozzles a   | nd solve  | the       |           |
|           | problems.  | (Level3)            | )            | 1 1                         |           | U  |          | ,             |             |            |           |           |           |
| CO2       | Analyze tł   | ne perfo            | rmance       | of singl                    | e and n   | nultista                                   | ge air c | compresso     | ors and gas | turbines   | .(Level 4 | )         |           |
| CO3       | Construct  | the velo            | city dia     | gram of                     | steam     | turbine                                    | and de   | etermine i    | ts perform  | ance.(Le   | vel 3)    |           |           |
| CO4       | Acquire th   | e know              | ledge of     | IC eng                      | ines and  | d estim                                    | ate the  | performa      | nce param   | eters. (Le | evel 2)   |           |           |
| CO5       | Understan  | d the an            | alyze th     | e differ                    | ent refr  | igeratic                                   | on and a | air conditi   | ioning sys  | tem. (Lev  | vel 2& 4) |           |           |
|           | Mapping of Course Outcomes with Program Outcomes (Pos) |                     |              |                             |           |  |          |               |             |            |           |           |           |
| COs/POs   | PO1  | PO2                 | PO3          | PO4                         | PO5       | PO6  | COs/P    | Os            | PO1         | PO2        | PO3       | PO4       | PO5       |
| CO1       | 3  | 3                   | 2            | 2                           | 1         | 1  | CO1      |               | 3           | 3          | 2         | 2         | 1         |
| CO2       | 3  | 3                   | 2            | 2                           | 1         | 1  | CO2      |               | 3           | 3          | 2         | 2         | 1         |
| CO3       | 3  | 3                   | 2            | 2                           | 1         | 1  | CO3      |               | 3           | 3          | 2         | 2         | 1         |
| CO4       | 3  | 2                   | 2            | 2                           | 1         | 2  | CO4      |               | 3           | 2          | 2         | 2         | 1         |
| CO5       | 3  | 2                   | 2            | 2                           | 1         | 2  | CO5      |               | 3           | 2          | 2         | 2         | 1         |
| COs       | / PSC  | )1                  | PS           | O2                          | PS        | O3   |          | PSO4          |             |            |           |           |           |
| PSOs      |  |                     |              |                             |           |  |          |               |             |            |           |           |           |
| CO1       | 3  |                     |              | 2                           | -         | 2  |          | 2             |             |            |           |           |           |
| CO2       | 3  |                     |              | 2                           | -         | 2  |          | 2             |             |            |           |           |           |
| CO3       | 3  |                     |              | 2                           |           | 2  |          | 2             |             |            | _         |           |           |
| CO4       | 3  |                     |              | 3                           |           | 2  |          | 3             |             |            |           |           |           |
| CO5       | 3  |                     |              | 3                           |           | 2  |          | 3             | 1 0 1/      |            |           |           |           |
|           | 3  | $\frac{2}{1} \ln ($ | dicates      | Streng                      | gth of (  | Correl                                     | ation:   | <u>3- Hış</u> | gh, 2- Me   | dium, I    | -Low      |           |           |
|           |  |                     |              |                             |           |  |          |               |             |            |           |           |           |
|           |  |                     |              | П                           |           |  |          |               |             |            |           |           |           |
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|           |  | В                   | En<br>Sci    | Hu<br>Sci                   | Prc       |  | Op       | Ir            | Š           | P          |           |           |           |
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|           |  |                     |              |                             |           |  |          |               |             |            |           |           |           |

Subject Code: Subject Name : THERMAL ENGINEERING Ty/Lb/ L **T**/ P/R С SLr ETL EBME22008 **Prerequisite: Engineering Thermodynamics** Ty 3 0/0 0/0 3

An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

## **UNIT- I: STEAM GENERATORS, CONDENSERS AND NOZZLE**

EDUCATIO

Types and Classifications, high pressure boilers – Benson, Lamont and Babcock-Wilcox Boiler- mountings and Accessories - Criteria for selection of a boiler. Steam Condensers-Classifications - Evaporative and surface condensers-

Steam nozzles--isentropic flow through nozzles-convergent, convergent divergent nozzles-critical pressure ratioeffect of friction.

# **UNIT- II: AIR COMPRESSORS AND GAS TURBINES**

Reciprocating Compressor – Single Stage and Multi-stage operations, Effect of clearance, Volumetric efficiency. Rotary Compressor - Construction & Working of centrifugal compressor.

Gas turbines- classifications-Methods for improvement of Thermal efficiency -Inter-cooling, Reheating, Regeneration, Gas turbine fuels-Applications.

# **UNIT-III: STEAM TURBINES**

Impulse and Reaction Principles - Compounding-velocity and pressure compounding- Velocity diagrams for single stage turbines, Speed regulations – Governing.

# **UNIT- IV: INTERNAL COMBUSTION ENGINES**

Working principles of IC Engines- Stages of combustion in IC engines- Knocking and Detonation- factors affecting knocking-ignition delay-factors affecting ignition delay-Supercharging and turbo charging- various types of loading devices.

# **UNIT- V: REFRIGERATION AND AIR-CONDITIONING**

Working principles of Vapour Compression refrigeration cycle -P-H & T-S diagrams, Calculation of COP, effect of sub-cooling and superheating, Vapour absorption refrigeration cycles – Refrigerants – Properties. Introduction to Psychrometry - Psychrometric charts - Psychrometric processes - Principles of air-Conditioning– Types of a/c systems – Summer, Winter comfort and Year round air-conditioning.

#### Total No. of Periods 45

**\*NOTE:** Use of approved Steam Tables, Refrigeration Tables and Psychrometric Charts are permitted in Examination.

# **TEXT BOOKS**

1) Rajput R. K., (2012) "Thermal Engineering", Laxmi Publications (P) Ltd.

2) C. P. Kothandaraman and S. Domkundwar, (2004) "Thermodynamics and Thermal Engineering" Dhanpat Rai & Co. (P) Ltd.

# REFERENCES

- 2) P. L. Ballaney, (1994) "Thermal Engineering", Khanna Publishers, New Delhi.
- 3) W.P.Stoecker and J. W. Jones, "Refrigeration and Air Conditioning", Tata McGraw Hill Co. Ltd.,
- 4) Ganesan V., (2012) "Internal Combustion Engines", Tata McGraw Hill New Delhi, 4<sup>th</sup> edition.



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| Subject Code   | : S   | ubject Na              | me : MF                      | CHAN          | ICS OF           | MACH          | IINES -            | -II             | T / L/<br>ETL      | L        | T /<br>S.L | P/        | R      | С   |
|--|---|------------------------|------------------------------|---------------|------------------|---------------|--------------------|-----------------|--------------------|----------|------------|-----------|--------|-----|
| EBME22009  |   | nonomici               | to. Fngin                    | ooning        | Jochon           | iog Mod       | hania              | of              | Tr                 | 2        | 1/0        | 0/0       |        | 1   |
|  | N   | Terequisi<br>Iachine-I | te. Engin                    | eering r      | vietnam          | ics, met      | mannes             | 01              | Тy                 | 5        | 1/0        | 0/0       |        | -   |
| L : Lecture T :  | Tutor   | ial SLr :              | Supervise                    | ed Learn      | ing P:           | Practica      | 1 R : Re           | esearch         | C: Cred            | its      |            |           |        | I   |
| T/I/FTI · The  | ory/L   | h/Embed                | ded Theor                    | v and L       | ah               |               |                    |                 |                    |          |            |           |        |     |
| T/L/LTL . The  | <b>OBJECTIVE:</b> The purpose of study is to understand and apply the dynamic analysis of machineries |                        |                              |               |                  |               |                    |                 |                    |          |            |           |        |     |
| <b>OBJECTIVE</b> : The purpose of study is to understand and apply the dynamic analysis of machineries.                                      |   |                        |                              |               |                  |               |                    |                 |                    |          |            |           |        |     |
| COURSE OUTCOMES (COs) : The student will be able to Understand the force analysis of reciprocating mechanisms and its application. (Level 2) |   |                        |                              |               |                  |               |                    |                 |                    |          |            |           |        |     |
|  |   | Closeify t             | a the forc                   | e analys      | sis of rec       | dontifu       | ng meer            | tiona of        | and its            | applica  | ttion.     | Level 2   | ).<br> |     |
| 02   |   | (level 3)              | le vibrato                   | ry syste      | ins and i        | dentify       | the equa           | uions of        | amere              | nt mec   | namea      | li systen | IS.    |     |
| CO3  |   | Solve the              | problems                     | of the v      | ibratorv         | systems       | . (Level           | 3).             |                    |          |            |           |        |     |
| <b>CO4</b>   |   | Demonstr               | ate the dy                   | namic b       | alancing         | of rotat      | ing and            | recipro         | cating n           | nasses.  | ( level    | 3)        |        |     |
| CO5  |   | Distinguis             | h the diff                   | erent spe     | eed gove         | ernors ar     | nd their           | characte        | eristic cu         | urves (1 | level 4    | ).        |        |     |
|  |   | Ma                     | pping of                     | Course        | Outcon           | nes witł      | n Progra           | am Out          | comes (            | Pos)     |            |           |        |     |
| COs/POs  | <b>PO1</b>  | PO2                    | PO3                          | PO4           | PO5              | <b>PO6</b>    | <b>PO7</b>         | <b>PO8</b>      | PO9                | PO       | <b>D10</b> | PO11      | P      | 012 |
| CO1  | 3   | 3                      | 2                            | 2             | 2                | 1             | 2                  | 1               | 2                  |          | 2          | 2         |        | 2   |
| CO2  | 3   | 3                      | 3                            | 2             | 2                | 2             | 2                  | 2               | 2                  |          | 2          | 2         |        | 2   |
| <u>CO3</u>   | 3   | 3                      | 3                            | 2             | 2                | 2             | 2                  | 2               | 2                  |          | 2          | 2         |        | 2   |
| <u>CO4</u>   | 3   | 3                      | 3                            | 2             | 2                | 2             | 2                  | 2               | 2                  |          | 2          | 2         |        | 2   |
| CO5  | 3   | 3                      |                              | $\frac{2}{2}$ | 2<br>DC          | $\frac{2}{2}$ | 2<br>D             | $\frac{2}{104}$ | 2                  |          | 2          | 2         |        | 2   |
| COS / PSUS   | 1   | <u>2501</u>            | PS(                          | )2            | PSO3 PS          |               |                    | <u>004</u>      |                    |          |            |           |        |     |
|  |   | 3                      |                              |               | -                | L             |                    | <u>2</u><br>2   |                    |          |            |           |        |     |
| CO2  |   | 3                      | 2                            |               |                  | 2             |                    | <u>2</u><br>2   |                    |          |            |           |        |     |
| CO4  |   | 3                      | 2                            |               |                  | 2             |                    | $\frac{2}{2}$   |                    |          |            |           |        |     |
| CO5  |   | 3                      | 2                            |               |                  | 2             |                    | 2               |                    |          |            |           |        |     |
| 3/2/1 indicates  | s Strei   | ngth of Co             | orrelation                   | 3- Hi         | gh, 2- M         | ledium,       | 1-Low              |                 |                    |          |            |           |        |     |
|  |   |                        | e                            |               |                  |               |                    |                 |                    |          |            |           |        |     |
| Category   | Basic Science   | Engineering Science    | Humanities and social Scienc | Program Core  | Program elective | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |          |            |           |        |     |
|  |   |                        |                              | Ŧ             |                  |               |                    |                 |                    |          |            |           |        |     |

#### University with Graded Autonomy Status (An ISO 21001 : 2018 Certified Institution)

Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code:<br>EBME22009 | Subject Name : MECHANICS OF MACHINES –II                               | Ty/Lb/<br>ETL | L | T/<br>SLr | P/<br>R | С |
|----------------------------|--|---------------|---|-----------|---------|---|
|                            | <b>Prerequisite: Engineering Mechanics, Mechanics<br/>of Machine-I</b> | Ту            | 3 | 1/0       | 0/0     | 4 |

#### UNIT I FORCE ANALYSIS AND FLYWHEELS

EDUCAT

Static force analysis of mechanisms – D' Alemberts principle - Inertia force and Inertia torque – Dynamic force analysis - Dynamic Analysis in Reciprocating Engines – Gas Forces - Equivalent masses - Bearing loads - Crank shaft Torque–Engine shakingforces - Turning moment diagrams - Flywheels of engines and punch press.

### UNIT II BALANCING

Static and dynamic balancing - Balancing of rotating masses in several planes - Partial Balancing of a single cylinder Engine – Primary and secondary unbalanced forces.

# UNIT III FREE VIBRATION

Basic features of vibratory systems - Basic elements and lumping of parameters - Degrees of freedom -Single degree of freedom – Longitudinal and transverse Free vibration - Equations of motion natural frequency - Types of Damping -Damped free vibration –Whirling of shafts and critical speed -Torsional systems; Natural frequency of two and three rotor systems – torsionally equivalent shaft system.

### UNIT IV FORCED VIBRATION

Response to periodic forcing - Harmonic Forcing - Forced vibration caused by unbalance - Support motion - Force transmissibility and amplitude transmissibility - Vibration isolation

#### UNIT V MECHANISMS FOR CONTROL

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors - Characteristics - Effect of friction - Controlling Force - Quality of governors - effect of friction. Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in aero plane, automobiles and ships.

Total No. of Periods: 60

# **TEXT BOOKS:**

1. Ambedkar A. G., Mechanism and Machine Theory, Prentice Hall of India, New Delhi, 2007.

#### REFERENCES

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.

2. Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", Affiliated East-Press Pvt.Ltd., New Delhi, 1988.

- 3. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw-Hill, Inc., 1995.
- 4. Rao J.S. and Dukkipati R.V., "Mechanism and Machine Theory ", Wiley-Eastern Limited, New Delhi, 1992.
- 5. John Hannah and Stephens R.C., "Mechanics of Machines", Viva low-Priced Student Edition, 1999.
- 6. Sadhu Singh "Theory of Machines" Pearson Education, 2002.



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| Subject Code:          | : Subj  | ject Nan   | ne : MAN    | UFAC                      | <b>TURIN</b> | G TECH     | INOLO      | GY - II         | Ty/Lb       | / L      | T/          | P/R | С  |
|------------------------|---|------------|-------------|---------------------------|--------------|------------|------------|-----------------|-------------|----------|-------------|-----|----|
| EBME22ET3              |   |            |             |                           |              |            |            |                 | ETL         |          | SLr         |     |    |
|                        | Prer  | equisite   | : Manufa    | cturing                   | Techno       | ology - I  |            |                 | ETL         | 2        | 0/0         | 2/0 | 3  |
| L : Lecture T :        | Tutoria   | 1 SLr :    | Supervis    | ed Learr                  | ning P:      | Project    | R : Rese   | earch C: 0      | Credits     |          |             |     |    |
| T/L/ETL : The          | ory/Lab   | /Embed     | ded Theor   | y and L                   | ab           |            |            |                 |             |          |             |     |    |
| OBJECTIVE              | :   |            |             |                           |              |            |            |                 |             |          |             |     |    |
| To imp                 | part kno  | wledge a   | and skill i | n metal o                 | cutting p    | process a  | ind smai   | rt manufa       | acturing te | chnology | <i>i</i>    |     |    |
| COURSE OU              | тсом  | ES (CO     | (3.5)       | )                         |              |            |            |                 |             |          |             |     |    |
| CO1                    | Understand the concepts of metal cutting and related informations (Level 2) |            |             |                           |              |            |            |                 |             |          |             |     |    |
| CO2                    | Acquire skill in special purpose machines (Level 4)                         |            |             |                           |              |            |            |                 |             |          |             |     |    |
| CO3                    | Select ar   | propria    | te method   | of man                    | ifacturir    | ig based   | 1 on the   | requirem        | nent (Leve  | 14)      |             |     |    |
| CO4                    | Understa  | and the c  | concepts a  | nd appli                  | cations      | of smar    | t manuf    | acturing        | (Level 3)   | 1 1)     |             |     |    |
| CO5                    | Acquire   | skill in s | smart man   | ufacturi                  | ng techr     | niques (   | Level 4)   | )               | ( /         |          |             |     |    |
|                        | <b>^</b>  | Ma         | pping of    | Course                    | Outcom       | nes with   | Progra     | m Outco         | omes (POs   | 5)       |             |     |    |
| Cos/Pos                | PO1   | PO2        | PO3         | PO4                       | PO5          | <b>PO6</b> | <b>PO7</b> | PO8             | PO9         | PO10     | <b>PO11</b> | PO  | 12 |
| CO1                    | 3   | 3          | 2           | -                         | 2            | 3          | 3          | 2               | 3           | 2        | 2           |     | 2  |
| CO2                    | 3   | 3          | 3           | -                         | 2            | 3          | 3          | 2               | 3           | 2        | 2           |     | 2  |
| CO3                    | 3   | 3          | 3           | -                         | 2            | 3          | 3          | 2               | 3           | 2        | 2           |     | 2  |
| C04                    | 3   | 3          | 2           | -                         | 3            | 3          | 3          | 2               | 3           | 2        | 2           |     | 2  |
| $C_{OS}/PSO_{S}$       | <u>3</u>  | 3          |             | -                         | <u> </u>     |            | 3<br>D(    |                 | <u> </u>    | 2        | 2           |     | 2  |
| $\frac{C08/F508}{C01}$ | <u>P5</u>   | 2          | P50         | J2                        | PS           | <u>03</u>  | P:         | <u>304</u><br>2 | P505        |          |             |     |    |
| CO2                    |   | 3<br>2     | 3           |                           |              | 2          |            | 3               |             |          |             |     |    |
| CO3                    |   | <u>,</u>   | 3           |                           |              | 2          |            | 3               |             |          |             |     |    |
| <b>CO4</b>             |   | 3          | 3           |                           |              | 3          |            | 3               |             |          |             |     |    |
| CO5                    |   | 3          | 3           |                           |              | 3          |            | 3               |             |          |             |     |    |
| 3/2/1 indicates        | Strengt   | h of Co    | rrelation   | 3- Hig                    | h, 2- Me     | edium, 1   | 1-Low      |                 |             |          |             | · · |    |
|                        |   |            |             |                           |              |            |            |                 |             |          |             |     |    |
|                        |   |            | ce          |                           |              |            |            |                 |             |          |             |     |    |
|                        |   |            | ien         |                           |              |            |            |                 |             |          |             |     |    |
|                        |   |            | Sc          |                           |              |            |            |                 |             |          |             |     |    |
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| iteg                   | ıce   | S          | and         | re                        | elec         | ve         | plin       | uou             | roj         |          |             |     |    |
| ü                      | cieı  | ing        | ies         | Co                        | am           | scti       | scij       | luc             | ul /F       |          |             |     |    |
|                        | c S   | ieer       | mit         | am                        | 3gr          | Ele        | Di         | Ŭ               | tice        |          |             |     |    |
|                        | asi   | ıgir       | jmt         | ogr                       | Pr(          | Den        | ntei       | kil             | rac         |          |             |     |    |
|                        | E   | Еr         | Η̈́         | $\mathbf{P}_{\mathbf{r}}$ |              | Ō          | I          | S               | <u>ц</u>    |          |             |     |    |
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|--|------------------------|
| University with Graded Autonomy Status                               |                        |
| (An ISO 21001 : 2018 Certified Institution)                          |                        |
| Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India. |                        |

| Subject Code: | Subject Name : MANUFACTURING TECHNOLOGY - II | T / L/ | L | Τ/   | <b>P</b> / | С |
|---------------|--|--------|---|------|------------|---|
|               |  | ETL    |   | S.Lr | R          |   |
| EBME22ET3     | Prerequisite: Manufacturing Technology - I   | ETL    | 2 | 0/0  | 2/0        | 3 |

# **UNIT- I: THEORY OF METAL CUTTING**

Metal cutting types - Mechanism of metal cutting - Cutting forces - Chip formation - Merchant's circle diagram -Calculations – Tool geometry - Machinability - Tool wear - Tool life - Cutting tool materials - Cutting fluids.

# UNIT- II: SPECIAL PURPOSE MACHINES-I

Shaper, Planer, slotter: Specification - Types - Mechanism – Calculations Boring: Specification - Types - Operations - Boring tool - Jig Boring machine. Broaching: Specification - Types - Tool nomenclature - Broaching process.

# Lab Components

Shaping, and Slotting Practice: Cutting key ways and dove tail hexagonal machining using Shaper, Internal keyway using slotter

# UNIT- III: SPECIAL PURPOSE MACHINES-II

Milling: Specification - Types - Cutter nomenclature - Types of cutter - Milling processes - Indexing – Cam and thread milling.

Grinding: Types of grinding machine - Designation and selection of grinding wheel - Bonds – Reconditioning of grinding wheel – Lapping, honing and super finishing.

# Lab Components

Grinding Practice: Cylindrical grinding, Surface grinding.

Milling Practice: Hexagonal milling, Contour milling

# **UNIT- IV: GEAR CUTTING MACHINES**

Kinematics of gear shaping and gear hobbing - Gear generation principles specifications – Cutters - Bevel geargenerator - Gear finishing methods.

# Lab Components

Machining of helical gear using hobbing machine, Spur gear milling

# **UNIT- V: SMART MANUFACTURING**

Industry 4.0, Cyber Physical system, IoT and Cloud computing for manufacturing, Digital manufacturing, Additive manufacturing, Sustainable manufacturing, advanced simulation, Augmented reality

# Lab Components

Additive manufacturing: Simple components design, slicing and fabrication using FDM machine

# **TEXT BOOKS**

- 1) S. K. Hajra Choudry, S. K. Bose, (2010) "Elements of Workshop Technology -Volume I & II". Media promoters.
- 2) P. C. Sharma, (2008) "A text book of Production Engineering", S. Chand and Co. Ltd., IV Edition.
- 3) Masoud Soroush, Michael Baldea, Thomas F. Edgar (2020) "Smart Manufacturing" Elsevier Science. *REFERENCES* 
  - 1) H.M.T, (1990) "Production Technology Handbook", TMH.
  - 2) Richara R. Kibbe, John E. Neely, Roland O. Meyer and Warrent T. White, (2009) "Machine Tool Practices", VI Edition, Prentice Hall of India.
  - 3) N. K. Mehta, (2012) "Machine Tool Design and NC", Tata McGraw Hill Publishing Co. Ltd.
  - 4) Jaeger R.C, (1988) "Introduction to microelectronics fabrication", Addison Wesley pub. Co.,
- 5) C. Elanchezian, M. Vijayan, (2004) "Machine Tools" Anuradha Publications.



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| Subject Code:<br>EBOL22I01 | Subject Name: ONLINE COURSE<br>NPTEL/SWAYAM/Any MOOC APPROVED BY<br>AICTE/UGC | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|----------------------------|---|---------------|---|-----------|-----|---|
|                            | Pre requisite:  | IE            | 1 | 0/0       | 1/0 | 1 |

Students should register for the online course with a minimum course duration of 4 weeks through the online portals such as NPTEL/SWAYAM/Any MOOC in the beginning of the semester. A mentor will be assigned by the department for monitoring the students.

Students are expected to attend the online classes regularly and submit the weekly assignments before the due dates. Students should appear for the online examination and submit the certificate at the end of the semester .Internal Examination will be conducted by the examiners duly appointed by the head of the department.



| Subject Code  | bubject Code: Subject Nan   |   |          |           | MICS       | LAB     |         |       | T / L/ |           | L    | Γ/<br>SIr | <b>P/ R</b> | C  |  |  |  |  |  |
|---|---|---|----------|-----------|------------|---------|---------|-------|--------|-----------|------|-----------|-------------|----|--|--|--|--|--|
| EBME22L04   |   |   |          |           |            |         |         |       |        |           | ĥ    | 5.L1      |             |    |  |  |  |  |  |
|   | Prer  | Prerequisite: Mechanics of Machines-I &II |          |           |            |         |         |       |        |           | 0 (  | )/0       | 3/0         | 1  |  |  |  |  |  |
| L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits |   |   |          |           |            |         |         |       |        |           |      |           |             |    |  |  |  |  |  |
| T/L/ETL : Theory/Lab/Embedded Theory and Lab  |   |   |          |           |            |         |         |       |        |           |      |           |             |    |  |  |  |  |  |
| OBJECTIVE   | <b>TIVES:</b> The student will learn<br>Working of simple mechanisms      |   |          |           |            |         |         |       |        |           |      |           |             |    |  |  |  |  |  |
| • WORK1   | For find natural frequency of vibrating system at different models        |   |          |           |            |         |         |       |        |           |      |           |             |    |  |  |  |  |  |
| COURSE OU   | <b>DURSE OUTCOMES (COs) : The student will be able to</b>                 |   |          |           |            |         |         |       |        |           |      |           |             |    |  |  |  |  |  |
| CO1   | Gain knowledge in kinematics and Dynamics of Machinery (Level 2)          |   |          |           |            |         |         |       |        |           |      |           |             |    |  |  |  |  |  |
| CO2   | Characterize the dynamic properties of component or equipments (          |   |          |           |            |         |         |       |        | (Level 4) |      |           |             |    |  |  |  |  |  |
| CO3   | Analyze the vibration characteristics (Level 4)                           |   |          |           |            |         |         |       |        |           |      |           |             |    |  |  |  |  |  |
| CO4   | Apply various principles for dynamic solutions (Level 3)                  |   |          |           |            |         |         |       |        |           |      |           |             |    |  |  |  |  |  |
| CO5   | Illustrate the method of static and dynamic balancing of masses (Level 4) |   |          |           |            |         |         |       |        |           |      |           |             |    |  |  |  |  |  |
| Mapping of Course Outcomes with Program Outcomes (POs)                                  |   |   |          |           |            |         |         |       |        |           |      |           |             |    |  |  |  |  |  |
| Cos/Pos   | <b>PO1</b>  | PO2                                       | PO3      | PO4       | PO5        | PO6     | PO7 PO8 |       | PO9    |           | PO10 | PO11      | PO          | 12 |  |  |  |  |  |
| CO1   | 3   | 3   | 3        | 3         | 3          | 2       | 2       | 2     | 3      |           | 3    | 2         |             | 2  |  |  |  |  |  |
| CO2   | 3   | 3   | 3        | 3         | 3          | 3 2     |         | 2     | 3      |           | 3    | 2         |             | 2  |  |  |  |  |  |
| CO3   | 3   | 3   | 3        | 2         | 3          | 3 2     |         | 2     | 3      |           | 3    | 2         |             | 2  |  |  |  |  |  |
| CO4   | 3   | 3   | 3        | 2         | 3          | 2       | 2       | 2     | 3      |           | 3    | 2         | 2           |    |  |  |  |  |  |
| CO5   | 3   | 3   | 3        | 2         | 3          | 2       | 2       | 2     | 3      |           | 3    | 2         |             | 2  |  |  |  |  |  |
| Cos / PSOs  | PS  | 501                                       | PS       | 02        | PS         | 03      | PS      | 504   |        |           |      |           |             |    |  |  |  |  |  |
| CO1   |   | 3   | 3        |           |            | 2       |         | 3     |        |           |      |           |             |    |  |  |  |  |  |
| CO2   |   | 3   | 3        |           | 2 3        |         |         | 3     |        |           |      |           |             |    |  |  |  |  |  |
| CO3   | í   | 3   | 3        |           | 2          |         | 3       |       |        |           |      |           |             |    |  |  |  |  |  |
| CO4   | í   | 3   | 3        |           |            | 2       |         | 3     |        |           |      |           |             |    |  |  |  |  |  |
| CO5   | í   | 3   | 3        |           |            | 2       |         | 3     |        |           |      |           |             |    |  |  |  |  |  |
| 3/2/1 indicates   | Strengt   | h of Cor                                  | relation | 3- High   | n, 2- Me   | dium, 1 | -Low    |       |        |           |      |           |             |    |  |  |  |  |  |
|   |   |   |          |           |            |         |         |       |        |           |      |           |             |    |  |  |  |  |  |
|   |   |   | ce       |           |            |         |         |       |        |           |      |           |             |    |  |  |  |  |  |
|   |   |   | ien      |           |            |         |         |       |        |           |      |           |             |    |  |  |  |  |  |
|   |   |   | l Sc     |           |            |         |         |       |        |           |      |           |             |    |  |  |  |  |  |
| Ŕ   |   | JCe                                       | cia      |           | <i>j</i> e |         | ~       |       |        |           |      |           |             |    |  |  |  |  |  |
| gor   |   | cieı                                      | d sc     |           | ctiv       |         | nary    | lent  | ject   |           |      |           |             |    |  |  |  |  |  |
| ate   | ince  | S<br>S                                    | ano      | ore       | ele        | ive     | iplii   | por   | Pro    |           |      |           |             |    |  |  |  |  |  |
|   | Scie  | ling                                      | ties     | Ŭ         | ram        | lect    | lisc    | om    | al/    |           |      |           |             |    |  |  |  |  |  |
|   | sic (   | inee                                      | iani     | gran      | rog        | n El    | er L    | III C | ictic  |           |      |           |             |    |  |  |  |  |  |
|   | Ba  | -<br>Bug                                  | Hun      | Prog      | P          | Dpe     | Int     | Sk    | Prá    |           |      |           |             |    |  |  |  |  |  |
|   |   |   |          | <b> →</b> |            |         | ✓       |       |        |           |      |           |             |    |  |  |  |  |  |
|   | 1   | 1   | 1        |           |            |         |         |       |        |           |      |           |             |    |  |  |  |  |  |



| Subject Code: | Subject Name :                            | T / L/ | L | Τ /  | <b>P/ R</b> | C |
|---------------|---|--------|---|------|-------------|---|
| -             | DYNAMICS LAB                              | ETL    |   | S.Lr |             |   |
| EBME22L04     | Prerequisite: Mechanics of Machines-I &II | Lb     | 0 | 0/0  | 3/0         | 1 |

#### **KINEMATICS (Demonstration only)**

- 1. Kinematics of four bar mechanisms Slider Crank, Crank Rocker Mechanism.
- 2. Kinematics of Gears Spur, Helical, Bevel, Worm.
- 3. Kinematics of Gear trains Simple, Compound, Epicyclic & differential gear trains.

#### 1. DYNAMICS

- a. Motorized Gyroscope Verification of Laws.
- b. Connecting Rod and Flywheel Determination of M.I. by oscillation.
- c. Governors Watts, Porter, Proell and Hartnell Study of characteristics and determination of Sensitivity, effort etc.
- d. Cam-profile of the cam-study of Jump phenomenon Determination of Critical Speeds.

### 2. VIBRATING SYSTEMS

- a. Helical Spring Determination of natural frequency
- b. Compound Pendulum Determination of natural frequencies moment of inertia.
- c. Torsional vibration Determination of natural frequencies Single rotor system Two rotor system
- d. Flywheel Determination of torsional natural frequencies moment of inertia.
- e. Whirling of shaft Determination of critical speed of shaft.

#### **3. BALANCING**

Static and dynamic balancing of rotating masses



| Subject Code:     |  | ubject Na  | me : THE  | RMAL I    | ENGINE           | ERING    | LAB-I    | T        | T / L/ L T /   |     |         |       |    |         | C  |  |  |
|-------------------|--|--|---|-----------|------------------|----------|----------|----------|----------------|-----|---------|-------|----|---------|----|--|--|
| EBME22L05         |  |  |   |           |                  |          |          | E        | ETL            |     |         | S.Lr  | •  |         |    |  |  |
|                   |  | Prerequisite: Thermodynamics and Thermal   |   |           |                  |          |          |          | Lb             | )   | 0       | 0/    | 0  | 3/0     | 1  |  |  |
| I · Lecture T · 7 | g<br>parvised Learning D. Project D. Desearch C. Credite |  |   |           |                  |          |          |          |                |     |         |       |    |         |    |  |  |
| T/L/ETL · Theo    | rv/Lah/  | Embedded   | Theory ar   | nd Lab    | 1.110jec         | <i></i>  | searen e | . crea   | 11.5           |     |         |       |    |         |    |  |  |
|                   |  |  |   | la Luo    |                  |          |          |          |                |     |         |       |    |         |    |  |  |
| • To eva          | luate th   | e performa   | nce of stea   | ım turbir | nes and IC       | Cengines | 3.       |          |                |     |         |       |    |         |    |  |  |
| COURSE OUT        | ГСОМІ  | ES (COs) :   |   |           |                  | 8        |          |          |                |     |         |       |    |         |    |  |  |
| CO1               | CO1 Unders   |  | Understand the concept of working and performance of steam turbines                       |           |                  |          |          |          |                |     |         |       |    |         |    |  |  |
| CO2               |  | Analyze th   | alyze the performance and heat balance test of IC engines                                 |           |                  |          |          |          |                |     |         |       |    |         |    |  |  |
| CO3               |  | Determine  | termine and Draw performance characteristics curve of IC engines                          |           |                  |          |          |          |                |     |         |       |    |         |    |  |  |
| CO4               | ]  | Determine  | termine the IP and Mechanical efficiency on multi cylinder diesel engine using Morse test |           |                  |          |          |          |                |     |         |       |    |         |    |  |  |
| CO5               |  | Analyse the performance, emission and combustion characteristics of diesel engines with di |   |           |                  |          |          |          |                |     | fferent | fuels |    |         |    |  |  |
| Mapping of Co     | ourse O  | utcomes w  | vith Progr  | am Outo   | comes (P         | os)      |          |          |                |     |         | ,<br> |    |         |    |  |  |
| FF8               |  |  | 8-  |           | (                | )        |          |          |                |     |         |       |    |         |    |  |  |
| Cos/Pos           | PO1  | PO2  | PO3   | PO4       | PO5              | PO6      | PO7      | PO8      |                | PO9 | P       | O10   | PC | PO11 PC |    |  |  |
|                   |  |  |   |           |                  |          |          |          |                |     |         |       |    |         | 12 |  |  |
| CO1               | 3  | 2  |   | 2         | 1                |          | 2        |          |                |     |         |       |    |         |    |  |  |
| CO2               | 3  | 1  |   | 2         |                  |          | 2        |          |                |     |         |       |    |         |    |  |  |
| C03               | 2  | -  |   | 3         |                  |          | 3        |          |                |     |         |       |    |         |    |  |  |
| C04               | 3  | 1  |   | 2         | -                |          | 2        |          |                |     |         |       |    |         |    |  |  |
| <u>CO5</u>        | 2  |  | DC  | 3         | DC               |          | 3        |          |                |     |         |       |    |         |    |  |  |
| Cos / PSOs        | 2PS0   | 2  | PS02  |           | PS               | 503      | P        | 804      |                |     |         |       |    |         |    |  |  |
| <u>CO1</u>        |  | 3  | $\frac{2}{2}$   |           |                  |          |          |          |                |     |         |       |    |         |    |  |  |
| <u>CO2</u>        | 2  |  | 2   |           |                  |          |          |          |                |     |         |       |    |         |    |  |  |
| C03               | 2  |  | 2   |           | -                |          | -        |          |                |     |         |       |    |         |    |  |  |
| <u>CO4</u>        | 2  |  | 2   |           | -                |          |          |          |                |     |         |       |    |         |    |  |  |
| 2/2/1 : 1:        | C4   |  | 2   | 2 11      | h 2 Madium 1 Law |          |          |          |                |     |         |       |    |         |    |  |  |
| 3/2/1 indicates   | Streng   | gth of Col   | rrelation   | 3- Hig    | gn, 2- Mi        | eaium,   | 1-LOW    |          |                |     |         |       |    |         |    |  |  |
|                   |  |  |   |           |                  |          |          |          |                |     |         |       |    |         |    |  |  |
|                   |  |  | al  |           |                  |          |          |          |                |     |         |       |    |         |    |  |  |
|                   |  |  | )CI   |           | ve               |          | N        | <b>_</b> | L.             |     |         |       |    |         |    |  |  |
|                   |  |  | l sc  |           | cti              |          | Jar      | eni      | ec             |     |         |       |    |         |    |  |  |
|                   | lce  |  | anc   | e         | ele              | /e       | lilc     | uo       | roj            |     |         |       |    |         |    |  |  |
|                   | ier  | ng   | Se  | C<br>C    | B                | ctiv     | cij      | du       | I/P            |     |         |       |    |         |    |  |  |
|                   | Sc   | eri  | e liti  | u<br>U    | gra              | flee     | Dis      | S        | cal            |     |         |       |    |         |    |  |  |
|                   | sic  | ine  | nce   | graı      | log              | n E      | er ]     | E        | lcti           |     |         |       |    |         |    |  |  |
| ory               | Ba   | ing  | lun<br>cie  | roξ       | Р                | be       | Int      | Sk       | $\Pr_{\delta}$ |     |         |       |    |         |    |  |  |
| tegu              |  | ЦN   | З   |           |                  |          |          |          |                | ✓   |         |       |    |         |    |  |  |
| Cat               |  |  |   |           |                  |          |          |          |                |     |         |       |    |         |    |  |  |
|                   | 1  |  |   | 1         | 1                |          |          | 1        | 1              |     |         |       |    |         |    |  |  |


| Subject Code: | Subject Name : THERMAL ENGINEERING LAB-I | T / L/ ETL | L | Τ /  | P/ R | С |
|---------------|--|------------|---|------|------|---|
|               |  |            |   | S.Lr |      |   |
| EBME22L05     | Prerequisite: Thermal Engineering        | Lb         | 0 | 0/0  | 3/0  | 1 |

#### LIST OF EXPERIMENTS:

#### IC ENGINES LAB

- 1. Study of IC engines components and loading devices.
- 2. Valve timing and port timing diagrams.
- 3. Performance test on 4-stroke twin cylinder diesel engine.
- 4. Heat balance test on 4-stroke single cylinder diesel engine.
- 5. Performance test on single cylinder 4-stroke petrol engine.
- 6. Morse test on multi cylinder petrol engine.
- 7. Retardation test to find frictional power of a diesel engine.
- 8. Combustion and Exhaust analysis of an IC Engine with different Fuels.

#### STEAM LAB

- 1. Study of steam generators and turbines.
- 2. Performance and energy balance test on a steam generator.
- 3. Performance and energy balance test on a steam turbine.
- 4. Performance test on a steam condenser.



| Subject Code: | Subject Name: TECHNICAL SKILL-II               | T / L/<br>ETL/IE | L | T /<br>S.Lr | P/ R | С |
|---------------|--|------------------|---|-------------|------|---|
| EBME22I02     | Pre requisite: All Subjects Studied Up to Date | IE               | 0 | 0/0         | 2/0  | 1 |

Students should acquire skill in the domain/inter disciplinary area from government/private training centers/industries /University for a minimum period of 15 calendar days. The training can be through off line, online or mixed mode. Students are supposed to prepare Technical skill report at the end of the training and submit the report along with the certificate in proof of the training, during the viva voce examination conducted by the examiners duly appointed by the head of the department.



# **SEMESTER VI**

| EDUCATIONAL AND RESEARCH INSTITUTE          | Soluted Wirns op to |
|---|---------------------|
| DEEMED TO BE UNIVERSITY                     | * * * *             |
| University with Graded Autonomy Status      |                     |
| (An ISO 21001 : 2018 Certified Institution) |                     |

(An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code                  | : Su   | bject Na                       | Name : HEAT AND MASS TRANSFER |               |                  |             |                  |                |                  | L       | <b>T</b> /                  | P/R   | C       |
|-------------------------------|--|--------------------------------|-------------------------------|---------------|------------------|-------------|------------------|----------------|------------------|---------|-----------------------------|-------|---------|
|                               |  |                                |                               |               |                  |             |                  |                | ETL              |         | SLr                         |       |         |
| EBME22010                     | Pr   | erequisi                       | te: Engir                     | neering       | Therm            | odynan      | nics             |                | Ту               | 3       | 1/0                         | 0/0   | 4       |
| L : Lecture T :               | Tutoria  | l S Lr                         | : Supervis                    | sed Lear      | ning P :         | Project     | R : Res          | earch (        | C: Credits       |         |                             | 1     | <b></b> |
| T/L/ETL : The                 | eory/Lab   | /Embed                         | ded Theor                     | ry and L      | ab               |             |                  |                |                  |         |                             |       |         |
| OBJECTIVE                     | S: The s   | student v                      | vill learn                    |               |                  |             |                  |                |                  |         |                             |       |         |
| Conce                         | pt and r   | nodes of                       | heat and                      | mass tra      | nsfer.           |             |                  | _              |                  |         |                             |       |         |
| Conce                         | pt of va   | rious hea                      | t transfer                    | correlat      | ions and         | l their ei  | ngineerin        | ng calc        | ulations.        |         |                             |       |         |
| • Conce                       | $\frac{\text{pt and t}}{\text{TCOM}}$  | ypes of r<br>$\mathbf{FS}$ (CO | $\frac{1}{1}$                 | ngers         |                  |             |                  |                |                  |         |                             |       |         |
| COURSE OC                     | Unders   | tand the                       | $\frac{s}{knowled}$           | )<br>re of Co | nduction         | heat tr     | ansfer ar        | nd its a       | nnlications      | (Level  | 2)                          |       |         |
|                               | Apply  | the conc                       | ant of for                    | sed and       | free con         | vection     | hoot tror        | nu no a        | d its applic     | ations  | $(\mathbf{I}_{\text{AVA}})$ | 3)    |         |
| CO2                           | Evelor   | a the ope                      | liestions                     | of redict     | ion host         | transfo     |                  |                | iu ns applie     | ations. | (Level                      | 3)    |         |
| <u>CO</u> 4                   | Explore the applications of radiation heat transfer. (Level 3)<br>Understand the knowledge of phase change heat transf |                                |                               |               |                  |             |                  |                | and heat         | arahan  | ~~~ in                      | anain | aamina  |
| 04                            | applica  | tions. (L                      | evel 2)                       | uge of        | phase of         | anster      | and neat         | excitait       | gers m           | engin   | eening                      |       |         |
| CO5                           | Apply  | the mass                       | transfer c                    | concepts      | s. (Lev          | el 3)       |                  |                |                  |         |                             |       |         |
| Mapping of C                  | Course Outcomes with Program Outcomes (POs)  |                                |                               |               |                  |             |                  |                |                  |         |                             |       |         |
| COs/POs                       | PO1  | PO2                            | PO3                           | PO4           | PO5              | PO6         | PO7              | PO8            | PO9              | PO10    | ) PO                        | 11 ]  | PO12    |
| CO1                           | 3  | 3                              | 2                             | 1             | 2                | 1           | 2                | 1              | 1                | 1       |                             | -     | 2       |
| CO2                           | 3  | 3                              | 2                             | 2             | 2                | 1           | 1                | 1              | 2                | 2       |                             | -     | 2       |
| CO3                           | 2  | 3                              | 2                             | 1             | 2                | 2           | 2                | 1              | 1                | 2       |                             | -     | 2       |
| CO4                           | 3  | 2                              | 1                             | 1             | 2                | 1           | 1                | 1              | 1                | 1       |                             | -     | 2       |
| CO5                           | 3  | 3                              | 2                             | 3             | 2                | 1           | 1                | 1              | 2                | 2       |                             | -     | 2       |
| COs / PSOs                    | PS   | 501                            | PSC                           | 02            | PS               | 03          | PS               | 504            |                  |         |                             |       |         |
| COI                           |  | 3                              | 2                             |               |                  | 2           |                  | 3              |                  |         |                             |       |         |
| <u>CO2</u>                    |  | 3                              | 2                             |               |                  | 2           |                  | 3              |                  |         |                             |       |         |
| <u>CO3</u>                    |  | 3                              | 2                             |               |                  | 2           |                  | 3              |                  |         |                             |       |         |
| C04                           |  | 3                              |                               |               |                  | 2           |                  | <u>3</u>       |                  |         |                             |       |         |
| $\frac{COJ}{2/2/1}$ indicator | Strongt  | 5<br>th of Cou                 | <u>4</u>                      | 2 Uia         |                  |             | 1 Low            | 2              |                  |         |                             |       |         |
| 5/2/1 mulcates                | Strengt  |                                | Telation                      | <u>3- nig</u> | 11, 2- 1vie      |             |                  |                |                  |         |                             |       |         |
| Open Electives                | asic Science   | gineering<br>ence              | manities and social<br>ence   | gram Core     | Program elective | en Elective | ter Disciplinary | cill Component | actical /Project |         |                             |       |         |
|                               | B  | En                             | Hu<br>Sci                     | Prc           |                  | Op          | In               | S              | 4<br>I           |         | _                           |       |         |
|                               |  |                                |                               |               |                  |             |                  |                |                  |         |                             |       |         |

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| Subject Code: | Subject Name : HEAT AND MASS TRANSFER    | Ty/Lb/ | L | <b>T</b> / | P/R | С |
|---------------|--|--------|---|------------|-----|---|
| EDME22010     |  | ETL    |   | SLr        |     |   |
| EBNIE22010    | Prerequisite: Engineering Thermodynamics | Ту     | 3 | 1/0        | 0/0 | 4 |

#### **UNIT-I: CONDUCTION**

EDUCA

Introduction of heat transfer - Mode of Heat Transfer- Fourier' Law of Conduction - General Differential equation of Heat Conduction- Heat conduction through Plane Wall, Cylinders and Spherical systems Composite Systems - Critical thickness of insulation - Extended surfaces (Fins).

#### **UNIT-II: CONVECTION**

Basic Concepts - Boundary Layer Concept - Types of Convection - Forced Convection-External Flow- Flow Flow-Laminar over flat plates. Cylinders and Spheres-Internal and Turbulent Flow-Combined Laminar and Turbulent -Free Convection - Flow over Vertical Plate, Horizontal Plate and long horizontal cylinder.

#### **UNIT-III: RADIATION**

Basic Laws of Radiation, Radiation shape factor, shape factor algebra for radiant heat exchange between black and gray bodies and Radiation shield-, Introduction to Radiosity and Irradiation.

#### **UNIT- IV: PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER**

Boiling heat transfer phenomenon – modes of boiling, pool boiling regime-flow boiling thro horizontal pipes.boiling empirical correlations. Condensation-film and drop wise condensation-Nusselt theory of condensation over vertical surface.

Heat exchangers- Classifications, parallel, counter and cross flow- Fouling factors- LMTD and NTU methods

#### **UNIT- V: MASS TRANSFER**

**Basic Concepts** 

Diffusion Mass Transfer - Fick's Law of Diffusion - Steady state Molecular Diffusion - Equimolar counter diffusion - isothermal evaporation.

#### **Convective Mass Transfer**

Convective Mass Transfer Correlations- Sherwood number, Schmidt number, Stanton number- mass transfer coefficients- Laminar, turbulent and Laminar-turbulent conditions.

#### Total No. of Periods : 60

**\*NOTE:** Use of approved HMT data book is permitted in the University Examination.

#### **TEXT BOOKS**

- 1) C.P.Kothandaraman, (2005) "Fundamentals of Heat and Mass Transfer", New age International (p) Ltd-109098.
- 2) R.C.Sachdeva (2010). "Fundamentals of Heat and Mass Transfer", New age International (p) Ltd -109098, 4<sup>th</sup> edition.
- 3) R.K.Rajput (2007) "Heat and Mass transfer", Chand Publishers

## REFERENCES

- 1) J.P.Holman (2001) "Heat transfer", McGraw Hill Book Company, 9<sup>th</sup> edition.
- 2) Ozisik.N.M. (1998) "Heat transfer", McGraw Hill Book Company.
- 3) Michael A. Boles and Yunus A. Cengel (2002), "Thermodynamics: An Engineering Approach", McGraw-Hill.



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# 12

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10

# EDUCATIONAL AND RESEARCH INSTITUTE DEEMED TO BE UNIVERSITY University with Graded Autonomy Status (An ISO 21001 : 2018 Certified Institution)

|                 | Su   | ubject Name : CAD,CAM & CIM |              |           |            |          | ilennai-93             |                   | Ty/Lb/     | L      | T/  | P/R | С  |  |  |
|-----------------|--|-----------------------------|--------------|-----------|------------|----------|------------------------|-------------------|------------|--------|-----|-----|----|--|--|
|                 | Pr   | oroquisi                    | te: Desim    | n of Ma   | chine F    | lomonte  | 2                      |                   |            | _      | SLr |     |    |  |  |
|                 | Ma   | anufacti                    | iring Tecl   | hnology   |            | Aemenu   | ,                      |                   | Ту         | 3      | 0/0 | 0/0 | 3  |  |  |
| Subject Code:   |  |                             |              |           |            |          |                        |                   |            |        |     |     |    |  |  |
| EBME22011       |  |                             |              |           |            |          |                        |                   |            |        |     |     |    |  |  |
| L : Lecture T : | Tutoria  | l S.Lr                      | : Supervis   | ed Lear   | ning P :   | Project  | R : Res                | earch C           | C: Credits |        |     |     |    |  |  |
| T/L/ETL : The   | ory/Lab  | /Embed                      | ded Theor    |           |            |          |                        |                   |            |        |     |     |    |  |  |
| • To pro        | CTIVE<br>vide an   | :<br>overvie                | w of how     | sign, d   | evelopment | t of Ma  | nufacturir             | g plan            | s and      |        |     |     |    |  |  |
| manuf           | acture   | the need                    | 1 for into a | notion o  |            |          |                        |                   |            |        |     |     |    |  |  |
| • 10 unc        | ierstand   | the need                    | 1 for integ  | ration o  | I CAD,     |          |                        |                   |            |        |     |     |    |  |  |
|                 |  |                             | COUR         | SE OU     | ГСОМЕ      | 5)       |                        |                   |            |        |     |     |    |  |  |
| CO1             | Underst  | and the o                   | concepts a   | ind uses  | of vario   | ous CAE  | devices                | s (Leve           | 12)        |        |     |     |    |  |  |
| CO2             | Apply v  | arious C                    | AD mode      | ling tecl | hniques    | (Level 3 | 3)                     |                   |            |        |     |     |    |  |  |
| CO3             | Underst  | and the                     | CNC mac      | hines an  | d intege   | ration o | f CAD/O                | CAD/CAM (Level 2) |            |        |     |     |    |  |  |
| CO4             | Analyze  | and wri                     | te down p    | art prog  | rammin     | nilling  | g operations (Level 4) |                   |            |        |     |     |    |  |  |
| CO5             | Apply g  | roup tec                    | hnology a    | nd com    | outer aid  | ning an  | d understar            | nd the F          | MS conce   | pt and |     |     |    |  |  |
|                 | functions (Level 3)<br>Manning of Course with Program Outcomes (Pos) |                             |              |           |            |          |                        |                   |            |        |     |     |    |  |  |
| Cog/Dog         | DO1  | DOJ                         |              | ng of Co  | Durse wi   | th Prog  | gram Ou                |                   | s (Pos)    | DO10   |     | DO  | 10 |  |  |
| COS/POS         | 2  | PO2 3                       | PO3          | PU4       | PU5        | PU0      | P0/                    | PUð               | P09        | POI    |     | PO  | 12 |  |  |
|                 | 3  | 3                           | 2            |           | 3          |          |                        |                   |            |        |     |     |    |  |  |
| CO2             | 3  | 3                           | 2            |           | 3          |          |                        |                   |            |        |     |     |    |  |  |
| CO4             | 3  | 3                           | 2            |           | 3          |          |                        |                   |            |        |     |     |    |  |  |
| CO5             | 3  | 3                           | 2            |           | 3          |          |                        |                   |            |        |     |     |    |  |  |
| Cos / PSOs      | PS   | 01                          | PSC          | )2        | PS         | 03       | PS                     | 504               |            |        |     |     |    |  |  |
| CO1             |  |                             | 3            | ;         |            | 3        |                        | 2                 |            |        |     |     |    |  |  |
| CO2             |  |                             | 3            | ;         |            | 3        |                        | 2                 |            |        |     |     |    |  |  |
| CO3             |  |                             | 3            | 3         |            | 3        |                        | 2                 |            |        |     |     |    |  |  |
| CO4             |  |                             | (*)          | ;         |            | 3        | 2                      |                   |            |        |     |     |    |  |  |
| CO5             |  |                             |              | ;         |            | 3        |                        | 2                 |            |        |     |     |    |  |  |
| 3/2/1 indicates | Strengt  | h of Coi                    | relation     | 3- Hig    | h, 2- Me   | edium, 1 | l-Low                  |                   | 1          |        |     |     |    |  |  |
|                 |  |                             |              |           |            |          |                        |                   |            |        |     |     |    |  |  |
|                 |  |                             | IJ           |           |            |          |                        |                   |            |        |     |     |    |  |  |
|                 |  | suce                        | oci          |           | ve         |          | y                      | t                 |            |        |     |     |    |  |  |
|                 | e  | Scie                        | s pu         |           | ecti       |          | inaı                   | nen               | ojec       |        |     |     |    |  |  |
| င်<br>ရေ        | ienc   | പ്പ                         | ss ai        | Core      | n el       | tive     | cipl                   | odu               | /Pr        |        |     |     |    |  |  |
| • +             | Sc   | čerii                       | nitie<br>e   | m (       | graı       | Elec     | Dis                    | Col               | ical       |        |     |     |    |  |  |
|                 | asic   | gint                        | mai          | ogra      | Pro        | en ]     | nter                   | kill              | ract       |        |     |     |    |  |  |
|                 | В  | En                          | Hu<br>Sci    | Prc       |            | Op       | Ц                      | N.                | <u>д</u>   |        |     | _   |    |  |  |
|                 |  |                             |              | ✓         |            |          |                        |                   |            |        |     |     |    |  |  |
|                 |  |                             |              |           |            | 1        | 1                      |                   |            |        |     |     |    |  |  |

Subject Name : CAD, CAM & CIM **Subject Code:** Ty/Lb/ **T**/ P/R L ETL SLr **EBME22011** Prerequisite: Design of Machine Elements, Тy 3 0/0 0/0 Manufacturing Technology

#### **UNIT- I INTRODUCTION**

A typical product cycle, CAD tools for the design process of product cycle, CAD / CAM system evaluation criteria, Input / Output devices;

Graphics Displays: Refresh display, DVST, Raster display, pixel value and lookup table, estimation of graphical memory, LCD, LED fundamentals. Concept of Coordinate Systems: Working Coordinate System, Model Coordinate System, Screen Coordinate System. Graphics exchange standards.

### **UNIT- II GEOMETRIC TRANSFORMATIONS AND MODELING**

Homogeneous representation; Translation, Scaling, Reflection, Rotation, Shearing in 2D and 3D;. Window to View-port transformation. Geometry and Topology, Comparison of wireframe, surface and solid models, Properties of solid model, properties of representation schemes, Concept of Half-spaces, Boolean operations. Schemes: B-rep, CSG, Sweep representation, ASM, Primitive instancing, Cell Decomposition and Octree encoding

#### **UNIT- III COMPUTER AIDED MANUFACTURING**

CAM Concepts, Objectives & scope, Nature & Type of manufacturing system, Evolution, Benefits of CAM, Role of management in CAM, Concepts of Computer Integrated Manufacturing, Impact of CIM on personnel, Role of manufacturing engineers, CIM Wheel to understand basic functions.

NC and CNC Technology: Types, Classification, Specification and components, Construction Details-Axis designation, NC/CNC tooling. Fundamentals of Part programming, Types of format, Part Programming for drilling, lathe and milling machine operations.

### **UNIT- IV GROUP TECHNOLOGY AND CAPP**

Introduction, part families, part classification and coding systems: OPITZ, PFA, FFA, Cell design, rank order clustering, composite part concepts, Benefits of group technology. Approaches to Process Planning, Different CAPP system, application and benefits

#### **UNIT- V FLEXIBLE MANUFACTURING SYSTEM**

Introduction & Component of FMS, Needs of FMS, general FMS consideration, Objectives, Types of flexibility and FMS, FMS lay out and advantages. Automated material handling system: Types and Application, Automated Storage and Retrieval System, Automated Guided Vehicles, Cellular manufacturing, Tool Management, Tool supply system, Tool Monitoring System, Flexible Fixturing, Flexible Assembly Systems.

#### **TEXT BOOKS**

- 1) Chris McMohan and Jimmie Browne, "CAD/CAM", Addison Wesley Publications, 2<sup>nd</sup> Ed.
- 2) HMT, (2000) "Mechatronics", Tata McGraw-Hill Ed.
- 3) Mikkel. P.Groover, (2007) "Automation, Production and Computer Integrated Manufacturing", PHI., Pvt Ltd.

#### **REFERENCE BOOKS**

1. Mikell P Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education

2. Rao, Tewari, Kundra, "Computer Aided Manufacturing", McGraw Hill.

3. P. Radhakrishnan, "Computer Numerical Control", New Central Book Agency

# **Total No. of Periods: 45**

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| Subject Code:     | Subj          | ect Nam      | e: DESIC    | GN OF N  | MACHI     | NE ELI     | EMENT      | <b>S - I</b> | Ty/Lb/           | L           | T/       | P/R     | С      |  |
|-------------------|---------------|--------------|-------------|--|-----------|------------|------------|--------------|------------------|-------------|----------|---------|--------|--|
| EBME22012         | Duon          | anicita      | Enginee     | nina Ma  | ahania    | Stuand     | -th of     |              | EIL              |             | SLr      |         |        |  |
|                   | Mate          | rials. M     | echanics    | of Macl  | hines -I  | , streng   | gui 01     |              | Ту               | 3           | 1/0      | 0/0     | 4      |  |
| L : Lecture T : T | Futorial      | S Lr :       | Supervis    | ed Learr   | ning P :  | Project    | R : Res    | earch C:     | Credits          | 1 1         |          |         |        |  |
| T/L/ETL : Theo    | ory/Lab/      | Embedd       | led Theor   | y and La   | .b        | Ũ          |            |              |                  |             |          |         |        |  |
| OBJECTIVES        | : The s       | tudent w     | vill learn  |  |           |            |            |              |                  |             |          |         |        |  |
| • To              | unders        | stand the    | e principl  | es invol   | ved in e  | valuatir   | ig the sl  | hape and     | d dimensi        | ons of a o  | componer | nt to s | atisfy |  |
|                   | ictional      | and stre     | ngth requi  | tudonta  | will be   | abla ta    |            |              |                  |             |          |         |        |  |
|                   | Inderat       | LS (CUs      | s): The S   |  | will be a |            | on theo    | mias of f    | ilumo (La        | (12)        |          |         |        |  |
| CO1 CO2           | Develop       | design       | thinking r  |  | e analys  | is Daseu   | oblem (    | Level 6      |                  | vel 2)      |          |         |        |  |
| CO2 1<br>CO3 1    | Design t      | he mach      | ine eleme   | nts like   | Shafts, 1 | Kevs. Co   | ouplings   | and Bea      | ,<br>arings. (Le | evel 6)     |          |         |        |  |
| CO4 S             | Select th     | e appro      | priate type | e of sprin   | ng based  | l on the   | requiren   | nents. (L    | evel 5)          |             |          |         |        |  |
| CO5 (             | Compar        | e the var    | rious type  | us types of fasteners on strength and application aspects. (Level 4) |           |            |            |              |                  |             |          |         |        |  |
| Mapping of Co     | ourse O       | utcome       | s with Pro  | ogram C  | Outcome   | es (POs)   |            |              |                  |             |          |         |        |  |
| Cos/Pos           | PO1           | PO2          | PO3         | PO4  | PO5       | <b>PO6</b> | <b>PO7</b> | <b>PO8</b>   | PO9              | <b>PO10</b> | PO11     | PO      | 12     |  |
| CO1               |               | 3            | 3           | 2  | 3         | 2          | 2          | 2            | 2                |             |          |         | 2      |  |
| CO2               | 3             | 3            | 3           | 2  | 3         | 2          | 2          | 2            | 2                |             |          |         | 2      |  |
| CO3               | 3             | 3            | 3           | 2  | 3         | 2          | 2          | 2            | 2                |             |          |         | 2      |  |
| CO4               | 3             | 3            | 3           | 2  | 3         | 2          | 2          | 2            | 2                |             |          |         | 2      |  |
| CO5               | 3             | 3            | 3           | 2  | 3         | 2          | 2          | 2            | 2                |             |          |         | 2      |  |
| Cos / PSOs        | PS            | 01           | PSO         | 02   | PS        | 03         | P          | <b>SO4</b>   |                  |             |          |         |        |  |
| CO1               |               |              |             | 3  |           | 2          |            | 2            |                  |             |          |         |        |  |
| CO2               |               |              |             | 3  |           | 2          |            | 2            |                  |             |          |         |        |  |
| CO3               |               |              | (°,         | 3  |           | 2          |            | 2            |                  |             |          |         |        |  |
| CO4               |               |              |             | 3  |           | 2          |            | 2            |                  |             |          |         |        |  |
| CO5               |               |              | 3           | 3  |           | 2          |            | 2            |                  |             |          |         |        |  |
| 3/2/1 indicates S | trengtl       | ı of Cor     | relation    | 3- High  | , 2- Me   | dium, 1    | -Low       |              |                  | 1           |          |         |        |  |
|                   |               |              |             |  |           |            |            |              |                  |             |          |         |        |  |
|                   |               |              |             |  |           |            |            |              |                  |             |          |         |        |  |
|                   |               |              | cial        |  | /e        |            | >          |              |                  |             |          |         |        |  |
| L <b>X</b>        | 0             |              | d sc        |  | ctiv      |            | nary       | nent         | ject             |             |          |         |        |  |
| 6 <b>g</b> 0]     | ence          | ад           | s an        | ore  | ı ele     | ive        | ipli       | Iodi         | Pro              |             |          |         |        |  |
| Cat               | Scie          | erin         | ities       | n C  | ran       | lect       | Disc       | Con          | cal              |             |          |         |        |  |
|                   | sic           | ine.<br>ince | nan<br>ince | grat   | rog       | 'nE        | er I       | ili (        | acti             |             |          |         |        |  |
|                   | $\mathbf{Ba}$ | Eng<br>Scie  | Hur<br>Scie | Pro  |           | Ope        | Int        | Sk           | Pr               |             |          |         |        |  |
| Γ Γ               |               |              |             | ~  |           |            |            |              |                  |             |          |         |        |  |

#### (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code:<br>EBME22012 | Subject Name : DESIGN OF MACHINE<br>ELEMENTS - I                          | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|----------------------------|---|---------------|---|-----------|-----|---|
| Prerequisite:              | Engineering Mechanics, Strength of Materials,<br>Mechanics of Machines -I | Ту            | 3 | 1/0       | 0/0 | 4 |

### **UNIT- I: INTRODUCTION TO DESIGN OF MACHINE ELEMENTS**

EDUCAT

Introduction to the design process-factors influencing machine design, selection of materials based on mechanical properties - Principal stresses for various load -Factor of safety-Theories of failure- design based on strength and stiffness- stress concentration-Design for Variable loading –Gerber line, Goodman's line, and Soderberg's Line.

### UNIT- II: SHAFTS AND COUPLINGS

Design of solid and hollow shafts based on strength and rigidity, Keys- different types of keys- Design Of Keys, keyways, failures of keys-Couplings - Rigid coupling- flexible coupling

### **UNIT- III: DESIGN OF SPRINGS**

Functions of springs-applications- spring materials-Design of helical, Belleville springs (disc) and torsion Spring–Design of Leaf Spring.

### **UNIT- IV: TEMPORARY AND PERMANENT JOINTS**

Threaded fasteners- stress in screwed threads, Bolted joints including eccentric loading- Design of Knuckle and cotter joints- Design of Welded joints- merits and demerits of welded joints, Types of welded joints, Weld symbols, Strength of parallel and fillet weld, strength of a welded joint, eccentrically loaded Welded joints.

#### **UNIT- V: DESIGN OF BEARINGS AND FLYWHEELS**

Introduction -Design of bearings - Sliding contact bearing – Design of journal bearings- Mckees equation- Lubrication in journal bearings -Rolling contact bearing (antifriction bearing). Types of fly wheels- Design of flywheels involving stresses in rim and arm.

#### **Total No. of Periods: 60**

**\*NOTE:** Use of PSG Design Data book is permitted in Examination

#### **TEXT BOOKS**

- 1) Shigley J.E and Mischke C. R., (2008) "Mechanical Engineering Design", Sixth Edition, Tata McGraw Hill.
- 2) Bhandari V.B, (2010) "Design of Machine Elements", Second Edition, Tata McGraw-Hill Book Co.

#### **REFERENCE BOOK:**

- 1. Sundararajamoorthy, T.V. and Shanmugan, Machine Design, Anuradha Agencies, 2003.
- Shigley, J.E., Charles, R.M. and Richard, G.B., Mechanical Engineering Design, 7th ed., McGraw-Hill,
   2004.



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|----------------------|--------------------|-------------|--------------|-------|
| eriyar E.V.R. High 🛛 | Road, Maduravoyal, | Chennai-95. | Tamilnadu, I | ndia. |

| Subject Code:   | : Su  | bject Na               | me : TH                      | ERMAI        | L ENGI          | NEERI         | NG LAI             | B-II            | Ty/Lb/<br>ETL      | L    | T/SLr | P/R | С  |  |
|---|---|------------------------|------------------------------|--------------|-----------------|---------------|--------------------|-----------------|--------------------|------|-------|-----|----|--|
| EBMEZ2L06   | Pr<br>Tr  | erequisi<br>ansfer     | te: Thern                    | nal Eng      | ineerin         | g , Heat      | and Ma             | ISS             | Lb                 | 0    | 0/0   | 3/0 | 1  |  |
| L : Lecture T : Tu  | ıtorial   | S.Lr :                 | Supervis                     | ed Lear      | ning P          | : Proje       | ct R : R           | esearcl         | n C: Credi         | ts   |       |     |    |  |
| T/L/ETL : Theory  | y/Lab/l   | Embedde                | ed Theor                     | y and L      | ab              |               |                    |                 |                    |      |       |     |    |  |
| OBJECTIVES: The   | e student   | will learn             | 1<br>                        |              | • 11            | 1 6           | . ,.               | 1.              | 1                  |      |       |     |    |  |
| <ul> <li>To evaluate the performance of air compressor, air blower and refrigeration and air conditioning systems.</li> <li>To determine the properties of different liquid fuels.</li> </ul> |   |                        |                              |              |                 |               |                    |                 |                    |      |       |     |    |  |
| • To study the different modes of heat transfer.  |   |                        |                              |              |                 |               |                    |                 |                    |      |       |     |    |  |
| COURSE OUTCOMES (COs) : ( 3- 5)   |   |                        |                              |              |                 |               |                    |                 |                    |      |       |     |    |  |
| CO1   | Calculate the performance of air compressor and blower and COP of a refrigeration system. (Level 3) |                        |                              |              |                 |               |                    |                 |                    |      |       |     |    |  |
| CO2   | Determine the flash, fire point and viscosities of different oils (Level 3)                         |                        |                              |              |                 |               |                    |                 |                    |      |       |     |    |  |
| CO3   | Determ  | ine the e              | missivity                    | of a gre     | y body.         |               |                    |                 |                    |      |       |     |    |  |
| CO4   | Estima  | te the the             | rmal cond                    | ductivity    | of an ii        | al and c      | omposite w         | vall. (Le       | vel 4)             |      |       |     |    |  |
| CO5   | Measure the effectiveness of pinfin and parallel and counter flow heat exchanger. (Level 3)         |                        |                              |              |                 |               |                    |                 |                    |      |       |     |    |  |
| Mapping of Cou  | apping of Course Outcomes with Program Outcomes (Pos)   |                        |                              |              |                 |               |                    |                 |                    |      |       |     |    |  |
| Cos/Pos   | PO1   | PO2                    | PO3                          | PO4          | PO5             | PO6           | PO7                | PO8             | PO9                | PO10 | PO11  | PO  | 12 |  |
| CO1   | 3   | 3                      | 1                            | 1            | 1               | 1             | 1                  | 2               | 2                  | 2    | 2     | 1   | L  |  |
| CO2   | 3   | 2                      | 2                            | 2            | 1               | 2             | 2                  | 2               | 2                  | 2    | 2     | 1   | l  |  |
| CO3   | 3   | 3                      | 2                            | 2            | 1               | 2             | 2                  | 2               | 2                  | 2    | 2     | 2   | 2  |  |
| CO4   | 3   | 3                      | 2                            | 2            | 2               | 2             | 2                  | 2               | 2                  | 2    | 2     | 1   | L  |  |
| CO5   | 3   | 3                      | 2                            | 2            | 2               | 2             | 2                  | 2               | 2                  | 2    | 2     | 1   | l  |  |
| Cos / PSOs  |   | 3                      | 3                            |              |                 | 2             |                    | 2               | 2                  | 2    | 2     | 2   | 2  |  |
| CO1   |   | 3                      | 2                            |              |                 | 2             |                    | 2               |                    |      |       |     |    |  |
| CO2   |   | 3                      | 2                            |              |                 | 2             |                    | 2               |                    |      |       |     |    |  |
| CO3   |   | 3                      | 2                            |              |                 | 2             |                    | 3               |                    |      |       |     |    |  |
| CO4   |   | 3                      | 2                            |              |                 | 2             |                    | 2               |                    |      |       |     |    |  |
| CO5   |   | 3                      | 2                            |              |                 | 2             |                    | 3               |                    |      |       |     |    |  |
| 3/2/1 indicates Stre  | ength of  | f Correla              | ation 3-                     | High, 2-     | - Mediu         | m, 1-Lo       | )W                 | 1               |                    | 1    |       |     |    |  |
|   |   |                        | cial                         |              | je              |               |                    |                 |                    |      |       |     |    |  |
| gory  | Basic Science   | Engineering<br>Science | Humanities and so<br>Science | Program Core | Program electiv | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |      |       |     |    |  |
| Cate  |   |                        |                              | <b>√</b>     |                 |               |                    |                 | $\checkmark$       |      |       |     |    |  |



| Subject Code:<br>EBME22L06 | Subject Name : THERMAL ENGINEERING LAB-II                     | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|----------------------------|---|---------------|---|-----------|-----|---|
|                            | Prerequisite: Thermal Engineering , Heat and Mass<br>Transfer | Lb            | 0 | 0/0       | 3/0 | 1 |

#### LIST OF EXPERIMENTS:

- 1. Performance test on reciprocating air compressor.
- 2. Performance test on a constant speed air blower.
- 3. Viscosity measurement using Redwood apparatus.
- 4. Viscosity measurement using Say bolt apparatus.
- 5. Determination of COP of a refrigeration system.
- 6. Determination of COP of air conditioning system.
- 7. Determination of flash point and fire point of the given lubricating oil sample.
- 8. Determination of thermal conductivity of an insulating material.
- 9. Determination of efficiency of a pin fin using natural and forced convection methods.
- 10. Determination of emissivity of a gray body using emissivity apparatus.
- 11. Determination of Stefan Boltzmann Constant.
- 12. Determination of effectiveness of a parallel flow and counter flow heat exchanger.
- 13. Determination of Heat Transfer in Drop and Film wise Condensation
- 14. Overall Heat Transfer Coefficient of Composite wall..



| Subject             | Code   | : 8                | ubject I            | Name: CA                      | AD/CAN               | M LAB            |               |                    |                          | Ty/Lb/             | L    | T/   | P/R | С        |  |  |
|---------------------|--|--------------------|---------------------|-------------------------------|----------------------|------------------|---------------|--------------------|--------------------------|--------------------|------|------|-----|----------|--|--|
| EBME2               | 22L07  | _                  |                     |                               |                      |                  |               |                    |                          | ETL                |      | SLr  | -   |          |  |  |
|                     |  |                    | re requ             | isite: CAl                    | D/CAM/               | CIM, N           | lachine       | Drawin             | ıg                       | Lb                 | 0    | 0/0  | 3/0 | 1        |  |  |
| L : Lect<br>T/L/ETI | ure T :<br>L : The                               | Tutoria<br>ory/Lab | I S Lr :<br>/Embedd | Supervise<br>led Theor        | ed Learn<br>y and La | ning P:<br>Ib    | Project       | R : Rese           | earch C:                 | Credits            | 1 1  | 1    |     | <u>.</u> |  |  |
| OBJEC               | TIVE   | S: The             | student v           | vill                          |                      |                  |               |                    |                          |                    |      |      |     |          |  |  |
| •                   | Get pr   | actical k          | nowledg             | e through                     | practice             | on CNO           | C Machi       | nes and            | related                  | software           |      |      |     |          |  |  |
| OURSE               | E OUT  | COME               | S (COs)             | :                             |                      |                  |               |                    |                          |                    |      |      |     |          |  |  |
| CO1                 |  | Under              | stand the           | e concepts                    | of meta              | l cutting        | and rela      | ated info          | rmation                  | (Level 2)          |      |      |     |          |  |  |
| CO2                 |  | Acqui              | re skill iı         | n special p                   | ourpose 1            | nachine          | s (Level      | 4)                 |                          |                    |      |      |     |          |  |  |
| CO3                 |  | Select             | appropri            | iate metho                    | d of ma              | nufactur         | ing bas       | ed on the          | he requirement (Level 4) |                    |      |      |     |          |  |  |
| <b>CO4</b>          |  | Under              | stand the           | e concepts                    | and app              | lications        | s of pow      | der meta           | allurgy (                | (Level 3)          |      |      |     |          |  |  |
| CO5                 |  | Expos              | e to vario          | ous advan                     | ced man              | ufacturii        | precision     | n compone          | nts (Leve                | el 3)              |      |      |     |          |  |  |
| Mappin              | ng of C  | course C           | utcome              | s with Pro                    | ogram (              | Outcome          | es (POs)      | 1                  |                          |                    |      |      |     |          |  |  |
| Cos/Pos             | 5  | PO1                | PO2                 | PO3                           | PO4                  | PO5              | PO6           | PO7                | PO8                      | PO9                | PO10 | PO11 | PO  | 12       |  |  |
| CO1                 |  | 3                  | 3                   | 2                             | -                    | 2                | 3             | 3                  | 2                        | 3                  | 2    | 2    |     | 2        |  |  |
| CO2                 |  | 3                  | 3                   | 3                             | -                    | 2                | 3             | 3                  | 2                        | 3                  | 2    | 2    |     | 2        |  |  |
| CO3                 |  | 3                  | 3                   | 3                             | -                    | 2                | 3             | 3                  | 2                        | 3                  | 2    | 2    |     | 2        |  |  |
| CO4                 |  | 3                  | 3                   | 2                             | -                    | 3                | 3             | 3                  | 2                        | 3                  | 2    | 2    |     | 2        |  |  |
| CO5                 |  | 3                  | 3                   | 2                             | -                    | 3                | 3             | 3                  | 2                        | 3                  | 2    | 2    |     | 2        |  |  |
| Cos / PS            | SOs  | PS                 | 501                 | PSC                           | )2                   | PS               | 03            | PS                 | <b>504</b>               |                    |      |      |     |          |  |  |
| CO1                 |  |                    | 3                   | 3                             |                      | ,<br>,           | 2             |                    | 3                        |                    |      |      |     |          |  |  |
| CO2                 |  |                    | 3                   | 3                             |                      |                  | 2             |                    | 3                        |                    |      |      |     |          |  |  |
| CO3                 |  |                    | 3                   | 3                             |                      |                  | 2             |                    | 3                        |                    |      |      |     |          |  |  |
| CO4                 |  |                    | 3                   | 3                             |                      |                  | 3             |                    | 3                        |                    |      |      |     |          |  |  |
| CO5                 |  |                    | 3                   | 3                             |                      |                  | 3             |                    | 3                        |                    |      |      |     |          |  |  |
| <b>H/M/L</b> i      | indica   | tes Stre           | ngth of (           | Correlatio                    | on H-                | High, M          | I- Medi       | um, L-L            | ωW                       |                    | 1    |      |     |          |  |  |
|                     |  |                    |                     |                               |                      |                  |               |                    |                          |                    |      |      |     |          |  |  |
|                     | Category<br>Basic Science<br>Engineering Science |                    |                     | Humanities and social Science | Program Core         | Program elective | Open Elective | Inter Disciplinary | Skill Component          | Practical /Project |      |      |     |          |  |  |
|                     |  |                    |                     |                               | ✓                    |                  |               |                    |                          | $\checkmark$       |      |      |     |          |  |  |



| Subject Code: | Subject Name :<br>CAD / CAM LAB            | Ty/Lb/E<br>TL | L | T/<br>SLr | P/R | С |
|---------------|--|---------------|---|-----------|-----|---|
|               | Prerequisite: CAD,CAM&CIM, Machine Drawing | Lb            | 0 | 0/0       | 3/0 | 1 |

#### List of Experiments

#### 1. CAD LAB

- 1. Introduction to computer Aided Design and Drafting Packages.
- 2. 2D Drawing using Auto CAD/ Solid works or CATIA Software
- 3. 2D sectional views, part drawing, assembly drawing, detailed drawing.
- 4. Dimensioning, annotations, symbols Welding, Surface finish, threads, Text, Bill of Materials, Title Block.
- 5. Exercises Knuckle joint, Gib & Cotter joint, Screw Jack, Foot step bearing.
- 6. Orthographic views, Isometric views.
- 7. Solid modeling features-Boolean operations.

#### CAM LAB

NC part programme with G and M codes should be generated, tool path simulation and execution to be done for the following machines.

- 1. Exercises in CNC lathe.
  - 1. Step Turning
  - 2. Taper Turning
  - 3. Thread Cutting
  - 4. Eccentric Turning
- 2. Exercises in CNC milling machines.
  - 1. Contour Milling
  - 2. Hexagonal Milling



| Subject Code                    | : Subj<br>QUA   | ject: SO<br>ANTITA     | OFT SKIL<br>ATIVE SI             | LS II -(<br>KILLS | QUALI            | TATIV         | E AND              |                 | T / L/<br>ETL/I    | L       | T /<br>S.Lr | <b>P/ R</b> | С   |
|---------------------------------|---|------------------------|----------------------------------|-------------------|------------------|---------------|--------------------|-----------------|--------------------|---------|-------------|-------------|-----|
| EBCC22I07                       | Dw  | mania                  | to: Docio                        | Mathan            | notios           |               |                    |                 | E                  | 0       | 0/0         | 2/0         | 1   |
| I. I. a atura T.                | Tutorial  | SLav                   | Cumomia                          |                   | iaucs.           | Ducient       | D.D.a.             | a a ma ha (     |                    | U       | 0/0         | 2/0         | I   |
| L: Lecture 1 :<br>T/L/ETL · The | i utorial   | Embedi                 | Supervise                        | v and L           | nng P:<br>ah     | Project       | R : Rese           | earch C         | .: Credits         |         |             |             |     |
| OBJECTIVE                       | <b>S:</b>   | Linoca                 |                                  | y und E           | uo               |               |                    |                 |                    |         |             |             |     |
| To bri                          | ing beha  | avioural               | patterns                         | of stud           | ents.            |               |                    |                 |                    |         |             |             |     |
| • To tra                        | in them   | for cor                | porate cu                        | lture.            |                  |               |                    |                 |                    |         |             |             |     |
| • To cre                        | eate self   | awarer                 | ness.                            |                   |                  |               |                    |                 |                    |         |             |             |     |
| • To bu                         | ild conf  | ïdence.                |                                  |                   |                  |               |                    |                 |                    |         |             |             |     |
| To tra                          | in the st   | tudents                | for facing                       | g the in          | terview          | s and d       | evelop i           | interpe         | ersonal rela       | tionshi | p.          |             |     |
| COURSE OU                       | TCOM  | ES (CO                 | s):(3-5)                         |                   |                  |               |                    |                 |                    |         |             |             |     |
| CO1                             | Recog   | nize and               | d apply a                        | rithmeti          | ic know          | ledge i       | n a vari           | ety of          | contexts.          |         |             |             |     |
| CO2                             | Ability<br>criticis                                   | to ider<br>m.          | ntify and                        | criticall         | ly evalu         | ate phi       | losophie           | cal arg         | uments an          | d defen | d them fr   | om          |     |
| CO3                             | Gain tl   | ne skill               | in solvin                        | g H.C.F           | F & L.C          | $M - P_1$     | roblem             | and Pr          | ofit & Los         | s probl | ems.        |             |     |
| CO4                             | Gain the skill in solving the problems in Permutation |                        |                                  |                   |                  |               |                    |                 | nbinations         | 1       |             |             |     |
| CO5                             | Data Interpretation using different graphs.           |                        |                                  |                   |                  |               |                    |                 |                    |         |             |             |     |
| Mapping of C                    | ourse O   | utcome                 | s with Pr                        | ogram (           | Outcom           | es (Pos)      |                    |                 |                    |         |             |             |     |
| Cos/Pos                         | PO1   | PO2                    | PO3                              | PO4               | PO5              | PO6           | PO7                | PO8             | PO9                | PO10    | PO11        | PO          | 012 |
| CO1                             | 3   | 3                      | 3                                | 3                 | 3                | 3             | 1                  | 1               | 3                  | 2       | 3           | 3           |     |
| CO2                             | 2   | 2                      | 2                                | 3                 | 1                | 3             | 1                  | 3               | 3                  | 3       | 3           | 1           |     |
| CO3                             | 3   | 3                      | 3                                | 3                 | 3                | 3             | 2                  | 2               | 3                  | 3       | 3           | 3           |     |
| CO4                             | 3   | 3                      | 3                                | 3                 | 3                | 3             | 1                  | 1               | 3                  | 2       | 3           | 3           |     |
| CO5                             | 2   | 2                      | 2                                | 3                 | 1                | 3             | 1                  | 3               | 3                  | 3       | 3           | 1           |     |
| Cos / PSOs                      | PS  | 01                     | PSC                              | 02                | PS               | O3            | PS                 | 504             |                    |         |             |             |     |
| CO1                             |   |                        |                                  |                   |                  |               |                    |                 |                    |         |             |             |     |
| CO2                             |   |                        |                                  |                   |                  |               |                    |                 |                    |         |             |             |     |
| CO3                             |   |                        |                                  |                   |                  |               |                    |                 |                    |         |             |             |     |
| C04                             |   |                        |                                  |                   |                  |               |                    |                 |                    |         |             |             |     |
| 3/2/1 indica                    | tes Stre  | ngth of                | Correlati                        | on 3-1            | High, 2-         | Mediu         | n, 1-Lo            | w               | <b>I</b>           |         |             |             |     |
|                                 |   | 0                      |                                  |                   |                  |               |                    |                 |                    |         |             |             |     |
| egory                           | Basic Science   | Engineering<br>Science | Humanities and social<br>Science | Program Core      | Program elective | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |         |             |             |     |
| Cat                             |   |                        |                                  |                   |                  |               |                    | ~               |                    |         |             |             |     |

#### Subject: SOFT SKILLS II - QUALITATIVE AND L T / L/ Т / **QUANTITATIVE SKILLS** ETL/I S.Lr Е **Prerequisite: Basic Mathematics.** IE 0 0/0 6

Logical Statements - Arguments - Assumptions - Courses of Action.

EDUCATI

# **UNIT II Logical Reasoning II**

Logical conclusions – Deriving conclusions from passages – Theme detection.

# **UNIT III Arithmetical Reasoning I**

Number system - H.C.F & L.C.M - Problem on ages - Percentage - Profit & Loss - Ratio & Proportion – Partnership.

# **UNIT IV Arithmetical Reasoning II**

Time & Work - Time & Distance - Clocks - Permutations & Combinations - Heights & Distances -Odd man out and Series.

# **UNIT V Data Interpretation**

Tabulation – Bar graphs – Pie graphs – Line graphs.

# **REFERENCE BOOK:**

1. R.S.Agarwal, A modern approach to Logical Reasoning, S.Chand & Co., (2017).

2. R.S.Agarwal, A modern approach to Verbal and Non verbal Reasoning, S.Chand & Co., (2017).

3. R.S.Agarwal, Quantitative Aptitude for Competitive Examinations, S.Chand & Co., (2017).

- 4. A.K.Gupta, Logical and Analytical Reasoning, Ramesh Publishing House, (2014).
- 5. B.S.Sijwali, Indu sijwali, A new approach to Reasoning (Verbal and Non verbal), Arihant Publishers, (2014).

(An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India. **Subject Code: EBCC22I07 UNIT I Logical Reasoning I** 6



P/R

2/0

С

1

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| Subject Code: | Subject Name: TECHNICAL SKILL-III              | T / L/<br>ETL/IE | L | T /<br>S.Lr | P/ R | С |
|---------------|--|------------------|---|-------------|------|---|
| EBME22I03     | Pre requisite: All Subjects Studied Up to Date | IE               | 0 | 0/0         | 2/0  | 1 |

Students should acquire skill in the domain/inter disciplinary area from government/private training centers/industries /University for a minimum period of 15 calendar days. The training can be through off line, online or mixed mode. Students are supposed to prepare Technical skill report at the end of the training and submit the report along with the certificate in proof of the training, during the viva voce examination conducted by the examiners duly appointed by the head of the department.



| Subject Code:<br>EBME22I04 | Subject Name : MINI-PROJECT /INTERNSHIP | T / L/<br>ETL/IE | L | T /<br>S.Lr | P/ R | С |
|----------------------------|---|------------------|---|-------------|------|---|
|                            |   | IE               | 0 | 0/0         | 3/0  | 1 |

#### **MINI PROJECT:**

Students will have an opportunity to expose their knowledge and talent to make an innovative project. Students are supposed to do innovative projects useful to industries/society in the area of relevant Engineering, inter and multi-disciplinary areas, under the guidance of a staff member. They have to prepare a project report and submit to the department.

At the end of the semester Viva-Voce examination will be conducted by the internal Examiner duly appointed by the Head of the department and the students will be evaluated.

#### **INTERNSHIP**

Students are supposed to undergo internship in related Industries for a minimum period of 30days cumulatively during the semester. They have to prepare a report on the Internship with a certificate in proof from competent authority in the industry. At the end of the semester Viva-Voce examination will be conducted by the Examiners duly appointed by the Head of the department and the students will be evaluated.



# **SEMESTER VII**



| Subject Code    | :             | Subjec  | t Name: I                      | NDUST        | RIAL A               | UTOM          | ATION              | I               | Ty/Lb/             | L        | T/   | P/R | С  |  |
|-----------------|---------------|---|--------------------------------|--------------|----------------------|---------------|--------------------|-----------------|--------------------|----------|------|-----|----|--|
| EBME22013       |               |   |                                |              |                      |               |                    |                 | EIL                |          | SLr  |     |    |  |
|                 | Pre I         | requisite   | e: Manufa                      | icturing     | Techno               | ology-I a     | & II,              |                 | Tv                 | 3        | 0/0  | 0/0 | 3  |  |
| I · Lecture T · | Tutorial      | trical an   | <u>a Electro</u><br>· Supervis | ed Lear      | gineerin<br>ning P · | lg<br>Project | R · Rese           | earch C:        | Credits            |          |      |     |    |  |
| T/L/ETL : The   | ory/Lab       | /Embedo   | ded Theor                      | y and La     | ılıng T<br>ıb        | Tiojeet       | R . Rest           |                 | Cicuits            |          |      |     |    |  |
| OBJECTIVE       | S: The s      | student v   | vill gain                      |              |                      |               |                    |                 |                    |          |      |     |    |  |
| • kn            | owledge       | e in hydr   | aulic, pnei                    | umatic a     | nd mech              | atronics      | system             | in Autor        | nation.            |          |      |     |    |  |
| OURSE OUT       | COME          | S (COs)   | :                              |              |                      |               |                    |                 |                    |          |      |     |    |  |
| CO1             | Underst       | and Pne   | umatic and                     | d hydrau     | ilic princ           | ciples, co    | omponer            | nts and f       | unctions (         | Level 2) |      |     |    |  |
| CO2             | Analyze       | e and De  | sign the P                     | neumati      | c and hy             | draulic       | circuits f         | for autor       | nation (Le         | vel 4)   |      |     |    |  |
| CO3             | Recogn        | ecognise the various components of mechatronics system (Level 2)              |                                |              |                      |               |                    |                 |                    |          |      |     |    |  |
| CO4             | Discuss       | scuss the various actuation systems and System models in automation (Level 3) |                                |              |                      |               |                    |                 |                    |          |      |     |    |  |
| CO5             | Design        | sign the Mechatronic system for the required automation (Level 4)             |                                |              |                      |               |                    |                 |                    |          |      |     |    |  |
| Mapping of C    | ourse O       | rse Outcomes with Program Outcomes (POs)                                      |                                |              |                      |               |                    |                 |                    |          |      |     |    |  |
| Cos/Pos         | PO1           | PO2   | PO3                            | PO4          | PO5                  | <b>PO6</b>    | <b>PO7</b>         | PO8             | PO9                | PO10     | PO11 | PO  | 12 |  |
| CO1             | 3             | 3   | 2                              | 2            | 3                    | 3             | 2                  | 3               | 3                  | 3        | 3    |     | 2  |  |
| CO2             | 3             | 3   | 3                              | 3            | 3                    | 3             | 2                  | 3               | 3                  | 3        | 3    |     | 2  |  |
| CO3             | 3             | 3   | 2                              | 2            | 3                    | 3             | 2                  | 3               | 3                  | 3        | 3    |     | 2  |  |
| CO4             | 3             | 3   | 2                              | 2            | 3                    | 3             | 2                  | 3               | 3                  | 3        | 3    |     | 2  |  |
| CO5             | 3             | 3   | 3                              | 3            | 3                    | 3             | 2                  | 3               | 3                  | 3        | 3    |     | 2  |  |
| Cos / PSOs      | PS            | 501   | PSC                            | 02           | PS                   | 03            | PS                 | 504             |                    |          |      |     |    |  |
| CO1             | ,<br>,        | 3   | 3                              |              | 1                    | 2             |                    | 3               |                    |          |      |     |    |  |
| CO2             | ,<br>,        | 3   | 3                              |              | 1                    | 2             |                    | 3               |                    |          |      |     |    |  |
| CO3             | ,<br>,        | 3   | 3                              |              | 1                    | 2             |                    | 3               |                    |          |      |     |    |  |
| CO4             | í             | 3   | 3                              |              | 2                    | 2             |                    | 3               |                    |          |      |     |    |  |
| CO5             | í             | 3   | 3                              |              | 2                    | 2             |                    | 3               |                    |          |      |     |    |  |
| 3/2/1 indicates | Strengt       | h of Cor  | relation                       | 3- High      | n, 2- Me             | dium, 1       | -Low               |                 |                    |          |      | 1   |    |  |
|                 |               |   |                                |              |                      |               |                    |                 |                    |          |      |     |    |  |
| Category        | Basic Science | Engineering Science   | Humanities and social Science  | Program Core | Program elective     | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |          |      |     |    |  |
|                 |               |   |                                |              |                      |               |                    |                 |                    |          |      |     |    |  |

| Subject Code: | Subject Name : INDUSTRIAL AUTOMATION  | Ty/Lb/ | L | Τ/  | P/R | С |
|---------------|---|--------|---|-----|-----|---|
| EDME22012     |   | ETL    |   | SLr |     |   |
| EBNIE22015    | Pre requisite: Manufacturing Technology-I & II,<br>Electrical and Electronics Engineering | Ту     | 3 | 0/0 | 0/0 | 3 |

#### **UNIT- I BASIC PRINCIPLES OF HYDRAULICS AND PNEUMATICS**

Hydraulic principles - Hydraulic pumps - pumping circuits - Hydraulic actuators - Characteristics - Hydraulic valves types and Applications – Hydraulic Fluids. Fundamentals of pneumatics – Control elements – logic circuits - position - pressure sensing - switching - Electro-pneumatic - Electro-hydraulic circuits. Symbols of hydraulic and pneumatic circuits.

#### **UNIT- II DESIGN OF HYDRAULIC AND PNEUMATIC CIRCUITS**

Hydraulic circuits – Reciprocating – Quick-return – sequencing – synchronizing –Accumulators circuits – Safety circuits - Industrial circuits. Pneumatic circuits - classic - cascade - step counter - combination methods. Design of Hydraulic and pneumatic circuits - Selection of components - Installation and Maintenance of Hydraulic and Pneumatic power packs.

#### **UNIT-III MECHATRONICS, SENSORS AND TRANSDUCERS**

Introduction to Mechatronics Systems - Measurement Systems - Transducers - Performance Terminology -Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors - Selection of Sensors.

#### **UNIT- IV ACTUATION SYSTEM AND SYSTEM MODELS**

Hydraulic, Pneumatic and electrical actuation Systems - Mechanical Switches - Solid State Switches -Solenoids - D.C Motors - A.C Motors - Stepper Motors. Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Translational Systems, Electromechanical Systems – Hydraulic – Mechanical Systems.

#### **UNIT-V CONTROLLERS AND DESIGN OF MECHATRONICS SYSTEMS**

Continuous and discrete process Controllers -- PID Controllers -- Digital Controllers, Digital Logic Control --Micro Processors Control. Programmable Logic Controllers - Basic Structure - Input / Output Processing -Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls. Stages in designing Mechatronics Systems -Case Studies of Mechatronics Systems, Pick and place robot automatic Car Park Systems - Engine Management Systems.

#### **TEXT BOOKS**

1) S.Ilango and V.Soundarrajan ,(2011) "Introduction to Hydraulics and Pneumatics", Prentice hall india,2<sup>nd</sup> Edition.

2) K.Shanmugasundaram (2006) "Hydraulic and Pneumatic control" S.Chand &Co.

3) W. Bolton, "Mechatronics", Pearson Education, Second Edition, 1999.

#### REFERENCES

1) Michael B. Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2000.

2) Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, "Mechatronics", Chapman and Hall, 1993.

3) Lawrence J. Kamm, "Understanding Electro – Mechanical Engineering", An Introduction to Mechatronics, Prentice - Hall of India Pvt., Ltd., 2000.

4) Nitaigour Premchand Mahadik, "Mechatronics", Tata McGraw-Hill publishing Company Ltd, 2003

5) Anthony Esposito, (2008) "Fluid power with applications", Pearson education Pvt. Ltd, 7<sup>th</sup> edition.

6) W.Bolton, (2012) "Pneumatic and Hydraulic Systems", Butterworth, 3<sup>rd</sup> edition.

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#### 11



| Subject Code:       | Subj     | ect Name  | e: DESIGN                        | OF MA     | CHINE       | ELEME     | ENTS - II | [         | Ty/Lb/     | L         | Τ/           | P/R      | С   |  |
|---------------------|----------|---|----------------------------------|-----------|-------------|-----------|-----------|-----------|------------|-----------|--------------|----------|-----|--|
| EBME22014           |          |   |                                  |           |             |           |           |           | ETL        |           | SLr          |          |     |  |
|                     | Prer     | equisite:   | Design of                        | Machine   | e Elemen    | its - I   |           |           | Ту         | 3         | 1/0          | 0/0      | 4   |  |
| L : Lecture T :     | Tutoria  | ISLr:   | Supervise                        | d Learni  | ng P:H      | Project R | t : Resea | urch C: ( | Credits    | 1         |              |          |     |  |
| T/L/ETL : Theor     | ry/Lab/E | mbedded   | Theory an                        | d Lab     |             |           |           |           |            |           |              |          |     |  |
| <b>OBJECTIVES</b> : | The stu  | dent will   | learn                            |           |             |           |           |           |            |           |              |          |     |  |
| • To und            | erstand  | the princ   | iples invol                      | ved in ev | valuating   | the shap  | be and di | imension  | s of a com | ponent to | o satisfy fu | nctional | and |  |
| COURSE OUT          | COMES    | $\overline{\mathbf{S}(\mathbf{COs})}$ :   |                                  |           |             |           |           |           |            |           |              |          |     |  |
| CO1                 | Underst  | tand and  | perform t                        | he failur | e analys    | is hased  | on theo   | ries of f | ailure (Le | vel 2)    |              |          |     |  |
| CO2                 | Develo   | n design  | thinking r                       | rocess a  | nd defir    | e the nr  | oblem (   | Level 6   |            | ver 2)    |              |          |     |  |
| CO3                 | Design   | ign the machine elements like Shafts, Keys, Couplings and Bearings. (Level 6)     |                                  |           |             |           |           |           |            |           |              |          |     |  |
| CO4                 | Select t | the appropriate type of spring based on the requirements. (Level 5)               |                                  |           |             |           |           |           |            |           |              |          |     |  |
| CO5                 | Compa    | are the various types of fasteners on strength and application aspects. (Level 4) |                                  |           |             |           |           |           |            |           |              |          |     |  |
| Mapping of Co       | urse Ou  | tcomes w  | omes with Program Outcomes (POs) |           |             |           |           |           |            |           |              |          |     |  |
| Cos/Pos             | PO1      | PO2   | PO3                              | PO4       | <b>PO10</b> | PO11      | PO1       | 2         |            |           |              |          |     |  |
| CO1                 | 3        | 3   | 3                                | 2         | 3           | 3         | 2         | 2         | 2          | 2         | 2            |          | 2   |  |
| CO2                 | 3        | 3   | 3                                | 2         | 3           | 3         | 2         | 2         | 2          | 2         | 2            | 2        | 2   |  |
| CO3                 | 3        | 3   | 3                                | 2         | 3           | 3         | 2         | 2         | 2          | 2         | 2            | 2        | 2   |  |
| CO4                 | 3        | 3   | 3                                | 2         | 3           | 3         | 2         | 2         | 2          | 2         | 2            |          | 2   |  |
| CO5                 | 3        | 3   | 3                                | 2         | 3           | 3         | 3         | 2         | 2          | 2         | 2            |          | 2   |  |
| Cos / PSOs          | PS       | 501   | PSC                              | )2        | PS          | 603       | PS        | 504       |            |           |              |          |     |  |
| CO1                 |          | 3   | 3                                |           | í           | 3         |           | 2         |            |           |              |          |     |  |
| CO2                 |          | 3   | 3                                |           |             | 3         |           | 2         |            |           |              |          |     |  |
| CO3                 |          | 3   | 3                                |           | í           | 3         |           | 2         |            |           |              |          |     |  |
| CO4                 |          | 3   | 3                                |           |             | 3         |           | 2         |            |           |              |          |     |  |
| CO5                 | ,        | 3   | 3                                |           |             | 3         |           | 2         |            |           |              |          |     |  |
| 3/2/1 indicates     | Strengt  | h of Cor  | relation                         | 3- High   | n, 2- Me    | dium, 1   | -Low      |           | 1          |           |              |          |     |  |
|                     |          |   |                                  |           |             |           |           |           |            |           |              |          |     |  |
|                     |          |   | nce                              |           |             |           |           |           |            |           |              |          |     |  |
|                     |          |   | cie                              |           |             |           |           |           |            |           |              |          |     |  |
|                     |          | 0   | al S                             |           |             |           |           |           |            |           |              |          |     |  |
|                     |          | ence  | oci                              |           | ive         |           | <u>5</u>  | Ħ         | з          |           |              |          |     |  |
|                     | s        | Scie  | s pu                             |           | ecti        |           | ina       | ner       | ojec       |           |              |          |     |  |
| ry                  | ienc     | 33  | ss an                            | Ore       | n el        | tive      | cipl      | npc       | /Pr        |           |              |          |     |  |
| ego                 | Sci      | erii  | nitie                            | m C       | grat        | Ilec      | Dis       | Cor       | cal        |           |              |          |     |  |
| Cat                 | ısic     | gine  | nar                              | gra       | Prog        | en E      | ter       | ill       | acti       |           |              |          |     |  |
| _                   | B        | Εnξ   | Hui                              | Pro       |             | Opí       | In        | Sk        | Pr         |           |              |          |     |  |
|                     |          |   |                                  | ~         |             |           |           |           |            |           |              |          |     |  |
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|                     |          |   |                                  |           |             |           |           |           |            |           |              |          |     |  |



Design of Flat belts and pulleys – Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys - Design of Transmission chains and Sprockets.

# UNIT 2 SPUR GEARS AND PARALLEL AXIS HELICAL GEARS

Prerequisite: Design of Machine Elements - I

Speed ratios and number of teeth-Force analysis- Tooth stresses –Dynamic effects-Fatigue strength-Factor of Safety-Gear materials-Design of Straight tooth spur and helical gears based on strength and wear considerations- Pressure angle in the normal and transverse plane –Equivalent number of teeth – Forces for helical gears.

Subject Name : DESIGN OF MACHINE ELEMENTS - II

**UNIT 3 BEVEL AND WORM GEARS** Straight bevel gear: Tooth terminology- Design of pair of straight bevel gears - Tooth forces and stresses Worm Gear: Merits and demerits- Terminology. Design of the worm and gear - Forces and stresses, efficiency.

# **UNIT- IV: DESIGN OF SPEED REDUCERS**

Design of speed reducers –Geometric Progression – Standard Step ratio- Ray diagram – Kinematic arrangement of Gears -Number of teeth on gears.

## **UNIT- V: CLUTCHES AND BRAKES**

Design of plate clutches – Cone clutches – Centrifugal clutches- Electromagnetic clutches. Band and Block brakes- External shoe brakes – Internal expanding shoe brake.

Total No. of Periods 60

\*NOTE: Use of P.S.G Design Data Book is permitted in the University examination

## TEXT BOOKS

**Subject Code:** 

**EBME22014** 

- 1) Shigley J.E and Mischke C. R., (2003) *"Mechanical Engineering Design"*, Sixth Edition, Tata McGraw Hill.
- 2) Sundararajamoorthy T. V and Shanmugam .N, (2003) "Machine Design", Anuradha Publications, Chennai.

## REFERENCES

- 1) Maitra G.M. and Prasad L.V., "Hand book of Mechanical Design", II Edition, Tata McGraw Hill 10985.
- 2) Bhandari, V.B., "Design of Machine Elements", Tata McGraw Hill Publishing Company Ltd., 109094.
- 3) Prabhu. T.J., (2000) "Design of Transmission Elements", Mani Offset, Chennai.
- 4) Hamrock B.J., Jacobson B. and Schmid S.R., "Fundamentals of Machine Elements", Tata McGraw-Hill Book Co., 1090909.
- 5) Ugural A,C, (2003) "Mechanical Design, An Integrated Approach", Tata McGraw-Hill.



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|----------------------------|---------------|---------------------|-------------|------------|-------------------|-----------|-----------|------------|---------------|------------|-----------|-----|----------|
|                            | Prere<br>Elem | equisite:<br>ents-I | Strength    | of M       | laterials,        | Desig     | n of N    | Aachine    | Ту            | 3          | 1/0       | 0/0 | 4        |
| L : Lecture T : T          | utorial       | S Lr : Suj          | pervised Le | earning I  | P: Projec         | t R : Res | search C: | Credits    |               |            |           |     | <u> </u> |
| T/L/ETL : Theor            | y/Lab/Ei      | mbedded             | Theory and  | d Lab      |                   |           |           |            |               |            |           |     |          |
| • Fundam                   | entals of     | f finite ele        | ement anal  | vsis and t | heir appl         | ications. |           |            |               |            |           |     |          |
| Method                     | of solvi      | ng one, t           | wo and iso  | -paramet   | ric eleme         | nts.      |           |            |               |            |           |     |          |
| OURSE OUTCO                | OMES (        | COs):               |             |            |                   |           |           |            |               |            |           |     |          |
| CO1                        | Underst       | and the l           | basic conc  | epts in l  | Finite El         | ement M   | lethod.   | (Level 2   | 2)            |            |           |     |          |
| CO2                        | Identify      | the appl            | lication ar | d charac   | cteristics        | of Finit  | te Eleme  | ent Anal   | ysis eleme    | ents. (Lev | el 2)     |     |          |
| CO3                        | Develop       | the elei            | ment chara  | acteristic | equation equation | ons and g | generatio | on of glo  | obal equat    | ions. (Lev | vel 6)    |     |          |
| CO4                        | Analyze       | e the suit          | able boun   | dary cor   | nditions          | to a gloł | oal equat | tion of H  | FEA eleme     | ents. (Lev | el 4)     |     |          |
| CO5                        | Apply F       | FEA soft            | ware to an  | alyze th   | e machi           | ne eleme  | ents. (Le | evel 3)    |               |            |           |     |          |
| Mapping of Cou             | irse Out      | tcomes w            | ith Progra  | m Outco    | omes (PC          | )s)       |           |            |               |            |           |     |          |
| Cos/Pos                    | PO1           | PO2                 | PO3         | PO4        | PO5               | PO6       | PO7       | PO8        | PO9           | PO10       | PO11      | POI | 12       |
| CO1                        | 3             | 3                   | 3           | 2          | 2                 | 2         | 1         | 1          | 2             | 2          | 1         |     | 2        |
| CO2                        | 3             | 3                   | 3           | 3          | 2                 | 2         | 1         | 1          | 2             | 2          | 1         | 1   | 2        |
| CO3                        | 3             | 3                   | 3           | 3          | 2                 | 2         | 1         | 1          | 2             | 2          | 1         |     | 2        |
| CO4                        | 3             | 3                   | 3           | 3          | 2                 | 2         | 1         | 1          | 2             | 2          | 1         | 1   | 2        |
| CO5                        | 3             | 3                   | 3           | 3          | 3                 | 2         | 1         | 1          | 2             | 2          | 1         |     | 2        |
| Cos / PSOs                 | PS            | 601                 | PSC         | )2         | PS                | 503       | P         | <b>SO4</b> |               |            |           |     |          |
| CO1                        |               | 3                   | 3           |            | ,                 | 2         |           | 3          |               |            |           |     |          |
| CO2                        |               | 3                   | 3           |            | ,                 | 2         |           | 3          |               |            |           |     |          |
| CO3                        |               | 3                   | 3           |            | ź                 | 2         |           | 3          |               |            |           |     |          |
| CO4                        |               | 3                   | 3           |            | ,                 | 2         |           | 3          |               |            |           |     |          |
| CO5                        |               | 3                   | 3           |            |                   | 2         |           | 3          |               |            |           |     |          |
| 3/2/1 indicates S          | Strengt       | h of Cor            | relation    | 3- High    | n, 2- Me          | dium, 1   | -Low      |            |               |            |           |     |          |
|                            |               |                     | e)          |            |                   |           |           |            |               |            |           |     |          |
|                            |               |                     | ienc        |            |                   |           |           |            |               |            |           |     |          |
|                            |               |                     | Sci         |            |                   |           |           |            |               |            |           |     |          |
|                            |               | ce                  | cial        |            | e                 |           |           |            |               |            |           |     |          |
| jory                       |               | zien                | so          |            | ctiv              |           | lary      | ent        | ect           |            |           |     |          |
| ateg                       | nce           | S                   | and         | le         | ele               | ve        | plir      | uoc        | Proj          |            |           |     |          |
| C                          | cie           | ring                | ties        | Cc         | am                | ecti      | isci      | omj        | al /l         |            |           |     |          |
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|                            | Bas           | ingi                | Hum         | rog        | P1                | Dper      | Inte      | Ski        | Pra           |            |           |     |          |
|                            |               | Ш                   |             |            | ×                 |           |           |            |               |            |           |     |          |
|                            |               |                     |             |            |                   |           |           |            |               |            |           |     |          |

| Subject Code: | Subject Name : FINITE ELEMENT ANALYSIS                               | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|---------------|--|---------------|---|-----------|-----|---|
| EDME22015     | Prerequisite: Strength of Materials, Design of Machine<br>Elements-I | Ту            | 3 | 1/0       | 0/0 | 4 |

#### **UNIT-I INTRODUCTION**

Historical Background – Mathematical Modeling of field problems in Engineering –Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

#### UNIT- II ONE-DIMENSIONAL PROBLEMS

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors-Assembly of Matrices - Solution of problems from solid mechanics including thermal stresses-heat transfer. Natural frequencies of longitudinal vibration and mode shapes. Fourth Order Beam Equation –Transverse deflections and Transverse Natural frequencies of beams.

#### UNIT- III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements and Quadrilateral elements- Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts.

#### UNIT- IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Constitutive matrices and Strain displacement matrices – Stiffness matrix – Stress calculations - Plate and shell elements.

UNIT- V ISOPARAMETRIC FORMULATION AND ADVANCED TOPICS9Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One and<br/>two dimensions – Serendipity elements – Numerical integration - Matrix solution techniques – Solutions<br/>Techniques to Dynamic problems – Introduction to Analysis Software- Introduction to Non Linearity.

#### Lab Components

#### Design the following machine elements using CAD software, analyse using FEA software.

- 1. Shafts subjected to Bending Moment and Twisting Moment
- 2. Open and Closed coiled helical springs
- 3. Leaf Springs
- 4. Wire ropes for various loads
- 5. Connecting rod

#### Design and simulation of linkages.

- 1. Simulation of Single Slider Crank chain Mechanism for I.C. Engines.
- 2. Simulation of 4 bar mechanism.
- 3. Simulation of crank and slotted lever mechanism.

#### **TEXT BOOKS:**

- 1. J.N.Reddy, "An Introduction to the Finite Element Method", 3rd Edition, Tata McGrawHill,2005
- 2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., NewDelhi, 2007.

#### **REFERENCES:**

- 1. Logan, D.L., "A first Subject in Finite Element Method", Thomson Asia Pvt. Ltd., 2002.
- 2. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and
- Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.
- 3. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butter worth Heinemann, 2004.
- 4. Chandrupatla and Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Ibrahim Zeid, "Introduction to CAD/CAM", Tata McGraw Hill Co.

Total No. of Periods: 45



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| Subject Code:                    | S        | ubject   | Name<br>UGMF   | :VIRT                         | TUAL<br>REAL | REA     | ALITY    | Ту        | /Lb/     | L              | T/          | P/R      | С        |  |  |
|----------------------------------|----------|--|----------------|-------------------------------|--------------|---------|----------|-----------|----------|----------------|-------------|----------|----------|--|--|
| EBME22ET4                        | P        | rereau   | usite:         | Manufa                        | cturin       | g T     | echnol   | Dgv.      | E<br>ETL | 2              | 5.Lr<br>0/0 | 2/0      | 3        |  |  |
|                                  | C        | CAD CA   | AM, The        | rmal Er                       | ngg.         | 8       |          |           |          |                | 0/0         | 2/0      | 5        |  |  |
| L:LectureT:Tuto                  | rial     | SLr:   | Supervise      | edLearni                      | ngP:Pr       | ojectR  | :Resear  | chC:Cre   | dits     |                |             |          |          |  |  |
| T/L/ETL:Theory                   | /Lab/E   | Embedd   | edTheory       | yandLab                       |              |         |          |           |          |                |             |          |          |  |  |
| OBJECTIVE:C                      | )BJEC    | TIVE:  | The stud       | ents will                     | learn        |         |          |           |          |                |             |          |          |  |  |
| To introduce                     | e the re | elevanc  | e of this      | course t                      | to the o     | existin | g techno | ology th  | rough de | emonstra       | tions, ca   | ase stuc | lies and |  |  |
| <ul> <li>To understar</li> </ul> | nd virtu | al reali   | ty, augm       | ented rea                     | ality an     | id usin | g them t | o build ] | Biomedi  | cal engir      | neering a   | applicat | ions     |  |  |
| COURSEOUT                        | COME     | MES(COs) : The students will be able to  |                |                               |              |         |          |           |          |                |             |          |          |  |  |
| CO1                              | Unde     | rstand t   | the physi      | cal princ                     | iples o      | f VR &  | & AR     |           |          |                |             |          |          |  |  |
| CO2                              | Creat    | e a con  | nfortable.     | high-pe                       | rforma       | nce V   | R applic | ation us  | ing Unit | y              |             |          |          |  |  |
| CO3                              | Analy    | nalyze and understand the working of various state of the art VR & AR devices. |                |                               |              |         |          |           |          |                |             |          |          |  |  |
| CO4                              | Anal     | alyze & Design a system or process to meet given specifications with realist   |                |                               |              |         |          |           |          |                |             |          |          |  |  |
| C05                              | engir    | neering  | <u>constra</u> | $\frac{\text{ints}}{2D - AI}$ | )            |         |          |           |          |                |             |          |          |  |  |
| CU5<br>Monning of Cou            | Creat    | Cutcomes with Program Outcomes (POs)   |                |                               |              |         |          |           |          |                |             |          |          |  |  |
| COs/POs                          | PO1      | PO2  | PO3            | PO4                           | PO5          | PO6     | PO7      | PO8       | PO9      | PO10           | PO11        |          | PO12     |  |  |
| CO1                              | 3        | 3  | 3              | 3                             | 2            | 3       | 107      | 2         | 3        | 2              | 3           |          | 3        |  |  |
| CO2                              | 3        | 3  | 3              | 3                             | - 3          | 3       | 1        | 3         | 2        | 2              | 3           |          | 3        |  |  |
| CO3                              | 3        | 3  | 3              | 3                             | 3            | 3       | 1        | 2         | 3        | 3              | 3           |          | 3        |  |  |
| CO4                              | 3        | 3  | 3              | 3                             | 3            | 3       | 1        | 2         | 3        | 3              | 2           |          | 3        |  |  |
| CO5                              | 3        | 2  | 3              | 2                             | 3            | 3       | 1        | 2         | 3        | 3              | 2           |          | 3        |  |  |
| COs /PSOs                        | P        | SO1  | PS             | 02                            | Р            | SO3     | PS       | 504       |          |                |             |          |          |  |  |
| CO1                              |          | 3  | 3              | ;                             |              | 3       |          | 3         |          |                |             |          |          |  |  |
| CO2                              | Í        | 3  |                | 3                             |              | 3       |          | 3         |          |                |             |          |          |  |  |
| CO3                              |          | 3  | 3              | 3                             | 1            | 3       |          | 3         |          |                |             |          |          |  |  |
| CO4                              | í        | 3  | 3              | 3                             |              | 3       |          | 3         |          |                |             |          |          |  |  |
| CO5                              |          | 2  | 3              | \$                            |              | 3       |          | 3         |          |                |             |          |          |  |  |
|                                  | 3/       | /2/1 inc   | licates S      | trength                       | of Cor       | relatio | on 3-H   | ligh, 2-  | Medium   | , <b>1-Low</b> |             |          |          |  |  |
|                                  |          |  | ocial          |                               | ive          |         | <u>5</u> | 1         | t        |                |             |          |          |  |  |
| ~                                | lce      |  | and s          | e                             | electi       | ve      | olina    |           | rojec    |                |             |          |          |  |  |
| gory                             | cier     | ing  | ies a          | Col                           | am (         | ectiv   | iscip    | duur      | al /P    |                |             |          |          |  |  |
| ateş                             | ic S     | neer   | anit<br>Ice    | ram                           | ogr          | 1 El¢   |          | 5         | ctice    |                |             |          |          |  |  |
| Ũ                                | Bas      | ngii<br>cien   | lum<br>cier    | rogı                          | Pr           | ben     | Inte     |           | Prac     |                |             |          |          |  |  |
|                                  |          | ŇМ   | Ň              |                               |              | 0       |          |           |          |                |             |          |          |  |  |
|                                  |          |  |                |                               |              |         |          |           |          |                |             |          |          |  |  |
|                                  |          |  |                |                               |              |         |          |           |          |                |             |          |          |  |  |

EDUCATIONAL AND RESEARCH INSTITUTE DEEMED TO BE UNIVERSITY University with Graded Autonomy Status (An ISO 21001 : 2018 Certified Institution) Periyar EVA High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code: | Subject Name: VIRTUAL REALITY AND<br>AUGMENTED REALITY | Ty /<br>Lb/ETL | L | T<br>/S.Lr | <b>P/ R</b> | С |
|---------------|--|----------------|---|------------|-------------|---|
| EBME22ET4     | Prerequisite: Manufacturing Technology,                | ETL            | 2 | 0/0        | 2/0         | 3 |
|               | CAD CANI, I nermai Engg.                               |                |   |            |             |   |

# UNIT I INTRODUCTION

The three I's of virtual reality-commercial VR technology and the five classic components of a VR system – Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers,

navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.

# Lab components:

1.Installation of Unity and Visual Studio, setting up Unity for VR development

2.Demonstration of the working of HTC Vive

# UNIT II VR DEVELOPMENT PROCESS

Geometric modeling - kinematics modeling - physical modeling - behaviour modeling - model Management. Lab components:

1.Demonstration of the working of Google Cardboard

2.Develop a scene in Unity that includes a cube, plane and sphere

# UNIT III CNTENT CREATION CONSIDERATION FOR VR

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment

# Lab components:

1. Change the colour and material of Game object

2. Change the texture of Game object

# UNIT IV VR ON THE WEB & VR ON THE MOBILE

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)- frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics

# Lab components:

1.Create an immersive environment (living room)

2. Create an immersive environment (tennis court)

# UNIT V APPLICATIONS OF VR &AR

Mechanical applications-Robotics applications- Advanced Real time Tracking- other applications- games, movies, simulations.

# Lab components:

1.Assembly of Gear box using VR & AR 2. Assembly of tailstock using VR & AR

# **TEXT BOOKS:**

- 1. C. Burdea& Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc.,2008
- 2. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA.

# **REFERENCES:**

1. Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg& Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575

2. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability), Steve Aukstakalnis, Addison-Wesley Professional; 1 edition, 2016.

3. The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything, Robert Scoble&Shel Israel, Patrick Brewster Press; 1 edition, 2016.

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| Subject Cod     | le: Su  | bject ]  | Name :      | DESI                                      | GN Al      | ND SI     | MULA     | TION    | Ty / Lb  | / L      | T /          | P/<br>R | C |
|-----------------|---|--|-------------|---|------------|-----------|----------|---------|----------|----------|--------------|---------|---|
| EBME22L08       |   | <b>ND</b>  |             |   |            |           |          |         | ETL      |          | <b>5.</b> LI | K       |   |
|                 | Pr  | erequis  | ite: Nil    |   |            |           |          |         | Lb       | 0        | 0/0          | 3/0     | 1 |
| L : Lecture T   | : Tutor   | ial SI   | r : Super   | vised L                                   | earning    | g P : Pro | oject R  | : Resea | rch C: C | redits   |              |         |   |
| T/L/ETL : Th    | neory/La  | ab/Emb   | edded Th    | neory an                                  | ld Lab     |           |          |         |          |          |              |         |   |
| OBJECTIV        | ES:   |  |             |   |            |           |          |         |          |          |              |         |   |
| • To ge         | t practi  | cal knov   | vledge of   | model                                     | ing of v   | various   | machin   | e parts | using Au | to CAE   | and oth      | er      |   |
| mode            | ling sof  | tware.   |             |   |            |           |          |         |          |          |              |         |   |
| COURSE O        | UTCO  | MES (C   | 2Os): (3)   | - 5)                                      |            |           |          |         |          |          |              |         |   |
| CO1             | Understa  | nd the Ba  | asics of CA | D Mode                                    | ling Pack  | age       |          |         | <u> </u> |          |              |         |   |
| CO2             | Draw th   | e 2D dia   | igram, par  | t drawin                                  | g and as   | ssembly   | drawing  | g using | Auto CAI | <u>ر</u> |              |         |   |
| CO3             | Understa  | Inderstand the knowledge on design packages (Solid works and C |             |   |            |           |          |         |          | s)       |              |         |   |
| CO4             | Ability to  | o draw the   | e various 1 | nachine p                                 | oarts usir | ng CATI   | A Softwa | are.    |          |          |              |         |   |
| CO5             | Analyze the material properties and deflections in Ansys Software |  |             |   |            |           |          | ire     |          |          |              |         |   |
| Mapping of      | Course  | e Outcomes with Program Outcomes (Pos)                         |             |   |            |           |          |         |          |          |              |         |   |
| Cos/Pos         | PO1   | PO2  | PO3         | PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO1 |            |           |          |         |          |          |              |         |   |
| CO1             | 3   | 3  | 3           | 3   | 3          | 3         |          | 2       | 2        | 3        | 3            |         | 2 |
| CO2             | 3   | 3  | 3           | 3   | 3          | 3         |          | 2       | 2        | 3        | 3            |         | 2 |
| CO3             | 3   | 3  | 3           | 3   | 3          | 3         |          | 2       | 2        | 3        | 3            |         | 2 |
| CO4             | 3   | 3  | 3           | 3   | 3          | 3         |          | 2       | 2        | 3        | 3            |         | 2 |
| CO5             | 3   | 3  | 3           | 3   | 3          | 3         |          | 2       | 2        | 3        | 3            |         | 2 |
| Cos / PSOs      | ]   | PSO1   | F           | PSO2                                      | ]          | PSO3      |          | PSO4    |          |          |              |         |   |
| CO1             |   | 3  | 3           |   |            | 3         |          |         |          |          |              |         |   |
| CO2             |   | 3  | 3           |   |            | 3         |          |         |          |          |              |         |   |
| CO3             |   | 3  | 3           |   |            | 3         |          |         |          |          |              |         |   |
| CO4             | ĺ   | 3  | 3           |   |            | 3         |          |         |          |          |              |         |   |
| CO5             |   | 3  | 3           |   |            | 3         |          |         |          |          |              |         |   |
| 3/2/1 indicates | Strengt   | h of Co  | rrelation   | 3- Hig                                    | h, 2- Me   | edium, 1  | 1-Low    |         |          |          |              |         |   |
|                 |   |  |             |   |            |           |          |         |          |          |              |         |   |
|                 |   |  |             |   |            |           |          |         |          |          |              |         |   |
|                 |   |  | ial         |   |            |           |          |         |          |          |              |         |   |
|                 |   |  | soc         |   | tive       |           | ary      | nt      | sct      |          |              |         |   |
|                 | e   |  | pu          | c)  | lec        | e         | lina     | one     | oje      |          |              |         |   |
|                 | ien   | ng   | es a        | Con                                       | m e        | Stiv      | cip      | du      | P.       |          |              |         |   |
| Å               | Sc  | erii<br>e  | niti6<br>e  | m (                                       | grai       | Elec      | Dis      | Col     | ical     |          |              |         |   |
| Or              | asic  | gine   | mar<br>enc  | gra                                       | Pro        | en I      | ter      | dill    | acti     |          |              |         |   |
| teg             | B   | Eng  | Huı<br>Scie | Pro                                       | H          | Opé       | In       | Sk      | Pr       |          |              |         |   |
| Ca              |   |  |             | _ √                                       |            |           |          |         | ✓        |          |              |         |   |
|                 |   |  |             |   |            |           |          |         |          |          |              |         |   |



| Subject Code:<br>EBME22L08 | Subject Name : DESIGN AND SIMULATION LAB | Ty / Lb/<br>ETL | L | T /<br>S.Lr | P/<br>R | C |
|----------------------------|--|-----------------|---|-------------|---------|---|
|                            | Prerequisite: Nil                        | Lb              | 0 | 0/0         | 3/0     | 1 |

# **List of Exercises**

- 1. Introduction to computer Aided Design and Modeling Package
- 2. Exercises (2-D & 3-D) using Design packages:

Part Modeling: Generation of various 3D models through protrusion, revolve, shell sweep, Creation of various features, Study of parent child relation, Feature based and Boolean based modeling surface and assembly modeling, Study of various standard translators, Design simple components

**3.** Exercise using Analysis software: Structural Analysis:

i) Determination of deflection and stresses in bar

ii)Determination of deflection and stresses in 2D and 3D trusses and beams.

Thermal Analysis

i)Steady state heat transfer Analysis of plane and axis symmetric components.ii)2D problem with conduction and convection boundary conditions.

# **Softwares Recommended:**

- 1. CATIA V5
- 2. Solid Works
- 3. ANSYS



| Pre ro<br>Tutorial<br>y/Lab/En<br>The st<br>practic<br>design   | equisite:<br>SLr:<br>mbedded<br>udent w  | Industria<br>Supervised<br>Theory and<br>vill learn   | <b>d auton</b><br>d Learnin<br>d Lab                      | nation  |   |   |  |   |  |   |  |   |
|---|--|---|---|---|---|---|--|---|--|---|--|---|
| Tutorial<br>y/Lab/Ei<br>The st<br>practic<br>desigr   | S Lr :<br>mbedded<br>udent w   | Supervised<br>Theory and<br>vill learn  | d Learni<br>d Lab   | ng P:H  |   | Pre requisite: Industrial automation  |  |   |  |   |  |   |
| The st<br>practic<br>desigr   | udent w  | vill learn  |   |   | Project R   | : Resea   | rch C: C   | Credits   |  |   |  | <u> </u>  |
| practic<br>desigr   |  |   |   |   |   |   |  |   |  |   |  |   |
| h kits  | e simpl<br>and ir  | e prograr<br>nplement   | ns on m<br>pneun  | nicropro<br>natic an  | cessors<br>d hydra  | and mi<br>aulic ci  | cro con<br>rcuits w  | trollers.<br>vith autor   | nation s   | tudio so  | ftware   | and   |
| OMES (  | COs):  |   |   |   |   |   |  |   |  |   |  |   |
| Recogni   | ize the v  | arious con  | nponent   | s of Hyd  | lraulics a  | and Pneu  | imatic ci  | rcuits (Le  | vel 2)   |   |  |   |
| Design a  | and imp  | lement hy   | draulic c   | circuits v  | vith auto   | mation  | studio so  | oftware and   | d kit (Le  | vel 4)  |  |   |
| CO3 Design and implement pneumatic circuits with automation studio software and kit (Level 4)                             |  |   |   |   |   |   |  |   |  |   |  |   |
| Understand the concepts and applications of robots (Level 2)<br>Write programming for controllers in automation (Level 4) |  |   |   |   |   |   |  |   |  |   |  |   |
| Mapping of Course Outcomes with Program Outcomes (POs)  |  |   |   |   |   |   |  |   |  |   |  |   |
| PO1   | PO2  | PO3   | PO4   | PO5   | <b>PO6</b>  | PO7   | PO8  | PO9   | <b>PO10</b>  | PO11  | PO   | 2   |
| 3   | 3  | 2   | 2   | 3   | 3   | 2   | 3  | 3   | 3  | 3   |  | 2   |
| 3   | 3  | 3   | 3   | 3   | 3   | 2   | 3  | 3   | 3  | 3   | 2  |   |
| 3   | 3  | 3   | 3   | 3   | 3   | 2   | 3  | 3   | 3  | 3   |  | 2   |
| 3   | 3  | 2   | 2   | 3   | 3   | 2   | 3  | 3   | 3  | 3   | 2  |   |
| 3   | 3  | 3   | 3   | 3   | 3   | 2   | 3  | 3   | 3  | 3   |  | 2   |
| PS  | 01   | PSC   | )2  | PS  | 603   | PS  | 504  |   |  |   |  |   |
|   | 3  | 3   |   | ,   | 2   |   | 3  |   |  |   |  |   |
|   | 3  | 3   |   |   | 2   |   | 3  |   |  |   |  |   |
|   | 3  | 3   |   | ,   | 2   |   | 3  |   |  |   |  |   |
|   | 3  | 3   |   |   | 2   |   | 3  |   |  |   |  |   |
|   | 3  | 3   | ~   |   | 2   |   | 3  |   |  |   |  |   |
|   | 3/2/1 i  | indicates S   | Strengtl  | h of Cor  | relation  | 1 <b>3-</b> Hig   | gh, 2- M   | edium, 1-   | Low  |   |  |   |
| Basic Science   | Engineering Science  | Humanities and social Science   | Program Core  | Program elective  | Open Elective   | Inter Disciplinary  | Skill Component  | Practical /Project  |  |   |  |   |
|   | practic design design h kits           DMES (           Recogni           Design i           Design i | practice simple<br>design and in<br>h kits<br><b>MES</b> (COs) :<br>Recognize the v<br>Design and imp<br>Design and i | practice simple program<br>design and implement<br>h kits | practice simple programs on a<br>design and implement pneum<br>h kits | practice simple programs on incropro<br>design and implement pneumatic an<br>h kits | practice simple programs on incroprocessors<br>design and implement pneumatic and hydra<br>h kits | practice simple programs on microprocessors and implement pneumatic and hydraulic cich kits<br>$\overrightarrow{PMES(COs):}$ tecognize the various components of Hydraulics and Pneu<br>Design and implement hydraulic circuits with automation<br>Design and implement pneumatic circuits with automation<br>Inderstand the concepts and applications of robots (Level<br>Vrite programming for controllers in automation (Level 4)<br>rse Outcomes with Program Outcomes (POs)<br>PO1 PO2 PO3 PO4 PO5 PO6 PO7<br>3 3 2 2 3 3 2<br>3 3 3 3 3 3 3 2<br>3 3 3 2 2 3 3 2<br>3 3 3 2 2 3 3 2<br>PSO1 PSO2 PSO3 PS<br>3 3 2 2<br>3 3 3 2 2<br>3 3 3 2 2<br>PSO1 PSO2 PSO3 PS<br>3 3 2 2<br>3 3 3 2 2<br>3 | practice simple programs on incroprocessors and incro condesign and implement pneumatic and hydraulic circuits with automation studio score the various components of Hydraulics and Pneumatic circles series and implement hydraulic circuits with automation studio score sign and implement pneumatic circuits with automation studio score score and applications of robots (Level 2) Vrite programming for controllers in automation (Level 4) resourcemes with Program Outcomes (POs)<br>PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8<br>3 3 2 2 3 3 2 3<br>3 3 3 3 3 3 3 3 3 2 3<br>3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 | practice simple programs on microprocessors and micro controllers.<br>design and implement pneumatic and hydraulic circuits with autor<br>h kits | practice simple programs on incroprocessors and incro contoners.<br>design and implement pneumatic and hydraulic circuits with automation s<br>h kits<br>$\frac{\text{MES}(\text{COs}):}{\text{Ecognize the various components of Hydraulics and Pneumatic circuits (Level 2)} \\ \text{Design and implement hydraulic circuits with automation studio software and kit (Level a) inderstand the concepts and applications of robots (Level 2) Vrite programming for controllers in automation (Level 4) rse Outcomes with Program Outcomes (POS) \frac{\text{PO1}  \text{PO2}  \text{PO3}  \text{PO4}  \text{PO5}  \text{PO6}  \text{PO7}  \text{PO8}  \text{PO9}  \text{PO10} \\ \hline 3  3  2  2  3  3  2  3  3  3 \\ \hline 3  3  3  3  3  3  3  2  3  3 $ | practice simple programs on microprocessors and micro contoners.<br>design and implement pneumatic and hydraulic circuits with automation studio software and kit (Level 2)<br>Zecognize the various components of Hydraulics and Pneumatic circuits (Level 2)<br>Zesign and implement hydraulic circuits with automation studio software and kit (Level 4)<br>Design and implement pneumatic circuits with automation studio software and kit (Level 4)<br>Zesign and implement pneumatic circuits with automation studio software and kit (Level 4)<br>Tree Outcomes with Program Outcomes (POs)<br>PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11<br>3 3 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 | practice simple programs on microprocessors and micro controlets.<br>design and implement pneumatic and hydraulic circuits with automation studio software h kits<br>MES (COs) :<br>tecognize the various components of Hydraulics and Pneumatic circuits (Level 2)<br>Design and implement hydraulic circuits with automation studio software and kit (Level 4)<br>Design and implement pneumatic circuits with automation studio software and kit (Level 4)<br>Design and implement pneumatic circuits with automation studio software and kit (Level 4)<br>Inderstand the concepts and applications of robots (Level 2)<br>Vrite programming for controllers in automation (Level 4)<br>res Outcomes with Program Outcomes (POs)<br>POI PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO1<br>3 3 2 2 3 3 3 3 3 3 2 3 3 3 3 3 3 3 3 3 |



| Subject Code: | Subject Name : INDUSTRIAL AUTOMATION LAB | Ty/Lb/ | L | Τ/  | P/R | С |
|---------------|--|--------|---|-----|-----|---|
| EDME221.00    |  | ETL    |   | SLr |     |   |
| EBME22L09     | Prerequisite: Industrial automation      | Lb     | 0 | 0/0 | 3/0 | 1 |

#### LIST OF EXPERIMENTS:

- a. Exercises in PLC Trainer Kit.
- b. Exercises in Pneumatic / Hydraulic Trainer Kit.
- c. Exercises in Electro Pneumatic kit.
- d. Exercises in Industrial Robot.
- e. Exercises in microprocessors and micro controllers.
- f. Design of pneumatic and hydraulic circuits using Automation Studio software.



| Subject Code:<br>EBME22105 | Subject Name: PROJECT PHASE-I | Ty/Lb/<br>ETL/IE | L | T/<br>SLr | P/R | С |
|----------------------------|-------------------------------|------------------|---|-----------|-----|---|
|                            | Pre requisite: All Courses    | IE               | 0 | 0/0       | 3/3 | 2 |

Students are expected to do the Project in a group of 3 to 4 students. They should identify the area/topic of the Project and should collect the literatures related to the project. Students intending to do Industrial projects will approach the industries with the support of the university, identify the industrial problem and finalize the project. In case of Industrial projects apart from Industry guide, a guide has to be appointed by the department. At the end of the Semester the students should submit their Project Phase - I report to the Department and Viva -Voce examination will be conducted by the examiners duly appointed by the Head of the department.



| Subject Code:  | 5  | Subject Na                | me: FO                        | REIGN        | LANGU            | AGE           |                    | Т               | y/Lb/              | -        | Τ/         | D/D      | C     |
|--|--|---------------------------|-------------------------------|--------------|------------------|---------------|--------------------|-----------------|--------------------|----------|------------|----------|-------|
| FBFI 22IXX   |  |                           |                               |              |                  |               |                    | ]               | ETL/IE             | L        | SLr        | P/K      | C     |
| LDI LZZIAA   | 1  | Pre Requis                | ite: Nil                      |              |                  |               |                    |                 | IE                 | 1        | 0/0        | 1/0      | 1     |
| L : Lecture T  | : Tuto   | rial S.Lr :               | Supervised                    | l Learnin    | ıg P : Pı        | oject R       | : Researc          | h C: C          | Credits            | 1 1      |            |          |       |
| T/L/ETL : Theo   | ry/Lab   | /Embeddec                 | l Theory an                   | d Lab        |                  |               |                    |                 |                    |          |            |          |       |
| <b>OBJECTIVE :</b><br>higher studies/p   | The<br>rofessi   | main objec<br>onal career | tive of this abroad           | course i     | s to equi        | p the stu     | idents wit         | h one f         | foreign lang       | uage whi | ch will en | able the | m for |
|  |  |                           | COURSE                        | OUTCO        | MES (C           | Os): (3-      | 5)                 |                 |                    |          |            |          |       |
| CO1 Students will gain the knowledge of identifying phonetics of all the letters in one foreign language |  |                           |                               |              |                  |               |                    |                 |                    |          |            |          |       |
| CO2  |  | Students v                | vill gain the                 | knowled      | lge of rea       | ading sm      | all words          | and in          | one foreign        | language | :          |          |       |
| CO3  |  | Students v                | vill gain the                 | knowled      | lge of wr        | iting skill   | l in one fo        | reign la        | anguage.           |          |            |          |       |
| CO4  |  | Students v                | vill gain the                 | knowled      | lge of rea       | ding skil     | l in one fo        | oreign la       | anguage            |          |            |          |       |
| CO5  |  | Students v                | ill gain the                  | knowled      | lge of spo       | oken skill    | l in one fo        | reign la        | anguage            |          |            |          |       |
|  | Mapping of Course Outcomes with Program Outcomes (POs) |                           |                               |              |                  |               |                    |                 |                    |          |            |          |       |
| COs/POs  | PO1  | PO2                       | PO3                           | PO4          | PO5              | PO6           | PO7                | <b>PO8</b>      | PO9                | PO10     | PO11       | PO1      | 2     |
| CO1  | 2  | 1                         | 1                             | 1            | 1                | 3             | 3                  | 3               | 3                  | 3        | 3          | 3        |       |
| CO2  | 3  | 2                         | 3                             | 3            | 2                | 3             | 3                  | 3               | 3                  | 3        | 3          | 2        |       |
| CO3  | 3  | 3                         | 3                             | 3            | 2                | 3             | 3                  | 3               | 3                  | 3        | 3          | 2        |       |
| CO4  | 3  | 2                         | 3                             | 3            | 2                | 3             | 3                  | 3               | 3                  | 3        | 3          | 2        |       |
| CO5  | 3  | 3                         | 3                             | 3            | 2                | 3             | 3                  | 3               | 3                  | 3        | 3          | 2        |       |
| COs / PSOs   |  | PSO1                      | PSC                           | )2           | PS               | PSO3 PSO4     |                    |                 |                    |          |            |          |       |
| CO1  |  |                           |                               |              |                  |               |                    |                 |                    |          |            |          |       |
| CO2  |  |                           |                               |              |                  |               |                    |                 |                    |          | _          |          |       |
| CO3  |  |                           |                               |              |                  |               |                    |                 | _                  |          | _          |          |       |
| CO4  |  |                           |                               |              |                  |               |                    |                 |                    |          |            |          |       |
|  | C4   | -41 - f C -               | 1-4                           | 2 11:-1      | - 2 M-           | JP 1          | T                  |                 |                    |          |            |          |       |
| 3/2/1 indicates  | Stren  | gth of Co                 | rrelation                     | 3- Higi      | n, 2- Me         | aium, I       | -Low               |                 |                    |          |            |          |       |
| Category   | Basic Science  | Engineering Science       | Humanities and social Science | Program Core | Program elective | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |          |            |          |       |
|  |  |                           | ~                             |              |                  |               |                    |                 |                    |          |            |          |       |



| Subject Code:<br>EBFL22IXX | Subject Name : FOREIGN LANGUAGE | Ty/Lb/<br>ETL/IE | L | T/<br>SLr | P/R | С |
|----------------------------|---------------------------------|------------------|---|-----------|-----|---|
|                            | Pre Requisite: Nil              | IE               | 1 | 0/0       | 1/0 | 1 |

Foreign language is introduced in the curriculum to make the students globally employable. Students should select and register for any one of the foreign languages from the given list. At the end of the course students should be able to read, write and converse the language in the basic level. At the end of the semester the assessment will be done through internal examination by the examiner duly appointed by the head of the department.

| S.NO | COURSE CODE          | COURSE NAME |
|------|----------------------|-------------|
| 1    | EBFL22I01/HBFL22I01  | FRENCH      |
| 2    | EBFL22I02/ HBFL22I02 | GERMAN      |
| 3    | EBFL22I03/ HBFL22I03 | JAPANESH    |
| 4    | EBFL22I04/ HBFL22I04 | ARABIC      |
| 5    | EBFL22I05/ HBFL22I05 | CHINESE     |
| 6    | EBFL22I06/HBFL22I06  | RUSSIAN     |
| 7    | EBFL22I07/HBFL22I07  | SPANISH     |



# **SEMESTER VIII**

| Subject Code:<br>EBCC22ID1 | Subje<br>AND    | ect Nam<br>INDUST  | e : EN<br>FRIAL                  | GINEE<br>MANA       | RING<br>GEME        | ECON<br>NT         | OMICS                 | 5 Ty/Lb/<br>ETL    | L                     | T/<br>SLr   | P/R         | С    |
|----------------------------|-----------------|--|----------------------------------|---------------------|---------------------|--------------------|-----------------------|--------------------|-----------------------|-------------|-------------|------|
|                            | Prere           | equisite:  | Nil                              |                     |                     |                    |                       | Ту                 | 3                     | 0/0         | 0/0         | 3    |
| L : Lecture T : T          | utorial         | SLr : S  | Supervi                          | sed Lear            | ming P              | : Proje            | ct R : R              | esearch C:         | Credits               |             |             |      |
| T/L/ETL : Theor            | y/Lab./         | Embedd   | led The                          | ory and             | Lab.                |                    |                       |                    |                       |             |             |      |
| <b>OBJECTIVE:</b> T        | The stuc        | lent will  | learn:                           |                     |                     |                    |                       |                    |                       |             |             |      |
| COURSE OUTC                | Concep<br>COMES | ts of ind  | ustrial i                        | manager<br>tudent v | ment an<br>will be  | d econo<br>able to | omics                 |                    |                       |             |             |      |
| CO1                        | Unders          | Understand the various concepts of organizations and economics related to it (Level 2) |                                  |                     |                     |                    |                       |                    |                       |             |             |      |
| CO2                        | Expose          | e to the b   | ehavio                           | r of the            | human               | in the c           | organiza              | tion (Level        | 2)                    |             |             |      |
| CO3                        | Analyz          | the de   | mand a                           | nd supp             | ly patte            | rns and            | l costs re            | elated to it (     | Level 4               | )           |             |      |
| CO4                        | Illustra        | te the va  | arious n                         | nethods             | of prod             | uction             | with cos              | st effectiver      | less (Le              | vel 3)      |             |      |
| CO5                        | Identif         | y the eff  | ect of c                         | ost on n            | nacro e             | conomi             | cs (Leve              | el 2)              |                       |             |             |      |
| Mapping of Cou             | irse Ot         | itcomes  | (COs)                            | with Pr             | ogram               | Outco              | mes (PC               | Ds) & Prog         | ram Sp                | ecific Outc | omes (PSOs) | )    |
| COs/POs                    | PO1             | PO2  | PO3                              | PO4                 | PO5                 | PO6                | PO7                   | PO8                | PO9                   | PO10        | PO11        | PO12 |
| CO1                        | 2               | 2  | 2                                | -                   | 3                   | 2                  | -                     | 3                  | 3                     | 3           | 3           | 2    |
| CO2                        | 2               | 2  | 2                                | -                   | 3                   | 2                  | -                     | 3                  | 3                     | 3           | -           | 2    |
| CO3                        | 2               | 2  | 2                                | -                   | 3                   | 2                  | -                     | 2                  | 3                     | 3           | 3           | 2    |
| CO4                        | 2               | 2  | 2                                | -                   | 3                   | 2                  | -                     | 2                  | 3                     | 3           | 3           | 2    |
| CO5                        | 2               | 2  | 2                                | -                   | 3                   | 2                  | -                     | 2                  | 3                     | 3           | 3           | 2    |
| COs / PSOs                 | PS              | 501  | PS                               | <b>SO2</b>          | P                   | SO3                | PSO<br>4              |                    |                       |             |             |      |
| CO1                        |                 | 2  |                                  | 3                   |                     | 3                  | 3                     |                    |                       |             |             |      |
| CO2                        |                 | 2  |                                  | 3                   |                     | 3                  | 3                     |                    |                       |             |             |      |
| CO3                        |                 | 2  |                                  | 3                   |                     | 3                  | 3                     |                    |                       |             |             |      |
| CO4                        |                 | 2  |                                  | 3                   |                     | 3                  | 3                     |                    |                       |             |             |      |
| CO5                        |                 | 2  |                                  | 3                   |                     | 3                  | 3                     |                    |                       |             |             |      |
| 3/2/1 indicates St         | rength          | of Corr  | elation                          | 3- Hi               | gh, 2- N            | Aediun             | n, 1-Lov              | <b>v</b>           |                       |             | 1           |      |
| ıtegory                    | Basic Science   | Engineer<br>ing  | Humanities and<br>social Science | Program             | Program<br>elective | Open Elective      | Inter<br>Disciplinary | Skill<br>Component | Practical<br>/Project |             |             |      |
| C                          |                 |  |                                  |                     |                     |                    |                       |                    |                       |             |             |      |

#### (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code: | Subject Name : ENGINEERING ECONOMICS<br>AND INDUSTRIAL MANAGEMENT | Ty/Lb/<br>ETL/IE | L | T/<br>SLr | P/R | С |
|---------------|---|------------------|---|-----------|-----|---|
| EBCC22ID1     | Prerequisite: Nil   | Ту               | 3 | 0/0       | 0/0 | 3 |

#### UNIT - I Introduction to Management

DUCA

The Nature of Management –Management: Science or Art – Difference between administration and management - Evolution of management thought - Roles of managers– F.W.Taylor and Henri Fayol contribution to the management- Organization and the environmental factors.

#### UNIT - II Managing Organizational Behavior

Definition- need and Importance of Organizational Behavior – Nature and Scope of Organizational Behavior - Role of managers – Contributing disciplines to Organizational Behavior - Frame work of Organizational Behavior.

#### UNIT – III Demand & Supply Analysis

Meaning of demand, the demand curve, Elasticity of demand, types of elasticity of demand. Supply –Meaning, the supply curve, equilibrium with supply and demand curves.

#### **UNIT IV Theory of Production**

Meaning of Production, Basic concepts- total, average, and marginal product, short run and long run production Function, Law of Variable Proportion. Production function with two variable inputs – Isoquants – Meaning, Properties, ISO cost Lines, All variable inputs – Returns to Scale, Cost Analysis: Determinants of Costs, types of Cost.

#### **UNIT V Macro Economic Concepts**

National income concepts, Inflation, Balance of Payment, Circular flow of income Monetary and Fiscal Policy, Demonetization, Exchange Rates

#### **REFERENCE BOOKS:**

- 1. Meenakshi Gupta Principles of Management PHI Learning Pvt. Ltd.-2009.
- 2. L.M.Prasad Principles and Practice of Management Sultan Chand & Sons 7<sup>th</sup> Edition 2007.
- 3. Harold Koontz Principles of Management Tata McGraw Hill 2004.
- 4. Mithani, D.M, Managerial Economics- Theory & applications, Himalaya pub.
- 5. Mehta, P, L, Managerial Economics. Analysis, problem & cases, Sultan Chand



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Q

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9

9

**Total No. of Periods**


| Subject Code: | Subject Name: PROJECT PHASE-II | Ty/Lb/ | L | <b>T</b> / | P/R   | С |
|---------------|--------------------------------|--------|---|------------|-------|---|
| EBME22L10     |                                | ETL    |   | SLr        |       |   |
|               | Pre requisite: Project Phase-I | Lb     | 0 | 0/0        | 12/12 | 8 |
|               |                                |        |   |            |       |   |

To make the students to make use of the knowledge and skill developed during their four years of study and to apply them for making an innovative product/process for the development of society and industries.

Students are expected to do a Project work either in an Industry or at the University in the field of relevant Engineering /inter-disciplinary /multi-disciplinary area in a group of 3 or 4 students. The work to be carried out in Phase II should be continuation of Phase I. Each group will be allotted a guide based on the area of Project work. In case of industrial Project external guide has to be allotted from Industry. Inter disciplinary/multi-disciplinary project can be done with students of different disciplines as a group. Monthly reviews will be conducted during the semester to monitor the progress of the project by the project review committee. Students have to submit the Project thesis at the end of the semester and appear for the Project Viva-Voce examination conducted by the examiners duly appointed by the Controller of Examination. In case of industrial project certificate in proof has to be included in the report along with the bonofide certificate.



# **ELECTIVE SUBJECTS**



# **ELECTIVE:**

# THERMAL ENGINEERING



|                     | 0 21001 . 2010 00 | fillieu matit | ulion             |
|---------------------|-------------------|---------------|-------------------|
| Periyar E.V.R. High | Road, Maduravoya  | , Chennai-95. | Tamilnadu, India. |

| Subject Co<br>EBME22E                 | ode:<br>01 | Sul   | bject Na   | me: AD            | VANC    | ED IC F   |            | Ty/Lb/<br>ETL | L       | T/<br>SLr  | P/R       | C       |     |    |
|---------------------------------------|------------|---|--|-------------------|---------|-----------|------------|---------------|---------|------------|-----------|---------|-----|----|
|                                       |            | Pre<br>En   | erequisi<br>gineerir   | te: Thern         | nodynai | nics and  | d Ther     | mal           |         | Ту         | 3         | 0/0     | 0/0 | 3  |
| L : Lecture                           | T : Tı     | utorial   | l S Lr   | : Supervis        | ed Lear | ning P:   | Practic    | al R : R      | esearch | C: Credits | 5         |         |     |    |
| T/L/ETL : T                           | Theor      | y/Lab   | /Embed   | ded Theor         | y and L | ab        |            |               |         |            |           |         |     |    |
| • Re                                  | cent a     | dvand   | cements  | of I.C Er         | gines   |           |            |               |         |            |           |         |     |    |
| • Vai                                 | rious a    | alterna   | ative fue  | ls for I.C        | engines |           |            |               |         |            |           |         |     |    |
| COURSE                                | OUT        | COM   | ES (CO   | s) : The <b>S</b> | tudent  | will be a | able to    |               |         |            |           |         |     |    |
| COI                                   | Und        | lerstar   | nd and a   | pply the k        | nowledg | ge of fue | el injecti | on syste      | ms and  | combustic  | on proces | s of IC |     |    |
|                                       | engi       | nes.(I  | Level 28   | 23)               |         |           |            |               |         |            |           |         |     |    |
| CO2                                   | Dist       | Distinguish the types of combustion chambers used in CI engine.(Level 1)    |  |                   |         |           |            |               |         |            |           |         |     |    |
| CO3                                   | Ana        | lyze the pollution formations mechanism and control in IC engines.(Level 4) |  |                   |         |           |            |               |         |            |           |         |     |    |
| CO4                                   | Und        | lerstar   | erstand and apply the knowledge of various alternative fuels in IC engines.(Level 2&3) |                   |         |           |            |               |         |            |           |         |     |    |
| CO5                                   | App        | ly the  | ly the recent trends techniques in IC engines.(Level 3)                                |                   |         |           |            |               |         |            |           |         |     |    |
| Mapping o                             | f Cou      | rse O   | se Outcomes with Program Outcomes (POs)  |                   |         |           |            |               |         |            |           |         |     |    |
| COs/POs                               | P          | <b>PO</b> 1   | PO2  | PO3               | PO4     | PO5       | PO6        | PO7           | PO8     | PO9        | PO10      | PO11    | PO  | 12 |
| CO1                                   |            | 3   | 2  | 1                 | 2       | 1         | 1          | 3             | 1       | 1          | 1         | -       |     | 1  |
| CO2                                   |            | 2 3 1 1 1 1 2 1 1 1 -   |  |                   |         |           |            |               |         | 1          |           |         |     |    |
| CO3                                   |            | 2   | 3  | 2                 | 2       | 1         | 1          | 3             | 1       | 1          | 1         | -       |     | 1  |
| CO4                                   |            | 2   | 3  | 2                 | 1       | 1         | 1          | 3             | 1       | 1          | 1         | -       |     | 1  |
| CO5                                   |            | 3   | 2  | 2                 | 2       | 1         | 1          | 1             | 1       | 1          | 1         | -       |     | 2  |
| Cos / PSOs                            |            | PS  | 01   | PSC               | )2      | PS        | 03         | PS            | 504     |            |           |         |     |    |
| CO1                                   |            |   | 3  | 2                 |         | 2         | 2          |               | 2       |            |           |         |     |    |
| CO2                                   |            |   | 3  | 2                 |         | 2         | 2          |               | 2       |            |           |         |     |    |
| CO3                                   |            |   | 3  | 2                 |         | 4         | 2          |               | 2       |            |           |         |     |    |
| CO4                                   |            |   | 3  | 2                 |         | 4         | 2          |               | 2       |            |           |         |     |    |
| CO5                                   |            |   | 3  | 2                 |         | 4         | 2          |               | 2       |            |           |         |     |    |
| 3/2/1 indic                           | cates      | Strer   | ngth of  | Correlat          | ion:    | 3- High   | , 2- Me    | edium,        | 1-Low   |            |           |         |     |    |
|                                       |            |   |  | ial               |         |           |            |               |         |            |           |         |     |    |
|                                       |            |   |  | soc               |         | tive.     |            | ary           | ent     | ect        |           |         |     |    |
|                                       |            | nce   | 50   | and               | ore     | elec      | ve         | plin          | pone    | Proj       |           |         |     |    |
| L L L L L L L L L L L L L L L L L L L | <b>`</b>   | Scie  | guing  | ties              | 1 Cc    | ram       | lecti      | Disci         | om      | al /]      |           |         |     |    |
| ate                                   |            | sic   | inee   | nani              | gran    | rog       | nΕ         | er D          | ill C   | actic      |           |         |     |    |
|                                       |            | $\mathbf{Ba}$   | Eng  | Hun<br>Scie       | Pro§    | Ч         | Ope        | Int           | Sk      | Prí        |           |         |     |    |
|                                       |            |   |  |                   |         | ~         |            |               |         |            |           |         |     |    |
|                                       |            |   |  |                   |         |           |            |               |         |            |           |         |     |    |



| Subject Code: | Subject Name : ADVANCED IC ENGINES       | Ty/Lb/ | L | Τ/  | P/R | С |
|---------------|--|--------|---|-----|-----|---|
| EDME 22EA1    |  | ETL    |   | SLr |     |   |
| FDIVIE22EU1   | Prerequisite: Thermodynamics and Thermal | Tv     | 3 | 0/0 | 0/0 | 3 |
|               | Engineering                              | Гy     | 5 | 0/0 | 0/0 | 5 |

#### **UNIT- I: SPARK IGNITION ENGINES**

Spark Ignition Engine Mixture Requirements - Fuel- Injection Systems-Monopoint and Multi point Injection – Stages of Combustion-Normal and Abnormal Combustion-factors Affecting Knock-Combustion Chambers.

#### **UNIT- II: COMPRESSION IGNITION ENGINES**

States of Combustion in C.I.Engine – Direct and Indirect Injection Systems - Combustion Chambers – Fuel Spray Behavior and Structure-Spray Penetration and Evaporation-Air Motion - Turbo charging.

#### **UNIT- III: POLLUTANT FORMATION AND CONTROL**

Pollutant –Global warming- Sources and Types –Formation of NOx - Hydro-Carbon Emission Mechanism - Carbon Monoxide. Formation-Particulate Emissions-Methods of Controlling Emissions - Catalytic Converters and Particulate Traps-EGR technique.

#### **UNIT- IV: ALTERNATIVE FUELS**

Bio-fuel – Vegetable oil – Bio diesel -Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas-Properties, Suitability, Engine Modifications, Merits and Demerits as Fuels-Flexible fuel vehicles-modifications-merits and demerits

#### **UNIT- V: RECENT TRENDS**

Lean Burn Engines-Stratified Charge Engines-Homogeneous Charge Compression Ignition – Common rail direct injection engine, Hybrid electrical vehicles – series, parallel and series, parallel configuration – Design – Drive train, sizing of components. Fuel cells-types-construction and working.

#### Total No. of Periods: 45

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#### **TEXT BOOK**

1) V.Ganesan, (2008) "Internal combustion engines", Tata McGraw Hill.

#### REFERENCES

- 1) Mathur and Sharma, (1990) "Internal combustion engines".
- 2) John Heywood, (1988) "Internal combustion engines fundamentals", Tata McGraw Hill Co.
- 3) Benson and White house (1983) "Internal combustion engines Vol I & Vol II", Pergamon press.
- 4) Domkundwar, "Internal combustion engines" Dhanpat Rai & Co. (P) Ltd.



| Subject Code:             | Subj     | ect Nan                    | ne: ELE                     | CTRIC                 | AND H                  | IYBRII     | ) VEHI   | CLES     | Ty/Lb/         | L        | <b>T</b> / | P/R   | С   |
|---------------------------|----------|----------------------------|-----------------------------|-----------------------|------------------------|------------|----------|----------|----------------|----------|------------|-------|-----|
| <b>EBME22E02</b>          |          |                            |                             |                       |                        |            |          |          | ETL/IE         |          | SLr        |       |     |
|                           | Prer     | equisite                   | e: Basi                     | c Ele                 | ectrical               | and        | Elec     | tronics  | Tv             | 3        | 0/0        | 0/0   | 3   |
|                           | Engi     | neering                    | 5                           |                       |                        |            |          |          | -5             | Ũ        | 0/0        | 0/0   | U C |
| L : Lecture T : T         | 'utorial | S Lr                       | : Supervis                  | ed Lear               | ning P:                | Project    | R : Res  | earch C  | : Credits      |          |            |       |     |
| T/L/ETL : Theor           | ry/Lab   | /Embed                     | ded Theor                   | y and L               | ab                     |            |          |          |                |          |            |       |     |
| <b>OBJECTIVE:</b>         |          |                            |                             |                       |                        |            |          |          |                |          |            |       |     |
| • Recent                  | advanc   | cements                    | of I.C En                   | gines                 |                        |            |          |          |                |          |            |       |     |
| Various                   | alterna  | ative fue                  | ls for I.C                  | engines.              |                        |            |          |          |                |          |            |       |     |
| COUDSE OUT                | COM      |                            | a) . ( <b>2</b> 5)          |                       |                        |            |          |          |                |          |            |       |     |
| COURSE OUT                | Unde     | <b>LS (CU</b><br>rstand tl | 8) : ( 3- 3)<br>he electric | al vehic              | les conc               | ents and   | lvehicle | kinetia  | es and dyna    | mice     |            |       |     |
| $CO^2$                    | Desic    | i stanu li                 | attery nacl                 | tor the               | types of               | f electric | vehicle  | hacad    | on its care    | city     |            |       |     |
| CO2                       | Unde     | rstand t                   | he workin                   | $\frac{101}{9}$ of DC | $\frac{1}{8} \Delta C$ | electric   | al moto  | rs       | i oli its capa | icity    |            |       |     |
| CO4                       | Apply    | y the kn                   | owledge o                   | of gears,             | differen               | tial and   | clutches | s to the | transmissic    | on of el | ectric veh | icles |     |
| CO5                       | Desig    | gn the dr                  | rive train of               | of hybrid             | d vehicle              | es         |          |          |                |          |            |       |     |
| Mapping of Co             | urse O   | utcome                     | s with Pr                   | ogram (               | Outcom                 | es (POs    | 5)       |          |                |          |            |       |     |
| COs/POs                   | PO1      | PO2                        | PO3                         | PO4                   | PO5                    | PO6        | PO7      | PO8      | PO9            | PO       | 0 PO11     | PO    | 12  |
| CO1                       | 2        | 2                          | 2                           | 2                     | 3                      | 2          | 3        | 2        | 2              | 2        |            |       | 1   |
| CO2                       | 2        | 2                          | 2                           | 2                     | 3                      | 2          | 3        | 2        | 2              | 2        |            |       | 1   |
| CO3                       | 2        | 2                          | 2                           | 2                     | 3                      | 2          | 3        | 2        | 2              | 2        |            |       | 1   |
| CO4                       | 2        | 2                          | 2                           | 2                     | 3                      | 2          | 3        | 2        | 2              | 2        |            |       | 1   |
| CO5                       | 2        | 2                          | 2                           | 2                     | 3                      | 2          | 3        | 2        | 2              | 2        |            |       | 1   |
| Cos / PSOs                | P        | SO1                        | PSC                         | 02                    | PS                     | 03         | PS       | 504      |                |          |            |       |     |
| COl                       |          | 3                          | 2                           |                       |                        |            |          | 2        |                |          |            |       |     |
| CO2                       |          | 3                          | 2                           |                       |                        |            |          | 2        |                |          |            |       |     |
| CO3                       |          | 3                          | 2                           |                       |                        |            |          | 2        |                |          |            |       |     |
| C04                       |          | 3                          | 2                           |                       |                        |            |          | 2        |                |          |            |       |     |
| CUS<br>2/2/1 indicator St | monot    | 3<br>h of Cor              | <u> </u>                    | 2 11:~                | h 2 Ma                 | dium 1     |          | Z        |                |          |            |       |     |
| 5/2/1 malcates St         | rengu    |                            | relation                    | 3- Hig                | n, 2- Me               | aium, 1    |          |          |                |          |            |       |     |
|                           |          |                            |                             |                       |                        |            |          |          |                |          |            |       |     |
|                           |          |                            | lı                          |                       |                        |            |          |          |                |          |            |       |     |
|                           |          |                            | ocia                        |                       | ve                     |            | y        |          | t              |          |            |       |     |
|                           |          |                            | d sc                        |                       | cti                    |            | nar      | nen      | jec            |          |            |       |     |
|                           | nce      | 50                         | an                          | ore                   | ele                    | ve         | pli      | lod      | Pro            |          |            |       |     |
|                           | cie      | ing                        | ies                         | ŭ                     | am                     | ecti       | isci     | uc       | al //          |          |            |       |     |
|                           | ic S     | ieel                       | amit<br>ce                  | am                    | ogr                    | Ē          | D        | I C      | tic            |          |            |       |     |
| ıry                       | 3asi     | ngir<br>ien                | um;<br>ien                  | ogr                   | Pr                     | ben        | nte      | ikil     | rac            |          |            |       |     |
| egc                       | E        | Er<br>Sc                   | Hı<br>Sc                    | Pr                    | ,                      | Ō          | Ĩ        | S        | F              |          |            |       |     |
| Cat                       |          |                            |                             |                       | N                      |            |          |          |                |          |            |       |     |
| -                         |          |                            |                             |                       |                        |            |          |          |                |          |            |       |     |



| Subject Code: | Subject Name :<br>VEHICLES         | ELECTRIC   | AND | HYBRID      | Ty/Lb/<br>ETL/IE | L | T/<br>SLr | P/R | С |
|---------------|------------------------------------|------------|-----|-------------|------------------|---|-----------|-----|---|
| EBME22E02     | Prerequisite: Basic<br>Engineering | Electrical | and | Electronics | Ту               | 3 | 0/0       | 0/0 | 3 |

#### UNIT I ELECTRIC VEHICLES

Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics ofvehicle motion - Propulsion System Design.

#### UNIT II BATTERY

#### Basics - Types, Parameters - Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

#### **UNIT III DC & AC ELECTRICAL MACHINES**

Motor and Engine rating, Requirements, DC machines, Three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines.

#### **UNIT IV ELECTRIC VEHICLE DRIVE TRAIN**

Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motorsizing.

#### UNIT V HYBRID ELECTRIC VEHICLES

Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components.

### **Text books:**

1. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press,

2011.

2. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003.

### **Reference Books:**

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010.

2. Sandeep Dhameja, "Electric Vehicle Battery Systems", Newnes, 2000 .http://nptel.ac.in/courses/108103009/

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| Subject Code:        | Su       | bject Na             | me :              |           |                 |              |          |          | T/L/       | L       | T /        | <b>P/ R</b> | С      |  |  |
|----------------------|----------|----------------------|-------------------|-----------|-----------------|--------------|----------|----------|------------|---------|------------|-------------|--------|--|--|
| EBME22E03            |          |                      |                   | ILE EN    | GINE            | <u>ERING</u> |          |          | EIL        | 2       | S.Lr       | 0           | 2      |  |  |
|                      | En       | erequisi<br>gineerii | te: Inern<br>1g-I | nodynai   | nics and        | a Inern      | nai      |          | 1          | 3       | U          | U           | 3      |  |  |
| L : Lecture T : Tu   | torial   | SLr : St             | pervised          | Learning  | g P:Pro         | oject R      | : Resear | ch C: C  | Credits    |         |            |             | I      |  |  |
| T/L/ETL : Theory     | //Lab/Ei | mbeddec              | l Theory a        | ind Lab   |                 |              |          |          |            |         |            |             |        |  |  |
| <b>OBJECTIVE</b> : T | he stude | ent will             | learn             |           |                 |              |          |          |            |         |            |             |        |  |  |
| Various a            | utomob   | oile parts           | s, power          | transmis  | sion fro        | m engi       | ne to va | rious p  | arts of th | e autom | obile, eng | gine co     | oling, |  |  |
| lubricatio           | n and al | lso abou             | t various p       | ollutant  | s and its       | control      | •        |          |            |         |            |             |        |  |  |
| COURSE OUTC          | COMES    | MES (COs) : (3-5)    |                   |           |                 |              |          |          |            |         |            |             |        |  |  |
| CO1                  | Gain th  | ne know              | ledge of v        | ehicle st | ructures        | .(Level      | 2)       |          |            |         |            |             |        |  |  |
| CO2                  | Apply    | the skill            | of auxilia        | ry syste  | ms in IC        | engine       | s.(Level | 3)       |            |         |            |             |        |  |  |
| CO3                  | Demor    | nstrate th           | e power t         | ransmiss  | sions sys       | stems.(L     | level 3) |          |            |         |            |             |        |  |  |
| CO4                  | Apply    | the know             | wledge of         | steering  | , brakes        | and sus      | pension  | system   | s.(Level 3 | )       |            |             |        |  |  |
| CO5                  | Unders   | stand the            | concept of        | of the fu | el cells        | and hyb      | rid vehi | cles.(Le | evel 2)    |         |            |             |        |  |  |
| Mapping of Cou       | rse Out  | comes v              | vith Prog         | ram Ou    | tcomes          | (Pos)        |          |          |            |         |            |             |        |  |  |
| Cos/Pos              | PO1      | PO2                  | PO3               | PO4       | PO5             | PO6          | PO7      | PO8      | PO9        | PO10    | PO11       | PO          | 12     |  |  |
| COI                  | 3        | 2                    | 1                 | 1         | -               | 1            | 1        | 1        | 1          | 1       | -          |             | 1      |  |  |
| CO2                  | 3        | 2                    | 2                 | 2         | -               | 1            | 2        | 1        | 1          | 2       | -          |             | 2      |  |  |
| CO3                  | 2        | 2                    | 1                 | 1         | -               | 1            | 1        | 1        | 1          | 1       | -          |             | 1      |  |  |
| CO4                  | 2        | 2                    | 2                 | 2         | -               | 1            | 1        | 1        | 1          | 2       | -          |             | 1      |  |  |
| CO5                  | 2        | 1                    | 1                 | 1         | -               | 2            | 2        | 1        | 1          | 1       | -          |             | 2      |  |  |
| Cos / PSOs           | PS       | 01                   | PSC               | )2        | PS              | 03           | PS       | 04       |            |         |            |             |        |  |  |
| CO1                  | ,        | 3                    | 2                 |           | 4               | 2            |          | 2        |            |         |            |             |        |  |  |
| CO2                  | ,        | 3                    | 2                 |           | 4               | 2            |          | 2        |            |         |            |             |        |  |  |
| CO3                  | ,        | 3                    | 2                 |           | 4               | 2            |          | 2        |            |         |            |             |        |  |  |
| CO4                  | ,        | 3                    | 2                 |           | 4               | 2            |          | 2        |            |         |            |             |        |  |  |
| CO5                  |          | 3                    | 2                 |           | ]               | 1            |          | 3        |            |         |            |             |        |  |  |
| 3/2/1 indicates St   | trength  | of Corr              | elation           | 3- High   | <u>, 2- Mee</u> | lium, 1      | -Low     | _        |            | -1      |            |             |        |  |  |
|                      |          | SS                   | cial              |           |                 |              |          | cal Skil |            |         |            |             |        |  |  |
| Ŕ                    | s        | cience               | id Soc            |           | ives            | s            | ject     | echni    |            |         |            |             |        |  |  |
| 10g6                 | nce      | lg S                 | s an              | ore       | llect           | tive         | Pro      | L / S    |            |         |            |             |        |  |  |
| Cate                 | ciel     | erin                 | itie              | n C       | пE              | lec          | al /     | hips     | ills       |         |            |             |        |  |  |
|                      | ic S     | ine                  | nan<br>nce        | grat      | grat            | пE           | tica     | rnsl     | Sk         | 1       |            |             |        |  |  |
|                      | 3asi     | gug                  | Hun<br>Scie       | βroξ      | Pro£            | Ope          | rac      | nte      | oft        |         |            |             |        |  |  |
|                      |          |                      |                   |           | <u> </u>        |              |          | Π        |            | 1       |            |             |        |  |  |
|                      |          |                      |                   |           |                 |              |          |          |            | 1       |            |             |        |  |  |

#### (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code: | Subject Name:                            | T / L/ | L | Τ/   | <b>P/ R</b> | С |
|---------------|--|--------|---|------|-------------|---|
|               | AUTOMOBILE ENGINEERING                   | ETL    |   | S.Lr |             |   |
| EBME22E03     |  |        |   |      |             |   |
|               | Prerequisite: Thermodynamics and Thermal | Т      | 3 | 0/0  | 0/0         | 3 |
|               | Engineering                              |        |   |      |             |   |

#### **UNIT- I: VEHICLE STRUCTURE AND ENGINES**

Vehicle construction –types-chassis layout- body-integral and chassis mounted body- vehicle specifications-power and torque requirements- choice of engine for different applications. Engine types and construction –cylinder arrangement-piston- cylinder head connecting rod – crank shaft-valves- liners-manifolds.

#### **UNIT- II: ENGINE AUXILIARY SYSTEMS AND POLLUTION CONTROL**

Fuel supply system to SI and CI engines–injection timing. Lubrication system-cooling system-ignition system-Spark timing-firing order, electronic fuel injection system-types. Pollution from engines and their control-Indian emission standards-supercharging-turbo charging.

#### **UNIT- III: TRANSMISSION SYSTEMS**

Clutches –need-types-single& multi plate –diaphragm-fluid coupling-torque converter Gear boxes-manualsliding mesh- constant mesh-synchro mesh- epicyclic gear boxes-automatic transmission. Universal jointpropeller shaft-Hotchkiss drive- torque tube drive. Differential-need-types- construction. Four wheel driverear axle.

#### UNIT- IV: STEERING AND SUSPENSION SYSTEMS

Principle of steering-steering geometry and wheel alignment-steering linkages-steering gear boxes-power steering.

Wheel and tyre construction-type and specification-tyre wear and causes-front axles arrangements. Suspension system-need and types-independent systems-coil-leaf spring-torsion bar-shock absorbers-air suspension.

#### **UNIT- V: BRAKE SYSTEMS**

Auto Electrical Components and Alternative Power Plants. Brake –need –types-mechanical-hydraulic-pneumatic-power brake-trouble shooting of brakes. Principles of modern electrical systems-battery-dynamo- starting motor- lighting- automobile conditioning. Electric hybrid vehicle and fuel cells.

#### TEXT BOOKS

1) K.K.Ramalingam, (2007) "Automobile Engineering", SciTech Publications.

2) Kirpal Singh, (2012) "Automobile Engineering vol-I&II".

3) R.B.Gupta, (2013) "Automobile Engineering", Satya Prakashan Publishing.

#### REFERENCES

Joseph Heitner, "Automotive Mechanics", Affiliated East West Press Ltd.
 "Newton and Steeds, Motor Vehicles", ELBS –13 EDITION.

3. William Crouse, (2007) "Automotive Mechanics", Tata McGraw Hill.

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| Subject Code:               | Sub      | ject Na      | me : SUS      | TAINA         | BLE E     | NERGY     | ζ          |            | Ty/Lb/     | L     | T/   | P/R | С   |
|-----------------------------|----------|--------------|---------------|---------------|-----------|-----------|------------|------------|------------|-------|------|-----|-----|
| EBME22E04                   |          |              |               |               |           |           |            |            | ETL        |       | SLr  |     |     |
|                             | Prei     | requisit     | e: Therm      | odynan        | nics and  | l Therr   | nal        |            | Ту         | 3     | 0/0  | 0/0 | 3   |
|                             | Eng      | ineerin      | g             |               |           |           |            |            | -          |       |      |     |     |
| L : Lecture T : 7           | Tutoria  | 1 S Lr       | : Supervis    | ed Lear       | ning P :  | : Project | R : Res    | earch C    | : Credits  |       |      |     |     |
| T/L/ETL : Theo              | ory/Lab  | /Embed       | ded Theor     | y and L       | ab        |           |            |            |            |       |      |     |     |
| OBJECTIVES                  | S: Stude | ents will    | learn         |               |           |           |            |            |            |       |      |     |     |
| • The cor                   | ncept, p | orinciple    | s and char    | acteristi     | cs of dif | fferent r | enewabl    | e energy   | y systems. |       |      |     |     |
| Energy                      | conver   | sion tec     | hniques       |               |           |           |            |            |            |       |      |     |     |
| COURSE OUT                  | ГСОМ     | ES (CO       | <b>(3-5</b> ) | )             |           |           |            |            |            |       |      |     |     |
| CO1 U                       | Indersta | and the b    | pasic conc    | epts of s     | solar rad | iation a  | nd their u | utilizati  | ons(Leve   | el 2) |      |     |     |
| CO2 A                       | pply th  | ie solar l   | knowledge     | e in vari     | ious pra  | ctical ap | plication  | ns(Lev     | el 3)      |       |      |     |     |
| CO3 C                       | arryout  | t out cor    | structions    | of diffe      | erent ene | ergy con  | version    | techniq    | ues(Level  | 12)   |      |     |     |
| CO4 E                       | xplain   | the prine    | ciples of e   | nergy co      | onversio  | n from    | earth and  | l ocean.   | .(Level 3) |       |      |     |     |
| CO5 D                       | emonst   | trate the    | working       | of MHD        | and co    | ncept of  | Fuel cel   | ls(Lev     | el 3)      |       |      |     |     |
| Mapping of Co               | ourse O  | Jutcome      | es with Pr    | ogram         | Outcom    | es (POs   | 5)         |            |            |       |      |     |     |
| COs/POs                     | PO1      | PO2          | PO3           | PO4           | PO5       | PO6       | PO7        | PO8        | PO9        | PO10  | PO11 | PC  | 012 |
| CO1                         | 3        | 2            | 1             | 1             | 1         | 2         | 2          | 2          | 1          | 1     | -    | 2   |     |
| CO2                         | 3        | 2            | 2             | 2             | 1         | 2         | 2          | 2          | 1          | 2     | 2    | 2   |     |
| CO3                         | 3        | 2            | 2             | 1             | 1         | 1         | 1          | 2          | 1          | 1     | 1    | 2   |     |
| CO4                         | 3        | 2            | 2             | 2             | 1         | 1         | 1          | 2          | 1          | 2     | -    | 1   |     |
| CO5                         | 3        | 2            | 2             | 1             | 1         | 1         | 1          | 1          | 1          | 1     | -    | 1   |     |
| COs / PSOs                  | PS       | 01           | PSC           | 02            | PS        | 03        | PS         | 504        |            |       |      |     |     |
| CO1                         |          | 3            | 2             |               | ,         | 2         |            | 1          |            |       |      |     |     |
| CO2                         |          | 3            | 2             |               | ,         | 2         |            | 2          |            |       |      |     |     |
| CO3                         |          | 3            | 1             |               |           | 1         |            | 2          |            |       |      |     |     |
| <u>CO4</u>                  |          | 3            | 1             |               |           | 1         |            | 1          |            |       |      |     |     |
|                             |          | 5<br>h -£ () | <u> </u>      | 2 11:-        |           | l<br>     | 1 T        | 1          |            |       |      |     |     |
| $\frac{3/2}{1}$ indicates S | strengt  | h of Co      | rrelation     | <u>3- Hig</u> | h, 2- Mi  | edium,    | I-Low      |            |            |       |      |     |     |
|                             |          |              |               |               |           |           |            |            |            |       |      |     |     |
|                             |          |              | al            |               |           |           |            |            |            |       |      |     |     |
|                             |          |              | ocia          |               | ve        |           | y          | t          | t          |       |      |     |     |
|                             |          |              | d se          |               | scti      |           | nar        | nen        | jec        |       |      |     |     |
|                             | nce      | 50           | an            | ore           | ele       | ive       | ipli       | poi        | Pro        |       |      |     |     |
|                             | cie      | ring         | ties          | Ŭ             | am        | ecti      | isc        | om         | al         |       |      |     |     |
|                             | ic S     | nee<br>Ice   | ani<br>Ice    | ram           | 0g1       | E         | r D        | II C       | ctic       |       |      |     |     |
| ory                         | 3as      | ngi<br>ien   | um<br>Xien    | lgo.          | Pr        | pen       | nte        | Skil       | Prac       |       |      |     |     |
| [egi                        | H        | ы            | Б Х           | P1            |           | Ō         | I          | <b>9</b> 1 | н          |       | _    |     |     |
| Cai                         |          |              |               |               | v         |           |            |            |            |       |      |     |     |



| Subject Code: | Subject Name : | SUSTAINABLE ENI | Ty/Lb/ | L       | Τ/  | P/R | С   |     |   |
|---------------|----------------|-----------------|--------|---------|-----|-----|-----|-----|---|
| EBME22E04     |                |                 |        |         | ETL |     | SLr |     |   |
|               | Prerequisite:  | Thermodynamics  | and    | Thermal | Tv  | 3   | 0/0 | 0/0 | 3 |
|               | Engineering    |                 |        |         | J   | C . | 0,0 | 0/0 |   |

#### **UNIT- I PRINCIPLES OF SOLAR RADIATION:**

Role and Potential of new and renewable source, the solar energy option, Environmental impact of solar power, Solar constant, extra-terrestrial and terrestrial solar radiation, solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, solar radiation data.

#### **UNIT- II SOLAR ENERGY**

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

SOLAR ENERGY STORAGE: Different methods, sensible, latent heat and stratified storage, solar ponds. Solarapplications - solar heating/cooling techniques, solar distillation and drying, photovoltaic energy conversion.

#### **UNIT- III WIND ENERGY AND BIOMASS**

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics. BIOMASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-Gas digestors, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation, economic aspects.

#### UNIT- IV GEOTHERMAL, TIDAL AND WAVE ENERGY

GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing OTEC: Principles, utilization, setting of OTEC plants, thermodynamic cycles. TIDAL AND WAVE ENERGY: Potential and conversion techniques, mini hydel power plants, and their economics.

#### **UNIT- V:DIRECT ENERGY CONVERSION**

Need for DEC, Carnot cycle, limitations, principles of DEC. Thermo-electric generators, MHD Power generators, principles, working.

Fuel cells: principle, working -types - Selection of fuels and operating conditions.

#### Total No. of Periods : 45

#### TEXT BOOKS

- 1) G.D.Rai, (2004) "Non-Conventional Energy Sources" Khanna Publishers.
- 2) Ashok V Desai, (2003) "Non-Conventional Energy", Wiley Eastern.
- 3) K.M.Mittal, (2007) "Non-Conventional Energy Systems", Wheeler Publishing.
- 4) Ramesh & Kumar, (2007) "Renewable Energy Technologies", Narosa Publishing House.

#### REFERENCES

- 1) Twidell & Weir, (2006) "Energy Sources", Taylor & Francis
- 2) Sukhame, (2009) "Solar Energy".
- 3) B.S.Magal Frank Kreith, (2010) "Solar Power Engineering"

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| Subject Code  | : Su<br>PR | bject Na<br>OPULS   | nme : GA<br>SION                                  | S DYN     | AMICS      | AND J    | ET        |                         | Ty/Lb/<br>ETL | L         | T/<br>SLr | P/R | С  |
|---------------|------------|---|---|-----------|------------|----------|-----------|-------------------------|---------------|-----------|-----------|-----|----|
| EBME22E05     | Pro        | erequisi  | te: Engi  | neering   | Therm      | odynan   | nics      |                         | Ту            | 3         | 0/0       | 0/0 | 3  |
| L : Lecture T | : Tutoria  | l S Lr  | : Supervis  | ed Lear   | ning P:    | Practic  | al R : R  | esearch                 | C: Credits    | 5         |           |     |    |
| T/L/ETL : The | eory/Lab   | /Embed  | ded Theor   | y and L   | ab         |          |           |                         |               |           |           |     |    |
| OBJECTIVE     | S: The s   | student   | will learn  | l         |            |          |           | 4                       |               |           |           |     |    |
| • The b       | asic diffe | erence be   | etween ind  | compres   | sible and  | d compr  | essible f | low.                    |               |           |           |     |    |
| • The p       | henomen    | ion of sh   | lock wave   | s and its | s effect c | on flow. | 1-:       |                         |               |           |           |     |    |
| • Basic       |            | $\frac{1}{1}$   | ut jet prop                                       | tudont    | ind Rock   | ket Prop | ulsion.   |                         |               |           |           |     |    |
| COURSE OU     | Gain th    | ES (CO<br>e fundar  | s): The s   | wledge    | of com     | ible to  | , flow ar | d its pr                | operties ()   | [ aval 2) |           |     |    |
| C01           | Solve th   | e proble  | ems in con  | stant ar  | d variab   | le area  | ducts (I  | $\frac{10}{2}$ revel 3) | opernes. (I   | Level 2)  |           |     |    |
| CO3           | Analyze    | Analyze the flow properties in different ducts. (Level 4) |   |           |            |          |           |                         |               |           |           |     |    |
| CO3           | T that y Z |   | the flow properties in different ducts. (Level 4) |           |            |          |           |                         | <u> </u>      | 1100      |           |     |    |
| CO4           | Underst    | tand the  | phenome   | non of d  | ifferent   | shock w  | vaves and | d their e               | effects. (Le  | vel 1&2)  |           |     |    |
| CO5           | Apply t    | he know   | ledge of  | propuls   | sions in 1 | ockets a | and jets. | (Level                  | 3)            |           |           |     |    |
| Mapping of C  | Course C   | se Outcomes with Program Outcomes (POs)                   |   |           |            |          |           |                         |               |           |           |     |    |
| COs/POs       | PO1        | PO2   | PO3   | PO4       | PO5        | PO6      | PO7       | PO8                     | PO9           | PO10      | PO11      | PO  | 12 |
| CO1           | 3          | 2   | 2   | 2         | 1          | 1        | 1         | 1                       | 1             | 2         |           |     | 1  |
| CO2           | 3          | 2   | 2   | 2         | 1          | 1        | 1         | 1                       | 1             | 2         |           |     | 1  |
| CO3           | 3          | 2   | 2   | 2         | 2          | 1        | 1         | 1                       | 1             | 2         |           | 1   |    |
| CO4           | 3          | 2   | 2   | 2         | 1          | 1        | 1         | 1                       | 1             | 2         |           |     | 1  |
| CO5           | 3          | 2   | 2   | 2         | 1          | 2        | 2         | 2                       | 1             | 2         |           |     | 1  |
| COs / PSOs    | PS         | 01  | PSC   | 02        | PS         | O3       | PS        | SO4                     |               |           |           |     |    |
| CO1           |            | 3   | 2   |           | 2          | 2        |           | 2                       |               |           |           |     |    |
| CO2           |            | 3   | 2   |           | 2          | 2        |           | 2                       |               |           |           |     |    |
| CO3           |            | 3   | 2   |           | 2          | 2        |           | 2                       |               |           |           |     |    |
| CO4           |            | 3   | 2   |           | 2          | 2        |           | 2                       |               |           |           |     |    |
| CO5           |            | 3   | 2   |           |            | 2        |           | 2                       |               |           |           |     |    |
| 3/2/1 indicat | es Strei   | ngth of   | Correlat  | tion:     | 3- High    | , 2- Me  | edium,    | 1-Low                   |               |           |           |     |    |
|               |            |   |   |           |            |          |           |                         |               |           |           |     |    |
|               |            |   |   |           |            |          |           |                         |               |           |           |     |    |
|               |            |   | cial  |           | e          |          |           |                         |               |           |           |     |    |
| 5             |            |   | SO  |           | ctiv       |          | lary      | ent                     | ect           |           |           |     |    |
| g01           | lce        |   | and   | e         | elec       | /e       | olin      | one                     | roj           |           |           |     |    |
| ate           | cier       | ing   | es  | Col       | m          | ctiv     | scij      | duu                     | 1 <i>/</i> F  |           |           |     |    |
| U             | Č<br>C     | eer   | uniti<br>ce                                       | am        | gra        | Ele      | Di        | Ŭ                       | tica          |           |           |     |    |
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#### Subject Code: Subject Name : GAS DYNAMICS AND JET Ty/Lb/ **T**/ P/R С L PROPULSION SLr ETL/IE **Prerequisite: Engineering Thermodynamics** Ty 0/0 3 0/0 3 **EBME22E05**

### UNIT- I: COMPRESSIBLE FLOW – FUNDAMENTALS

Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states. Mach number, Critical Mach number, types of waves. Mach cone, Mach angle.

#### **UNIT- II: FLOW THROUGH VARIABLE AREA DUCTS**

Isentropic flow through variable area ducts. T-s and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles.

#### UNIT- III: FLOW THROUGH CONSTANT AREA DUCTS

Flow in constant area ducts with friction (Fanno flow) – Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length.

Flow in constant area ducts with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equation, variation of flow properties, Maximum heat transfer - Isothermal flow.

#### **UNIT- IV: NORMAL SHOCK**

Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal shocks. Prandtl Meyer equation, flow in convergent and divergent nozzle with shock

#### **UNIT- V: PROPULSION**

Theory of jet propulsion –Types of Jet engines- principles and working of pulse jet, ram jet, turbojet, turbofan and turbo prop engines. Types of rocket engines –Liquid and Solid propellant rocket- Propellants-feeding systems –Cryogenic rocket engine.

#### Total No. of Periods: 45

**\*NOTE:** Use of approved Gas tables permitted in the University Examination

#### TEXT BOOK

1) Yahya S.M., (2005) "Fundamental of Compressible flow", New Age International (P) Ltd., New Delhi. Third edition reprint.

#### REFERENCES

- 1) Patrick & William, (1997) "Fundamentals Of Compressible Flow", McGraw Hill-Inc.
- 2) Ganesan.V, (2010) "Gas Turbines", Tata McGraw Hill Publishing Company, New Delhi.



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| Subject Code:                            |  | Subjec   | et Name<br>(  | : REFF<br>CONDI                         | RIGER A               | ATION<br>IG   | AND A              | AIR             | Ty/Lb/<br>ETL      | L                           | T/<br>SLr  | P/R      | С     |
|--|--|--|---|---|-----------------------|---------------|--------------------|-----------------|--------------------|-----------------------------|------------|----------|-------|
| EBME22E06                                | Pre  | erequisi   | te: Thern   | nodynai                                 | mics, Tł              | nermal        | Enginee            | ring            | Ту                 | 3                           | 0/0        | 0/0      | 3     |
| L : Lecture T : Tu                       | ıtorial  | SLr:   | Supervise   | ed Learr                                | ning P:               | Project       | R : Rese           | arch C:         | Credits            |                             |            |          |       |
| T/L/ETL : Theory                         | y/Lab/   | Embed  | ded Theor   | y and L                                 | ab                    |               |                    |                 |                    |                             |            |          |       |
| • The work<br>• Different<br>• Alternate | cing pr<br>cycle<br>refrig   | S: Stude<br>rinciple<br>s used i<br>gerants t                                      | ents will le<br>of refrige<br>n refrigera<br>o reduce g | earn<br>rators ar<br>ation.<br>global w | nd air co<br>arming   | nditioni<br>• | ng syste           | ms.             |                    |                             |            |          |       |
| COURSE OUTC                              |  | ES(CO)   | $\frac{s}{1}$ : (3-5)                                   | )                                       | <u> </u>              |               | 1                  | 1 6 '           |                    | 1.0                         |            |          |       |
| COI Gai                                  | in the   | basic ki   | nowledge  | of vario                                | us refrig             |               | cycles a           | nd refrig       | gerants(L          | $\frac{\text{evel } 2}{14}$ |            |          |       |
| CO2 Ana                                  | alyze the various refrigeration cycles using thermodynamic concepts(Level 4) |  |   |   |                       |               |                    |                 |                    |                             |            |          |       |
| CO3 Une                                  | dersta   | nd the d   | lesign and  | workin                                  | g princij             | ples of v     | various c          | ompone          | nts of refr        | igeratio                    | n and air- | conditi  | oning |
| CO4 Apr                                  | tems.(   | ly the psychometric knowledge to calculate the cooling and heating load. (Level 3) |   |   |                       |               |                    |                 |                    |                             |            |          |       |
| CO5 Un                                   | dersta   | nd the f   | undament  | al conce                                | e to calc             | rvogeni       | e coom             | ering an        | d low-tem          | nerature                    | of prope   | rties of |       |
| mat                                      | terials  | (Level   | 2)  |   | pis of c              | ryogenn       | cinginic           | ang an          |                    | perature                    | or prope   |          |       |
| Mapping of Cou                           | rse O  | utcome   | s with Pr   | ogram (                                 | Outcom                | es (POs       | ;)                 |                 |                    |                             |            |          |       |
| COs/POs P                                | 01   | PO2  | PO3   | PO4                                     | PO5                   | PO6           | PO7                | PO8             | PO9                | PO10                        | PO11       | PO       | 012   |
| CO1                                      | 3  | 2  | 2   | 2                                       | 1                     | 3             | 3                  | 3               | 2                  | 2                           | -          |          | 3     |
| CO2                                      | 2  | 3  | 3   | 3                                       | 2                     | 2             | 2                  | 2               | 2                  | 3                           | -          |          | 2     |
| CO3                                      | 3  | 2  | 2   | 2                                       | 1                     | 2             | 2                  | 2               | 2                  | 2                           | -          |          | 3     |
| CO4                                      | 2  | 2  | 2   | 2                                       | 1                     | 2             | 2                  | 2               | 2                  | 3                           | -          |          | 2     |
| CO5                                      | 2  | 3  | 3   | 3                                       | 2                     | 2             | 2                  | 2               | 2                  | 3                           | -          |          | 2     |
| COs / PSOs                               | PS   | 01   | PSC   | 02                                      | PS                    | 603           | PS                 | <b>504</b>      |                    |                             |            |          |       |
| CO1                                      | 3  | 5  | 3   |   |                       | 3             |                    | 3               |                    |                             |            |          |       |
| CO2                                      | 3  | 5  | 3   |   |                       | 3             |                    | 3               |                    |                             |            |          |       |
| CO3                                      | 3  |  | 2   |   | ,                     | 2             |                    | 2               |                    |                             |            |          |       |
| <u>CO4</u>                               | 3  | 5  | 3   |   |                       | 3             |                    | 3               |                    |                             |            |          |       |
| CO5                                      | 3  |  | 2   | <u> </u>                                |                       | 2             |                    | 2               |                    |                             |            |          |       |
| 3/2/1 indicates Sti                      | rength   | n of Col   | relation  | 3- Hig                                  | h, 2- Me              | edium, i      | l-Low              |                 |                    | 1                           |            |          |       |
| egory                                    | Basic Science  | Engineering<br>Science   | Humanities and social<br>Science                        | Program Core                            | Program elective      | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |                             |            |          |       |
| Cat                                      |  |  |   |   | <ul> <li>✓</li> </ul> |               |                    |                 |                    |                             |            |          |       |

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| Subject Code: | Subject Name : REFRIGERATION AND                  | Ty/Lb   | L | <b>T</b> / | P/R | C |
|---------------|---|---------|---|------------|-----|---|
|               | AIR   | /ETL/IE |   | SLr        |     |   |
|               | CONDITIONING                                      |         |   |            |     |   |
| EBME22E06     | Prerequisite: Thermodynamics, Thermal Engineering | Ту      | 3 | 0/0        | 0/0 | 3 |

#### **UNIT- I: REFRIGERATION CYCLES AND REFRIGERANTS**

EDUCAT

Vapour Compression Réfrigération Cycle-Simple Saturated Vapour Compression Réfrigération Cycle. Thermodynamic Analysis of the above. Refrigerant Classification, Designation, Alternate Refrigerants, Global Warming Potential & Ozone Depleting Potential Aspects.

#### **UNIT- II: SYSTEM COMPONENTS**

Refrigerant Compressors – Reciprocating Open & Hermetic Type, Screw Compressors and Scroll Compressors – Construction and Operation Characteristics. Evaporators – DX Coil, Flooded Type Chillers Expansion Devices - Automatic Expansion Valves, Capillary Tube & Thermostatic Expansion Valves. Condensing UNIT-s and Cooling Towers.

#### UNIT- III: CYCLING CONTROLS AND SYSTEM BALANCING

Pressure and Temperature Controls. Range and Differential Settings. Selection and Balancing of System Components-Graphical Method.

#### **UNIT- IV: PSYCHROMETRY & AIR CONDITIONING**

Moist Air Behavior, Psychrometric Chart, Different Psychrometric Process Analysis. Summer and Winter Air-conditioning, Cooling Load Calculations, Air Distribution Patterns, Dynamic and Frictional Losses in Air Ducts, Equal Friction Method, Fan Characteristics in Duct Systems.

#### **UNIT- V: INTRODUCTION TO CRYOGENIC ENGINEERING**

Introduction to cryogenic engineering-applications of cryogenics in various fields-low temperature properties of materials- mechanical, thermal, electrical and magnetic properties- properties of cryogenic fluids-cryogenic fluid storage and transfer systems- cryogenic insulation.

### Total No. of Periods : 45

#### TEXT BOOKS

1) W.F.Stocker and J.W.Jones, (2009) "Refrigeration & Air Conditioning", McGraw Hill Book Company.

2) Randall F.Barron, (1985) "Cryogenic systems", Oxford University press.

#### REFERENCES

- 1) R.J.Dossat, (2005) "Principles of Refrigeration", John Wiley and Sons Inc., 6<sup>th</sup> edition.
- 2) Manohar Prasad, (2009) "Refrigeration and Air Conditioning", Wiley Eastern Ltd.



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EDUCATIONAL AND RESEARCH INSTITUTE DEEMED TO BE UNIVERSITY University with Graded Autonomy Status (An ISO 21001 : 2018 Certified Institution)

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| Subject Code:        | S  | Subjec  | t Name     | : CO             | OMPUT<br>MICS                  | ATION      | IAL F           | LUID       | Ty/Lb       | L         | T/        | P/R    | С      |
|----------------------|--|---|------------|------------------|--------------------------------|------------|-----------------|------------|-------------|-----------|-----------|--------|--------|
|                      |  |   |            | DINA             | MICS                           |            |                 |            | /ETL/IE     |           | SLr       |        |        |
| EBME22E07            | Prere<br>trans   | equisit<br>sfer an                                      | te: Therr  | nodyna<br>Mechan | mics, H<br>lics                | eat and    | l Mass          |            | Ту          | 3         | 0/0       | 0/0    | 3      |
| L : Lecture T : Tut  | torial   | S Lr :  | : Supervis | ed Lear          | ning P:                        | Project    | R : Res         | earch      | C: Credits  |           |           |        |        |
| T/L/ETL : Theory     | /Lab/E   | mbeda   | led Theor  | y and La         | ab                             |            |                 |            |             |           |           |        |        |
| <b>OBJECTIVES:</b> S | Student  | s will  | learn      |                  |                                |            |                 |            |             |           |           |        |        |
| • G                  | overnii  | ng equ  | ation of f | luid dyn         | amics.                         | •. •       | . 1             | <b></b>    | X 7 1       | .1 1      |           |        |        |
| • M                  | lethods  | s of sol  | ving the e | equation         | s by Fin                       | ite elem   | ent and         | Finite     | Volume me   | thods     |           |        |        |
| COURSE OUTC          | COMES (COs) : (3-5)<br>derstand the fundamental knowledge of governing equations and boundary conditions (Level 2) |   |            |                  |                                |            |                 |            |             |           |           |        |        |
| CO1 Und              | erstand  | d the fu  | undament   | al know          | ledge of                       | governi    | ing equa        | tions a    | and boundar | ry condi  | ions.(Lev | el 2)  |        |
| CO2 Ana              | lyze th  | e cond  | luction pr | oblems           | using fir                      | nite diffe | erence m        | ethod      | (Level 4)   |           |           |        |        |
| CO3 Solv             | ve the f   | luid fl   | ow proble  | ms in di         | iffusion                       | ume n      | method.(Level3) |            |             |           |           |        |        |
| CO4 App              | ly the o   | y the one dimensional equation to solve convection prob |            |                  |                                |            |                 |            |             | nite volu | me metho  | d.(Lev | rel 3) |
| CO5 Calc             | culate t   | he flui   | d flow fi  | eld usin         | g finite v                     | .(Leve     | 14)             |            |             |           |           |        |        |
| Mapping of Cour      | se Out   | tcome   | s with Pr  | ogram (          | Dutcom                         | es (POs    | )               |            |             |           |           |        |        |
| COs/POs PO           | D1 F   | PO2   | PO3        | PO4              | PO5                            | PO6        | PO7             | PO8        | PO9         | PO1       | 0 PO11    | PO     | 12     |
| CO1                  | 3  | 2   | 1          | 1                | 2                              | 1          | 1               | 2          | 2           | 2         | -         |        | 1      |
| CO2                  | 3  | 3   | 2          | 2                | 2                              | 2          | 2               | 2          | 2           | 2         | -         |        | 1      |
| CO3                  | 3  | 3   | 2          | 2                | 2                              | 2          | 2               | 2          | 2           | 2         | -         |        | 1      |
| CO4                  | 3  | 2   | 2          | 2                | 2                              | 2          | 2               | 2          | 2           | 2         | -         |        | 1      |
| CO5                  | 3  | 2   | 2          | 2                | 2                              | 2          | 2               | 2          | 2           | 2         | -         |        | 1      |
| COs / PSOs           | <b>PSO</b>   | 1   | PSC        | )2               | PS                             | 03         | PS              | <b>504</b> |             |           |           |        |        |
| CO1                  | 3  |   | 2          |                  | 4                              | 2          |                 | 2          |             |           |           |        |        |
| CO2                  | 3  |   | 3          |                  | 4                              | 2          |                 | 3          |             |           |           |        |        |
| CO3                  | 3  |   | 3          |                  | 4                              | 2          |                 | 3          |             |           |           |        |        |
| CO4                  | 3  |   | 3          |                  | 4                              | 2          |                 | 3          |             |           |           |        |        |
| CO5                  | 3  |   | 3          |                  | 2                              | 2          |                 | 3          |             |           |           |        |        |
| 3/2/1 indicates Stro | ength o  | of Cor  | relation   | 3- Hig           | n, 2- Me                       | edium, 1   | l-Low           | 1          |             |           |           |        |        |
|                      |  |   |            |                  |                                |            |                 |            |             |           |           |        |        |
|                      |  |   | al a       |                  |                                |            |                 |            |             |           |           |        |        |
|                      |  |   | ocia       |                  | ve                             |            | 2               | <u>.</u>   | t           |           |           |        |        |
|                      |  |   | d sc       |                  | cti                            |            | nar             | len        | jec         |           |           |        |        |
| nce                  |  | 50  | an         | ore              | ele                            | ve         | ipli            | por        | Pro         |           |           |        |        |
| cie                  |  | cing  | ies        | Ŭ                | am                             | ecti       | isci            | iuo        | al //       |           |           |        |        |
| c                    |  | ce<br>ce  | anit<br>ce | am               | ogr                            | Ē          | <u>Ū</u>        | I C        | tic         |           |           |        |        |
| ory<br>Jasi          | •  | ngii<br>ien   | um:<br>ien | 1g0              | $\mathbf{P}_{\mathbf{\Gamma}}$ | pen        | nte             | skil       | rac         |           |           |        |        |
| leg(                 | <u>ا</u>   | S Е   | Hı<br>Sc   | Pr               | /                              | Ō          | Ι               |            | H           |           |           |        |        |
| Cai                  |  |   |            |                  | v                              |            |                 |            |             |           |           |        |        |

#### Subject Name : COMPUTATIONAL FLUID Subject Code: Tv/Lb L **T**/ P/R **DYNAMICS** ETL/IE SLr Prerequisite: Thermodynamics. Heat and Mass **EBME22E07** Ty 3 0/0 0/0 3 transfer and Fluid Mechanics

In ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

### **UNIT- I: GOVERNING EQUATIONS AND BOUNDARY CONDITIONS**

EDUCATIO

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations - Chemical species transport - Physical boundary conditions - Time-averaged equations for Turbulent Flow - Turbulent-Kinetic Energy Equations - Mathematical behavior of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

#### **UNIT- II: FINITE DIFFERENCE METHOD**

Derivation of finite difference equations - Simple Methods - General Methods for first and second order accuracy - solution methods for finite difference equations - Elliptic equations - Iterative solution Methods -Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations.

#### **UNIT- III: FINITE VOLUME METHOD (FVM) FOR DIFFUSION**

Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank – Nicolson and fully implicit schemes.

#### **UNIT- IV: FINITE VOLUME METHOD FOR CONVECTION DIFFUSION**

Steady one-dimensional convection and diffusion - Central, upwind differencing schemes-properties of discretization schemes - Conservativeness, Boundedness, Trasnportiveness, Hybrid, Power-law, QUICK Schemes.

#### **UNIT- V: CALCULATION FLOW FIELD BY FVM**

Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections - Pressure Correction equation, SIMPLE algorithm and its variants. Turbulence models, mixing length model, Two equation  $(k-\varepsilon)$  models – High and low Reynolds number models

### **Total No. of Periods: 45**

#### TEXT BOOKS

1) Ghoshdastidar, P.S., (1998) "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd.

2) Versteeg, H.K., and Malalasekera, W., (1998) "An Introduction to Computational Fluid Dynamics: The finite volume Method", Longman.

#### REFERENCES

1) Patankar, S.V. (2004) "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation.

2) Muralidhar, K., and Sundararajan, T., (1995) "Computations Fluid Flow and Heat Transfer", Narosa Publishing House, NewDelhi.

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| Subject Code:      | Subject Name : TURBO MACHINES   |              |             |          |               |           |             |          | Ty/Lb/     | L         | Τ/        | P/R    | С    |  |  |
|--------------------|---|--------------|-------------|----------|---------------|-----------|-------------|----------|------------|-----------|-----------|--------|------|--|--|
|                    |   |              |             |          |               |           |             |          | ETL        |           | SLr       |        |      |  |  |
| EBME22E08          | Pro   | erequisi     | te: Fluid   | Mechar   | nics, Th      | ermal     |             |          | Ту         | 3         | 0/0       | 0/0    | 3    |  |  |
|                    | En  | gineeriı     | ng          |          |               |           |             |          |            |           |           |        |      |  |  |
| L : Lecture T :    | Tutoria   | l SLr :      | Supervise   | ed Learr | ning P:       | Project   | R : Rese    | earch C: | Credits    | 11        |           |        |      |  |  |
| T/L/ETL : The      | ory/Lab   | /Embed       | ded Theor   | y and L  | ab            |           |             |          |            |           |           |        |      |  |  |
| <b>OBJECTIVE:</b>  | The co  | ourse ai     | ms at giv   | ving an  | overvie       | ew of a   | different   | types    | of turbo 1 | machine   | ery used  | for en | ergy |  |  |
| transformation,    | , such as   | s pumps      | , fans, con | npressor | rs, as we     | ll as hye | draulic, s  | steam ar | d gas-turb | ines.     |           |        |      |  |  |
| COURSE OU          | Understand the concepts of turbo machines and its applications. (Level 2)                 |              |             |          |               |           |             |          |            |           |           |        |      |  |  |
| 01                 | Analyze the performance of turbo machines using first law of thermodynamics (Level $A$ )  |              |             |          |               |           |             |          |            |           |           |        |      |  |  |
| CO2                | Analyze   | e the per    | formance    | of turbo | o machir      | nes usin  | g first lav | w of the | rmodynam   | nics. (Le | evel 4)   |        |      |  |  |
| CO3                | Solve the turbo machines problems using velocity triangle concepts. (Level 3)             |              |             |          |               |           |             |          |            |           |           |        |      |  |  |
| CO4                | Understand the working principles of centrifugal and axial flow and radial flow           |              |             |          |               |           |             |          |            |           | npressors | (Level | 2)   |  |  |
| CO5                | Calculate stage losses, stage efficiency and pressure ratio in axial flow and radial flow |              |             |          |               |           |             |          |            | ow turbin | e.(Le     | vel 3) |      |  |  |
| Mapping of Co      | ourse C   | utcome       | es with Pr  | ogram    | Outcom        | es (POs   | 5)          | 1        |            | 1         | I         |        |      |  |  |
| COs/POs            | PO1   | PO2          | PO3         | PO4      | PO5           | PO6       | PO7         | PO8      | PO9        | PO10      | PO11      | PO     | 12   |  |  |
| COl                | 3   | 2            | 1           | -        | -             | 1         | 1           | 1        | 1          | 1         | -         | 1      |      |  |  |
| CO2                | 3   | 3            | 2           |          | -             | 1         | 1           |          |            | 2         | -         | 1      |      |  |  |
| $CO_3$             | 3   | 3            | 3           | 1        | -             |           |             |          |            | 2         | -         | 1      |      |  |  |
| CO4                | 3   | 3            | 2           | -        | -             | 1         | 1           | 1        | 1          | 1         | -         | 1      |      |  |  |
| $CO_{S} / PSO_{S}$ | <br>  | 01           |             | 1        | -<br>PS       |           |             | <u> </u> | 1          |           | -         | 1      |      |  |  |
| CO1                | 15  | 3            | 2           | 52       | 15            | 2         | 1.          | 1        |            |           |           |        |      |  |  |
| CO2                |   | 3            | 2           |          |               | 2         |             | 1        |            |           |           |        |      |  |  |
| CO3                |   | 3            | 2           |          |               | 2         |             | 1        |            |           |           |        |      |  |  |
| CO4                |   | 3            | 2           |          |               | 2         |             | 1        |            |           |           |        |      |  |  |
| CO5                | 2   | 3            | 2           |          |               | 2         |             | 1        |            |           |           |        |      |  |  |
| 3/2/1 indicates S  | Strengt   | h of Co      | rrelation   | 3- Hig   | h, 2- Me      | edium,    | 1-Low       | 1 1      | •          |           |           | ·      |      |  |  |
|                    |   |              |             |          |               |           |             |          |            |           |           |        |      |  |  |
|                    |   |              | cial        |          | 0             |           |             |          |            |           |           |        |      |  |  |
|                    |   |              | SOC         |          | stiv          |           | ary         | ent      | ect        |           |           |        |      |  |  |
|                    | JCe   |              | and         | re       | elec          | ve        | plin        | ono      | roj        |           |           |        |      |  |  |
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|                    | ic S  | leel         | anit<br>ice | am.      | ogr           | El        | ĹĎ          | 1 C      | tica       |           |           |        |      |  |  |
| ory                | Bas   | ngii<br>cien | um:<br>cien | rogı     | $\mathbf{Pr}$ | pen       | Inte        | Skil     | Prac       |           |           |        |      |  |  |
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| ŭ                  |   |              |             |          |               |           |             |          |            |           |           |        |      |  |  |

#### Subject Code: Subject Name : TURBO MACHINES Ty/Lb/ L **T**/ P/R С ETL SLr **Prerequisite: Fluid Mechanics Thermal** Tv 3 **EBME22E08** 0/0 0/0 3 Engineering

### **UNIT-1 INTRODUCTION**

Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification, Application of first and second laws of thermodynamics to turbo machines.

### **UNIT- 2 ENERGY EXCHANGE IN TURBOMACHINES**

Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor.

### **UNIT- 3 CENTRIFUGAL COMPRESSORS**

Construction details, types, impeller flow losses, slip factor, diffuser analysis losses and performance curves.

### **UNIT- 4 AXIAL AND RADIAL FLOW COMPRESSORS**

Axial and radial flow compressors and pumps- general analysis, Effect of blade discharge angle on performance, Theoretical head – capacity relationship.

### **UNIT- 5 AXIAL AND RADIAL FLOW TURBINES**

Velocity diagrams, losses and coefficients, blade design principles, testing and performance characteristics.

#### Total No. of Periods 45

### TEXT BOOKS:

1. Gas Turbine, V.Ganesan, Tata McGraw Hill Co. Ltd., 3rd edition, 2010

2. Turbines, Compressors & Fans, S. M. Yahya, Tata McGraw HillCo. Ltd., 2nd edition, 2002

### **REFERENCE BOOKS:**

2. D. G. Shepherd, "Principals of Turbo machines", the Macmillan Company (1964).

- 3. , S. L.Dixon, "Fluid Mechanics & Thermodynamics of Turbo machines", Elsevier (2005).
- 4. B.K. Venkanna, "Turbomachine", PHI, New Delhi 2009.

5. M. S. Govindgouda and A. M.Nagaraj, "A Text Book of Turbomachines", , M. M. Publications, 4Th Ed, 2008.

6. V. Kadambi and Manohar Prasad, "An Introduction to Energy Conversion, Volume III, Turbo machinery", New Age International Publishers, reprint 2008.



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# PROGRAM ELECTIVE DESIGN ENGINEERING



|          | (An 150 /      | 21001:2018     | Certified Instit | ution)              |
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| Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India. |               |                        |                          |                      |                 |               |                |             |                |             |            |       |    |
|--|---------------|------------------------|--------------------------|----------------------|-----------------|---------------|----------------|-------------|----------------|-------------|------------|-------|----|
| Subject Code:  | Subj          | ect Nam                | e: MEC                   | HANIC                | AL VIB          | RATIO         | NS             |             | Ty/Lb/         | L           | Τ/         | P/R   | C  |
| <b>EBME22E09</b>   |               |                        |                          |                      |                 |               |                |             | ETL            |             | SLr        |       |    |
|  | I             | Pre requ               | isite: Stro              | ength of             | materi          | als; Me       | chanics        | of          | Tv             | 3           | 0/0        | 0/0   | 3  |
|  |               |                        | <u> </u>                 | Machir               | <u>ies- II.</u> | <b>D</b> • (  |                | 1.0         | - J            | Ũ           | 0/0        | 0/0   | ·  |
| T/L/ETL : Theo   | ory/Lab       | /Embedo                | led Theor                | ed Learr<br>y and La | ling P:<br>b    | Project       | R : Rese       | earch C:    | Credits        |             |            |       |    |
| OBJECTIVES   | : The s       | tudent v               | vill learn               |                      |                 |               |                |             |                |             |            |       |    |
| Multi d  | egree o       | f freedoi              | n system i               | in differe           | ent mode        | es.           |                |             |                |             |            |       |    |
| • Vibrati  | on meas       | suremen                | t techniqu               | es.                  |                 |               |                |             |                |             |            |       |    |
| OURSE OUTO   | COMES         | S (COs)                | :                        |                      |                 |               |                |             |                |             |            |       |    |
| CO1  | Underst       | and the f              | fundamen                 | tals of vi           | bration         | systems       | . (Level       | 2)          |                |             |            |       |    |
| CO2  | Evaluat       | e the Na               | tural frequ              | ency of              | Longitu         | dinal an      | d Transv       | verse vib   | ration sys     | tem. (Lev   | vel 5)     |       |    |
| CO3  | Analyze       | the tors               | ional vibr               | ation sys            | stem at c       | lifferent     | modes.         | (Level 4)   | )              |             |            |       |    |
| CO4 5  | Solve fr      | ee, damj               | ped and fo               | rced vib             | ration sy       | ystems c      | of single,     | , Two an    | d multi de     | gree of f   | reedom. (l | Level | 3) |
| CO5  | Acquire       | knowle                 | dge in var               | ious vib             | ration m        | easurem       | nent syst      | ems.(Le     | vel 2)         |             |            |       |    |
| Mapping of Co  | ourse O       | utcome                 | s with Pro               | ogram C              | )utcome         | es (POs)      |                |             |                |             |            |       |    |
| Cos/Pos  | PO1           | PO2                    | PO3                      | PO4                  | PO5             | PO6           | <b>PO7</b>     | PO8         | PO9            | <b>PO10</b> | PO11       | PO    | 12 |
| CO1  | 3             | 1                      | 1                        | 1                    | 1               | -             | -              | -           | 2              | 2           | -          |       | 2  |
| CO2  | 3             | 3                      | 3                        | 3                    | 2               | -             | _              | _           | 2              | 2           | 1          |       | 2  |
| CO3  | 3             | 3                      | 3                        | 3                    | 2               | -             | -              | -           | 2              | 2           | 1          |       | 2  |
| CO4  | 3             | 2                      | 3                        | 3                    | 2               | -             | -              | -           | 2              | 2           | 1          |       | 2  |
| CO5  | 3             | 2                      | 1                        | 1                    | 1               | _             | _              | _           | 2              | 2           | _          |       | 2  |
| Cos / PSOs   | PS            | 01                     | PSC                      | )2                   | PS              | 603           | PS             | 504         |                |             |            |       |    |
| <u>CO1</u>   |               | 2                      | 2                        |                      | ,               | <u>ז</u>      |                | 1           |                |             |            |       |    |
| CO2  | -             | 3                      | 2                        |                      | -               | 2             |                | 2           |                |             |            |       |    |
| CO3  |               | 3                      | 2                        |                      |                 | 2             |                | 2           |                |             |            |       |    |
| <b>CO4</b>   |               | 3                      | 2                        |                      |                 | 2             |                | 2           |                |             |            |       |    |
| CO5  |               | 3                      | 2                        |                      |                 | 2             |                | 1           |                |             |            |       |    |
| 3/2/1 indicates S  | Strengt       | h of Cor               | relation                 | 3- High              | . 2- Me         | dium. 1       | -Low           |             |                |             |            |       |    |
|  | , in engli    |                        |                          |                      |                 |               |                | Г           |                |             |            |       |    |
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| ategory  | Basic Science | Engineering<br>Science | Humanities an<br>Science | Program Core         | Program ele     | Open Elective | Inter Discipli | Skill Compo | Practical /Pro |             |            |       |    |
| C  |               |                        |                          |                      | ~               |               |                |             |                |             |            |       |    |

| Subject Code: | Subject Name : MECHANICAL VIBRATIONS                          | Ty/Lb/ | L | Τ/  | P/R | С |
|---------------|---|--------|---|-----|-----|---|
|               |   | ETL    |   | SLr |     |   |
| EBME22E09     | Prerequisite: Strength of Materials, Mechanics of Machines-II | Ту     | 3 | 0/0 | 0/0 | 3 |

#### **UNIT-I:INTRODUCTION**

Relevance of and need for vibration Analysis- Mathematical Modelling of Vibrating Systems - Discrete and Continuous Systems - Review of Single degree of Freedom Systems - Free and Forced Vibrations, Various **Damping Models** 

#### **UNIT- II: TWO DEGREE-OF-FREEDOM SYSTEMS**

General Solution to Free vibration problem-Damped Free Vibration, Forced Vibration of un-damped System -Dynamic Vibration Absorbers-Technical Applications.

#### **UNIT- III:MULTI-DEGREE OF FREEDOM SYSTEMS**

Free and Forced Vibrations of multi-degree of freedom systems in longitudinal, torsional and lateral modes -Matrix methods of solution - normal modes - orthogonal principle- energy methods, Introduction to vibration of plates.

#### **UNIT- IV: CONTINOUS SYSTEMS**

Torsional vibrations – Longitudinal vibrations of rods – Transverse vibrations of beams- Governing equations of motion - Natural frequencies and normal modes - energy methods.

#### **UNIT- V:VIBRATION MEASUREMENT**

Vibration monitoring-Data Acquisition- Vibration parameter selection - vibration sensors-accelerometers-Performance characteristics-sensor location-signal pre-amplification – vibration meters-vibration signaturesstandards-vibration testing equipment-in-site, Balancing of rotors.

#### **Total No. of Periods: 45**

#### **TEXT BOOK**

1) J.S.Rao and K.Gupta, (1999)"Introductory Subject on Theory and Practice of Mechanical Vibrations", Wiley Eastern Ltd.

#### REFERENCES

1) P.Srinivasan, (1990) "Mechanical Vibration Analysis", Tata-McGraw Hill, New Delhi.

2) G.K.Grover, (2006) "Mechanical Vibrations", New Chand and Bros, Roorkey.



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| Subject Code:   | Subj  | ject Name: DESIGN OF PRODUCTION TOOLS |                   |           |               |            |            | S          | Ty/Lb/      | L      | Τ/   | P/R | С |
|-----------------|---|---------------------------------------|-------------------|-----------|---------------|------------|------------|------------|-------------|--------|------|-----|---|
|                 |   |                                       |                   |           |               |            |            |            | ETL         |        | SLr  |     |   |
| EBME22E10       | Prer<br>mac   | equisite<br>hine eler                 | : Manufa<br>nents | cturing   | Techno        | logy, D    | esign of   |            | Ту          | 3      | 0/0  | 0/0 | 3 |
| L : Lecture T : | Tutoria   | l S Lr                                | : Supervis        | ed Learr  | ning P:       | Project    | R : Rese   | earch C:   | Credits     | 1 1    |      |     |   |
| T/L/ETL : The   | ory/Lab   | /Embedd                               | led Theor         | y and La  | ıb            |            |            |            |             |        |      |     |   |
| OBJECTIVES      | S: The s  | student v                             | vill learn        | <u> </u>  |               |            |            |            |             |        |      |     |   |
| • The de        | sign of   | jigs and                              | fixtures.         |           |               |            |            |            |             |        |      |     |   |
| • Differe       | ent types   | s of press                            | s tools and       | l various | elemen        | ts of a p  | ress tool  | s.         |             |        |      |     |   |
| To imp          | oart kno  | wledge i                              | n basics, c       | lesign ar | nd drawi      | ng of pr   | oductior   | n tools    |             |        |      |     |   |
| COURSE OU       | TCOM  | ES (CO                                | s):               |           |               |            |            |            |             |        |      |     |   |
| CO1             | Underst   | and the                               | different e       | lements   | and prin      | nciples of | of jigs an | nd fixtur  | es (Level 2 | 2)     |      |     |   |
| CO2             | Select a  | nd creat                              | e a jig for       | a given   | compon        |            |            |            |             |        |      |     |   |
| CO3             | Select and create a fixture for a given component (Level 7) |                                       |                   |           |               |            |            |            |             |        |      |     |   |
| CO4             | Underst   | and the                               | sheet meta        | l operat  | ions, ele     | ments a    | nd die d   | esign pr   | ocess (Lev  | rel 4) |      |     |   |
| CO5             | Select a  | nd creat                              | e a press t       | ool for a | ı given c     | ompone     | nt (Leve   | el 7)      |             |        |      |     |   |
| Mapping of C    | ourse O   | utcome                                | s with Pro        | ogram (   | Outcome       | es (POs)   | )          |            |             |        |      |     |   |
| Cos/Pos         | PO1   | PO2                                   | PO3               | PO4       | PO5           | PO6        | PO7        | PO8        | PO9         | PO10   | PO11 | PO1 | 2 |
| CO1             | 3   | 2                                     | 2                 | -         | 3             | 3          | 2          | 2          | 3           | 2      | 3    |     | 2 |
| CO2             | 3   | 3                                     | 3                 | 3         | 3             | 3          | 2          | 2          | 3           | 2      | 3    |     | 2 |
| CO3             | 3   | 3                                     | 3                 | 3         | 3             | 3          | 2          | 2          | 3           | 2      | 3    |     | 2 |
| CO4             | 3   | 2                                     | 2                 | -         | 3             | 3          | 2          | 2          | 3           | 2      | 3    |     | 2 |
| CO5             | 3   | 3                                     | 3                 | 3         | 3             | 3          | 2          | 2          | 3           | 2      | 3    |     | 2 |
| Cos / PSOs      | PS  | 01                                    | PSC               | 02        | PS            | 03         | PS         | <b>SO4</b> |             |        |      |     |   |
| CO1             |   | 3                                     | 3                 |           |               | 2          |            | 3          |             |        |      |     |   |
| CO2             |   | 3                                     | 3                 |           |               | 2          |            | 3          |             |        |      |     |   |
| CO3             |   | 3                                     | 3                 |           |               | 2          |            | 3          |             |        |      |     |   |
| CO4             |   | 3                                     | 3                 |           |               | 2          |            | 3          |             |        |      |     |   |
| CO5             |   | 3                                     | 3                 |           |               | 2          |            | 3          |             |        |      |     |   |
| 3/2/1 indicates | Strengt   | h of Cor                              | relation          | 3- Hig    | h, 2- Me      | edium, 1   | 1-Low      |            |             | -      |      |     |   |
|                 |   |                                       |                   |           |               |            |            |            |             |        |      |     |   |
|                 |   |                                       | e                 |           |               |            |            |            |             |        |      |     |   |
|                 |   |                                       | ienc              |           |               |            |            |            |             |        |      |     |   |
|                 |   |                                       | Sc                |           |               |            |            |            |             |        |      |     |   |
| x               |   | ce                                    | cial              |           | e             |            |            |            |             |        |      |     |   |
| gor             |   | cien                                  | so                |           | ctiv          |            | lary       | ent        | ect         |        |      |     |   |
| ateg            | nce   | S                                     | and               | re        | elec          | ve         | plin       | onoc       | roj         |        |      |     |   |
| Ű               | cie   | ing                                   | ies               | C         | am            | ecti       | Isci       | luic       | H la        |        |      |     |   |
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|                 | 3asi  | ngir                                  | nmi               | ıgo:      | $\mathbf{Pr}$ | pen        | nte        | Skil       | Prac        |        |      |     |   |
|                 | H   | Ē                                     | Ĥ                 | P1        |               | Õ          | I          |            | н           |        |      | _   |   |
|                 |   |                                       |                   |           | *             |            |            |            |             |        |      |     |   |

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| Subject Code: | Subject Name : DESIGN OF PRODUCTION TOOLS                          | Ty/Lb/ | L | Τ/  | P/R | С |
|---------------|--|--------|---|-----|-----|---|
|               |  | ETL    |   | SLr |     |   |
| EBME22E10     | Prerequisite: Manufacturing Technology, Design of machine elements | Ту     | 3 | 0/0 | 0/0 | 3 |

#### **UNIT- I: LOCATING AND CLAMPING PRINCIPLES**

EDUCA

OBJECTIVES of tool design- Function and advantages of Jigs and fixtures, Basic elements-principles of location .Locating methods and devices, Principles of clamping Mechanical actuation, pneumatic and hydraulic actuation. Standard parts, Drill bushes and Jig buttons, Tolerances and materials used.

#### **UNIT-II: JIGS**

Design and development of jigs and fixtures for given component- Types of Jigs -Post, Turnover, Channel, latch, box, pot, angular post jigs, Indexing jigs, automatic drill jigs- rack and pinion operated air operated jigs - Design and drawing of channel, box, indexing and angular post jigs

#### UNIT- III: FIXTURES

General principles of milling, Lathe, boring, broaching and grinding fixtures and shaping fixtures .Assembly, Inspection and Welding fixtures, Modular fixtures. Design and drawing of turning, milling and grinding fixtures

#### **UNIT- IV: PRESS WORKING**

Press Working Terminologies - operations ,Types of presses , press accessories , Computation of press capacity , Strip layout , Material Utilization , Shearing action ,Clearances ,Press Work Materials , Center of pressure, recent trends in tool design- computer Aids for sheet metal forming Analysis

#### UNIT- V: ELEMENTS OF CUTTING, BENDING, FORMING AND DRAWING DIES

Design of various elements of dies, Die Block, Punch holder, Die set, Stops, Strippers, Pilots - Selection of Standard parts. Design and drawing of simple blanking, piercing, compound and progressive dies.

#### Total No. of Periods: 45

#### TEXT BOOKS

- 1) Joshi, P.H. (2004) "Jigs and Fixtures", Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi.
- 2) Donaldson, Lecain and Goold, (2000) "Tool Design", III rd Edition, Tata McGraw Hill.

#### REFERENCES

- 1) K.Venkataraman, (2005) "Design of Jigs Fixtures & Press Tools", Tata McGraw Hill, New Delhi.
- 2) Kempster, (1974) "Jigs and Fixture Design", Hoddes and Stoughton "Third Edition.
- 3) Joshi, P.H. Press Tools (2006) "Design and Construction", Wheels publishing, 2 edition
- 4) Hoffman, "Jigs and Fixture Design", Thomson Delmar Learning, Singapore
- 5) "Design Data Hand Book", PSG College of Technology, Coimbatore.



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| Subject Code:   | Subj<br>DES   | ject Nan<br>SIGN Ol   | ne :<br>F MATEI               | RIAL H         | IANDLI           | NG EQ         | UIPME              | INTS            | Ty/Lb/<br>ETL      | L        | T/<br>SLr   | P/R | С |  |  |
|-----------------|---------------|---|-------------------------------|----------------|------------------|---------------|--------------------|-----------------|--------------------|----------|-------------|-----|---|--|--|
| EBME22E11       | Prer          | equisite  | : Design of                   | of Mach        | ine Eler         | nents.        |                    |                 | Ту                 | 3        | 0/0         | 0/0 | 3 |  |  |
| L : Lecture T : | : Tutoria     | l S.Lr  | : Supervis                    | sed Lear       | ning P:          | Project       | R : Res            | earch C         | : Credits          |          |             |     |   |  |  |
| T/L/ETL : The   | eory/Lat      | /Embed  | ded Theor                     | y and L        | ab               |               |                    |                 |                    |          |             |     |   |  |  |
| OBJECTIVE       | :             |   |                               |                |                  |               |                    |                 |                    |          |             |     |   |  |  |
| • D             | esign of      | differen  | t types of                    | material       | handlin          | g systen      | ns used f          | for engi        | neering an         | d proces | ss industri | es. |   |  |  |
| <u> </u>        | <b>**</b> •   | COURSE OUTCOMES (COs) : (3-5)   |                               |                |                  |               |                    |                 |                    |          |             |     |   |  |  |
|                 | Unders        | Juderstand the basic principles of material handling equipments. (Level 2)<br>Apply the design knowledge of various drives for material handling equipments. (Level 3)              |                               |                |                  |               |                    |                 |                    |          |             |     |   |  |  |
| C02             | Apply         | Apply the design knowledge of various drives for material handling equipments. (Level 3)<br>Differentiate various types of material handling device based on application. (Level 4) |                               |                |                  |               |                    |                 |                    |          |             |     |   |  |  |
| CO4             | Design        | esign and application of Hoist, Cranes, Conveyors and Elevators. (Level 6)  |                               |                |                  |               |                    |                 |                    |          |             |     |   |  |  |
| CO5             | Selection     | election of material handling device for different applications. (Level 5)  |                               |                |                  |               |                    |                 |                    |          |             |     |   |  |  |
|                 | percett       | Mapping of Course with Program Outcomes (Pos)   |                               |                |                  |               |                    |                 |                    |          |             |     |   |  |  |
| Cos/Pos         | PO1           | PO2   | PO3                           | PO4            | PO5              | PO6           | <b>PO7</b>         | PO8             | <b>PO9</b>         | PO10     | PO11        | PO  | 2 |  |  |
| CO1             | 3             | 3   | 3                             | 2              | 1                | 2             | 2                  | 1               | 2                  | 1        | 2           |     | 2 |  |  |
| CO2             | 3             | 3   | 3                             | 2              | 2                | 2             | 2                  | 1               | 2                  | 2        | 2           |     | 2 |  |  |
| CO3             | 3             | 3   | 3                             | 2              | 2                | 2             | 2                  | 1               | 2                  | 2        | 2           |     | 2 |  |  |
| CO4             | 3             | 3   | 3                             | 2              | 2                | 2             | 2                  | 1               | 2                  | 2        | 2           |     | 2 |  |  |
| CO5             | 3             | 3   | 3                             | 2              | 2                | 2             | 2                  | 1               | 2                  | 2        | 2           |     | 2 |  |  |
| Cos / PSOs      | PS            | 01  | PSC                           | 02             | PS               | 03            | PS                 | <b>504</b>      |                    |          |             |     |   |  |  |
| CO1             |               | 3 3 3 2   |                               | 2              |                  |               |                    |                 |                    |          |             |     |   |  |  |
| CO2             |               | 3   | 3                             |                | í                | 3             | 2                  |                 |                    |          |             |     |   |  |  |
| CO3             |               | 3   | 3                             |                |                  | 3             |                    | 2               |                    |          |             |     |   |  |  |
| CO4             |               | 3   | 3                             |                | •                | 3             |                    | 2               |                    |          |             |     |   |  |  |
| COS             | <u>C</u> 4    | <u>3</u><br>1 f. C  | 3                             | 2 11           |                  | 3             | 1 T                | 2               |                    |          |             |     |   |  |  |
| 3/2/1 indicates | Strengt       | n of Col  | rrelation                     | <u>3- Hi</u> g | gn, 2- M         | eaium,        | I-LOW              |                 |                    |          |             |     |   |  |  |
| Category        | Basic Science | Engineering Science   | Humanities and social Science | Program Core   | Program elective | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |          |             |     |   |  |  |
|                 |               |   |                               |                | ļ                |               |                    |                 |                    |          |             |     |   |  |  |

#### Subject Code: Subject Name : L **T**/ P/R С Ty/Lb/ **DESIGN OF MATERIAL HANDLING EQUIPMENTS** ETL SLr Prerequisite: Design of Machine Elements. Tv 0/0 3 0/0 3 **EBME22E11**

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### UNIT- I: INTRODUCTION TO MATERIALS HANDLING EQUIPMENT

EDUCAT

Overview - consideration in material handling system design, ten principles of material handling. Types of material handling equipments-trolleys, industrial trucks, AGV, monorails and other rail guided vehicles, conveyors, cranes, hoists and elevators.

#### **UNIT- II: DESIGN OF HOISTS**

Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types.

### UNIT- III: DRIVES OF HOISTING GEAR

Hand and power drives - Travelling gear - Rail travelling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.

#### **UNIT- IV: CONVEYORS**

# Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

#### **UNIT- V: ELEVATORS**

Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.

#### Total No. of Periods: 45

\*NOTE: Use of Approved Data Book is permitted in examination

### **TEXT BOOKS:**

- 1. Rudenko, N. (1970) Materials handling equipment. ELnvee Publishers
- 2. Mikell Groover, P. (2006) *Automation, Production system and computer integrated Manufacturing*. Second Edition, Prentice Hall of India Pvt. Ltd

### REFERENCES

- 1. Alexandrov, M. (1981) Materials Handling Equipments. MIR Publishers
- 2. Boltzharol, A. (1958) Materials Handling Handbook. The Ronald Press Company
- 3. P.S.G. Tech, (2003) Design Data Book. Kalaikathir Achchagam
- 4. Lingaiah. K. and Narayana Iyengar, (1983) Machine Design Data Hand Book. Vol.1 & 2, Suma Publishers
- 5. Spivakovsy, A.O. and Dyachkov, V.K. (1985) Conveying Machines. Volumes I and II, MIR Publishers



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| Subject Code:  | S        | ubject Na   | ame : A l             | PPLI                      | E D TR              | IBOLO         | GY          |            | Ty/Lb/      | L           | Τ/             | P/R      | С     |
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|                |          |   |                       |                           |                     | ETL           |             | SLr        |             |             |                |          |       |
| EBME22E12      | P<br>a   | rerequisi<br>nd Mach  | ite: Engir<br>ineries | T<br>v                    | 3                   | 0/0           | 0/0         | 3          |             |             |                |          |       |
| L : Lecture T  | : Tutor  | al SLr :  | Supervis              | ed Leari                  | ning P:             | Project       | R : Rese    | earch C:   | Credits     |             |                |          |       |
| T/L/ETL : Th   | eory/La  | b/Embed   | ded Theor             | ry and L                  | ab                  | U             |             |            |             |             |                |          |       |
| OBJECTIVE      | E: The   | e student v   | will learn            |                           |                     |               |             |            |             |             |                |          |       |
| • T            | 'o impa  | rt knowle   | dge in the            | friction                  | , wear a            | spects of     | f machine   | compo      | nents.      |             |                |          |       |
| • T            | o unde   | rstand the  | material j            | propertie                 | es which            | ibologic      | al characte | ristics    | of surfa    | ces.        |                |          |       |
| • T            | o unde   | erstand th  | e analyti             | cal beh                   | avior of            | differe       | ent type    | s bearin   | igs and de  | esign o     | of bearin      | igs base | ed on |
| a              | nalytica | al /theoret   | ical appro            | ach.                      |                     |               |             |            |             |             |                |          |       |
| COURSE OU      | JTCO     | COMES (COs) : (3-5) The student will able to                |                       |                           |                     |               |             |            |             |             |                |          |       |
| COl            | Under    | stand the   | fundamer              | ntal conc                 | cepts of t          | friction      | wear and    | d surface  | e treatment | s. (Lev     | rel 2)         |          |       |
| <u>CO2</u>     | Apply    | Apply the knowledge of wear and surface treatment in metals |                       |                           |                     |               |             |            |             | ls. (Lev    | vel 3          |          |       |
| <u>CO3</u>     | Expos    | e to lubri  | cation in h           | nydrody                   | namic ar            | nd hydro      | ostatic be  | earings.   | (Level 2)   |             |                |          |       |
| <u>CO4</u>     | Analy    | ze the the  | ory of ela            | sto-hydi                  | rodynam             | ic lubri      | cation. (   | Level 4)   |             |             | / <del>*</del> | 1.0      |       |
|                | Illustr  | ate the be  | havior of             | tribolog                  | ical com            | ponents       | s using d   | ifferent   | working co  | onditio     | ns. (Leve      | el 3)    |       |
| Mapping of C   | ourse (  | Dutcomes  | with Prog             | ram Ou                    | tcomes (            | POs)          | DO7         | DOQ        | DOO         | <b>DO10</b> | DO1            | 1 DC     | 12    |
| Cos/Pos        | POI      | PO2   | P03                   | P04                       | P05                 | PUo           | PO/         | P08        | P09         | POIU        | POI            | I PC     | 112   |
| COl            | 3        | 2   | 1                     | 2                         | 1                   | 1             | 1           | -          | 1           | 1           | 1              |          | 1     |
| CO2            | 3        | 3   | 1                     | 3                         | 1                   | 1             | 1           | -          | 1           | 1           | 1              |          | 1     |
| CO3            | 3        | 3   | 1                     | 3                         | 1                   | 1             | 1           | -          | 1           | 1           | 1              |          | 1     |
| <u>CO4</u>     | 3        | 3   | 1                     | 3                         | 1                   | 1             | 1           | -          | 1           | 1           | 1              |          | 1     |
| <u>CO5</u>     | 3        | 3   | 1                     | 3                         | 1                   | 1             | 1           | -          | 1           | 1           | 1              |          | 1     |
| Cos / PSOs     | P        | <u>soi</u>  | PSC                   | 02                        | PS                  | 03            | PS          | <u>504</u> |             |             |                |          |       |
|                |          | 3   | 2                     |                           | 1 $2$               |               |             |            |             |             |                |          |       |
| <u>CO2</u>     |          | 3   | 2                     |                           |                     | 1             |             | 2          | -           |             |                |          |       |
| <u>CO3</u>     |          | 3   | 2                     |                           | -                   | <u> </u><br>1 |             | 2          |             |             |                |          |       |
| C04            |          | 3   |                       | <u>,</u>                  |                     | <u> </u><br>1 |             | 2          |             |             |                |          |       |
| $\frac{2}{2}$  | Strong   | 3<br>th of Co   | rrolation             | 2 Uia                     | h 2 Ma              | l<br>dium     | 1 I ow      | 2          |             |             |                |          |       |
| 5/2/1 mulcates | Streng   |   |                       | <u>- 3- mg</u>            | 11, <b>2</b> - 1910 |               |             |            |             |             |                |          |       |
|                |          |   | -                     |                           |                     |               |             |            |             |             |                |          |       |
|                |          |   | ocia                  |                           | ve                  |               | v           |            | <u>.</u>    |             |                |          |       |
|                |          |   | d sc                  |                           | cti                 |               | nar         | lent       | jec         |             |                |          |       |
|                | nce      | 50  | and                   | ore                       | ele                 | ve            | plii        | pon        | Pro         |             |                |          |       |
|                | cie      | ing   | ies                   | CC                        | am                  | ecti          | isci        | mc         | 1 /1 Ia     |             |                |          |       |
|                | cS       | lee1  | unit<br>ce            | am                        | g                   | Еľ            | Â           | Ŭ          | tica        |             |                |          |       |
|                | asi      | ien   | ien i                 | ıgc                       | Pro                 | en            | nter        | kill       | rac         |             |                |          |       |
|                | В        | EnSc  | Ht<br>Sc              | $\mathbf{P}_{\mathbf{r}}$ |                     | Of            | I           | S          | <u>ц</u>    |             |                |          |       |
|                |          |   |                       |                           | <b>√</b>            |               |             |            |             |             |                |          |       |
| ry             |          |   |                       |                           |                     |               |             |            |             |             |                |          |       |
| ego            |          |   |                       |                           |                     |               |             |            |             |             |                |          |       |
| <b>Jatu</b>    |          |   |                       |                           |                     |               |             |            |             |             |                |          |       |
|                |          |   |                       |                           |                     |               |             |            |             |             |                |          |       |

| Subject Code: | Subject Name : A P P L I E D TRIBOLOGY                               | Ty/Lb/ | L | Τ/  | P/R | С |
|---------------|--|--------|---|-----|-----|---|
|               |  | ETL    |   | SLr |     |   |
| EBME22E12     | Prerequisite: Engineering Mechanics, Fluid Mechanics and Machineries | Ту     | 3 | 0/0 | 0/0 | 3 |

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#### **UNIT- I - SURFACE INTERACTION AND FRICTION**

DUCA

Topography of Surfaces – Surface features-Properties and measurement – Surface interaction –Adhesive Theory of Sliding Friction –Rolling Friction-Friction properties of metallic and non-metallic materials.

#### UNIT- II WEAR AND SURFACE TREATMENT

Types of wear – Mechanism of various types of wear – Laws of wear – Theoretical wear models-Wear of Metals and Non-metals – Surface treatments – Surface modifications – surface coatings methods

#### UNIT- III LUBRICANTS AND LUBRICATION REGIMES

Lubricants and their physical properties- Viscosity and other properties of oils –Additives-and selection of Lubricants- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes.

#### UNIT- IV THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION

Reynolds Equation,-Assumptions and limitations-One and two dimensional Reynolds Equation-Reynolds and Somerfield boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic and Hydrostatic bearings.

#### UNIT- V HIGH PRESSURE CONTACTS

Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory-Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication

#### Total No. of Periods: 45

#### **TEXT BOOKS:**

1. Rabinowicz.E, "Friction and Wear of materials", John Willey & Sons , UK, 1995

2. Cameron, A. "Basic Lubrication Theory", Ellis Herward Ltd., UK, 1981

#### REFERENCES

1. Halling, J. (Editor) – "Principles of Tribology", Macmillian – 1984.

2. Williams J.A. "Engineering Tribology", Oxford Univ. Press, 1994.

3. S.K.Basu, S.N.Sengupta & B.B.Ahuja, "Fundamentals of Tribology", Prentice –Hall of India Pvt Ltd, New Delhi, 2005

4. G.W.Stachowiak & A.W.Batchelor, Engineering Tribology, Butterworth-Heinemann, UK, 2005



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| Subj<br>DES<br>ASS  | ect Nar<br>IGN F(<br>EMBLY  | ne:<br>OR MAN<br>Y  | UFAC'  | TURE   | AND  |  | T  | Y/Lb/<br>ETL   | L  | T/<br>SL<br>r  | P/<br>R   |  | С  |  |  |  |
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| Tutori              | al SL<br>b/Embe   | r : Supervedded The   | vised Le   | earning  | P : Pra  | ctical R   | : Research C: Credits  |  |  |  |   |  |  |  |  |  |
| $\frac{S}{S}$ : The | e purpos  | e of study  | $\frac{1}{1}$ is to it   | npart th   | e gener  | al desig   | n. mar   | ufactur  | ing and a  | ssembly  | princ   | iples  | s in   |  |  |  |
| acturing            | р <b>ы</b> гроз<br>3.   | e er staaj  | , 15 00 11   |  | e Bener  |  | ,  |  |  | .ssellerj  | P   | -p   | ,  |  |  |  |
| TCON                | IES (C  | Os) : The   | e studer   | nts will   | be able  | to   |  |  |  |  |   |  |  |  |  |  |
| Unders              | stand the   | e basic pr  | inciples   | s of Mar   | ability.   | (Level   | Level 2)   |  |  |  |   |  |  |  |  |  |
| Disting             | guish the   | e various   | types of   | f form d   | lesign iı  | 1 casting  | g, forg  | ing and  | machinii   | ng. (Leve  | el 4)   |  |  |  |  |  |
| Analyz              | ze and re   | edesign th  | ne comp  | onent fo   | or the ea  | ase of m   | anufa  | cturing.   | (Level 4   | )  |   |  |  |  |  |  |
| Exposi              | ire to m  | odern too   | ol like C  | Compute  | r aided  | Design   | for As   | sembly.  | (Level 2   | 2)   |   |  |  |  |  |  |
| Analyz              | $\frac{1}{2}$ e and e   | valuate D   | esign fo   | or assen   | bly thr  | ough cas   | se stuc  | lies. (Le  | evel 4)  |  |   |  |  |  |  |  |
| ourse               | Outcon  | nes with  | Program  | m Outc   | omes (l  | POs)   | DOG  |  | <b>DO10</b>  |  |   | DO   | 10   |  |  |  |
| POI                 | PO2   | P03   | PO4  | P05  | PO6  | PO7  | PO8  | P<br>09  | POIO   | PO   | 11  | PO.  | 12   |  |  |  |
| 3                   | 3   | 3   | 2  | 1  | 2  | 2  | 1  | 2  | 2  | 2  | 2   | 2  | 2  |  |  |  |
| 3                   | 3   | 3   | 2  | 2  | 2  | 2  | 1  | 2  | 2  | 2  | 2   | -  | 2  |  |  |  |
| 3                   | 3   | 3   | 2  | 2  | 2  | 2  | 1  | 2  | 2  | 2  | 2   | 2  | 2  |  |  |  |
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| 3                   | 3   | 3   | 2  | 2  | 2  | 2  | 1  | 2  | 2  | 2  | 2   |  | 2  |  |  |  |
| PS                  | 01  | PSC   | 02   | PS   | 03   | PS   | 504  |  |  |  |   |  |  |  |  |  |
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| Basic Science       | Engineering Science   | Humanities and social<br>Science  | Program Core   | Program elective   | Open Elective  | Inter Disciplinary   | Skill Component  | Practical /Project   |  |  |   |  |  |  |  |  |
|                     | Subj<br>DES<br>ASS<br>Pre I<br>Mac<br>I<br>Tutori<br>cory/La<br>S: The<br>acturing<br>TCOM<br>Unders<br>Disting<br>Analyz<br>Expose<br>PO1<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3 | Subject Nat<br>DESIGN FO<br>ASSEMBL<br>Pre requisit<br>Machine El<br>I<br>Tutorial S L<br>cory/Lab/Ember<br>S: The purpos<br>acturing.<br>TCOMES (C<br>Understand the<br>Distinguish the<br>Analyze and re<br>Exposure to m<br>Analyze and re<br>Course Outcom<br>PO1 PO2<br>3 3<br>3 3<br>3 3<br>3 3<br>3 3<br>3 3<br>3 3<br>3 3<br>3 3<br>3 | Subject Name:         DESIGN FOR MANA         ASSEMBLY         Pre requisite: Streng         Machine Elements-I         I         Tutorial       S Lr : Super-         cory/Lab/Embedded The         S:       The purpose of study         acturing.         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(Level 4)       2       2       2       1       2       2         3       3       2       2       1       2       2 | Subject Name:<br>DESIGN FOR MANUFACTURE ANDTy/Lb/<br>ETLLT/DESIGN FOR MANUFACTURE AND<br>ASSEMBLYTy/Lb/<br>ETLLT/Pre requisite: Strength of Materials, Design of<br>Machine Elements-I, Manufacturing Technology-<br>IT30//0Tutorial S Lr : Supervised Learning P : Practical R : Research C: Credits<br>sory/Lab/Embedded Theory and LabS: The purpose of study is to impart the general design, manufacturing and assembly<br>acturing.TOMES (COS) : The students will be able toUnderstand the basic principles of Manufacturability. (Level 2)Distinguish the various types of form design in casting, forging and machining. (Level Analyze and evaluate Design for assembly through case studies. (Level 4)FOOM EOG PO7PO8P PO10PO1PO2PO3PO4PO5PO6PO7PO8PPO10PO10PO10PO10PO10PO10PO10PO10PO10PO10PO10PO10PO10PO10PO2< | Subject Name:<br>DESIGN FOR MANUFACTURE ANDTy/Lb/<br>ETLLT/<br>SLP/<br>SLP/<br>SLP/<br>RPre requisite: Strength of Materials, Design of<br>Machine Elements-I, Manufacturing Technology-<br>IT30/00Tutorial S Lr : Supervised Learning P : Practical R : Research C: Credits<br>ory/Lab/Embedded Theory and LabS: The purpose of study is to impart the general design, manufacturing and assembly princ<br>acturing.TOMES (COs) : The students will be able toUnderstand the basic principles of form design in casting, forging and machining. (Level 4)Analyze and redesign the component for the ease of manufacturing. (Level 2)Analyze and redesign for assembly through case studies. (Level 2)Analyze and reduce Design for assembly through case studies. (Level 2)Outcomes with Program Outcomes (POs)PO1PO2PO3PO4PO5PO6PO7PO8PPPO10PO1133222122233322212223332221222332221222333222122233322122 <td< td=""><td>Subject Name:<br/>DESIGN FOR MANUFACTURE ANDTy/Lb/<br/>ETLLT/<br/>SLP/<br/>SLP/<br/>SLPre requisite: Strength of Materials, Design of<br/>Machine Elements-1, Manufacturing Technology-<br/>1T30/00/0Tutorial S Lr : Supervised Learning P : Practical R : Research C: Credits<br/>cory/Lab/Embedded Theory and LabT30/00/0St repurpose of study is to impart the general design, manufacturing and assembly principles<br/>taturing.T0/00/0TOOMES (COs) : The students will be able to<br/>Understand the basic principles of Manufacturability. (Level 2)Understand the basic principles of form design in casting, forging and machining. (Level 4)Exposure to modern tool like Computer aided Design for Assembly. (Level 2)Analyze and redesign the component for the ease of manufacturing. (Level 4)Seposure to modern tool like Computer aided Design for Assembly. (Level 2)Analyze and evaluate Design for assembly through case studies. (Level 4)FOOMES OUTCOMES with Program Outcomes (POs)PP01P01P01P01P02P03P04P05P06P07P08P33222122233322122233222122233222122233322122233322122<t< td=""></t<></td></td<> | Subject Name:<br>DESIGN FOR MANUFACTURE ANDTy/Lb/<br>ETLLT/<br>SLP/<br>SLP/<br>SLPre requisite: Strength of Materials, Design of<br>Machine Elements-1, Manufacturing Technology-<br>1T30/00/0Tutorial S Lr : Supervised Learning P : Practical R : Research C: Credits<br>cory/Lab/Embedded Theory and LabT30/00/0St repurpose of study is to impart the general design, manufacturing and assembly principles<br>taturing.T0/00/0TOOMES (COs) : The students will be able to<br>Understand the basic principles of Manufacturability. (Level 2)Understand the basic principles of form design in casting, forging and machining. (Level 4)Exposure to modern tool like Computer aided Design for Assembly. (Level 2)Analyze and redesign the component for the ease of manufacturing. (Level 4)Seposure to modern tool like Computer aided Design for Assembly. (Level 2)Analyze and evaluate Design for assembly through case studies. (Level 4)FOOMES OUTCOMES with Program Outcomes (POs)PP01P01P01P01P02P03P04P05P06P07P08P33222122233322122233222122233222122233322122233322122 <t< td=""></t<> |  |  |  |

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|               | DEEMED TO BE UNIVERSITY<br>University with Graded Autonomy Status<br>(An ISO 21001 : 2018 Certified Institution)<br>Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilna | du, India.    |   | NAAC<br>* * * |     |  |
|---------------|--|---------------|---|---------------|-----|--|
| Subject Code: | Subject Name : DESIGN FOR MANUFACTURE AND<br>ASSEMBLY  | Ty/Lb/<br>ETL | L | T/<br>SLr     | P/R |  |

| Subject Code.    | ASSEMBLY   | ETL | L | SLr | r/ĸ | C |
|------------------|--|-----|---|-----|-----|---|
| <b>EBME22E13</b> | Prerequisite: Strength of Materials, Design of Machine | Ту  | 3 | 0/0 | 0/0 | 3 |
|                  | Elements-I, Manufacturing Technology-I                 | -   |   |     |     |   |

#### **UNIT-I: INTRODUCTION**

General design principles for manufacturability - strength and mechanical factors, Process capability - Feature tolerances - Geometric tolerances - Assembly limits -Datum features - Tolerance stacks.

#### **UNIT- II: FORM DESIGN - CASTING**

Production methods on form design - Casting considerations - Requirements and rules - Redesign of components for castings and Case studies.

#### **UNIT- III: FORM DESIGN - FORGING**

Forging considerations - Requirements and rules - Redesign of components for forging and Case studies.

#### **UNIT- IV: FORM DESIGN - MACHINING**

Machining considerations - Requirements and rules -Redesign of components for Machining and Case studies.

#### **UNIT- V: DESIGN FOR ASSEMBLY METHODS**

Approaches to design for assembly - Qualitative evaluation procedures, knowledge based approach, Computer aided DFA methods. Assemblability measures. Boothroyd - Dewhurst DFA method - Redesign of a simple product - Case studies.

#### Total No. of Periods: 45

#### **TEXT BOOKS:**

- 1. Harry Peck, (1983) Design for Manufacture. Pittman Publication
- 2. Alan Redford and Chal, (1994) *Design for Assembly Principles and Procedures*. McGraw Hill International

#### REFERENCES

- 1. Robert Matousek, (1963) Engineering Design A Systematic Approach. Blackie & Sons Ltd
- 2. James G. Bralla, (1986) Hand Book of Product Design for Manufacturing. McGraw Hill Co
- 3. Swift, K.G. (1987) Knowledge Based Design for Manufacture.



| Subject Code:  |               | Subject  | t Name: 🛛  | MECHA            | ANICS            | OF FRA        | ACTUR              | E               | Ty/Lb/<br>ETL/IE   | L        | T/<br>SLr | P/R       | C     |  |
|--|---------------|--|--|------------------|------------------|---------------|--------------------|-----------------|--------------------|----------|-----------|-----------|-------|--|
| EBME22E14  |               | Pre r<br>Enginee   | equisite:<br>ring Meta   | Strea<br>allurgy | ngth             | of Ma         | aterials,          | ,               | Ту                 | 3        | 0/0       | 0/0       | 3     |  |
| L : Lecture T :  | Tutori        | al S Lr  | : Supervis   | sed Lear         | ning P           | : Project     | R : Res            | search          | C: Credits         |          |           |           |       |  |
| T/L/ETL : The  | ory/La        | b/Embed  | ded Theor  | y and L          | ab               |               |                    |                 |                    |          |           |           |       |  |
| OBJECTIVES   | S: The        | e student v  | will learn   |                  | <b>C</b> 11(     |               |                    |                 | 1.1                |          | c · · 1 1 |           |       |  |
| <ul> <li>Solid i<br/>fatigue</li> </ul>                | load a        | nics of ci   | acked col  | mponen           | ts of dif        | ferent n      | nodes by           | y whic          | h these con        | nponents | fail unde | er static | e and |  |
| OURSE OUT  | COM           | ES (COs)   | : The stu  | ident wi         | ll be ab         | le to         |                    |                 |                    |          |           |           |       |  |
| CO1  |               | Identify th  | ne various   | failure          | mechani          | sms in c      | lifferent          | materi          | als. (Level 2      | 2)       |           |           |       |  |
| CO2  |               | Evaluate 1   | aluate fracture toughness using linear fracture tests. (Level 5)                           |                  |                  |               |                    |                 |                    |          |           |           |       |  |
| CO3  |               | Apply the  | ply the crack driving force in linear and non-linear materials. (Level 4)                  |                  |                  |               |                    |                 |                    |          |           |           |       |  |
| CO4  |               | Estimate   | timate the life of fatigue crack growth for both linear and nonlinear materials. (Level 3) |                  |                  |               |                    |                 |                    |          |           |           |       |  |
| CO5  |               | Employ the knowledge of fracture mechanics in engineering application. (Level 3) |  |                  |                  |               |                    |                 |                    |          |           |           |       |  |
| Mapping of Course Outcomes with Program Outcomes (POs) |               |  |  |                  |                  |               |                    |                 |                    |          |           |           |       |  |
| Cos/Pos  | <b>PO1</b>    | PO2  | PO3  | PO4              | PO5              | <b>PO6</b>    | <b>PO7</b>         | PO8             | PO9                | PO10     | PO11      | PO12      | 2     |  |
| CO1  | 3             | 3  | 3  | 3                | 2                | 2             | 2                  | -               | 2                  | 2        | 1         | 2         | 2     |  |
| CO2  | 3             | 3  | 3  | 3                | 2                | 2             | 2                  | -               | 2                  | 2        | 1         | 2         | 2     |  |
| CO3  | 3             | 3  | 3  | 3                | 2                | 2             | 2                  | -               | 2                  | 2        | 1         | 2         | 2     |  |
| CO4  | 3             | 3  | 3  | 3                | 2                | 2             | 2                  | -               | 2                  | 2        | 1         | 2         |       |  |
| CO5  | 3             | 3  | 3  | 3                | 2                | 2             | 2                  | -               | 2                  | 2        | 1         | 2         |       |  |
| Cos / PSOs   | P             | SO1  | PSC  | 02               | PS               | 03            | PS                 | SO4             |                    |          |           |           |       |  |
| CO1  |               | 3  | 3  |                  | 1                |               | 2                  |                 |                    |          |           |           |       |  |
| CO2  |               | 3  | 3  |                  | 1                |               | 2                  |                 |                    |          |           |           |       |  |
| CO3  |               | 3  | 3  |                  | 1                | L             |                    | 2               |                    |          |           |           |       |  |
| C04  |               | 3  | 3  |                  | 1                | L             |                    | 2               |                    |          |           |           |       |  |
| 3/2/1 indicates S                                      | Streng        | th of Corr   | elation 3  | - High, 2        | - Mediu          | -<br>m, 1-Lov | w                  | -               |                    |          |           |           |       |  |
|  |               |  |  |                  |                  |               |                    |                 |                    |          |           |           |       |  |
| Category   | Basic Science | Engineering Science  | Humanities and social Science  | Program Core     | Program elective | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |          |           |           |       |  |
|  |               |  |  |                  | V                |               |                    |                 |                    |          |           |           |       |  |

#### Subject Code: Subject Name : MECHANICS OF FRACTURE Tv/Lb/ L **T**/ P/R С SLr ETL/IE **Prerequisite:** Strength of Materials, **EBME22E14** Ty 0/0 0/0 3 3 **EngineeringMetallurgy**

### UNIT- I ELEMENTS OF SOLID MECHANICS

The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation - limit analysis – Airy's function – field equation for stress intensity factor.

### UNIT- II STATIONARY CRACK UNDER STATIC LOADING

Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation - plastic zone size – Dugdaale model – determination of J integral and its relation to crack opening displacement.

#### UNIT- III ENERGY BALANCE AND CRACK GROWTH

Griffith analysis – stable and unstable crack growth –Dynamic energy balance – crack arrest mechanism –K1c test methods - R curves - determination of collapse load.

#### UNIT- IV FATIGUE CRACK GROWTH CURVE

Empirical relation describing crack growth law – life calculations for a given load amplitude – effects of changing the load spectrum -- rain flow method– external factors affecting the K1c values.- leak before break analysis.

#### **UNIT- V APPLICATIONS OF FRACTURE MECHANICS**

Crack Initiation under large scale yielding – thickness as a design parameter – mixed mode fractures - crack instability in thermal and residual stress fields - numerical methods

#### Total No. of Periods: 45

#### **TEXT BOOKS:**

- 1. David Broek, "Elementary Engineering Fracture Mechanics ", Fifthoff and Noerdhoff International Publisher, 1978.
- 2. 2. Kare Hellan, "Introduction of Fracture Mechanics", McGraw-Hill Book Company, 1985.

#### **REFERENCES:**

- 1. Preshant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, 1999.
- 2. John M.Barson and Stanely T.Rolfe Fatigue and fracture control in structures Prentice hall Inc. Englewood, 1977.
- 3. Tribikram Kundu, "Fundamentals of Fracture Mechanics", Ane Books Pvt. Ltd. New Delhi/ CRC Press, 2012



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| Subject Code:     | Subje<br>INNO   | ct Na<br>VATIO   | me: D<br>N                       | ESIGN        | THI              | NKING         | AND                | Ty/Lb/<br>ETL/I | E                  | T/<br>SL   | / P/R     | С          |
|-------------------|-----------------|--|----------------------------------|--------------|------------------|---------------|--------------------|-----------------|--------------------|------------|-----------|------------|
|                   | Pre re          | quisite:   | NIL                              |              |                  |               |                    | Tv              | 3                  | 0/(        | 0/0       | 3          |
| EBME22E15         |                 |  |                                  |              |                  |               |                    | Lì              | 5                  | 0/0        | 0/0       | 5          |
| L : Lecture T :   | Tutorial        | S Lr   | : Supervi                        | sed Lea      | arning I         | P: Proje      | ect R : R          | Research C      | C: Credits         | 8          |           |            |
| T/L/ETL : The     | ory/Lab         | /Embedd  | led Theor                        | y and La     | ıb               |               |                    |                 |                    |            |           |            |
| • Solid           | S: The smechani | tudent with tudent with the second se | vill learn<br>racked co          | omponer      | nts of d         | lifferent     | modes b            | by which        | these co           | mponents f | ail under | static and |
| fatigue           | load co         | nditions   | •                                |              |                  |               |                    |                 |                    |            |           |            |
| OURSE OUT         | COME            | <b>S</b> (COs)   | :                                |              |                  |               |                    |                 |                    |            |           |            |
| CO1 U             | Jndersta        | and the f  | undament                         | al conce     | epts of de       | esign thi     | nking              |                 |                    |            |           |            |
| <b>CO2</b>        | Apply th        | e knowl  | edge of de                       | esign thi    | nking pi         | rocess in     | product            | developme       | ent                |            |           |            |
| CO3 I             | nnovate         | the new  | idea for j                       | product      | creation         | S             |                    |                 |                    |            |           |            |
| CO4 I             | Develop         | the proc   | luct design                      | n and str    | rategies         |               |                    |                 |                    |            |           |            |
| CO5 (             | Create a        | new bus  | siness idea                      | for a st     | artup.           |               |                    |                 |                    |            |           |            |
| Mapping of Co     | ourse O         | utcome   | s with Pro                       | ogram (      | Outcome          | es (POs)      |                    |                 |                    |            |           |            |
| Cos/Pos           | PO1             | PO2  | PO3                              | PO4          | PO5              | PO6           | <b>PO7</b>         | PO8             | PO9                | PO10       | PO11      | PO12       |
| CO1               | 3               | 3  | 2                                | 3            | 2                | 3             | 2                  |                 |                    | 2          |           | 2          |
| CO2               | 3               | 3  | 2                                | 3            | 2                | 3             | 2                  |                 |                    | 2          |           | 2          |
| CO3               | 3               | 3  | 2                                | 3            | 2                | 3             | 2                  |                 |                    | 2          |           | 2          |
| CO4               | 3               | 3  | 2                                | 3            | 2                | 3             | 2                  |                 |                    | 2          |           | 2          |
| CO5               | 3               | 3  | 2                                | 3            | 2                | 3             | 2                  |                 |                    | 2          |           | 2          |
| Cos / PSOs        | PS              | 01   | PSC                              | 02           | PS               | 503           | PSO4               |                 |                    |            |           |            |
| CO1               | ,               | 2  | 3                                |              |                  | 3             | 2                  |                 |                    |            |           |            |
| CO2               | ,               | 2  | 3                                |              |                  | 3             | 2                  |                 |                    |            |           |            |
| CO3               | ,               | 2  | 3                                |              |                  | 3             | 2                  |                 |                    |            |           |            |
| CO4               |                 | 2  | 3                                |              |                  | 3             | 2                  |                 |                    |            |           |            |
| CO5               | ,               | 2  | 3                                |              |                  | 3             | 2                  |                 |                    |            |           |            |
| 3/2/1 indicates S | Strengtl        | h of Cor   | relation                         | 3- High      | n, 2- Me         | dium, 1       | -Low               |                 |                    | ·          |           |            |
|                   |                 |  | _                                |              |                  |               |                    |                 |                    |            |           |            |
| Category          | Basic Science   | Engineering<br>Science   | Humanities and social<br>Science | Program Core | Program elective | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |            |           |            |
|                   |                 |  |                                  |              | $\checkmark$     |               |                    |                 |                    |            |           |            |

#### INNOVATION Pre requisite: NIL Ty **EBME22E15**

DESIGN

Periyar E.V.R

DUCA

Name:

# **Unit I Introduction to Design Thinking**

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

An ISO 21001 : 2018 Certified Institution)

THINKING

. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

## **Unit II Design Thinking Process**

Subject

Subject Code:

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking -person, costumer, journey map, brain storming, product development Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

## **Unit III Innovation**

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity. Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

## **Unit IV Product Design**

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies. Activity: Importance of modeling, how to set specifications, Explaining their own product design.

# **Unit V Design Thinking in Business Processes**

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business -Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes. Activity: How to market our own product, About maintenance, Reliability and plan for startup. Total No. of Periods: 45

## **Text Books**

1. Change by design, Tim Brown, Harper Bollins (2009)

2. Design Thinking for Strategic Innovation, Idris Mootee, 2013, John Wiley & Sons.

# **Reference Books**

- 1. Design Thinking in the Classroom by David Lee, Ulysses press
- 2. Design the Future, by Shrrutin N Shetty, Norton Press
- 3. Universal principles of design-William lidwell, kritinaholden, Jill butter.
- 4. The era of open innovation –chesbrough.H



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# PROGRAM ELECTIVE MANUFACTURING ENGINEERING

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|-----------|---|--|
|           | (Am ISO 24004 + 2018 Contified Institution)   |  |

| Subject Co   | de:   | Subje      | ct Nam       | e : IND   | USTRIA             | L'ROE           | SOTICS    | Tamilnad | Ty/Lb/E      | L         | Τ/        | P/R                | С             |
|--------------|---|------------|--------------|-----------|--------------------|-----------------|-----------|----------|--------------|-----------|-----------|--------------------|---------------|
|              |   |            |              |           |                    |                 |           |          | TL           |           | SLr       |                    |               |
| FRME22       | F16   | Prere      | quisite:     | Industr   | rial Auto          | omation         | 1         |          | Ту           | 3         | 0/0       | 0/0                | 3             |
| L : Lecture  | e T : Tut                                   | orialSLr : | Supervi      | sed Lea   | rning P :          | Project         | R : Res   | earch C  | C: Credits   |           |           |                    |               |
| T/L/ETL :    | /L/ETL : Theory/Lab/Embedded Theory and Lab |            |              |           |                    |                 |           |          |              |           |           |                    |               |
| OBJECT       | IVES: T                                     | o give an  | understa     | inding to | the stu            | dent wit        | h respec  | t to:    |              |           |           |                    |               |
| • Ba         | asic comp                                   | ponents of | f an indu    | strial ro | bot and            | Sensors         | used in   | robots   |              |           |           |                    |               |
| • Ro         | obot prog                                   | ramming    | method       | s and Ro  | obot app           | lications       | 5         |          |              |           |           |                    |               |
| COURSE       | OUTCO                                       | OMES (C    | <b>Os</b> ): |           |                    |                 |           |          |              |           |           |                    |               |
| CO1          | Unders                                      | tand the b | asic con     | cepts of  | a robot            | (Level 2        | 2)        |          |              |           |           |                    |               |
| CO2          | Identify                                    | and appl   | y the dif    | fferent c | ompone             | nts and         | operatio  | n with   | respect to r | obot (Lev | vel 3)    |                    |               |
| <u>CO3</u>   | Recogn                                      | ize the va | rious ty     | pes of se | $\frac{1}{1}$      | nd mach         | ine visio | on conc  | epts and its | applicat  | 10ns (Lev | <sup>7</sup> el 3) |               |
| C04<br>C05   | Design                                      | the robot  | cell and     | state its | el 4)<br>s applica | tions (I        | evel 4)   |          |              |           |           |                    |               |
| Mapping      | of Cours                                    | se Outcor  | nes with     | Progra    | am Outo            | comes (]        | Pos)      |          |              |           |           |                    |               |
| Cos/Pos      | PO1   | PO2        | PO           | PO4       | PO5                | PO6             | PO7       | PO8      | PO9          | PO10      | PO11      | POI                | 12            |
| 001          | 2   |            | 3            |           |                    |                 |           |          |              | 2         | 2         |                    | 2             |
| <u>CO1</u>   | 3   | 3          | 2            | 2         | 3                  | 3               | 2         | 2        | 3            | 3         | 3         |                    | $\frac{2}{2}$ |
| CO2          | 3   | 3          | 3            | 3         | 3                  | 3               | 2         | 2        | 3            | 3         | 3         |                    | 2             |
| CO3          | 3   | 3          | 2            | 2         | 3                  | 3               | 2         | 2        | 3            | 3         | 3         |                    | 2             |
| CO4          | 3   | 3          | 3            | 3         | 3                  | 3               | 2         | 2        | 3            | 3         | 3         | _                  | 2             |
|              | 3<br>DS                                     | 3          | 3<br>D       | <u> </u>  | 3<br>DS            | $\frac{3}{103}$ | 2<br>D    | 2        | 3            | 3         | 3         |                    | 2             |
| PSOs         | P3  | 01         | C P          | 3<br>)2   | rs                 | 05              | P.        | 4        |              |           |           |                    |               |
| CO1          |   | 3          |              | 3         |                    | 2               |           | 3        |              |           |           |                    |               |
| CO2          |   | 3          |              | 3         |                    | 2               |           | 3        |              |           |           |                    |               |
| CO3          |   | 3          |              | 3 2       |                    |                 |           | 3        |              |           |           |                    |               |
| CO4          |   | 3          |              | 3         |                    | 2               |           | 3        |              |           |           |                    |               |
| CO5          |   | 3          |              | 3         |                    | 2               |           | 3        |              |           |           |                    |               |
| 3/2/1 indica | ates Stre                                   | ngth of C  | Correlat     | ion 3-1   | High, 2-           | Mediu           | m, 1-Lo   | W        | r            | T         | 1         |                    |               |
|              |   |            |              |           |                    |                 |           |          |              |           |           |                    |               |
|              |   |            | _            |           |                    |                 |           |          |              |           |           |                    |               |
|              |   |            | cia          |           | e.                 |                 | ~         |          |              |           |           |                    |               |
|              |   |            | l so         |           | ctiv               |                 | lary      | ent      | ect          |           |           |                    |               |
| ~            | nce   |            | and          | re        | ele                | ve              | plir      | uoc      | roj          |           |           |                    |               |
| ory          | ciel  | ing        | ies          | C         | m                  | scti            | sci       | luic     | ul /I        |           |           |                    |               |
| teg          | C S   | eer        | unit<br>ce   | am        | gra                | Ele             | Di        | Ŭ        | tice         |           |           |                    |               |
| Ca           | asi   | ien        | ien i        | ogr       | Pro                | Den             | nter      | kill     | rac          |           |           |                    |               |
|              |   | Sc         | Ht<br>Sc     | Pr        |                    | Ō               | ГТ<br>    | S        | Ц            |           |           | _                  |               |
|              |   |            |              |           | ↓ V                |                 |           |          |              |           |           |                    |               |
|              |   |            |              |           |                    |                 |           |          |              |           |           |                    |               |
|              |   |            |              |           |                    |                 |           |          |              |           |           |                    |               |
|              |   |            |              |           | 1                  |                 |           |          |              |           |           |                    |               |
| Subject Code:    | Subject Name : INDUSTRIAL ROBOTICS  | Ty/Lb/ | L | Τ/  | P/R | С |
|------------------|-------------------------------------|--------|---|-----|-----|---|
|                  |                                     | ETL    |   | SLr |     |   |
| <b>EBME22E16</b> | Prerequisite: Industrial Automation | Ту     | 3 | 0/0 | 0/0 | 3 |

n ISO 21001 : 2018 Certified Institution Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

### **UNIT-I:INTRODUCTION**

Definition of a Robot - Basic Concepts -- Robot components -- manipulator-configurations -- joints- degree of freedom. Types of Robot Drives - Basic Robot Motion types - Point to Point Control - Continuous Path Control.

### **UNIT- II: COMPONENTS AND OPERATIONS**

EDUCAT

Basic Control System Concepts - open loop and closed loop control-Control System Analysis - Robot Actuation and Feed Back, Manipulators - Direct and Inverse Kinematics, Co-ordinate Transformation - Brief Robot Dynamics, Types of Robot and Effectors – Grippers – Tools as End Effectors – Robot / End Effort Interface.

### **UNIT-III:SENSING AND MACHINE VISION**

Range Sensing - Proximity Sensing - Touch sensing - Force and Torque Sensing. Introduction to Machine Vision – functions and applications.

### **UNIT- IV:ROBOT PROGRAMMING**

Methods - Languages -programming for pick and place applications-palletizing. Capabilities and Limitation -Artificial Intelligence – Knowledge Representation – Search Techniques – AI and Robotics.

### **UNIT- V:ROBOT CELL DESIGN AND APPLICATIONS**

Robot cell design-types and control.

Applications of Robots -process applications in welding and painting - Assembly applications- Material Handling applications.

### Total No. of Periods : 45

### **TEXT BOOK**

1) K. S. Fu, R. C. Gonalez, C.S.G. Lee, "Robotics Control Sensing Vision and Intelligence", McGraw Hill International Edition, 10987.

### REFERENCES

- 1) Mikell P. Groover, Mitchell Weiss, (2008) "Industrial Robotics, Technology, Programming and Application", Tata McGraw Hill International Editions, 10986.
- 2) Richard D. Klafter, Thomas A. Chonieleswski and Michael Negin, (1989) "Robotic Engineering An Integrated Approach", Prentice Hall Inc., Englewoods Cliffs, NJ, USA, 109809.



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| Subject Code:                       | Sub                 | ject Na   | me: NO                          | N-CON<br>FECHN       | VENTIO<br>IQUES  | ONAL                 | MACH                     | INING           | Ty/Lb/<br>ETL      | L             | T/<br>SLr  | P/R      | С     |
|-------------------------------------|---------------------|---|---------------------------------|----------------------|------------------|----------------------|--------------------------|-----------------|--------------------|---------------|------------|----------|-------|
| EBME22E17                           | Prer                | equisite  | : Manufa                        | cturing              | Techno           | logy I &             | : II                     |                 | Ту                 | 3             | 0/0        | 0/0      | 3     |
| L : Lecture T : '<br>T/L/ETL : Theo | Tutorial<br>pry/Lab | SLr:<br>Embedd  | Supervis                        | ed Leari<br>y and La | ning P:<br>Ib    | Project              | R : Rese                 | earch C:        | Credits            | 1 1           |            |          |       |
| OBJECTIVES                          | S: The s            | student w   | vill learn                      |                      |                  |                      |                          |                 |                    |               |            |          |       |
| • To                                | underst             | and basi  | cs of Non                       | convent              | ional ma         | achining             | techniq                  | ues             |                    |               |            |          |       |
| • 10<br>• To                        | know fl             | ne applic   | ations of u                     | non con              | ventiona         | lionai m<br>1 machir | aching<br>hing tech      | niques i        | n various i        | fields        |            |          |       |
| COURSE OU                           | ГСОМ                | ES (COs   | <u>s):</u>                      |                      |                  |                      |                          |                 |                    |               |            |          |       |
| CO1                                 | Explain             | the prin  | ciple, adv                      | antage a             | nd limita        | ations of            | differen                 | t Non c         | onvention          | al machi      | ning proce | esses. ( | Level |
|                                     | 2)                  |   |                                 | e                    |                  |                      |                          |                 |                    |               | U I        |          |       |
| CO2                                 | Compar              | e the dif   | ferent nor                      | conven               | tional pr        | ocesses              | for their                | capabil         | ity (Level         | 4)            |            |          |       |
| CO3                                 | Underst             | and the o   | different p                     | process p            | aramete          | rs and it            | s effect o               | on mater        | rial remova        | al (Leve      | 12)        |          |       |
| CO4                                 | ncorpo              | rate the h  | iybrid pro                      | cesses to            | o take ad        | lvantage             | $\frac{1}{1}$ s of diffe | erent pro       | bcesses (L         | $\frac{1}{2}$ |            |          |       |
| 05                                  | dentify             | ntify and use a suitable machining process based on their requirement (Level 3) |                                 |                      |                  |                      |                          |                 |                    |               |            |          |       |
| Mapping of Co                       | ourse O             | rse Outcomes with Program Outcomes (POs)  |                                 |                      |                  |                      |                          |                 |                    |               |            |          |       |
| Cos/Pos                             | <b>PO1</b>          | PO2   | PO3                             | PO4                  | PO5              | <b>PO6</b>           | PO7                      | PO8             | PO9                | PO10          | PO11       | P        | 012   |
| CO1                                 | 3                   | 3   | 2                               | 2                    | 3                | 2                    | 3                        | 2               | 3                  | 2             | 3          |          | 2     |
| CO2                                 | 3                   | 3   | 2                               | 2                    | 3                | 2                    | 3                        | 2               | 3                  | 2             | 3          |          | 2     |
| CO3                                 | 3                   | 3   | 2                               | 2                    | 3                | 2                    | 3                        | 2               | 3                  | 2             | 3          |          | 2     |
| CO4                                 | 3                   | 3   | 2                               | 2                    | 3                | 2                    | 3                        | 2               | 3                  | 2             | 3          |          | 2     |
| CO5                                 | 3                   | 3   | 2                               | 2                    | 3                | 2                    | 3                        | 2               | 3                  | 2             | 3          |          | 2     |
| Cos / PSOs                          | PS                  | 01  | PSC                             | )2                   | PS               | 03                   | PS                       | 04              |                    |               |            |          |       |
| CO1                                 | -                   | 3   | 3                               |                      | 2                | 2                    | Í                        | 3               |                    |               |            |          |       |
| CO2                                 |                     | 3   | 3                               |                      | 2                | 2                    |                          | 3               |                    |               |            |          |       |
| CO3                                 |                     | 3   | 3                               |                      | 2                | 2                    |                          | 3               |                    |               |            |          |       |
| CO4                                 | -                   | 3   | 3                               |                      |                  | 2                    |                          | 3               |                    |               |            |          |       |
| CO5                                 |                     | 3   | 3                               |                      | 2                | 2                    | í                        | 3               |                    |               |            |          |       |
| 3/2/1 indicates S                   | Strengt             | h of Cor  | relation                        | 3- Hig               | h, 2- Me         | edium, 1             | -Low                     |                 |                    |               | 1          |          |       |
|                                     |                     |   | al                              |                      |                  |                      |                          |                 |                    |               |            |          |       |
| Cate<br>gory                        | Basic Science       | Engineering<br>Science  | Humanities and soci:<br>Science | Program Core         | Program elective | Open Elective        | Inter Disciplinary       | Skill Component | Practical /Project |               |            |          |       |
|                                     |                     |   |                                 |                      | Ý                |                      |                          |                 |                    |               |            |          |       |

### Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India. Subject Code: Subject Name : NON CONVENTIONAL L **T**/ P/R С Ty/Lb/ MACHINING TECHNIQUES ETL SLr

An ISO 21001 : 2018 Certified Institution)

### **UNIT- I: INTRODUCTION, ELECTRICAL DISCHARGE MACHINING**

Prerequisite: Manufacturing Technology I & II

Need For Unconventional Processes - Classification - Electrical Discharge Machining Processes, Operating Principles - Dielectric - Electrode Material - Tool/Wear - Processes Parameters - Metal Removal Rate -Applications – Current Developments In EDM.

### **UNIT- II: ELECTRO CHEMICAL MACHINING**

EDUCATI

Electro Chemical Machining Process - Principles - Equipments - Metal Removal Analysis - Tool Material -Insulation – Process Parameters – ECH, ECG Etc., – Applications.

### **UNIT- III: ELECTRON BEAM, LASER BEAM AND PLASMA ARC MACHINING**

EBM process - principle - Gun construction - vacuum and non-vacuum technique - applications. LBM process, principles, pumping processes, Types of Emission- Beam control – Applications.

### **UNIT- IV: ULTRASONIC MACHINING**

Ultrasonic Machining Processes - Working Principles - Transducers - Concentrators - Nodal Point Clamping -Feed Mechanism - Metal Removal Rate - Process Parameters - Applications.

### **UNIT- V: ABRASIVE, WATER JET AND HYBRID MACHINING**

AJM Processes – Principle – Equipment – Metal Removal Rate – Process Parameters – Applications. WJM Process – Principle – Equipment – Applications. Introduction to hybrid machining-Electro Chemical Discharge Machining, Abrasive electrical discharge grinding-Principle, advantages, limitations and applications.

### Total No. of Periods : 45

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### TEXT BOOKS

**EBME22E17** 

- 1) P.K.Mishra (1997) "Non Conventional Machining". The Institution Of Engineers (India) text book Series
- 2) Vijay.K. Jain (2007) "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi

### REFERENCES

- 1) Benedict. G.F. (1987) "Nontraditional Manufacturing Processes" Marcel Dekker Inc., New York.
- 2) Pandey P.C. and Shan H.S. (2007) "Modern Machining Processes" Tata McGraw-Hill, New Delhi.
- 3) Mc Geough, (1998) "Advanced Methods of Machining" Chapman and Hall, London.
- 4) Paul De Garmo, J.T.Black, and Ronald.A.Kohser, (2001) "Material and Processes in Manufacturing", Prentice Hall of India Pvt. Ltd., New Delhi ,8th Edition.
- 5) P.C.Sharma, (1995) "TEXT BOOK of Production Engineering".



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| Subject Code:                       | S        | ubject N   | ame: PR            | OCESS<br>ESTIM       | PLANN<br>ATION     | NING A   | ND CO       | ST         | Ty/Lb/<br>ETL | L    | T/<br>SLr | P/R | C   |
|-------------------------------------|----------|--|--------------------|----------------------|--------------------|----------|-------------|------------|---------------|------|-----------|-----|-----|
| EBME22E18                           | Prer     | eanisite   | Manufa             | cturing              | Technol            | logy I & | II          |            | Ту            | 3    | 0/0       | 0/0 | 3   |
| L : Lecture T : T<br>T/L/ETL : Theo | Tutorial | S Lr :<br>Embedd   | Supervis           | ed Learn<br>y and La | ning P:            | Project  | R : Rese    | earch C:   | Credits       | 5    | 0/0       | 0/0 | 5   |
| OBJECTIVES                          | : The s  | tudent w   | vill learn         |                      |                    |          |             |            |               |      |           |     |     |
| Process                             | planni   | ng activi  | ties               |                      |                    |          |             |            |               |      |           |     |     |
| Various     Mathad                  | s eleme  | nts of co  | st of a pro        | duct.                | ina                |          |             |            |               |      |           |     |     |
| COURSE OUT                          | rcom     | ES (COs  | $\frac{1000}{3}$ : | ess plain            | iiiig              |          |             |            |               |      |           |     |     |
| CO1                                 | Underst  | lerstand the method of planning the various machining processes (Level 2)        |                    |                      |                    |          |             |            |               |      |           |     |     |
| CO2                                 | Analyze  | and des  | cribe the          | step by s            | step proc          | edure fo | or manuf    | facturing  | (Level 4)     | - /  |           |     |     |
| CO3                                 | Apply c  | omputer  | s for adva         | nced pro             | bcess pla          | nning (l | Level 3)    |            | . ,           |      |           |     |     |
| CO4                                 | Discuss  | uss the various cost involved in manufacturing of component or product (Level 2) |                    |                      |                    |          |             |            |               |      |           |     |     |
| CO5                                 | Evaluat  | uate and identify the economic method of manufacturing (Level 6)                 |                    |                      |                    |          |             |            |               |      |           |     |     |
| Mapping of Co                       | ourse O  | e Outcomes with Program Outcomes (POs)   |                    |                      |                    |          |             |            |               |      |           |     |     |
| Cos/Pos                             | PO1      | PO2  | PO3                | PO4                  | PO5                | PO6      | PO7         | PO8        | PO9           | PO10 | PO11      | P   | 012 |
| CO1                                 | 3        | 3  | 3                  | 3                    | 3                  | 2        | 2           | 3          | 3             | 3    | 3         |     | 2   |
| CO2                                 | 3        | 3  | 3                  | 3                    | 3                  | 2        | 2           | 3          | 3             | 3    | 3         |     | 2   |
| CO3                                 | 3        | 3  | 3                  | 3                    | 3                  | 2        | 2           | 3          | 3             | 3    | 3         |     | 2   |
| CO4                                 | 3        | 3  | 3                  | 3                    | 3                  | 2        | 2           | 3          | 3             | 3    | 3         |     | 2   |
| CO5                                 | 3        | 3  | 3                  | 3                    | 3                  | 2        | 2           | 3          | 3             | 3    | 3         |     | 2   |
| Cos / PSOs                          | PS       | 01   | PSC                | 02                   | PS                 | 03       | PS          | <b>504</b> |               |      |           |     |     |
| CO1                                 |          | 3  | 3                  |                      |                    | 3        |             | 3          |               |      |           |     |     |
| CO2                                 |          | 3  | 3                  |                      |                    | 3        |             | 3          |               |      |           |     |     |
| CO3                                 |          | 3  | 3                  |                      |                    | 3        |             | 3          |               |      |           |     |     |
| CO4                                 |          | 3  | 3                  |                      |                    | 3        |             | 3          |               |      |           |     |     |
| CO5                                 |          | 3  | 3                  |                      |                    | 3        |             | 3          |               |      |           |     |     |
| 3/2/1 indicates S                   | strengt  | h of Cor   | relation           | 3- Hig               | h, 2- Me           | edium, 1 | l-Low       |            |               | •    |           |     |     |
| legory                              | cience   | ing  | ies and social     | Core                 | am elective        | ective   | isciplinary | omponent   | u /rroject    |      |           |     |     |
| Cai                                 | Basic S  | Engineer<br>Science  | Humanit<br>Science | Program              | <ul><li></li></ul> | Open Ele | Inter D     | Skill C    | Fractic       |      |           |     |     |

### Subject Code: Subject Name : PROCESS PLANNING AND COST Ty/Lb/ L **T**/ P/R С **ESTIMATION** ETL SLr **EBME22E18** Prerequisite: Manufacturing Technology I & II Тy 0/0 0/0 3 3

## **UNIT- I: PROCESS PLANNING**

Definition - OBJECTIVES - Scope - approaches to process planning- Process planning activities - Finished part requirements- operating sequences- machine selection –material selection parameters- Set of documents for process planning- Developing manufacturing logic and knowledge- production time calculation - selection of cost optimal processes.

## **UNIT- II: COMPUTER AIDED PROCESS PLANNING**

EDUCAT

Variant process planning - Generative approach -Forward and Backward planning, Input format, Logical Design of a Process Planning - Implementation considerations. Application of computer software's in process planning.

### **UNIT-III: ELEMENTS OF COST**

Introduction - Importance and aims of Cost estimation - Estimation procedure. Material Cost - Determination of Material Cost Labour Cost - Determination of Direct Labour Cost - Expenses - Cost of Product (Ladder of cost) -Illustrative examples. Analysis of overhead expenses - Factory expenses - Depreciation - Causes of depreciation - Methods of depreciation - Administrative expenses - Selling and Distributing expenses - Allocation of overhead expenses.

### **UNIT- IV: PRODUCT COST ESTIMATION**

Estimation in forging shop - Losses in forging - Forging cost - Illustrative examples. Estimation in welding shop - Gas cutting - Electric welding - illustrative examples. Estimation in foundry shop - Estimation of pattern cost and casting cost - Illustrative examples.

## **UNIT- V: ESTIMATION OF MACHINING TIME AND COST**

Estimation of machining time and cost for Lathe operations - Estimation of machining time and cost for drilling, boring, shaping, planning, milling and grinding operations - Illustrative examples. Value engineering - cost reduction

# Total No. of Periods : 45

### **TEXT BOOKS**

- 1) M.Adithan and B.S. Pabla, (1989) "Estimating and Costing", Konark Publishers Pvt. Ltd.
- 2) V.Jayakumar (2012) "Process Planning and Cost Estimation", Lakshmi Publication.

### REFERENCES

- 1) Nanua Singh, (1996) "System approach to Computer Integrated Design and Manufacturing", John Wiley & Sons, Inc.
- 2) Joseph G. Monks, (1982) "Operations Management, Theory & Problems", McGraw Hill Book Company.
- 3) T.R. Banga and S.C. Sharma, (2011) "Estimating and Costing", Khanna Publishers, 16thEdition
- 4) Sadhu singh, (2002) "Computer aided Design and manufacturing", Khanna publisher, new delhi, second edition.



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| Subject Code:   | S                    | ubject N  | ame: AD       | DITIVI        | E MAN       | UFACT      | URING        |            | Ty/Lb/     | L           | <b>T</b> / | P/R     | С       |  |  |
|-----------------|----------------------|---|---------------|---------------|-------------|------------|--------------|------------|------------|-------------|------------|---------|---------|--|--|
| EBME22E19       |                      |   |               |               |             |            |              |            | ETL        |             | SLr        |         |         |  |  |
|                 | Prer                 | equisite  | : Manufa      | cturing       | Techno      | logy I 8   | k II         |            | Ту         | 3           | 0/0        | 0/0     | 3       |  |  |
| L : Lecture T : | Tutoria              | l S Lr  | : Supervis    | ed Lear       | ning P:     | Project    | R : Rese     | earch C:   | Credits    | 1           |            |         |         |  |  |
| T/L/ETL : The   | ory/Lab              | /Embedd   | led Theor     | y and La      | ıb          |            |              |            |            |             |            |         |         |  |  |
| OBJECTIVE       | S: The s             | student v   | vill learn    |               | . 6 . 1.1   |            | <b>6</b>     |            | D          |             |            | • • •   |         |  |  |
| • 10 und        | ages and             | the fund  | amental c     | concepts      | of Add      | itive Ma   | inufactur    | ing (i.e.  | Rapid Pro  | ototyping)  | and 3-D    | printi  | ng, its |  |  |
| • To cla        | ages and<br>ssify va | rious tv  | nes of Ad     | lditive N     | Aanufact    | uring P    | rocesses     | and kn     | ow their   | working r   | rincinle   | advar   | ntages  |  |  |
| limitat         | ions etc             | inous ty  |               |               | fundiaco    | uning 1    | 10005505     | und Ki     | low then   | working p   | interpre,  | uuvui   | nuges,  |  |  |
| To hay          | ve a hol             | istic viev  | v of vario    | us appli      | cations     | of these   | technol      | ogies in   | relevant f | fields such | as mech    | nanical | l, Bio- |  |  |
| medica          | al, Aero             | space, el   | ectronics of  | etc           |             |            |              | U          |            |             |            |         | ,       |  |  |
| COURSE OU       | тсом                 | ES (CO  | s):           |               |             |            |              |            |            |             |            |         |         |  |  |
| CO1             | Describ              | e variou  | s CAD iss     | ues for 3     | 3D printi   | ototypin   | g and relat  | ed operati | ons for S  | STL m       | odel       |         |         |  |  |
|                 | manipu               | lation  |               |               |             |            |              |            |            |             |            |         |         |  |  |
| CO2             | Formula              | mulate and solve typical problems on reverse engineering for  |               |               |             |            |              |            |            | onstruction | n from pl  | nysical | l       |  |  |
|                 | prototy              | pe mode   | ls through    | digitizi      | ng and sj   | ace fittir | ıg.          |            |            |             |            |         |         |  |  |
| CO3             | Formula              | ate and s   | olve typic    | al proble     | ems on r    | everse e   | engineeri    | ng for s   | urface rec | onstruction | n from di  | gitized | 1       |  |  |
| <u> </u>        | mesh m               | nodels through topological modelling and subdivision surface fitting.   |               |               |             |            |              |            |            |             |            |         | an d    |  |  |
| 04              | explain              | n and summarize the principles and key characteristics of additive manufacturing technologies and<br>only used 3D printing and additive manufacturing systems |               |               |             |            |              |            |            |             |            |         |         |  |  |
| C05             | Describ              | only used 3D printing and additive manufacturing systems.   |               |               |             |            |              |            |            |             |            |         |         |  |  |
| 005             | parts.               | e and su  |               | ypical it     | ipia 1001   | ing pro    | 000000       | quick      | baten proc |             | plastic ai | iu mei  | ai      |  |  |
| Mapping of C    | ourse C              | outcome   | s with Pro    | ogram (       | Jutcome     | s (POs     | )            |            |            |             |            |         |         |  |  |
| Cos/Pos         | PO1                  | PO2   | PO3           | PO4           | PO5         | PO6        | <b>PO7</b>   | PO8        | PO9        | <b>PO10</b> | P011       | P       | 012     |  |  |
| CO1             | 2                    | 3   | 2             | 3             | 2           | 2          | -            | -          | 2          | 2           | -          | 2       |         |  |  |
| CO2             | 2                    | 2   | 2             | 3             | 3           | 2          | -            | -          | 2          | 2           | -          | 2       |         |  |  |
| CO3             | 2                    | 2   | -             | 3             | 2           | 2          | -            | -          | 2          | 2           | -          | 2       |         |  |  |
| CO4             | 2                    | 2   | 3             | 3             | 2           | 2          | -            | -          | 2          | 2           | -          | 2       |         |  |  |
| C05             | 2                    | 2   | 3             | 3             | 2           | 2          |              |            | 2          | 2           | -          | 2       |         |  |  |
| Cos / PSOs      | -<br>PS              | <u>-</u><br>SO1   | e<br>PS(      | $\frac{2}{2}$ | -<br>PS     | -          | P            | 504        | -          | -           |            | -       |         |  |  |
| CO1             | 2                    |   | 3             |               | 3           | 05         | -            |            |            |             |            |         |         |  |  |
| CO2             | 2                    |   | 3             |               | 3           |            | 3            |            |            |             |            |         |         |  |  |
| CO3             | 1                    |   | 2             |               | 2           |            | 3            |            |            |             |            |         |         |  |  |
| CO4             | 3                    |   | 3             |               | 3           |            | 2            |            |            |             |            |         |         |  |  |
| CO5             | 3                    |   | 3             |               | 3           |            | 2            |            |            |             |            |         |         |  |  |
| 3/2/1 indicates | Strengt              | h of Cor  | relation      | 3- High       | n, 2- Me    | dium, 1    | -Low         |            |            |             | 1          |         |         |  |  |
|                 |                      |   |               |               |             |            |              | It         | t          |             |            |         |         |  |  |
|                 | Se                   |   | pr o          |               |             | 1)         |              | ner        | ojec       |             |            |         |         |  |  |
|                 | ienc                 | <b>G</b>  | ence          |               | В           | tive       | lary         | mpc        | /Pr        |             |            |         |         |  |  |
| . 20 50         | c Sc                 | eri   | nitie<br>Scie | н             | gra<br>ive  | Elec       | plir         | Col        | ical       |             |            |         |         |  |  |
| or te           | asic                 | gine<br>Scie  | mai<br>ial    | igra<br>re    | Pro<br>lect | en l       | nter<br>isci | kill       | ract       |             |            |         |         |  |  |
|                 | В                    | е Еп  | Hu<br>soc     | Prc<br>Co:    | °.          | Op         | DF           | Š          | Ч          |             |            |         |         |  |  |
|                 |                      |   |               |               | ~           |            |              |            |            |             |            |         |         |  |  |
|                 |                      |   |               |               |             |            |              |            |            |             |            |         |         |  |  |



| Subject Code: | Subject Name: ADDITIVE MANUFACTURING          | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|---------------|---|---------------|---|-----------|-----|---|
|               | Prerequisite: Manufacturing Technology I & II | Ту            | 3 | 0/0       | 0/0 | 3 |

### **UNIT – I Introduction**:

Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes.

### UNIT – II Liquid-based Rapid Prototyping Systems:

Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

### UNIT – III Powder Based Rapid Prototyping Systems:

Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification; Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling : Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP

### **UNIT – IV Rapid Prototyping Data Formats:**

STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software's: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

### **UNIT – V RP Applications:**

Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.

### Total No. of Periods : 45

### **Text Books**

1.Rapid prototyping; Principles and Applications /Chua C.K., Leong K.F. and LIM C.S/World Scientific Publications 2. Rapid Manufacturing /D.T. Pham and S.S. Dimov/Springer

### **Reference Books**

1. Terry Wohlers, Wholers Report 2000, Wohlers Associates

2. Rapid Prototyping and Manufacturing /PaulF.Jacobs/ASME

B.Tech Mechanical Engineering - 2022 Regulation

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| Subject Code:     |                                     | Subject                             | Name: F                      | LEXIBI<br>SYST     | LE MAI<br>TEMS   | NUFAC        | TURIN              | G               | Ty/Lb/             | L      | T/                                       | P/R | С  |
|-------------------|-------------------------------------|-------------------------------------|------------------------------|--------------------|------------------|--------------|--------------------|-----------------|--------------------|--------|--|-----|----|
|                   |                                     | •••                                 |                              |                    |                  |              |                    |                 | ETL                |        | SLr                                      |     |    |
| EBME22E20         | Prer<br>Indu                        | equisite<br>istrial A               | : Manufa<br>utomation        | cturing<br>n; CAD/ | Techno<br>/CAM   | logy I ð     | έП;                |                 | Ту                 | 3      | 0/0                                      | 0/0 | 3  |
| L : Lecture T :   | Tutoria                             | l S Lr                              | : Supervis                   | ed Lear            | ning P:          | Project      | R : Rese           | earch C:        | Credits            | L      | L. L |     |    |
| T/L/ETL : The     | ory/Lab                             | /Embedo                             | ded Theor                    | y and La           | ıb               |              |                    |                 |                    |        |  |     |    |
| OBJECTIVES        | S: The                              | student v                           | vill learn                   |                    |                  |              |                    |                 |                    |        |  |     |    |
| •                 | To uno                              | derstand                            | the Mode                     | rn manu            | facturing        | g system     | 1S                 | C (             | . ,                |        |  |     |    |
| •<br>COURSE OU!   | $\frac{10 \text{ un}}{\text{TCOM}}$ | Serstand                            | the conce                    | pts and a          | application      | ons of fi    | lexible m          | ianutact        | uring syste        | ems    |  |     |    |
|                   |                                     | derstand                            | the conce                    | ents of f          | levible n        | nanufaci     | turing sy          | stems (I        | FMS) (Lev          | rel 2) |  |     |    |
| CO2               | Ar                                  | only the                            | use of con                   | puters i           | n FMS (          | Level 3      | )                  | stems (1        |                    | (12)   |  |     |    |
| CO3               | Ar                                  | ply the s                           | simulation                   | and dat            | a base n         | nanagem      | ,<br>ent in F      | MS (Le          | evel 3)            |        |  |     |    |
| CO4               | Jus                                 | stify the                           | implemen                     | tation of          | f FMS (I         | Level 4)     |                    |                 | ,                  |        |  |     |    |
| CO5               | Ur                                  | nderstand                           | the futur                    | e factory          | with th          | e applic     | ation of           | FMS co          | ncepts (Le         | vel 2) |  |     |    |
| Mapping of C      | ourse C                             | utcomes with Program Outcomes (POs) |                              |                    |                  |              |                    |                 |                    |        |  |     |    |
| Cos/Pos           | <b>PO1</b>                          | PO2                                 | PO3                          | PO4                | PO5              | PO6          | PO7                | PO8             | PO9                | PO10   | PO11                                     | PO  | 12 |
| CO1               | 3                                   | 3                                   | 2                            | 2                  | 3                | 3            | 2                  | 2               | 3                  | 3      | 3  |     | 2  |
| CO2               | 3                                   | 3                                   | 2                            | 2                  | 3                | 3            | 2                  | 2               | 3                  | 3      | 3  |     | 2  |
| CO3               | 3                                   | 3                                   | 3                            | 3                  | 3                | 3            | 2                  | 2               | 3                  | 3      | 3  |     | 2  |
| CO4               | 3                                   | 3                                   | 3                            | 3                  | 3                | 3            | 2                  | 2               | 3                  | 3      | 3  |     | 2  |
| CO5               | 3                                   | 3                                   | 2                            | 2                  | 3                | 3            | 2                  | 2               | 3                  | 3      | 3  |     | 2  |
| Cos / PSOs        | PS                                  | 601                                 | PSC                          | )2                 | PS               | 603          | PS                 | <b>504</b>      |                    |        |  |     |    |
| CO1               |                                     | 3                                   | 3                            |                    |                  | 2            |                    | 3               |                    |        |  |     |    |
| CO2               |                                     | 3                                   | 3                            |                    | ź                | 2            |                    | 3               |                    |        |  |     |    |
| CO3               |                                     | 3                                   | 3                            |                    |                  | 2            |                    | 3               |                    |        |  |     |    |
| CO4               |                                     | 3                                   | 3                            |                    |                  | 2            |                    | 3               |                    |        |  |     |    |
| CO5               |                                     | 3                                   | 3                            |                    |                  | 2            |                    | 3               |                    |        |  |     |    |
| /2/1 indicates St | trength                             | of Corr                             | elation                      | 3- High            | , 2- Med         | lium, 1-     | Low                |                 |                    |        | ·  |     |    |
| Category          | Basic Science                       | ngineering Science                  | umanities and social Science | ogram Core         | Program elective | pen Elective | inter Disciplinary | Skill Component | Practical /Project |        |  |     |    |
|                   |                                     | Щ                                   | <u> </u>                     |                    | ~                | 0            |                    |                 |                    |        |  |     |    |

## EDUCATIONAL AND RESEARCH INSTITUTE DEEMED TO BE UNIVERSITY University with Graded Autonomy Status (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India. Code: Subject Name : FLEXIBLE MANUFACTURING Ty/Lb/ L T/ P.

| Subject Code: | Subject Name : FLEXIBLE MANUFACTURING<br>SYSTEMS                                 | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|---------------|--|---------------|---|-----------|-----|---|
| EBME22E20     | Prerequisite: Manufacturing Technology I & II;<br>Industrial Automation; CAD/CAM | Ту            | 3 | 0/0       | 0/0 | 3 |

# UNIT- I PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS 9

Introduction to FMS - development of manufacturing systems - benefits - major elements of FMS - types of flexibility - FMS application and flexibility –single product, single batch, n - batch scheduling problem - knowledge based scheduling system.

# UNIT- II COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS 9

Introduction - composition of FMS - hierarchy of computer control - computer control of work center and assembly lines - FMS supervisory computer control - types of software specification and selection - trends.

### UNIT- III FMS SIMULATION AND DATA BASE

Application of simulation - model of FMS - simulation software - limitation - manufacturing data systems - data flow - FMS database systems - planning for FMS database.

### UNIT- IV GROUP TECHNOLOGY AND JUSTIFICATION OF FMS

Introduction - matrix formulation - mathematical programming formulation - graph formulation - knowledge based system for group technology - economic justification of FMS - application of possibility distributions in FMS systems justification.

### UNIT- V APPLICATIONS OF FMS AND FACTORY OF THE FUTURE

FMS application in machining, sheet metal fabrication, prismatic component production - aerospace application - FMS development towards factories of the future - artificial intelligence and expert systems in FMS - design philosophy and characteristics for future.

# Total No. of Periods: 45

# **TEXT BOOK:**

1. Jha.N.K., "Handbook of flexible manufacturing systems", Academic Press Inc., 1991.

### **REFERENCES:**

1. Groover M.P., "Automation, production systems and computer integrated manufacturing", Prentice Hall of India Pvt., New Delhi, 2007.

2. Kalpakjian S., "Manufacturing Engineering and Technology", Addison-Wesley Publishsing Co., 2013.

3. Radhakrishnan P. and Subramanyan S., "CAD/CAM/CIM", Wiley Eastern Ltd., New Age International Ltd., 1994.

4. Raouf A. and Daya B.M., "Flexible manufacturing systems: recent development", Elsevier Science, 1995.

5. Ohno T., "Toyota production system: beyond large-scale production", Productivity Press (India) Pvt. Ltd., 1992.

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## EDUCATIONAL AND RESEARCH INSTITUTE DEEMED TO BE UNIVERSITY University with Graded Autonomy Status (An ISO 21001 : 2018 Certified Institution)

|  | -             |  | Periyar E.V                   | .R. High R   | oad, Madu        | ravoyal, C    | hennai-95          | . Tamilnac      | lu, India.         | <u>г г</u> |            |     |    |
|--|---------------|--|-------------------------------|--------------|------------------|---------------|--------------------|-----------------|--------------------|------------|------------|-----|----|
| Subject Code:                              | , i           | Subject 1  | Name: P                       | OWDE         | R META           | ALLUR         | GY                 |                 | Ty/Lb/             | L          | Τ/         | P/R | С  |
|  |               |  |                               |              |                  |               |                    |                 | ETL                |            | SLr        |     |    |
| EBME22E21                                  | Prer          | equisite   | : Materia                     | ls Scien     | ce; Engi         | neering       | g Metallı          | urgy            | Ту                 | 3          | 0/0        | 0/0 | 3  |
| L : Lecture T :                            | Tutoria       | l S Lr   | : Supervis                    | ed Learr     | ning P:          | Project       | R : Rese           | earch C:        | Credits            | 1          |            |     |    |
| T/L/ETL : The                              | ory/Lab       | /Embedd  | led Theor                     | y and La     | lb               |               |                    |                 |                    |            |            |     |    |
| OBJECTIVES                                 | S: The s      | student v  | vill learn                    |              |                  |               |                    |                 |                    |            |            |     |    |
| • To und                                   | lerstand      | basics of  | f powder i                    | metallur     | gy<br>haises a   |               |                    |                 |                    |            |            |     |    |
| <ul> <li>To exp</li> <li>To kno</li> </ul> | ose vari      | ous pow  | n of powd                     | er metal     | lurgy in         | various       | fields             |                 |                    |            |            |     |    |
| COURSE OU                                  | TCOM          | ES (COs  | s) : The st                   | udent w      | vill be al       | ole to        |                    |                 |                    |            |            |     |    |
| CO1  | Underst       | and the  | fundamer                      | tals of      | powder 1         | netallur      | gy (Leve           | el 2)           |                    |            |            |     |    |
| CO2  | Interpre      | t the cha  | racterizati                   | on para      | meters of        | f metal j     | powders            | (Level          | 3)                 |            |            |     |    |
| CO3  | Compar        | ing the c  | lifferent n                   | nanufact     | uring me         | ethods o      | f compo            | nents by        | v powder n         | netallurgy | y(Level 3) |     |    |
| CO4  | Analyzi       | nalyzing the different sintering theories (Level 4)                                  |                               |              |                  |               |                    |                 |                    |            |            |     |    |
| CO5  | Differer      | ntiating a   | ind compa                     | ring diff    | erent ap         | plication     | ns of po           | wder me         | tallurgy (I        | Level 3)   |            |     |    |
| Mapping of C                               | ourse O       | rse Outcomes with Program Outcomes (POs)<br>PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 |                               |              |                  |               |                    |                 |                    |            |            |     |    |
| Cos/Pos                                    | PO1           | PO2  | PO3                           | PO4          | PO5              | PO6           | PO7                | <b>PO8</b>      | PO9                | PO10       | PO11       | PO  | 12 |
| CO1  | 2             | 2  | 2                             | 1            | 3                | 1             | 2                  | 2               | 2                  | 2          | 1          |     | 2  |
| CO2  | 3             | 2  | 2                             | 1            | 3                | 3             | 3                  | 2               | 2                  | 2          | -          |     | 2  |
| CO3  | 3             | 2  | 2                             | 1            | 3                | 3             | 3                  | 2               | 2                  | 2          | -          |     | 2  |
| CO4  | 3             | 2  | 2                             | 1            | 3                | 3             | 3                  | 2               | 2                  | 2          | -          |     | 2  |
| CO5  | 3             | 2  | 2                             | 1            | 3                | 3             | 3                  | 2               | 2                  | 2          | 3          |     | 2  |
| Cos / PSOs                                 | PS            | 501  | PSO                           | 02           | PS               | 03            | PS                 | <b>504</b>      |                    |            |            |     |    |
| CO1  |               | 2  | 2                             |              | 2                | 2             |                    | 3               |                    |            |            |     |    |
| CO2  |               | 3  | 2                             |              |                  | 3             |                    | 3               |                    |            |            |     |    |
| CO3  |               | 2  | 2                             |              | 2                | 2             |                    | 2               |                    |            |            |     |    |
| CO4  |               | 3  | 2                             |              | 3                | 3             |                    | 2               |                    |            |            |     |    |
| CO5  |               | 3  | 2                             |              | 3                | 3             |                    | 3               |                    |            |            |     |    |
| 3/2/1 indicates                            | Strengt       | h of Cor   | relation                      | 3- High      | 1, 2- Mee        | dium, 1       | -Low               | ,               |                    | T          |            |     |    |
| Category                                   | Basic Science | Engineering Science  | Humanities and social Science | Program Core | Program elective | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |            |            |     |    |
|  |               |  |                               |              |                  |               |                    |                 |                    |            |            |     |    |

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| Subject Code: | Subject Name :POWDER METALLURGY      | Ty/Lb/ | L | <b>T</b> / | P/R | С |
|---------------|--------------------------------------|--------|---|------------|-----|---|
|               |                                      | ETL    |   | SLr        |     |   |
| EBME22E21     | Prerequisite: Engineering Metallurgy | Ту     | 3 | 0/0        | 0/0 | 3 |

### UNIT- I INTRODUCTION OF POWDER METALLURGY AND PRODUCTION OF METAL **POWDERS**

Historical and modern developments in Powder Metallurgy. Advantages, limitations, applications and basic steps involved in Powder Metallurgy. Manufacture of metal powders: Conventional methods and modern methods of metal powder manufacture. Purity of metal powders. Blending techniques.

### **UNIT- II POWDER CHARACTERIZATION**

Powder characterization: problem of size determination. Method of size analysis and surface area assessment. Powder conditioning, fundamentals of powder compaction, density distribution

in green compacts, compressibility, green Strength, pyrophorocity and toxicity. Apparent density and flowability measurement.

### **UNIT- III POWDER COMPACTION**

Powder compaction: Mechanical, thermal and thermomechanical compacting processes. Presses used for transmission. Die design and tooling for consolidation of powders. New methods of consolidation. E.g. Powder rolling, Powder forging, Isostatic pressing. Advantages and limitations of these methods.

### **UNIT- IV SINTERING PROCESS**

Theories of sintering: Sintering mechanism, Roll of diffusion, Recrystallization, Por emigration, Pore-growth and coalescence. Liquid phase sintering and related processes. Effect of compacting pressure, sintering temperature and time on sintered properties. Type of sintering furnaces. Sintering atmospheres.

### **UNIT- V APPLICATIONS OF POWDER METALLURGY**

Manufacturing and application of important P/M components: Porous bearing, Electrical contact materials, Metallic filters, Cemented carbides, magnets, Friction materials and Composites.

Total No. of Periods: 45

### **Text Books:**

1. A. K. Sinha, "Introduction to Powder Metallurgy", Dhanpatrai Publication 2. P. C. Angelo and R. Subramanian, "Powder Metallurgy: Science, Technology and Applications",

### **Reference Books**

1. Powder Metallurgy-ASM Vol. II

- 2. Powder Metallurgy-Sands and Shakespeare
- 3. Powder Metallurgy-Dixtor R.H. and Clayton.

4. Cemented Tungsten carbide Production, properties and testing-Gopal S. Upadhayay



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# PROGRAM ELECTIVE INDUSTRIAL ENGINEERING

| EDUCATIONAL AND RESEARCH INSTITUTE          | SUNTED WITH OR<br>NAAC |
|---|------------------------|
| University with Graded Autonomy Status      |                        |
| (An ISO 21001 : 2018 Certified Institution) |                        |

|                               |                     |                      | Periyar E.V                      | .K. High K             | bau, Mauu        | ravoyai, ci   | iennai-95.         | Taminad         | iu, india.         |             |          |     |          |
|-------------------------------|---------------------|----------------------|----------------------------------|------------------------|------------------|---------------|--------------------|-----------------|--------------------|-------------|----------|-----|----------|
| Subject Cod                   | e:                  | Sub                  | ject Nam                         | e: ENT                 | ERPRIS           | SE RES        | OURCH              | £               | Ty/Lb<br>/ETI      | L           | T/       | P/  | С        |
| EDNIE22E2.                    | 2                   | Dro rogu             | icito: Mor                       | PLA.                   | ININING          | hnolog        | ., T &. TT.        |                 | /EIL               |             | SLr      | ĸ   |          |
|                               |                     | Applicati            | ion of Co                        | mputer                 | Science          | Engine        | ering              |                 | Ту                 | 3           | 0/0      | 0/0 | 3        |
| L : Lecture T<br>T/L/ETL : Th | ': Tutor<br>neory/L | ial S Li<br>ab/Embed | r : Supervi<br>dded Theo         | ised Lear<br>ory and I | rning P<br>Lab   | : Practic     | al R : R           | Research        | C: Credits         | 5           |          |     |          |
| OBJECTIV                      | ES: Th              | e student            | will learn                       | :                      |                  |               |                    |                 |                    |             |          |     |          |
| • Buildi                      | ng of bı            | isiness m            | odel for re                      | esource p              | olanning         | ; Impact      | of IT in           | I ERP           |                    |             |          |     |          |
| COURSE O                      | UTCO                | MES (CO              | <b>Os) : The</b>                 | student                | will be          | able to       |                    |                 |                    |             |          |     |          |
| CO1                           |                     | Understa             | and the co                       | ncepts o               | f ERP (I         | Level 2)      |                    |                 |                    |             |          |     |          |
| CO2                           |                     | Build the            | e business                       | Model a                | and imp          | ement E       | ERP (Lev           | vel 4)          |                    |             |          |     |          |
| CO3                           |                     | Understa             | and the pri                      | inciples               | of organ         | izationa      | l transfo          | rmation         | (Level 2)          |             |          |     |          |
| <u>CO4</u>                    |                     | Examine              | e the globa                      | al Indust              | rial Con         | petition      | and use            | Inform          | ation Tech         | nology (L   | Level 4) |     |          |
| CO5<br>Manning of             | Carrie              | Describe             | e the conce                      | epts of S              | Outpoir C        | nain Ma       | nageme             | nt (Leve        | el 2)              |             |          |     |          |
|                               |                     |                      |                                  |                        |                  | DO6           | S)<br>DO7          | DUS             | PO0                | <b>PO10</b> | PO11     | DO1 | 2        |
|                               | 101                 | 102                  | 103                              | 104                    | 105              | 2             | 10/                | 100             | 103                | 1010        | 1011     |     | )        |
|                               | 3                   | 2                    | 2                                | 2                      | 3                | 2             | 2                  | 3               | 3                  | 3           | 3        |     | <u>-</u> |
| $\frac{CO2}{CO2}$             | 3                   | 3                    | 3                                | 3                      | 3                | 2             | 2                  | 3               | 3                  | 3           | 3        | 4   | <u></u>  |
| <u>CO3</u>                    | 3                   | 2                    | 2                                | 2                      | 3                | 2             | 2                  | 3               | 3                  | 3           | 3        | 4   | 2        |
| <u>CO4</u>                    | 3                   | 3                    | 3                                | 3                      | 3                | 2             | 2                  | 3               | 3                  | 3           | 3        | 4   | 2        |
|                               | 3<br>D(             | 2                    |                                  | 2                      | 3<br>DC          | 2             |                    | 3               | 3                  | 3           | 3        | 4   | 2        |
| Cos / PSOs                    | P                   | 501                  | PSC                              | )2                     | PS               | 03            | PS                 | <u>504</u>      |                    |             |          |     |          |
|                               |                     | 3                    | 3                                |                        |                  | 3             |                    | 3               |                    |             |          |     |          |
| <u>CO2</u>                    |                     | 3                    | 3                                |                        |                  | 3             |                    | 3               |                    |             |          |     |          |
| CO3                           |                     | 3                    | 3                                |                        |                  | 3             |                    | 3               |                    |             |          |     |          |
| CO4                           |                     | 3                    | 3                                |                        |                  | 3             |                    | 3               |                    |             |          |     |          |
| CO5                           |                     | 3                    | 3                                |                        |                  | 3             |                    | 3               |                    |             |          |     |          |
| 3/2/1 indicates               | s Streng            | gth of Co            | rrelation                        | 3- Hig                 | gh, 2- M         | edium,        | 1-Low              |                 |                    | 1           | 1        | T   |          |
| Category                      | Basic Science       | Engineering Science  | Humanities and social<br>Science | Program Core           | Program elective | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |             |          |     |          |
|                               |                     |                      |                                  |                        |                  |               |                    |                 |                    |             |          |     |          |

### (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India. **Subject Code:** Subject Name : ENTERPRISE RESOURCE P/R Ty/Lb L **T**/ С **PLANNING** /ETL SLr **EBME22E22 Prerequisite: Nil** Ty 3 0/0 0/0 3

### **UNIT- I: INTRODUCTION TO ERP**

Integrated Management Information, Seamless Integration - Supply Chain Management- Integrated Data Model-Benefits Of ERP - Business Engineering And ERP- Definition Of Business Engineering - Principle of business engineering - Business engineering with information technology.

### **UNIT- II: BUSINESS MODELING FOR ERP**

Building The Business model - ERP implementation – An Overview – Role Of Consultant, Vendors and Users, Customization – Precautions - ERP Post implementation options ERP Implementation Technology – Guidelines for ERP Implementation.

### **UNIT-III: INTRODUCTION TO ORGANIZATIONAL TRANSFORMATION**

Fundamental elements of organizational transformation - Principles-Methodology -Models (LMI CIP, DSMCQ & PMP) - Process improvements in models ( Moen & Nolan strategy, NPRDC, LMI CIP) - Tools and Techniques.

### **UNIT- IV: GLOBAL INDUSTRIAL COMPETITION AND INFORMATION TECHNOLOGY 9**

Coping with competition – the impact and value of IT Systems – impact and value of IT – Value chain of a firm and strategic use of IT – development trends of IT. Introduction to SAP and its applications in ERP.

### **UNIT- V: SUPPLY CHAIN MANAGEMENT**

The concept of supply chain, logistics, customer and supply chain relation, role of IT in supply chain management – strategy and structure of supply chain – factors of supply chain – stages in supply chain progress.

### **Total No. of Periods: 45**

### **TEXT BOOKS**

1) Leon, (2014) "Enterprise Resource Planning", McGraw Hill, New Delhi

- 2) P. N. Rastogi, "Re-Engineering And Re-inventing the Enterprise", Wheeler Publishing
- 3) Dr. J. A. Edosomwan, (1995) "Organizational transformation and Process Re-Engineering" 1 edition.

### REFERENCES

1. Jose Antonio Fernandz, (2005) "The SAP R/3 Handbook", TMH, 3 edition 2. Vinod Kumar Garg and N.K. Venkita Krishnan, (2004) "Enterprise Resource Planning Concepts and Practice", PHI. Publishing Co.



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| Subject Code:                  | Subj<br>SIM   | ect I<br>ULATI                         | Name:<br>ON                     | SYST                 | EM ]             | MODE                   | LING               | AND             | Ty/Lb/<br>ETL      | L         | T/<br>SLr    | P/R      | C     |
|--------------------------------|---------------|--|---------------------------------|----------------------|------------------|------------------------|--------------------|-----------------|--------------------|-----------|--------------|----------|-------|
| EBME22E23                      | Pre r         | equisite                               | :                               |                      |                  |                        |                    |                 | Ту                 | 3         | 0/0          | 0/0      | 3     |
| L : Lecture T : T/L/ETL : Theo | Tutorial      | S Lr<br>Embedo                         | : Supervis<br>led Theory        | ed Learr<br>y and La | ning P:<br>ıb    | Project                | R : Rese           | earch C:        | Credits            | <u> </u>  | 1            |          |       |
| OBJECTIVES                     | S: The s      | tudent v                               | vill learn:                     |                      |                  |                        |                    |                 |                    |           |              |          |       |
| The basic system               | n conce       | pt and d                               | efinitions                      | of system            | m;<br>iono arrat |                        |                    |                 |                    |           |              |          |       |
| Analyze a system               | m and to      | model a                                | ise of the i                    | informat             | tion to in       | nprove (               | the perfo          | rmance.         |                    |           |              |          |       |
| OURSE OUT(                     | COME          |  | • The stu                       | dents w              | ill he ah        | le to                  |                    |                 |                    |           |              |          |       |
| CO1                            | Explain       | the syst                               | em concer                       | ot and ar            | m be ab          | rtional r              | nodeling           | method          | l to model         | the activ | ities of a s | static s | vstem |
| CO2                            | Describ       | e the bel                              | navior of a                     | dvnami               | ic system        | $\frac{1}{1}$ and $cr$ | eate an a          | nalogou         | is model fo        | or a dvna | mic system   | n:       | ystem |
| CO3                            | Simulat       | e the ope                              | eration of                      | a dynam              | nic system       | n and n                | nake imp           | roveme          | nt accordi         | ng to the | simulation   | ı resul  | ts.   |
| CO4                            | Identify      | the dist                               | ribution of                     | f data fro           | om the c         | ollected               | data               |                 |                    | U         |              |          |       |
| CO5                            | Create        | a model                                | building                        | and vali             | date the         | perform                | nance of           | the mod         | lel                |           |              |          |       |
| Mapping of Co                  | ourse O       | e Outcomes with Program Outcomes (POs) |                                 |                      |                  |                        |                    |                 |                    |           |              |          |       |
| Cos/Pos                        | PO1           | PO2                                    | PO3                             | PO4                  | PO5              | PO6                    | PO7                | <b>PO8</b>      | PO9                | PO10      | PO11         | PO       | 12    |
| CO1                            | 2             | 2                                      | 1                               | 1                    | 1                | 1                      | 1                  |                 | 2                  | 2         | 2            | 2        |       |
| CO2                            | 2             | 2                                      | 1                               | 1                    | 1                | 1                      | 1                  |                 | 2                  | 2         | 2            | 2        |       |
| CO3                            | 2             | 2                                      | 2                               | 1                    | 2                | 1                      | 1                  |                 | 2                  | 2         | 2            | 2        |       |
| CO4                            | 2             | 2                                      | 1                               | 1                    | 1                | 1                      | 1                  |                 | 2                  | 2         | 2            | 2        |       |
| CO5                            | 2             | 2                                      | 1                               | 1                    | 1                | 1                      | 1                  |                 | 2                  | 2         | 2            | 2        |       |
| Cos / PSOs                     | PS            | 01                                     | PSC                             | 02                   | PS               | 03                     | PS                 | 504             |                    |           |              |          |       |
| CO1                            |               |  |                                 |                      | 2                |                        | 2                  |                 |                    |           |              |          |       |
| CO2                            |               |  |                                 |                      | 2                |                        | 2                  |                 |                    |           |              |          |       |
| CO3                            |               |  |                                 |                      | 2                |                        | 2                  |                 |                    |           |              |          |       |
| CO4                            |               |  |                                 |                      | 2                |                        | 2                  |                 |                    |           |              |          |       |
| CO5                            |               |  |                                 |                      | 2                |                        | 2                  |                 |                    |           |              |          |       |
| 3/2/1 indicates S              | Strengt       | h of Cor                               | relation                        | 3- High              | n, 2- Me         | dium, 1                | -Low               |                 |                    |           |              |          |       |
|                                |               |  | П                               |                      |                  |                        |                    |                 |                    |           |              |          |       |
| Catego<br>ry                   | Basic Science | Engineering<br>Science                 | Humanities and socia<br>Science | Program Core         | Program elective | Open Elective          | Inter Disciplinary | Skill Component | Practical /Project |           |              |          |       |
|                                |               |  |                                 |                      | V                |                        |                    |                 |                    |           |              |          |       |

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### (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code: | Subject N<br>SIMULATIC | Name:<br>ON | SYSTEM | MODELING | AND | Ty/Lb/<br>ETL | L | T/<br>SLr | P/R | С |
|---------------|------------------------|-------------|--------|----------|-----|---------------|---|-----------|-----|---|
| EBME22E23     | Pre requisite:         | :           |        |          |     | Ту            | 3 | 0/0       | 0/0 | 3 |

### **UNIT I Introduction**

When simulation is the appropriate tool and when it is not appropriate, Advantages and disadvantages of Simulation; Areas of application, Systems and system environment; Components of a system; Discrete and continuous systems, Model of a system; Types of Models, Discrete-Event System Simulation Simulation examples: Simulation of queuing systems. General Principles.

### **UNIT II Statistical Models in Simulation**

### Statistical Models in Simulation:

Review of terminology and concepts, Useful statistical models, Discrete distributions. Continuous distributions, Poisson process, Empirical distributions. General Principles.

### **Queuing Models:**

Characteristics of queuing systems, Queuing notation, Long-run measures of performance of queuing systems, Long-run measures of performance of queuing systems cont...,Steady-state behavior of M/G/1 queue, Networks of queues,

### **UNIT III Random-Number Generation**

### **Random-Number Generation:**

Properties of random numbers; Generation of pseudo-random numbers, Techniques for generating random numbers, Tests

for Random Numbers,

### **Random Variate Generation:**

Inverse transform technique Acceptance-Rejection technique.

EDUCAT

### **UNIT IV Input Modeling**

### Input Modeling:

Data Collection; Identifying the distribution with data, Parameter estimation, Goodness of Fit Tests, Fitting a non-stationary Poisson process, Selecting input models without data, Multivariate and Time-Series input models.

Estimation of Absolute Performance:

Types of simulations with respect to output analysis, Stochastic nature of output data, Measures of performance and their estimation, Contd.

### UNIT V Measures of performance and their estimation

Measures of performance and their estimation,Output analysis for terminating simulations Continued..,Output analysis for steady-state simulations. Verification, Calibration And Validation: Optimization: Model building, verification and validation, Verification of simulation models, Verification of simulation and validation of models, Optimization via Simulation.

### **Textbooks:**

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete-Event System Simulation, 5th Edition, Pearson Education, 2010.

### **Reference Books:**

1. Lawrence M. Leemis, Stephen K. Park: Discrete – Event Simulation: A First Course, Pearson Education, 2006.

2. Averill M. Law: Simulation Modeling and Analysis, 4 th Edition, Tata McGraw-Hill, 2007

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| Subject Code:   | Su         | bject Na   | ame: TO     | TAL QU     | JALITY     | MANA       | AGEME      | ENT        | Ty/Lb/  | L    | Τ/   | P/R | С   |
|-----------------|------------|------------|-------------|------------|------------|------------|------------|------------|---------|------|------|-----|-----|
| EBME22E24       |            |            |             |            |            |            |            |            | ETL     |      | SLr  |     |     |
|                 | Pre        | requisite  | e: Manufa   | cturing    | Techno     | ology I &  | & II       |            | Ту      | 3    | 0/0  | 0/0 | 3   |
| L : Lecture T : | Tutoria    | l S Lr     | : Supervis  | ed Learr   | ning P:    | Project    | R : Rese   | earch C:   | Credits |      |      |     |     |
| T/L/ETL : The   | ory/Lab    | /Embedo    | led Theor   | y and La   | ıb         |            |            |            |         |      |      |     |     |
| OBJECTIVE       | S: The     | student v  | vill learn  |            |            |            |            |            |         |      |      |     |     |
| Various Princi  | ples and   | Tools of   | f TQM; IS   | O Stand    | ards       |            |            |            |         |      |      |     |     |
| OURSE OUT       | COME       | S (COs)    | •           |            |            |            |            |            |         |      |      |     |     |
| CO1             | Unders     | tand the   | various qu  | ality too  | ols and te | echnique   | es (Level  | 12)        |         |      |      |     |     |
| CO2             | Demon      | strate the | customer    | · satisfac | tion tech  | nniques    | (Level 3   | )          |         |      |      |     |     |
| CO3             | Expose     | d to qual  | ity auditin | ig systen  | ns and p   | orocedui   | es (Leve   | el 2)      |         |      |      |     |     |
| CO4             | Implem     | ent TQM    | I and TP    | M (Leve    | 14)        |            |            |            |         |      |      |     |     |
| CO5             | Implem     | ent Kaiz   | en and co   | nduct FN   | MEA. (L    | evel 3)    |            |            |         |      |      |     |     |
| Mapping of C    | ourse C    | Outcome    | s with Pro  | ogram (    | Outcome    | es (POs)   |            |            |         |      |      |     |     |
| Cos/Pos         | <b>PO1</b> | PO2        | PO3         | PO4        | PO5        | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | PO9     | PO10 | PO11 | P   | 012 |
| CO1             | 3          | 1          | 2           | 2          | 2          | 2          | 2          | 3          | 3       | 3    | 2    |     | 2   |
| CO2             | 3          | 1          | 2           | 2          | 2          | 2          | 2          | 3          | 3       | 3    | 3    |     | 3   |
| CO3             | 3          | 1          | 2           | 2          | 2          | 2          | 3          | 3          | 3       | 3    | 2    |     | 3   |
| CO4             | 3          | 1          | 2           | 2          | 2          | 2          | 3          | 3          | 3       | 3    | 3    | 1   | 2   |
| CO5             | 3          | 2          | 2           | 2          | 2          | 2          | 3          | 3          | 3       | 3    | 3    |     | 3   |
| Cos / PSOs      | PS         | 501        | PSO         | 02         | PS         | 03         | PS         | <b>SO4</b> |         |      |      |     |     |
| CO1             |            | 3          | 3           |            | 4          | 2          |            | 3          |         |      |      |     |     |
| CO2             |            | 3          | 3           |            | 4          | 2          |            | 3          |         |      |      |     |     |
| CO3             |            | 3          | 3           |            | 2          | 2          |            | 3          |         |      |      |     |     |
| CO4             |            | 3          | 3           |            | 2          | 2          |            | 3          |         |      |      |     |     |
| CO5             |            | 3          | 3           |            | 4          | 2          |            | 3          |         |      |      |     |     |
| 3/2/1 indicates | Strengt    | h of Cor   | relation    | 3- High    | , 2- Me    | dium, 1    | -Low       | 1 1        |         |      |      |     |     |
|                 |            |            | ee          |            |            |            |            |            |         |      |      |     |     |
|                 |            |            | ien         |            |            |            |            |            |         |      |      |     |     |
|                 |            |            | l Sc        |            |            |            |            |            |         |      |      |     |     |
|                 |            | nce        | ocia        |            | /e         |            | >          |            |         |      |      |     |     |
|                 |            | cieı       | d sc        |            | ctiv       |            | nary       | lent       | ject    |      |      |     |     |
|                 | ence       | S<br>ad    | an          | ore        | ı ele      | ive        | ilqi       | Iodi       | Pro     |      |      |     |     |
| ry              | Scie       | erin       | ities       | υC         | ram        | lect       | Disc       | Join       | cal /   |      |      |     |     |
| ego             | sic        | inee       | nani        | gran       | rog        | пE         | er I       | U U        | actic   |      |      |     |     |
| Cat             | Ba         | gung       | Iun         | Prog       | Ч          | Ope        | Int        | Sk         | Pre     |      |      |     |     |
|                 |            |            |             |            | ✓          | Ĭ          |            |            |         | 1    |      | 1   |     |
|                 |            |            |             |            |            |            |            |            |         |      |      |     |     |
|                 |            |            |             |            |            |            |            |            |         |      |      |     |     |
|                 |            |            |             |            |            |            |            |            |         |      |      |     |     |



| Subject Code: | Subject Name : TOTAL QUALITY MANAGEMENT       | Ty/L | L | Τ/  | P/R | С |
|---------------|---|------|---|-----|-----|---|
|               |   | b/ET |   | SLr |     |   |
| EBME22E24     |   | L    |   |     |     |   |
|               | Prerequisite: Manufacturing Technology I & II | Ту   | 3 | 0/0 | 0/0 | 3 |

### **UNIT-I: INTRODUCTION**

Definition of Quality, Dimensions, Planning of quality, conformance to specification, Quality costs-. Basic concepts and evolution of Total Quality Management, Principles of TQM, Deming Philosophy Deming prize MBNQA. Barriers to TQM Implementation.

### **UNIT- II: TQM PRINCIPLES**

Customer satisfaction-Customer Perception of Quality, Customer Complaints. Service Quality, Customer Retention. Employee Involvement- Motivation, Empowerment, Teams. Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement-Juran Triology, PDSA Cycle,58,Kaizen.Supplier Partnership- Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures-Basic Concepts. Strategy, Performance Measure.

### UNIT- III: STATISTICAL QUALITY CONTROL

The Seven Tools Of Quality, Statistical Fundamentals, Control Charts For Variables And Attributes, Process Capability, Concept Of Six Sigma, Phases And Defective UNIT-s Of Six Sigma .Overview Of GB,BB,MBB Leadership Characteristics ,Leadership Concept , Role Of Senior Management, Lean Management Principle, Strategic Planning New Seven Management Tools.

### **UNIT- IV: TQM TOOLS**

Benchmarking-Reasons to Benchmark, Benchmarking Process. Quality Function Deployment (QFD), pareto, process flow diagram, check sheets and histogram Taguchi Quality Loss Function. Total Productive Maintenance (TPM)-Concept, Improvement Needs, FMEA-Stages of FMEA.

### **UNIT- V: QUALITY SYSTEMS**

Need For ISO 09000 and Other Quality Systems, ISO 09000 – 2000 Quality System -Elements. Implementation Of Quality System, Documentation, Quality Auditing, Quality Council, Quality statements, Quality Management System TS 1609409, ISO 14000 Concept, Requirements And Benefits. Introduction To Capability Material Management (CMM), People Capability Management (PCM).

### **Total No. of Periods : 45**

### **TEXT BOOK**

1) Dale H Besterfied, "Total Quality Management", Prentice Hall Publishing House

### REFERENCES

- 1) S.Ramachandran, Dn.S.Jose, "Total Quality Management", Airwalk Publications, First Edition, December.
- 2) Kulneet Suri, (2004 05) "Total Quality Management: Priciples & Practce, Tools & Techniques", S.K. Kateria & sons, First Edition,
- *3)* James R.Evans & William M.Lidsay, "The Management and Control of Quality", (<sup>5th</sup> Edition), South Western(Thomson Learning),2002(ISBN 0-324-06680-5).
- 4) Feigenbaum.A.V. "Total Quality Management", Tata Mcgraw-Hill, 109091.
- 5) Oakland.J.S. "Total Quality Management", Butterworth-Heinemann Ltd., Oxford, 109809
- 6) R.S.Nagarajan, A.A.Arivalagar, "Total Quality Management", New Age International (p) Ltd., Publishers, First Edition.

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| Subject    | Code:               | Subjec     | t Name   | : FAC         | LITIES        | S PLAN     | NING            | AND        |            | Ty/Lb         | L          | Τ/          | P/R     | С    |
|------------|---------------------|------------|--|---------------|---------------|------------|-----------------|------------|------------|---------------|------------|-------------|---------|------|
|            |                     |            |  | DESI          | GN            |            |                 |            |            | /ETL          |            | SLr         |         |      |
| EBME2      | 2E25                | Prere      | quisite:   | Manufac       | cturing       | Technol    | logy-I&         | : II       |            |               |            |             |         |      |
|            |                     |            |  |               |               |            |                 |            |            | Ту            | 3          | 0/0         | 0/0     | 3    |
| L : Lectu  | ure T : T           | utorial    | SLr : S  | upervised     | l Learnir     | ng P:P     | roject R        | : Resea    | rch C: C   | redits        |            |             |         |      |
| T/L/ETL    | : Theor             | ry/Lab./l  | Embedd   | ed Theory     | and La        | b.         |                 |            |            |               |            |             |         |      |
| OBJEC      | TIVES:              | The stu    | ident wi   | ll learn To   | o explain     | n project  | manag           | ement fo   | or entrep  | reneurs       |            |             |         |      |
| COURSE     | E OUTC              | COMES      | (COs) :  | The stud      | lent will     | be able    | e to            |            |            |               |            |             |         |      |
| CO1        | Underst<br>handling | and the n  | eed for F  | Facilities re | quireme       | nt planniı | ng, selec       | tion of op | otimum lo  | ocation for t | he plant/j | olant layou | t/mate  | rial |
| CO2        | Illustrat           | e plant la | yout & n   | naterial ha   | ndling sy     | stem (Le   | vel 3)          |            |            |               |            |             |         |      |
| CO3        | Compar              | e the pro  | s and cor  | ns of altern  | ate locati    | ons for t  | he plant,       | plant lay  | outs & m   | aterial hand  | dling syst | ems (Leve   | (4)     |      |
| CO4        | Critical            | y examin   | ne/explor  | e the optio   | ns for pla    | ant locati | on, layo        | ut & mate  | erial hand | ling system   | (Level 5   | )           |         |      |
| CO5        | Judge w             | hich opti  | ion is bet   | ter compar    | red to the    | rest for:  | Plant lo        | cation, Pl | ant layou  | t & materia   | l handling | g system (I | Level 4 | 4)   |
| Map        | ping of             | Course     | Irse Outcomes (COs) with Program Outcomes (POs) & Program Specific Outcomes (PSO |               |               |            |                 |            |            |               |            |             | PSOs    | )    |
| COs/P      | Os                  | <b>PO1</b> | PO2  | PO3           | PO4           | PO5        | PO6             | <b>PO7</b> | <b>PO8</b> | PO9           | PO10       | PO11        | P       | 012  |
| CO1        |                     | 2          | 2  | 2             | 2             | 3          | 2               | 2          | 2          | 1             | 2          | 2           |         | 1    |
| CO2        |                     | 1          | 2  | 2             | 1             | 3          | 1               | 1          | -          | -             | 3          | 1           |         | 1    |
| CO3        |                     | 3          | 1  | 3             | 2             | 2          | 1               | 1          | 1          | 1             | 3          | 1           |         | 1    |
| CO4        |                     | 3          | 3  | 2             | 1             | 2          | 1               | 1          | -          | 1             | 2          | 1           |         | 1    |
| CO5        | DCO.                | 3          | 2  |               | $\frac{2}{2}$ | 3          | $\frac{1}{0^2}$ |            |            | 1             | 2          | 2           |         | 1    |
|            | r50s                | г <b>э</b> | 3  |               | 52            | rs         | 1               | r.         | 1          |               |            |             |         |      |
| C01        |                     |            | 3  | 2             |               |            | 1               |            | 1          |               |            |             |         |      |
| CO2<br>CO3 |                     |            | 3  | 2             |               |            | 1               |            | 1          |               |            |             |         |      |
| CO4        |                     |            | 3  | 2             |               |            | 1               |            | 1          |               |            |             |         |      |
| CO5        |                     | 3          | ì  | 2             |               |            | 1               |            | 1          |               |            |             |         |      |
|            |                     |            | 3/2/1 in   | dicates S     | trength       | of Corr    | elation         | 3- Hig     | gh, 2- Mo  | edium, 1-I    | Low        |             |         |      |
|            |                     |            |  |               |               |            |                 |            |            |               |            |             |         |      |
|            |                     |            |  |               |               |            |                 |            |            |               |            |             |         |      |
|            |                     |            | ce   | cial          |               | e          |                 |            |            |               |            |             |         |      |
|            |                     |            | cien   | l soc         |               | ctiv       |                 | lary       | ent        | ect           |            |             |         |      |
|            | ory                 | nce        | Š  | anc           | ore           | ele        | ve              | plir       | uod        | Proj          |            |             |         |      |
|            | liteg               | Scie       | guing  | ties          | CC            | ram        | lecti           | lisci      | om         | al //         |            |             |         |      |
| Č          | C.                  | sic 5      | inee   | nani<br>nce   | gran          | rogı       | n El            | er D       | III C      | Ictic         |            |             |         |      |
|            |                     | Ba         | Eng  | Hun<br>Scie   | Prog          | Р          | Dpe             | Int        | Ski        | Pra           |            |             |         |      |
|            |                     |            |  |               |               | ✓          |                 |            |            |               |            |             |         |      |
|            |                     |            |  |               |               |            |                 |            |            |               |            |             |         |      |
|            |                     |            |  |               |               |            |                 |            |            |               |            |             |         |      |

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**Subject Code:** 

**EBME22E25** 

**UNIT I:** 

**UNIT II:** 

study - types of layout

# REFERENCES

- 1. Tompkins, J.A. and J.A. White, (2003) "Facilities planning", John Wiley
- 2. Richard Francis.L. and John A.White, (2002) "Facilities Layout and location an analytical approach", PHI
- 3. James Apple.M,(1977) "Plant layout and Material Handling", John Wiley
- 4. Pannerselvam, R, (2007) "Production and Operations Management", PHI

Group technology – Production Flow analysis (PFA), ROC (Rank Order Clustering) – Line balancing, single, multi and mixed mode, parallel line and parallel station

### Plant location analysis – factors, costs, location decisions – single facility location models, multi facility location models- set covering problem - warehouse location problems

**INTRODUCTION** 

PLANT LOCATION

DESIGN

### **UNIT III:** LAYOUT DESIGN

Design cycle – SLP procedure, nadler's ideal approach, flow and activity analysis, computerized layout planning procedure - ALDEP, CORELAP, CRAFT

Facilities planning, significance, objectives, requirement, process, product and schedule design, need for layout

### **UNIT IV: GROUP TECHNOLOGY AND LINE BALANCING**

Subject Name : FACILITIES PLANNING AND

Prerequisite: Manufacturing Technology-I& II

10

UNIT V: MATERIAL HANDLING 10 Principles, unit load concept, material handling system design, handling equipment types, selection and specification, handling cost, containers and packaging

# Total No. of Periods: 45

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| Subject Code<br>EBME22E26           | : Su                | bject Na               | ame : QU                         | ALITY                  | ENGIN                                | IEERIN                 | IG                    | Ty/Lb                  | /ETL               | L            | T/<br>SLr   | P/R      | С       |
|-------------------------------------|---------------------|------------------------|----------------------------------|------------------------|--------------------------------------|------------------------|-----------------------|------------------------|--------------------|--------------|-------------|----------|---------|
|                                     | Pr                  | erequisi               | te: Nil                          |                        |                                      |                        |                       | T                      | y                  | 3            | 0/0         | 0/0      | 3       |
| L : Lecture T : T                   | utorial             | SLr : Sup              | pervised Le                      | earning I              | P : Projec                           | t R : Re               | search C              | : Credits              |                    |              |             |          |         |
| T/L/ETL : Theo                      | ry/Lab./            | Embeddeo               | d Theory a                       | nd Lab.                |                                      |                        |                       |                        |                    |              |             |          |         |
| <b>OBJECTIVE</b> : systems; also fo | The stu<br>cusedthe | dent will<br>theory a  | learn: Band applicat             | usic conc<br>ions of S | eptual ic<br>CM Netv                 | lea of So<br>works wit | upply Cl<br>th simple | hain Mar<br>e case stu | nagemen<br>dy      | t systems a  | nd its inte | rnal str | uctural |
|                                     |                     |                        |                                  | CO                     | URSE O                               | UTCOM                  | IES (CO               | <b>)</b> s):           |                    |              |             |          |         |
| CO1                                 | Re                  | call/Expl              | ain basic Ç                      | uality co              | oncepts, f                           | oundatio               | n for this            | s course (             | Level 2)           | )            |             |          |         |
| CO2                                 | I11                 | ustrate Co             | ontrol Char                      | ts for Va              | riables/A                            | ttributes              | for real              | life scena             | rios (Le           | vel 3)       |             |          |         |
| CO3                                 | Ех                  | amine Pr               | ocess Capa                       | bility (L              | evel 4)                              |                        |                       |                        |                    |              |             |          |         |
| CO2                                 | Co                  | ompare Sa              | mple Insp                        | ection sy              | stems (Le                            | evel 4)                |                       |                        |                    |              |             |          |         |
| CO3                                 | Re                  | call/Expl              | ain TQM c                        | concepts,              | TQM too                              | ols (Leve              | 12)                   |                        |                    |              |             |          |         |
| Mapping of Co                       | urse Ou             | tcomes (               | COs) with                        | Program                | n Outcor                             | mes (PO                | s) & Pro              | ogram Sp               | ecific O           | outcomes (PS | SOs)        |          |         |
| COs/POs                             | PO1                 | PO2                    | PO3                              | PO4                    | PO5                                  | PO6                    | PO7                   | PO8                    | PO9                | PO10         | PO11        | PO       | 12      |
| CO1                                 | 1                   | -                      | -                                | -                      | 1                                    | -                      | -                     | -                      | 1                  | 1            | -           |          | 1       |
| CO2                                 | 1                   | 1                      | -                                | 1                      | 1                                    | 1                      | -                     | -                      | 1                  | 1            | -           |          | 1       |
| CO3                                 | 1                   | 1                      | -                                | 1                      | 1                                    | 1                      | -                     | -                      | 1                  | 1            | -           |          | 1       |
| CO2                                 | 1                   | 1                      | -                                | 1                      | 1                                    | 1                      | -                     | 2                      | 2                  | 2            | 3           |          | 1       |
| CO3                                 | 1                   | -                      | 2                                | 1                      | 2                                    | 2                      | 2                     | 2                      | 3                  | 2            | 2           |          | 2       |
| COs / PSOs                          | P                   | 501                    | PSO                              | 52                     | PS                                   | 03                     | P                     | SO4                    |                    |              |             |          |         |
| CO1                                 |                     | 3                      | 2                                |                        |                                      | 2                      |                       | -                      |                    |              |             |          |         |
| CO2                                 |                     | 3                      | 2                                | ,                      |                                      | 2                      |                       | 1                      |                    |              |             |          |         |
| CO3                                 |                     | 3                      | 2                                |                        |                                      | 2                      |                       | 1                      |                    |              |             |          |         |
| CO2                                 |                     | 3                      | 2                                |                        |                                      | 2                      |                       | 1                      |                    |              |             |          |         |
| CO3                                 |                     | 3                      | 2                                | 1<br>4                 |                                      | 2                      |                       | 2                      |                    |              |             |          |         |
|                                     | -                   | 3/2/1 i                | ndicates                         | Strengt                | h of Cor                             | relation               | n <b>3- H</b> i       | igh, 2- N              | Iedium             | 1, 1-Low     |             |          |         |
| Category                            | Basic Science       | Engineering<br>Science | Humanities and social<br>Science | Program Core           | <ul> <li>Program elective</li> </ul> | Open Elective          | Inter Disciplinary    | Skill Component        | Practical /Project |              |             |          |         |
|                                     |                     |                        |                                  |                        |                                      |                        |                       |                        |                    |              |             |          |         |

### (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India. **Subject Code: T**/ P/R Subject Name : OUALITY ENGINEERING Tv/Lb/ L С ETL SLr **EBME22E26 Prerequisite: Nil** Τv 3 0/0 0/0

### UNIT I: **QUALITY CONCEPTS**

EDUCAT

Quality, History of Quality, Quality Control, Quality Assurance, Quality Costs, Optimum Quality, Opportunity Loss, Taguchi's Quality loss function

### **CONTROL CHARTS FOR VARIABLES & PROCESS CAPABILITY** UNIT II: 10

Statistical Process Control (SPC), Control Charts for Variables, Action & Warning Limits in Control Charts, Process Capability, Process Capability Indices, Process Capability Studies, Problems in Control Charts for Variables

### UNIT III: **OTHER CONTROL CHARTS**

Control Charts for Attributes, Special Control Charts – Group Control Chart, Moving Averages/Moving Range Control Charts, Difference Control Charts, Mid-Range and Median Control Charts & Cumulative Sum Control Charts

### UNIT IV: SAMPLING ISPECTION

Economics of Sampling, Sampling Methods, Sampling Plans, OC Curves, Quality Indices, Standard tables used in Sampling Inspection - Dodge-Romig & ABC Standard

### UNIT V: TOTAL QUALITY MANAGEMENT (TQM)

Main Concepts of TOM, Quality Dimensions, TOM concepts in depth - KAIZEN, POKA YOKE, Six Sigma, 5S & Kano's Model, TQM Tools - Benchmarking, QFD & FMEA

### **Total No. of Periods: 45**

### **REFERENCES:**

- 1. Douglas C. Montgomery, (2007) "Introduction to Statistical Quality Control", John Wiley & Sons
- 2. Grant E.L. and Leavenworth R.S., (2000), "Statistical Quality Control", TMH
- 3. Dale H. Besterfield, (2002) "Total Quality Management", Pearson Education Asia



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| Subject Code:   | Su                 | bject Na            | ame: IND                      | USTRY        | <b>4.0</b>                             |               |                    |                 | Ty/Lb/             | L    | T/<br>SI n | P/R | С   |
|-----------------|--------------------|---------------------|-------------------------------|--------------|--|---------------|--------------------|-----------------|--------------------|------|------------|-----|-----|
| FRME??E?7       | Pre                | requisite           | e: Manufa                     | cturing      | Techno                                 | ology I &     | ¢П                 |                 |                    | 3    | 0/0        | 0/0 | 3   |
|                 | Tutorial           |                     | . Cum a mula                  | a d T a a m  | ing D.                                 | Ducient       | D . D              | anah C          | Credite            | 3    | 0/0        | 0/0 | 5   |
| T/L/ETL : The   | orv/Lab            | Embedo              | led Theor                     | v and La     | ing P:<br>b                            | Project       | K : Kest           |                 | Creans             |      |            |     |     |
| OBIECTIVE       | $\mathbf{S}$ The s | tudent v            | vill learn                    | )            |  |               |                    |                 |                    |      |            |     |     |
| Objective       | <b>b</b> . The s   | student v           | viii learn                    |              |  |               |                    |                 |                    |      |            |     |     |
| OURSE OUT       | COME               | S (COs)             | :                             |              |  |               |                    |                 |                    |      |            |     |     |
| CO1             | Descri             | be Indus            | stry 4.0 an                   | d scope :    | for India                              | an Indus      | try                |                 |                    |      |            |     |     |
| CO2             | Demor              | nstrate c           | onceptual                     | framewo      | ork and i                              | road ma       | p of Indu          | ustry 4.0       | )                  |      |            |     |     |
| CO3             | Descri             | be Robo             | tic techno                    | logy and     | l Augme                                | ented rea     | lity for I         | Industry        | 4.0                |      |            |     |     |
| CO4             | Demor              | nstrate o           | bstacle an                    | d framev     | work cor                               | nditions      | for Indu           | stry 4.0        |                    |      |            |     |     |
| CO5             | Unders             | stand the           | e role of au                  | gmente       | d reality                              | in the a      | ge of Inc          | lustry 4        | .0                 |      |            |     |     |
| Mapping of C    | Course O           | outcome             | s with Pro                    | ogram C      | )utcome                                | es (POs)      |                    |                 |                    |      |            |     |     |
| Cos/Pos         | PO1                | PO2                 | PO3                           | PO4          | PO5                                    | PO6           | <b>PO7</b>         | PO8             | PO9                | PO10 | PO11       | P   | 012 |
| CO1             | 1                  |                     | 1                             |              |  | 2             | 2                  | 2               | 2                  | 2    | 2          | 2   |     |
| CO2             | 1                  |                     | 1                             |              |  | 2             | 2                  | 2               | 2                  | 2    | 2          | 2   |     |
| CO3             | 2                  | 2                   | 2                             | 2            | 2                                      | 2             | 2                  | 2               | 2                  | 2    | 2          | 2   |     |
| CO4             | 1                  | 2                   | 2                             | 1            | 2                                      | 1             | 1                  | 1               |                    | 1    | 2          | 2   |     |
| CO5             | 1                  | 1                   | 1                             | 1            | 1                                      | 1             | 1                  | 1               | 1                  | 1    | 1          | 1   |     |
| Cos / PSOs      | PS                 | 501                 | PSC                           | 02           | PS                                     | 03            | PS                 | 504             |                    |      |            |     |     |
| CO1             |                    |                     |                               |              | 2                                      |               | 1                  |                 |                    |      |            |     |     |
| CO2             |                    |                     |                               |              | 2                                      |               | 1                  |                 |                    |      |            |     |     |
| CO3             |                    |                     |                               |              | 2                                      |               | 1                  |                 |                    |      |            |     |     |
| CO4             |                    |                     |                               |              | 2                                      |               | 1                  |                 |                    |      |            |     |     |
| CO5             |                    |                     |                               |              | 2                                      |               | 1                  |                 |                    |      |            |     |     |
| 3/2/1 indicates | Strengt            | h of Cor            | relation                      | 3- High      | , 2- Me                                | dium, 1       | -Low               |                 |                    |      |            |     |     |
|                 |                    |                     |                               |              |  |               |                    |                 |                    |      |            |     |     |
| Category        | Basic Science      | Engineering Science | Humanities and social Science | Program Core | <ul> <li>▲ Program elective</li> </ul> | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |      |            |     |     |
|                 |                    |                     |                               |              |  |               |                    |                 |                    |      |            |     |     |



| Subject Code: | Subject Name: INDUSTRY 4.0                     | Ty/Lb/ | L | <b>T</b> / | P/R | С |
|---------------|--|--------|---|------------|-----|---|
|               |  | ETL    |   | SLr        |     |   |
| EBME22E27     | Pre requisite: Manufacturing Technology I & II | Ту     | 3 | 0/0        | 0/0 | 3 |

### **Unit-1: Introduction to Industry 4.0**

Introduction, core idea of Industry 4.0, origin concept of industry 4.0, Industry 4.0 production system, current state of industry 4.0, Technologies, How is India preparing for Industry 4.0

### **Unit-2: A Conceptual Framework for Industry 4.0**

Introduction, Main Concepts and Components of Industry 4.0, State of Art, Supportive Technologies, Proposed Framework for Industry 4.0.

### **Unit-3: Technology Roadmap for Industry 4.0**

Introduction, Proposed Framework for Technology Roadmap, Strategy Phase, Strategy Phase, New Product and Process Development Phase.

### **Unit-4:** Advances in Robotics in the Era of Industry 4.0

Introduction, Recent Technological Components of Robots- Advanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly.

### Unit-5: The Role of Augmented Reality in the Age of Industry 4.0

Introduction, AR Hardware and Software Technology, Industrial Applications of AR: Obstacles and Framework Conditions for Industry 4.0-Lack of A Digital Strategy alongside Resource Scarcity, Lack of standards and poor data security, Financing conditions, availability of skilled workers, comprehensive broadband infra- structure, state support, legal framework, protection of corporate data, liability, handling personal data.

### Total No. of Periods : 45

### Reference Books:

1. Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing the Digital Transformation".

- 2. Bartodziej, Christoph Jan, "The Concept Industry 4.0".
- 3. Klaus Schwab, "The Fourth Industrial Revolution".
- 4. Christian Schröder, "The Challenges of Industry 4.0 for Small and Medium-sized Enterprises".

List of Open Source Software/learning website: 1. www.nptel.ac.in/

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| Subject Code:     | S   | bubject N   | ame: SU                       | PPLY C       | CHAIN ]            | MANA          | GEMEN              | T               | T                  | y/Lb/<br>FTI | L         | T/<br>SI r | P/R    | C     |
|-------------------|---|---|-------------------------------|--------------|--------------------|---------------|--------------------|-----------------|--------------------|--------------|-----------|------------|--------|-------|
| <b>EBME22E28</b>  | Pre   | requisite   | : Manufa                      | cturing      | Techno             | logy I &      | & II               |                 |                    | Tv           | 2         | 0/0        | 0/0    | 2     |
| L. L. acture T 7  | Tutorio   | 1 51  | Cumomia                       | adlaam       | ina D.             | Draiaat       | D . Dag            | anah C          |                    | I y          | 3         | 0/0        | 0/0    | 3     |
| T/L/ETL : Theo    | ory/Lab   | Embedd  | led Theor                     | y and La     | b.                 | Floject       | K. Kest            |                 | . Cr               | euns         |           |            |        |       |
| OBJECTIVES        | : The   | student   | will learn                    | Basic        | Concep             | tual ide      | ea of si           | upplv d         | chai               | n mana       | agement   | system:    | Theor  | v and |
| application SCI   | M netw  | vorks wit   | th simple                     | casestuc     | ły                 |               |                    | 11 5            |                    |              | 0         | <b>,</b>   |        | 5     |
| OURSE OUTO        | COME  | S (COs)   | :                             |              |                    |               |                    |                 |                    |              |           |            |        |       |
| CO1               | Ur  | nderstand   | l the vario                   | us conce     | epts of su         | upply ch      | nain man           | agemer          | nt. (l             | Level 2      | )         |            |        |       |
| CO2               | Ar  | nalyze an   | d decide t                    | he prope     | er logisti         | cs. (Lev      | vel 4)             |                 |                    |              |           |            |        |       |
| CO3               | De  | evelop pr   | oper netw                     | ork to lo    | ocate sou          | irce and      | distribu           | tion cer        | nters              | at a op      | timal pri | cing. (Le  | vel 4) |       |
| CO4               | Co  | ordinate  | the suppl                     | y chain 1    | manager            | nent net      | work. (I           | Level 3)        | )                  |              |           |            |        |       |
| CO5               | Us  | e inform  | ation tech                    | nology i     | n supply           | v chain r     | nanagen            | nent. (L        | eve!               | 13)          |           |            |        |       |
|                   |   | Ma  | pping of                      | Course       | Outcom             | es with       | Progra             | m Outo          | com                | es (POs      | 5)        | -          |        |       |
| Cos/Pos           | <b>PO1</b>  | PO2   | PO3                           | PO4          | PO5                | PO6           | PO7                | PO8             |                    | PO9          | PO10      | PO11       | P      | 012   |
| CO1               | $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ |   |                               |              |                    |               |                    | -               |                    | 2            | 2         | 1          |        | 2     |
| CO2               | 3   | 3     3     3     1     3     2     2       3     3     3     1     3     2     2 |                               |              |                    |               |                    |                 |                    | 3            | 3         | 3          |        | 2     |
| CO3               | 3   | 3     3     3     1     3     2     2       3     2     2     -     2     2     2 |                               |              |                    |               |                    |                 |                    | 3            | 3         | 3          |        | 2     |
| CO4               | 3   |   |                               |              |                    |               |                    | 3               |                    | 3            | 3         | 2          |        | 2     |
| CO5               | 3   | $\begin{array}{c ccccccccccccccccccccccccccccccccccc$                             |                               |              |                    |               |                    | 2               |                    | 3            | 3         | 2          |        | 2     |
| Cos / PSOs        | PS  | 501   | PSC                           | )2           | PS                 | 03            | PS                 | <b>SO4</b>      |                    |              |           |            |        |       |
| CO1               |   | 3   | 3                             |              | 1                  | 1             |                    | 2               |                    |              |           |            |        |       |
| CO2               |   | 3   | 3                             |              |                    | 3             |                    | 3               |                    |              |           |            |        |       |
| CO3               |   | 3   | 3                             |              |                    | 3             |                    | 3               |                    |              |           |            |        |       |
| CO4               |   | 3   | 3                             |              |                    | 3             |                    | 3               |                    |              |           |            |        |       |
| CO5               |   | 3   | 3                             |              |                    | 3             |                    | 3               |                    |              |           |            |        |       |
| 3/2/1 indicates S | Strengt   | h of Cor  | relation                      | 3- High      | 1, 2- Me           | dium, 1       | -Low               | 1               | T                  |              | I         |            |        |       |
| Category          | Basic Science   | Engineering Science   | Humanities and social Science | Program Core | ≮ Program elective | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |              |           |            |        |       |

### **Subject Code:** Subject Name : SUPPLY CHAIN MANAGEMENT **T**/ P/R С Ty/Lb/ L ETL SLr **EBME22E28** Prerequisite: Manufacturing Technology I & II Тy 3 0/0 0/0 3

### UNIT- I: **INTRODUCTION**

Definition of logistics and SCM: evolution, scope, importance& decision phases = drivers of SC performance and obstacles.

### UNIT- II: LOGISTICS MANAGEMENT

Factors – Modes of Transportation - Design options for Transportation Networks-Routing and Scheduling – Inbound and outbound logistics- Reverse Logistics - 3PL- Integrated Logistics Concepts- Integrated Logistics Model - Activities - Measuring logistics cost and performance - Warehouse Management - Case Analysis

### UNIT- III: SUPPLY CHAIN NETWORK DESIGN

Distribution in Supply Chain - Factors in Distribution network design -Design options-Network Design in Supply Chain – Framework for network Decisions - Managing cycle inventory and safety.

### UNIT- IV: SOURCING AND PRICING IN SUPPLY CHAIN

Supplier selection and Contracts - Design collaboration - Procurement process. Revenue management in supply chain

### UNIT- V: COORDINATION AND TECHNOLOGY IN SUPPLY CHAIN

Supply chain coordination - Bullwhip effect - Effect of lack of co-ordination and obstacles - IT and SCM supply chain IT frame work. E Business & SCM. Metrics for SC performance – Case Analysis

### Total No. of Periods: 45

### REFERENCES

- 1. Sunil Chopra and Peter Meindl, (2007) "Supply Chain Management, Strategy, Planning, and operation",  $(2^{nd} ed.)$ , PHI
- 2. David J.Bloomberg, Stephen Lemay and Joe B.Hanna, (2002), "Logistics", PHI
- 3. Martin Christopher, "Logistics and Supply Chain Management –Strategies for Reducing Cost and Improving Service", (2<sup>nd</sup> ed.), Pearson Education Asia
- 4. Jeremy F.Shapiro, Thomson Duxbury, (2002) "Modeling the supply chain"
- 5. James B.Ayers, (2000) "Handbook of Supply chain management", St.Lucle Press





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|--------------|---------|--------|--------------|---------------|------------|--------|
| Periyar E.V. | R. High | Road,  | Maduravoyal, | Chennai-95.   | Tamilnadu, | India. |

| Subject Code<br>FBME22E29 | : Su<br>TE  | bject<br>ECHNO   | Name<br>LOGY                                  | : ]                             | BLOCK   | . (                               | CHAIN                            | Ty/Lb                             | /ETL                  | L          | T/<br>SLr | P/R     | С    |  |  |  |  |
|---------------------------|---|--|---|---------------------------------|---|-----------------------------------|----------------------------------|-----------------------------------|-----------------------|------------|-----------|---------|------|--|--|--|--|
|                           | Pr  | erequisi   | te: Nil                                       |                                 |   |                                   |                                  | Ту                                | 7                     | 3          | 0/0       | 0/0     | 3    |  |  |  |  |
| L : Lecture T : T         | Futorial  | SLr : Sup  | pervised Le                                   | earning H                       | P: Projec                                     | t R : Res                         | search C                         | : Credits                         |                       |            |           |         | _1   |  |  |  |  |
| T/L/ETL : Theo            | ory/Lab./H  | Embeddeo   | d Theory a                                    | nd Lab.                         |   |                                   |                                  |                                   |                       |            |           |         |      |  |  |  |  |
| OBJECTIVE:                | The stud<br>Ur<br>wi<br>De<br>Int   | lent will l<br>nderstand<br>th them,<br>esign, bu<br>tegrate io              | earn:<br>d how blo<br>ild, and d<br>deas from | ockchain<br>eploy sn<br>blockch | systems<br>hart cont<br>ain tech              | s (mainl<br>tracts an<br>nology i | y Bitco<br>d distrib<br>nto thei | in and E<br>outed app<br>r own pr | othereum<br>olicatior | n) work, T | Го secure | ly inte | ract |  |  |  |  |
|                           | Unders  | Understand the design principles of Bitcoin, Ethereum and Nakamoto consensus |   |                                 |   |                                   |                                  |                                   |                       |            |           |         |      |  |  |  |  |
|                           | Evoluo  |  | ty prives                                     | u and of                        | ficiona                                       | $\frac{1}{1000}$                  | von blog                         | block chain system.               |                       |            |           |         |      |  |  |  |  |
|                           | Evalua  | the Securi   | ry, privac                                    | y, and en                       | Vorificat                                     | tion prot                         |                                  | K CHAIII S                        | system.               |            |           |         |      |  |  |  |  |
|                           | Interne   | $\frac{1}{t}$ with a   | block cho                                     | in exetor                       | n by son                                      | ding on                           | d roadin                         | a transa                          | tions                 |            |           |         |      |  |  |  |  |
| C02                       | Design  | ract with a block chain system by sending and reading transactions.          |   |                                 |   |                                   |                                  |                                   |                       |            |           |         |      |  |  |  |  |
| CO3                       | urse Outcomes (COs) with Program Outcomes (POs) & Program Specific Outcon |  |   |                                 |   |                                   |                                  |                                   | -4 (D(                |            |           |         |      |  |  |  |  |
| COs/POs                   | PO1   | PO2  | PO3   | Program<br>PO4                  | PO5   | nes (POs                          | s) & Pro<br>PO7                  | gram Spo<br>PO8                   |                       | PO10       | PO11      | PO      | 12   |  |  |  |  |
| C01                       |   | 2  | 1   | 1                               | 100   | 1                                 | 10/                              | 100                               | 202                   | 2          | 3         | 2       |      |  |  |  |  |
|                           | 1   | 1  | •   | -                               |   | 1                                 |                                  |                                   | 4                     |            | 5         |         |      |  |  |  |  |
| CO2                       | 1   | 1  | 2   | 2                               | 3   | 1                                 |                                  |                                   | 1                     | 2          | 2         | 1       |      |  |  |  |  |
| CO3                       |   |  |   | 2                               | 2   |                                   |                                  |                                   |                       | 2          | 2         | 2       |      |  |  |  |  |
| CO2                       |   |  |   | 2                               | 2   |                                   |                                  |                                   |                       | 2          | 2         | 2       |      |  |  |  |  |
| CO3                       |   |  |   | 2                               | 2   |                                   |                                  |                                   |                       | 2          | 2         | 2       |      |  |  |  |  |
| COs / PSOs                | PSO1  | 1  | PSO2  |                                 | PSO3  |                                   | PSO4                             | •                                 |                       |            |           |         |      |  |  |  |  |
| CO1                       |   |  |   |                                 | 2   |                                   |                                  |                                   |                       |            |           |         |      |  |  |  |  |
| CO2                       |   |  |   |                                 | 2   |                                   |                                  |                                   |                       |            |           |         |      |  |  |  |  |
| CO3                       |   |  |   |                                 | 2   |                                   |                                  |                                   |                       |            |           |         |      |  |  |  |  |
| CO2                       |   |  |   |                                 | 2   |                                   |                                  |                                   |                       |            |           |         |      |  |  |  |  |
| CO3                       |   |  |   |                                 | 2   |                                   |                                  |                                   |                       |            |           |         |      |  |  |  |  |
| 3/2/1 indicates           | Strengt   | h of Co  | rrelation                                     | 3- Hig                          | h, 2- Me                                      | edium, 1                          | -Low                             |                                   |                       |            | 1         |         |      |  |  |  |  |
| ategory                   | Basic Science   | Engineerin<br>g Science  | Humanities and<br>social Science              | Program<br>Core                 | <ul> <li>Program</li> <li>elective</li> </ul> | Open Elective                     | Inter<br>Disciplinary            | Skill Component                   | Practical /Project    |            |           |         |      |  |  |  |  |
| C                         |   |  |   |                                 |   |                                   |                                  |                                   |                       |            |           |         |      |  |  |  |  |

| Subject Code:<br>FBME22E29 | Subject Na<br>TECHNOLOG | me :<br>SY | BLOCK | CHAIN | Ty/Lb/ETL | L | T/<br>SLr | P/R | С |
|----------------------------|-------------------------|------------|-------|-------|-----------|---|-----------|-----|---|
|                            | Prerequisite: N         | il         |       |       | Ту        | 3 | 0/0       | 0/0 | 3 |

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### Unit I: Basics

Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. • Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

### Unit II: Blockchain

Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public block chain.

### **Unit III: Distributed Consensus**

EDUCAT

Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

### **Unit IV: Crypto currency**

History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin

### **Unit V: Crypto currency Regulation**

Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Block chain.

Tutorial & Practical: Naive Block chain construction, Memory Hard algorithm - Hash cash implementation, Direct Acyclic Graph, Play with Go-ethereum, Smart Contract Construction, Toy application using Block chain, Mining puzzles

### Total No. of Periods : 45

### **Text Book**

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

### Reference Books

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies

- 2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
- 3. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger," Yellow paper. 2014.

4. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

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# OPEN ELECTIVE SUBJECTS

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| Subject Code:  |  | Subject   | Name: 1     | NDUST     | RIAL I     | ENGIN     | EERING    | Ĵ          | Ty/Lb      | L          | T/         | P/R        | С   |
|--|--|-----------|-------------|-----------|------------|-----------|-----------|------------|------------|------------|------------|------------|-----|
|  |  |           |             |           |            |           |           |            | /ETL       |            | SLr        |            |     |
| EBME22OE1  | Pre  | requisite | e: NIL      |           |            |           |           |            | Ту         | 3          | 0/0        | 0/0        | 3   |
| L : Lecture T :  | Tutoria                                    | l S Lr    | : Supervis  | ed Lear   | ning P:    | Project   | R : Res   | earch C:   | Credits    | 11         |            |            |     |
| T/L/ETL : The  | ETL : Theory/Lab/Embedded Theory and Lab   |           |             |           |            |           |           |            |            |            |            |            |     |
| OBJECTIVE  | <b>3JECTIVES</b> : The student will learn: |           |             |           |            |           |           |            |            |            |            |            |     |
| Various Techniques of work measurement; Details of plant layout and material handling devices; Basic concepts of ERP |  |           |             |           |            |           |           |            |            |            |            |            |     |
| OURSE OUT  | URSE OUTCOMES (COs) :                      |           |             |           |            |           |           |            |            |            |            |            |     |
| CO1  | Expose                                     | to variou | s concept   | s of Indu | ıstrial en | igineerir | ng. (Leve | el 2)      |            |            |            |            |     |
| CO2  | Select a                                   | nd Desig  | n the appi  | opriate   | plant lay  | out and   | associat  | ed mater   | ial handl  | ing syster | ns. (Leve  | l 4)       |     |
| CO3  | Analyze                                    | the wor   | k place an  | d design  | n suitable | e enviro  | nment to  | o provide  | comfort    | to the wo  | ork. (Leve | l 4)       |     |
| CO4  | Understa                                   | and the v | various fac | tors inv  | olved in   | fixing v  | vages an  | d incenti  | ives. (Lev | vel 2)     |            |            |     |
| CO5  | Plan the                                   | various   | resources   | of an en  | terprise.  | (Level    | 3)        |            |            |            |            |            |     |
| Mapping of C   | ourse C                                    | Outcome   | s with Pro  | ogram (   | Outcome    | es (POs)  | )         | 1          | -1         | 1          |            |            |     |
| Cos/Pos  | <b>PO1</b>                                 | PO2       | PO3         | PO4       | PO5        | PO6       | PO7       | PO8        | PO9        | PO10       | <b>PO1</b> | . <b>P</b> | 012 |
| CO1  | 3  | 1         | 2           | -         | 1          | 3         | 1         | 3          | 3          | 3          | 3          |            | 2   |
| CO2  | 3  | 3         | 3           | 2         | 3          | 3         | 2         | 2          | 3          | 3          | 3          |            | 2   |
| CO3  | 3  | 3         | 3           | 2         | 3          | 3         | 2         | 2          | 3          | 3          | 3          |            | 2   |
| CO4  | 3  | 2         | 2           | -         | 2          | 3         | 1         | 2          | 3          | 3          | 3          |            | 2   |
| CO5  | 3  | 3         | 3           | 2         | 3          | 3         | 2         | 2          | 3          | 3          | 3          |            | 2   |
| Cos / PSOs   | PS   | 501       | PSC         | 02        | PS         | 03        | PS        | 504        |            |            |            |            |     |
| CO1  | í  | 3         | 3           |           |            | 1         |           | 2          |            |            |            |            |     |
| CO2  | í  | 3         | 3           |           | ź          | 2         |           | 3          |            |            |            |            |     |
| CO3  |  | 3         | 3           |           | 2          | 2         |           | 3          |            |            |            |            |     |
| CO4  | ,  | 3         | 3           |           |            | 1         |           | 2          |            |            |            |            |     |
| CO5  | ,  | 3         | 3           |           | ,          | 2         |           | 2          |            |            |            |            |     |
| 3/2/1 indicates  | Strengt                                    | h of Cor  | relation    | 3- High   | n, 2- Me   | dium, 1   | -Low      |            |            |            | L          |            |     |
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| 5001   | ce   | Sci       | nu          | e         | lect       | e         | lina      | one        | roje       |            |            |            |     |
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Subject Name : INDUSTRIAL ENGINEERING **T**/ Ty/Lb/  $\mathbf{L}$ ETL SLr

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| LINIT- I-WORI | K STUDY & WORK | MEASUREMENT |  |
|---------------|----------------|-------------|--|

**Prerequisite: NIL** 

Work study - Techniques - Productivity, Improving productivity by reducing work content- Human factors in work study. Method study - Basic procedure - Recording techniques - Micro-motion study, Threbligs, SIMO chart, Principles of motion economy.

Work Measurement – Techniques – Time study – Allowances – Work sampling – PMTS – MTM.

### **UNIT- II:SITE SELECTION, PLANT LAYOUT & MATERIAL HANDLING**

Site Selection: Importance of plant location - choice of site for location - State regulations on location -Industrial Estates. Plant layout: Types of factory buildings, OBJECTIVES of good plant layout, Principles, Techniques used, Types, Flow pattern, Line Balance, computerized plant layout. Material Handling: Functions, OBJECTIVES, principles, Devices used, Relation between plant layout and material handling.

### **UNIT-III:ERGONOMICS**

Subject Code:

**EBME22OE1** 

Techniques – Analysis – Equipment Design – Fatigue – Motivation theory of Fatigue – Fatigue tests-Duties of a human factor Engineer - Human effectiveness improvement through ergonomics.

### **UNIT- IV:WAGES & INCENTIVES**

Wages: Wage & salary policies, systems of wage payments, Principles of wage administration, National Wage Policy, Fair wage committee report, Need based minimum wage Incentives: Need, Incentive plans, Comparison of various Incentive plans, Administration of wage incentives.

### **UNIT- V:ENTERPRISE RESOURCE PLANNING (ERP)**

Need for optimal use of Resources, MRP I & II, Supply chain Management, Evolution of ERP, BPR, Lean Manufacturing, Popular ERP Packages, Implementation of ERP, Benefits of ERP.

### **TEXT BOOKS**

- 1) O.P. Khanna, (2005) "Industrial Engineering and Management", Khanna Publishers.
- 2) K.KAhuja, "Industrial Management", Khanna Publishers.
- 3) Martand Telsang, "Industrial Engineering and Production Management".

### REFERENCES

- 1) M.Mahajan, "Industrial Engineering and Production Management", Dhanpat Rai &CO.,
- 2) B. Kumar, (2005) "Industrial Engineering", Khanna Publishers.
- 3) International Labour Organization (ILO), (2004) "Introduction to Work study", Universal Publishing Corporation.
- 4) H. B. Maynard, "Industrial Engineering, Handbook", McGraw Hill Book Company, International Edition.
- 5) Marvin E. Mandel, "Time & Motion study", Prentice Hall, Private Limited, International Edition.
- 6) James M Apple, "Principles of Layout & Materials Handling", Ronalds Press, International Edition.
- 7) V. K. Garg & N.K. Venkatakrishnan, (2004) "Enterprise Resource Planning, Concepts & Practice", Prentice Hall of India Private Limited.

### Total No. of Periods : 45



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| Subject Cod   | e: Su   | Subject Name : REFRIGERATION AND AIR |                |          |           |           |   |                 | Ty / Lb/     | L        | Τ /         | <b>P</b> / | C      |
|---|---|--------------------------------------|----------------|----------|-----------|-----------|---|-----------------|--------------|----------|-------------|------------|--------|
| BME220E2  |   | CONDITIONING                         |                |          |           |           |   | ETL             |              | S.Lr     | R           |            |        |
| DIVIE220E2  | Pr  | erequis                              | ite: Nil       |          |           |           |   |                 | Ту           | 3        | 0/0         | 0/0        | 3      |
| L : Lecture T   | : Tutor   | ial SL                               | r : Super      | vised L  | earning   | g P : Pro | oject R                                     | : Resear        | ch C: Cre    | edits    |             |            |        |
| T/L/ETL : Theory/Lab/Embedded Theory and Lab  |   |                                      |                |          |           |           |   |                 |              |          |             |            |        |
| <b>OBJECTIVES:</b> Students will learn  |   |                                      |                |          |           |           |   |                 |              |          |             |            |        |
| • The working principle of refrigerators and air conditioning systems.              |   |                                      |                |          |           |           |   |                 |              |          |             |            |        |
| Differ  | Different cycles used in refrigeration.   |                                      |                |          |           |           |   |                 |              |          |             |            |        |
| Alternate retrigerants to reduce global warming .     COURSE OUTCOMES (COs) : (3-5) |   |                                      |                |          |           |           |   |                 |              |          |             |            |        |
| COURSE O  | Gain the basic knowledge of various refrigeration cycles and refrigerants (Level 2) |                                      |                |          |           |           |   |                 |              |          |             |            |        |
| CO2   | Analyze   | the var                              | ious refrig    | veration | cvcles u  | sing the  | rmodvn                                      | amic cor        | cepts(Le     | (vel 4)  |             |            |        |
| CO3   | Underst   | and the                              | design and     | d workir | ng princi | ples of   | various                                     | compone         | ents of refr | igeratio | n and air-  | onditi     | ioning |
|   | systems   | .(Level 2                            | 2)             |          | 01        | 1         |   | 1               |              | 0        |             |            | 0      |
| CO4   | Apply t   | he psych                             | rometry k      | nowled   | ge to cal | culate t  | he cooli                                    | ng and h        | eating load  | d(Leve   | 13)         |            |        |
| CO5   | Underst   | and the                              | fundamen       | tal conc | epts of c | ryogeni   | c engine                                    | eering an       | d low-tem    | perature | e of proper | ties of    | f      |
| Monning of  | materia   | ls.(Level                            | 2)<br>mog with | Drogr    | am Au     | taamas    | $(\mathbf{D} \mathbf{\Omega}_{\mathbf{g}})$ |                 |              |          |             |            |        |
| $CO_{S}/PO_{S}$   | PO1   | PO2                                  | PO3            | PO4      |           | PO6       | $(\mathbf{I} \mathbf{O} \mathbf{S})$        | PO8             | POQ          | PO10     | PO11        | PO         | 12     |
| 003/103   | 101   | 102                                  | 105            | 104      | 105       | 100       | 107   | 100             | 10)          | 1010     | 1011        | 10         | 12     |
| <u>CO1</u>  | 3   | 2                                    | 2              | 2        | 1         | 3         | 3   | 3               | 2            | 2        | -           |            | 3      |
| <u>CO2</u>  | 2   | 3                                    | 3              | 3        | 2         | 2         | 2   | 2               | 2            | 3        | -           | _          | 2      |
| CO3   | 3   | 2                                    | 2              | 2        | 1         | 2         | 2   | 2               | 2            | 2        | -           |            | 3      |
| C04   | 2   | 2                                    | 2              | 2        | 1         | 2         | 2   | 2               | 2            | 3        | -           | _          | 2      |
| $CO_{S} / PSO_{S}$  | <u> </u>  | 3                                    | 3              | 5        | <u> </u>  | 2         | 2   | 2               | 1            | 3        | - 3         |            | 2      |
| C01   | PS  | <u>-</u><br>01                       | PS(            | 2        | PS        | <u></u>   | P   | <u>2</u><br>504 | 1            | 5        | 5           |            | 5      |
| $CO^2$  | 15  | 3                                    | 3              | 52       | 3 3       |           |   | 3               |              |          |             | _          |        |
| CO3   |   | 3                                    | 3              |          |           | 3         |   | 3               |              |          |             |            |        |
| CO4   |   | 3                                    | 2              |          | ,         | 2         |   | 2               |              |          |             |            |        |
| CO5   |   | 3                                    | 3              |          |           | 3         |   | 3               |              |          |             |            |        |
| 3/2/1 indicates   | Strengt   | h of Co                              | rrelation      | 3- Hig   | h, 2- Me  | edium, 1  | l-Low                                       |                 |              |          |             |            |        |
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|   | Scie  | ring                                 | ties           | CC       | am        | ecti      | isci  | mo              | al           |          |             |            |        |
| ory   | ic S  | nee<br>nce                           | nce            | ran      | lgoï      | Π         | r D   | II C            | ctic         |          |             |            |        |
| egc   | Bas   | ungi<br>ciei                         | lum<br>ciei    | rog      | P         | Iper      | Inte  | Ski             | Pra          |          |             |            |        |
| Cat   |   | щα                                   |                |          |           | v<br>✓    |   |                 |              |          |             |            |        |
| -   |   |                                      |                |          |           |           |   |                 |              |          |             |            |        |

# n ISO 21001 : 2018 Certified Institution Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code:<br>BME22OE2 | Subject Name : REFRIGERATION AND AIR<br>CONDITIONING | Ty / Lb/<br>ETL | L | T /<br>S.Lr | P/<br>R | С |
|---------------------------|--|-----------------|---|-------------|---------|---|
|                           | Prerequisite: Nil                                    | Ту              | 3 | 0/0         | 0/0     | 3 |

### **UNIT- I: REFRIGERATION CYCLES AND REFRIGERANTS**

EDUCA

Vapour Compression Réfrigération Cycle-Simple Saturated Vapour Compression Refrigeration Cycle. Thermodynamic Analysis of the above. Refrigerant Classification, Designation, Alternate Refrigerants, Global Warming Potential & Ozone Depleting Potential Aspects.

### **UNIT- II: SYSTEM COMPONENTS**

Refrigerant Compressors - Reciprocating Open & Hermetic Type, Screw Compressors and Scroll Compressors -Construction and Operation Characteristics. Evaporators - DX Coil, Flooded Type Chillers Expansion Devices -Automatic Expansion Valves, Capillary Tube & Thermostatic Expansion Valves. Condensing UNIT-s and Cooling Towers.

### UNIT- III: CYCLING CONTROLS AND SYSTEM BALANCING

Pressure and Temperature Controls. Range and Differential Settings. Selection and Balancing of System Components-Graphical Method.

### **UNIT-IV: PSYCHROMETRY & AIR CONDITIONING**

Moist Air Behavior, Psychrometric Chart, Different Psychrometric Process Analysis. Summer and Winter Airconditioning, Cooling Load Calculations, Air Distribution Patterns, Dynamic and Frictional Losses in Air Ducts, Equal Friction Method, Fan Characteristics in Duct Systems.

### **UNIT- V: INTRODUCTION TO CRYOGENIC ENGINEERING**

Introduction to cryogenic engineering-applications of cryogenics in various fields-low temperature properties of materials- mechanical, thermal, electrical and magnetic properties- properties of cryogenic fluids-cryogenic fluid storage and transfer systems- cryogenic insulation.

# Total No. of Periods:: 45

### **TEXT BOOKS**

1) W.F.Stocker and J.W.Jones, (2009) "Refrigeration & Air Conditioning", McGraw Hill Book. Company.

2) Randall F.Barron, (1985) "Cryogenic systems", Oxford University press.

### REFERENCES

1) R.J.Dossat, (2005) "Principles of Refrigeration", John Wiley and Sons Inc., 6th edition.

2) Manohar Prasad, (2009) "Refrigeration and Air Conditioning", Wiley Eastern Ltd.



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|   |   | 1 * A N                   | Periyar E.  | V.R. High R | load, Madu                | iravoyal, C | hennai-95 | 5. Tamilnad | lu, India.  | T I         | TT /   | D/    | C   |
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| Subject Cod   | le: St  | Subject Name : AUTOMOBILE |             |             |                           |             |           |             |             | L           | T /    | P/    | C   |
|   |   |                           | ENGIN       | EERIN       | G                         |             |           |             | ETL         |             | S.Lr   | K     |     |
| BME22OE3  | _   |                           |             |             |                           |             |           |             |             |             | 0.10   | 0.10  |     |
|   | Pr  | erequis                   | ite: Nil    |             |                           |             |           |             | Ту          | 3           | 0/0    | 0/0   | 3   |
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| L: Lecture I  | L: Lecture I: Tutorial SLr: Supervised Learning P: Project R: Research C: Credits |                           |             |             |                           |             |           |             |             |             |        |       |     |
| 1/L/EIL: Ineory/Lab/Embedded Ineory and Lab   |   |                           |             |             |                           |             |           |             |             |             |        |       |     |
|   |   |                           |             |             |                           |             |           |             |             |             |        |       |     |
| OBJECTIV  | E: The  | student                   | will learr  | 1           |                           |             |           |             |             |             |        |       |     |
| • Various automobile parts, power transmission from engine to various parts of the automobile, engine |   |                           |             |             |                           |             |           |             |             |             |        | ngine |     |
| cooling, lubrication and also about various pollutants and its control.                               |   |                           |             |             |                           |             |           |             |             |             |        |       |     |
|   |   |                           |             |             |                           |             |           |             |             |             |        |       |     |
| COURSE O  | UTCO  | MES (C                    | COs): (3    | <b>-</b> 5) |                           |             |           |             |             |             |        |       |     |
| CO1   | Ga  | ain the kı                | nowledge    | of vehic    | ele struct                | ures.(Le    | evel 2)   |             |             |             |        |       |     |
| CO2   | Aj  | pply the                  | skill of au | xiliary s   | ystems i                  | n IC eng    | gines.(L  | evel 3)     |             |             |        |       |     |
| CO3   | De  | emonstra                  | te the pov  | ver trans   | mission                   | s system    | ns.(Leve  | 13)         |             |             |        |       |     |
| CO4   | Aj  | pply the                  | knowledg    | e of stee   | ring, bra                 | akes, sus   | spension  | and ligh    | ting syste  | ms.(Lev     | /el 3) |       |     |
| <u>CO5</u>  | U   | nderstand                 | the conc    | ept of t    | he fuel c                 | ells and    | hybrid    | vehicles.   | (Level 2)   |             |        |       |     |
| Mapping of  | Course  | Outco                     | mes with    | Progra      | am Ou                     | tcomes      | (Pos)     |             | <b>D</b> 00 | <b>DO10</b> |        | 4 1   | 201 |
| Cos/Pos   | POI   | PO2                       | PO3         | PO4         | PO5                       | PO6         | PO7       | PO8         | PO9         | POI0        | POI    | 1 H   | 2   |
| CO1   | 3   | 2                         | 1           | 1           | -                         | 1           | 1         | 1           | 1           | 1           | -      | 1     |     |
| CO2   | 3   | 2                         | 2           | 2           | -                         | 1           | 2         | 1           | 1           | 2           | -      | 2     |     |
| CO3   | 2   | 2                         | 1           | 1           | -                         | 1           | 1         | 1           | 1           | 1           | -      | 1     |     |
| CO4   | 2   | 2                         | 2           | 2           | -                         | 1           | 1         | 1           | 1           | 2           | -      | 1     |     |
| CO5   | 2   | 1                         | 1           | 1           | -                         | 2           | 2         | 1           | 1           | 1           | -      | 2     |     |
| Cos / PSOs  |   | PSO1                      | F           | PSO2        | ]                         | PSO3        |           | PSO4        |             |             |        |       |     |
| CO1   |   | 3                         | 2           | ·           |                           | 2           |           | 2           |             |             |        |       |     |
| CO2   |   | 3                         | 2           |             |                           | 2           |           | 2           |             |             |        |       |     |
| CO3   |   | 3                         | 2           |             |                           | 2           |           | 2           |             |             |        |       |     |
| CO4   |   | 3                         | 2           | r.          |                           | 2           |           | 2           |             |             |        |       |     |
| CO5   |   | 3                         | 2           | r           |                           | 1           |           | 3           |             |             |        |       |     |
| 3/2/1 indicates   | Streng  | th of Co                  | rrelation   | 3- Hig      | h, 2- Me                  | edium, 1    | l-Low     |             |             |             |        |       |     |
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|   | nce   | 50                        | an          | ore         | ele                       | ive         | ipli      | lod         | Pro         |             |        |       |     |
|   | Scie  | ring                      | ties        | Ŭ           | am                        | ecti        | isc       | om          | al          |             |        |       |     |
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| jor   |   |                           |             |             |                           | -           |           |             |             |             |        |       |     |
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| C   |   |                           |             |             |                           |             |           |             |             |             |        |       |     |
|   |   |                           |             |             |                           |             |           |             |             |             |        |       |     |

### Subject Name : AUTOMOBILEGINEERING **Subject Code:** Ty / Lb/ L Т P/ С 1 S.Lr R ETL **EBME22OE3 Prerequisite: Nil** Ty 3 0/0 0/0 3

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### **UNIT- I: VEHICLE STRUCTURE AND ENGINES**

Vehicle Chassis -types- layout- vehicle specifications- power and torque requirements- choice of engine for different applications. Engine types and construction -- Cylinder- cylinder head-Crank case-Piston- connecting rod - crank shaft-valves-liners-manifolds.

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### **UNIT- II: ENGINE AUXILIARY SYSTEMS AND POLLUTION CONTROL** 9

Fuel supply system to SI and CI engines-Electronic. Lubrication system-cooling system-ignition system-. Pollution from engines and their control- Exhaust gas recirculation - Catalytic converters,

### **UNIT- III: TRANSMISSION SYSTEMS**

DUCATIO

Clutches -single& multi plate Gear boxes-manual- sliding mesh- constant mesh- automatic transmission. Universal joints-propeller shaft Differential.

### **UNIT- IV: STEERING AND SUSPENSION SYSTEMS**

Principle of steering-steering geometry -steering linkages-steering gear boxes- power steering. Wheel and tyre construction-type and specification-tyre wear- Suspension system-need and types- shock absorbers-air suspension.

### **UNIT- V: BRAKE SYSTEMS**

Auto Electrical Components,. Brake -need -types-mechanical- hydraulic- pneumatic-power brake-Principles of modern electrical systems-battery-dynamo- starting motor- lighting- automobile air conditioning. Electric hybrid vehicle and fuel cells.

### Total No. of Periods:: 45

### TEXT BOOKS

- 1) K.K.Ramalingam, (2007) "Automobile Engineering", SciTech Publications.
- 2) Kirpal Singh, (2012) "Automobile Engineering Vol-I&II".
- 3) R.B.Gupta, (2013) "Automobile Engineering", Satya Prakashan Publishing.

### REFERENCES

- 1) Joseph Heitner, "Automotive Mechanics", Affiliated East West Press Ltd.
- 2) "Newton and Steeds, Motor Vehicles", ELBS –13 EDITION.
- 3) William Crouse, (2007) "Automotive Mechanics", Tata McGraw Hill.

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|  |  |   | Periyar E.V | (An 150<br>.R. High Ro | oad, Madu | ravoyal, C   | hennai-95 | . Tamilna | du, India.   |          |           |            |    |
|--|--|---|-------------|------------------------|-----------|--------------|-----------|-----------|--------------|----------|-----------|------------|----|
| Subject Code   | e: Su  | bject N   | ame : IN    | DUST                   | RIAL I    | ROBO         | TICS      |           | Ty / Lb/     | L        | Τ /       | <b>P</b> / | С  |
| FRME??OF   | 1  |   |             |                        |           |              |           |           | ETL          |          | S.Lr      | R          |    |
|  | - Pr   | erequis   | ite: Nil    |                        |           |              |           |           | Ту           | 3        | 0/0       | 0/0        | 3  |
| L : Lecture T  | : Tutor                                      | Itorial SLr : Supervised Learning P : Project R : Research C: Credits |             |                        |           |              |           |           |              |          |           |            | _1 |
| T/L/ETL : Th   | /ETL : Theory/Lab/Embedded Theory and Lab    |   |             |                        |           |              |           |           |              |          |           |            |    |
| OBJECTIVE  | <b>TIVE: OBJECTIVES:</b> Students will learn |   |             |                        |           |              |           |           |              |          |           |            |    |
| • Basic  | compoi                                       | nents of  | an indus    | trial rob              | oot and   | Sensor       | s used i  | n robot   | S            |          |           |            |    |
| <ul> <li>Robot programming methods and Robot applications</li> </ul> |  |   |             |                        |           |              |           |           |              |          |           |            |    |
| COURSE O   | DURSE OUTCOMES (COs) : ( 3- 5)               |   |             |                        |           |              |           |           |              |          |           |            |    |
| CO1  | Unders                                       | stand the   | basic cor   | ncepts of              | f a robot | (Level       | 2)        |           |              |          |           |            |    |
| CO2  | Identif                                      | y and ap  | ply the di  | fferent c              | compone   | ents and     | operatio  | n with 1  | respect to r | obot (Le | evel 3)   |            |    |
| CO3  | Recog  | nize the  | various ty  | pes of se              | ensors a  | nd mach      | nine visi | on conc   | epts and its | applica  | tions (Le | vel 3)     |    |
| CO4  | Write p                                      | program   | me for rol  | oot (Lev               | el 4)     |              |           |           |              |          |           |            |    |
| CO5  | Design                                       | the rob   | ot cell and | l state its            | s applica | ations (L    | Level 4)  |           |              |          |           |            |    |
| Mapping of   | Course                                       | Outco   | mes with    | Progra                 | am Out    | tcomes       | (Pos)     |           |              |          |           |            |    |
| Cos/Pos  | PO1  | PO2   | PO3         | PO4                    | PO5       | PO6          | PO7       | PO8       | PO9          | PO10     | PO11      | PO         | 12 |
| CO1  | 3  | 3   | 2           | 2                      | 3         | 3            | 2         | 2         | 3            | 3        | 3         |            | 2  |
| CO2  | 3  | 3   | 3           | 3                      | 3         | 3            | 2         | 2         | 3            | 3        | 3         |            | 2  |
| CO3  | 3  | 3   | 2           | 2                      | 3         | 3            | 2         | 2         | 3            | 3        | 3         |            | 2  |
| CO4  | 3  | 3   | 3           | 3                      | 3         | 3            | 2         | 2         | 3            | 3        | 3         |            | 2  |
| CO5  | 3  | 3   | 3           | 3                      | 3         | 3            | 2         | 2         | 3            | 3        | 3         |            | 2  |
| Cos / PSOs   | PS   | 01  | PSO         | 02                     | PS        | 03           | P         | SO<br>4   |              |          |           |            |    |
| CO1  | -  | 3   | 3           |                        |           | 2            |           | 3         |              |          |           |            |    |
| CO2  |  | 3   | 3           |                        |           | 2            |           | 3         |              |          |           |            |    |
| CO3  |  | 3   | 3           |                        |           | 2            |           | 3         |              |          |           |            |    |
| CO4  |  | 3   | 3           |                        |           | 2            |           | 3         |              |          |           |            |    |
| CO5  |  | 3   | 3           |                        |           | 2            |           | 3         |              |          |           |            |    |
| 3/2/1 indicates  | Strengt                                      | h of Co   | rrelation   | 3- Hig                 | h, 2- Me  | edium, 1     | 1-Low     |           |              |          |           |            |    |
|  |  |   | nce         |                        |           |              |           |           |              |          |           |            |    |
|  |  |   | cie         |                        |           |              |           |           |              |          |           |            |    |
|  |  |   | al S        |                        |           |              |           |           |              |          |           |            |    |
|  |  | nce   | ocia        |                        | ve        |              | y         | t         | ÷            |          |           |            |    |
| <b>x</b>   | Ð  | cie   | d s         |                        | ecti      |              | nar       | nen       | ojec         |          |           |            |    |
| <b>g</b> 01  | enc  | 60  | s an        | ore                    | ı ele     | ive          | ilqi      | Iodi      | Prc          |          |           |            |    |
| ate  | Scie   | irin  | ties        | Ŭ                      | ran       | lect         | Disc      | Jon       | ial /        |          |           |            |    |
| Ű  | sic  | nee   | lani        | ran                    | rog       | υE           | er L      | II C      | ctic         |          |           |            |    |
|  | Ba   | igngi   | Iun         | Prog                   | Ч         | Dpe          | Int       | Ski       | Pra          |          |           |            |    |
|  |  |   |             |                        |           | $\checkmark$ |           |           |              |          |           | +          |    |
|  |  |   |             |                        |           |              |           |           |              |          |           |            |    |
|  |  |   |             |                        |           |              |           |           |              |          |           |            |    |
|  |  |   |             |                        |           |              |           |           |              |          |           |            |    |
#### **Subject Code:** Subject Name : INDUSTRIAL Ty / Lb/ L Т 1 P/ С **EBME22OE4 ROBOTICS** S.Lr R ETL **Prerequisite:** Nil 3 0/0 3 Tv 0/0

Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

# **UNIT- I: INTRODUCTION**

Definition of a Robot – Basic Concepts – Robot components –manipulator-configurations – joints- degree of freedom. Types of Robot Drives – Basic Robot Motion types – Point to Point Control – Continuous Path Control.

# UNIT- II: COMPONENTS AND OPERATIONS

Basic Control System Concepts – open loop and closed loop control-Control System Analysis – Robot Actuation and Feed Back, Manipulators – Direct and Inverse Kinematics, Co- ordinate Transformation – Brief Robot Dynamics, Types of Robot and Effectors – Grippers – Tools as End Effectors – Robot / End Effort Interface.

# UNIT- III: SENSING AND MACHINE VISION

Range Sensing – Proximity Sensing – Touch sensing – Force and Torque Sensing. Introduction to Machine Vision – functions and applications.

# UNIT- IV:ROBOT PROGRAMMING

Methods – Languages –programming for pick and place applications-palletizing. Capabilities and Limitation – Artificial Intelligence – Knowledge Representation – Search Techniques – AI and Robotics.

# UNIT- V:ROBOT CELL DESIGN AND APPLICATIONS

Robot cell design-types and control. Applications of Robots –process Applications in welding and painting – Assembly applications– Material Handling applications.

# TEXT BOOK

1) K. S. Fu, R. C. Gonalez, C.S.G. Lee, "Robotics Control Sensing Vision and Intelligence", McGraw Hill International Edition, 10987.

# REFERENCES

- 1) Mikell P. Groover, Mitchell Weiss, (2008) "Industrial Robotics, Technology, Programming and Application", Tata McGraw Hill International Editions, 10986.
- 2) Richard D. Klafter, Thomas A. Chonieleswski and Michael Negin, (1989) "Robotic Engineering An Integrated Approach", Prentice Hall Inc., Englewoods Cliffs, NJ, USA, 109809.



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| Subject Code:   | Subject Name : SUSTAINABLE ENERGY   |   |                           |                |  |           | Ty/<br>E       | Lb/<br>TL     | L              | T/<br>SLr | P/R                       | С    |     |    |  |  |
|-----------------|---|---|---------------------------|----------------|--|-----------|----------------|---------------|----------------|-----------|---------------------------|------|-----|----|--|--|
| EBME220E5       | Pre   | requisit  | e: NIL                    |                |  |           |                |               | Т              | y         | 3                         | 0/0  | 0/0 | 3  |  |  |
|                 |   |   |                           |                |  |           |                |               |                |           |                           |      |     |    |  |  |
| L : Lecture T : | Tutoria   | l S Lr  | : Supervis                | sed Lear       | ning P :   | Project   | R : Res        | earch C       | C: Cree        | lits      |                           |      | •   | •  |  |  |
| T/L/ETL : The   | ory/Lat   | /Embed  | ded Theor                 | ry and L       | ab   |           |                |               |                |           |                           |      |     |    |  |  |
| OBJECTIVE       | S: Stude  | ents will   | learn                     |                |  |           |                |               |                |           |                           |      |     |    |  |  |
| • The co        | oncept, p   | cept, principles and characteristics of different renewable energy systems. |                           |                |  |           |                |               |                |           |                           |      |     |    |  |  |
| • Energy        | conversion techniques         FCOMES (COs) : ( 3- 5)  |   |                           |                |  |           |                |               |                |           |                           |      |     |    |  |  |
| COURSE OU       | ICOMES (COs) : (3-5)         Understand the basic concepts of solar radiation and their utilizations(Level 2) |   |                           |                |  |           |                |               |                |           |                           |      |     |    |  |  |
| $CO^2$          |   | Apply the solar knowledge in various practical applications(Level 3)        |                           |                |  |           |                |               |                |           |                           |      |     |    |  |  |
| CO3             |   | rryout o  | ut constru                | ictions o      | f differe  | nt energ  | v conve        | rsion te      | chnia          |           | Tevel 2                   | )    |     |    |  |  |
| CO4             | Ev  | nlain th  | e principle               | es of ene      |  | version   | from ear       | th and        | ocean          |           | $\frac{1}{1}$ (Let ver 2) | )    |     |    |  |  |
| C04             |   | monstro   | to the wor                | $\frac{1}{12}$ | (15)   |           |                |               |                |           |                           |      |     |    |  |  |
| CO3             |   |   |                           |                |  |           |                |               | S(Le           | (el 3)    |                           |      |     |    |  |  |
| COs/POs         | PO1         PO2         PO3         PO4         PO5         PO6         PO7                                   |   |                           |                |  |           | 9<br>PO7       | PO8           | PC             | 9         | PO10                      | PO11 | PO  | 12 |  |  |
| CO1             | 3   | 2   | 105                       | 1              | 105  | 2         | 2              | 2             |                | 1         | 1                         | -    | 2   | 12 |  |  |
| CO2             | 3   | 2   | 2                         | 2              | 1  | 2         | 2              | 2             |                | 1         | 2                         | 2    | 2   |    |  |  |
| CO3             | 3   | 2   | 2                         | 1              | 1  | 1         | 1              | 2             |                | 1         | 1                         | 1    | 2   |    |  |  |
| CO4             | 3   | 2   | 2                         | 2              | 1  | 1         | 1              | 2             |                | 1         | 2                         | -    | 1   |    |  |  |
| CO5             | $\begin{array}{c ccccccccccccccccccccccccccccccccccc$   |   |                           | 1              | 1  | 1         | 1              |               | 1              | 1         | -                         | 1    |     |    |  |  |
| COs / PSOs      | PS  | 01  | PSO                       | D2             | PS   | 03        | PS             | 504           |                |           |                           |      |     |    |  |  |
| COI             |   | 3   | 2                         | r              |  | 2         |                | $\frac{1}{2}$ |                |           |                           |      |     |    |  |  |
| $CO_2$          |   | 3   | 2                         | r              | $\begin{array}{c c} 2 & 2 \\ \hline 1 & 2 \end{array}$ |           |                |               |                |           |                           |      |     |    |  |  |
| CO4             |   | 3   | 1                         |                |  | 1<br>1    |                | <u>2</u><br>1 |                |           |                           |      |     |    |  |  |
| CO5             |   | 3   | 1                         |                |  | 1         |                | 1             |                |           |                           |      |     |    |  |  |
| 3/2/1 indicates | Strengt   | h of Co   | rrelation                 | 3- Hig         | h, 2- Me   | edium,    | 1-Low          | 1             |                |           |                           |      |     |    |  |  |
|                 |   |   |                           |                |  | ,         |                |               |                |           |                           |      |     |    |  |  |
|                 | c Science   | eering Science  | mities and social Science | am Core        | ogram elective   | Elective  | . Disciplinary | Component     | tical /Project |           |                           |      |     |    |  |  |
| Category        | Basi  | Engin   | EmnH                      | banical        | JId  | uedO<br>✓ | Inter          | Skill         | Prac           |           |                           |      |     |    |  |  |

n ISO 21001 : 2018 Certified Institution Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

| Subject Code: | Subject Name : SUSTAINABLE ENERGY | Ty/Lb/ | L | Т/  | P/R | С |
|---------------|-----------------------------------|--------|---|-----|-----|---|
| EBME220E5     |                                   | ETL    |   | SLr |     |   |
|               | Prerequisite: NIL                 | Ту     | 3 | 0/0 | 0/0 | 3 |

#### **UNIT- I PRINCIPLES OF SOLAR RADIATION:**

EDUCAT

Role and Potential of new and renewable source, the solar energy option, Environmental impact of solar power, Solar constant, extra-terrestrial and terrestrial solar radiation, solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, solar radiation data.

#### **UNIT- II SOLAR ENERGY**

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

SOLAR ENERGY STORAGE: Different methods, sensible, latent heat and stratified storage, solar ponds. Solarapplications - solar heating/cooling techniques, solar distillation and drying, photovoltaic energy conversion.

#### **UNIT- III WIND ENERGY AND BIOMASS**

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics. BIOMASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-Gas digestors, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation, economic aspects.

#### UNIT- IV GEOTHERMAL, TIDAL AND WAVE ENERGY

GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing OTEC: Principles, utilization, setting of OTEC plants, thermodynamic cycles. TIDAL AND WAVE ENERGY: Potential and conversion techniques, mini hydel power plants, and their economics.

#### **UNIT- V:DIRECT ENERGY CONVERSION**

Need for DEC, Carnot cycle, limitations, principles of DEC. Thermo-electric generators, MHD Power generators, principles, working.

Fuel cells: principle, working -types - Selection of fuels and operating conditions.

#### Total No. of Periods : 45

#### **TEXT BOOKS**

- 5) G.D.Rai, (2004) "Non-Conventional Energy Sources" Khanna Publishers.
- 6) Ashok V Desai, (2003) "Non-Conventional Energy", Wiley Eastern.
- 7) K.M.Mittal, (2007) "Non-Conventional Energy Systems", Wheeler Publishing.
- 8) Ramesh & Kumar, (2007) "Renewable Energy Technologies", Narosa Publishing House.

#### REFERENCES

- 4) Twidell & Weir, (2006) "Energy Sources", Taylor & Francis
- 5) Sukhame, (2009) "Solar Energy".
- 6) B.S.Magal Frank Kreith, (2010) "Solar Power Engineering"



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| Subject Cod     | e: Su   | bject N   | ame : Co   | OMPO      | SITE N     | MATE      | RIALS      |  | Ty / Lb/    | L        | T /  | P/  | С  |  |  |
|-----------------|---|---|------------|-----------|------------|-----------|------------|--|-------------|----------|------|-----|----|--|--|
| ERME 220EA      | 5   |   |            |           |            |           |            |  | ETL         |          | S.Lr | K   |    |  |  |
|                 | , Pr  | erequis   | ite: Nil   |           |            |           |            |  | Ту          | 3        | 0/0  | 0/0 | 3  |  |  |
| L : Lecture T   | : Tutor   | ial SL  | r : Super  | vised L   | earning    | g P : Pro | oject R    | Resear                                       | rch C: Cro  | edits    |      |     | 4  |  |  |
| T/L/ETL : Th    | eory/La   | ab/Emb  | edded Th   | neory an  | id Lab     |           |            |  |             |          |      |     |    |  |  |
| OBJECTIVI       | ES: Stu   | dents w   | ill learn  |           |            |           |            |  |             |          |      |     |    |  |  |
| Differ          | ent con   | nposites  | s and thei | r manuf   | facturin   | g meth    | ods        |  |             |          |      |     |    |  |  |
| Desig           | n paran   | neters of   | f compos   | ites      |            |           |            |  |             |          |      |     |    |  |  |
| • To gai        | In knowledge in need and applications of composite materials<br>UTCOMES (COs) : ( 3- 5) The student will be able to |   |            |           |            |           |            |  |             |          |      |     |    |  |  |
| COURSE O        | UTCO  | MES (C  | COs): (3)  | 5- 5) Th  | e studer   | nt will b | e able to  | D  |             |          |      |     |    |  |  |
| CO1             | Unders  | stand the   | different  | compos    | ites and   | ring me   | thods (Lev | /el 2)                                       |             |          |      |     |    |  |  |
| CO2             | Know  | the mec   | hanics and | l perforr | nance of   | f compo   | site mat   | erials (L                                    | evel 3)     |          |      |     |    |  |  |
| CO3             | Unders  | stand the   | design pa  | arameter  | rs of con  | nposites  | (Level 2   | 2)   |             |          |      |     |    |  |  |
| CO4             | Analyz  | lyze and predict the failure in composites(Level 4) |            |           |            |           |            |  |             |          |      |     |    |  |  |
| CO5             | Design  | and Ma  | nufacture  | compos    | sites usin | ng simp   | le manuf   | facturing                                    | g technique | es (Leve | l 4) |     |    |  |  |
| Mapping of      | Course  | Outco   | mes with   | Progra    | am Out     | tcomes    | (Pos)      | 1  |             | 1        |      |     |    |  |  |
| Cos/Pos         | PO1   | PO2   | PO3        | PO4       | PO5        | PO6       | PO7        | PO8  | PO9         | PO10     | PO11 | PC  | 12 |  |  |
| CO1             | 3   | 1   | 2          | 2         | 2          | 2         | 2          | 3  | 3           | 3        | 2    |     | 2  |  |  |
| CO2             | 3   | 1   | 2          | 2         | 2          | 2         | 2          | 3  | 3           | 3        | 3    |     | 3  |  |  |
| CO3             | 3   | 1   | 2          | 2         | 2          | 2         | 3          | 3  | 3           | 3        | 2    |     | 3  |  |  |
| CO4             | 3   | 1   | 2          | 2         | 2          | 2         | 3          | 3  | 3           | 3        | 3    |     | 2  |  |  |
| CO5             | 3   | 2   | 2          | 2         | 2          | 2         | 3          | 3  | 3           | 3        | 3    |     | 3  |  |  |
| Cos / PSOs      |   | PSO1  | I          | PSO2      | ]          | PSO3      |            | PSO4   |             |          |      |     |    |  |  |
| CO1             | -   | 3   | 3          |           | -          | 2         |            | 3  |             |          |      |     |    |  |  |
| CO2             | -   | 3   | 3          |           | -          | 2         |            | 3  |             |          |      |     |    |  |  |
| CO3             |   | 3   | 3          |           |            | 2         |            | 3  |             |          |      |     |    |  |  |
| CO4             | -   | 3   | 3          |           | -          | 2         |            | 3  |             |          |      |     |    |  |  |
| CO5             | -   | 3   | 3          |           |            | 2         |            | 3  |             |          |      |     |    |  |  |
| 3/2/1 indicates | Strengt   | h of Co   | rrelation  | 3- Hig    | h, 2- Me   | edium, 1  | 1-Low      | <u>г                                    </u> |             | 1        |      |     |    |  |  |
|                 |   |   |            |           |            |           |            |  |             |          |      |     |    |  |  |
|                 |   |   | _          |           |            |           |            |  |             |          |      |     |    |  |  |
|                 |   |   | ocia       |           | /e         |           | >          |  |             |          |      |     |    |  |  |
|                 |   |   | d sc       |           | ctiv       |           | nar.       | ent  | ject        |          |      |     |    |  |  |
|                 | nce   | 50  | anc        | ore       | ele        | ve        | illq       | noq  | Pro         |          |      |     |    |  |  |
|                 | cie   | Buing   | ties       | CC        | am         | ecti      | isci       | om   | al /]       |          |      |     |    |  |  |
| ry              | ic S  | nee   | anit       | am.       | ogr        | E         | r D        | 1 C  | Stic        |          |      |     |    |  |  |
| oge             | Bas   | ngi   | um<br>zien | lgo.      | Pr         | pen       | Inte       | Skil   | Prac        |          |      |     |    |  |  |
| ate             | T   | ых  | НХ         | Ъ         |            | 0         |            |  | _           |          |      | +   |    |  |  |
|                 |   |   |            |           |            |           |            |  |             |          |      |     |    |  |  |



**Subject Code:** Subject Name : COMPOSITE MATERIALS Ty / Lb/ L Т P/ С S.Lr R ETL **EBME22OE6 Prerequisite:** Nil 3 Ty 0/0 0/0 3

#### **UNIT-I: INTRODUCTION**

Limitations of Conventional Materials- Definition of Composite Materials- Types and Characteristics Applications.

#### UNIT- II: MATERIALS

Fibers- Materials- Fiber Reinforced Plastics- Thermo set Polymers- Coupling Agents, Fillers and Additives-Metal Matrix and Ceramics Composites.

#### UNIT- III: MANUFACTURING

Fundamentals- bag moulding- compression moulding pultrusion- filament winding- other manufacturing process-quality inspection and non-destructive testing.

#### UNIT- IV: MECHANICS AND PERFORMANCE

Introduction to Micro-mechanics- Unidirectional Lamina-Laminates- Inter laminar Stress- Statics Mechanical Properties- Fatigue Properties- Impact Properties- Environmental Effects- Fracture Mechanics and Toughening mechanisms, Failure Modes

#### **UNIT- V: DESIGN**

Failure Predictions- Design Considerations- Joint Design- Codes- Design Examples. Optimization of Laminated Composites- Application of FEM for Design.

#### Total No. of Periods:: 45

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#### TEXT BOOKS

1) P.K.Mallick, (2006) "Fiber-Reinforced Composites", Monal Deklatr Inc., New York.

2) B.D.Agrawal and L.J.Broutmam, (2006) "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York.

#### REFERENCES

- 1) Micael hyer, (1998) "Stress Analysis of Fiber- Reinforced Composite Materials", TataMcGraw Hill.
- 2) *Ronald Gibson, (2007)* "Principles of Composite Material Mechanics", Tata McGraw Hill.



| Subject Code:                      | Su                  | bject Na             | ame: IND                      | DUSTRY               | ¥ <b>4.</b> 0    |                        |                     |                    | Ty/Lb/<br>ETL        | L          | T/<br>SLr  | P/R    | C        |  |  |  |
|------------------------------------|---------------------|----------------------|-------------------------------|----------------------|------------------|------------------------|---------------------|--------------------|----------------------|------------|------------|--------|----------|--|--|--|
| EBME22OE7                          | Pre r               | requisite            | e: NIL                        |                      |                  |                        |                     |                    | Ту                   | 3          | 0/0        | 0/0    | 3        |  |  |  |
| L : Lecture T :<br>T/L/ETL : Theo  | Tutorial<br>Dry/Lab | S Lr<br>Embedo       | : Supervis<br>led Theor       | ed Learn<br>y and La | ning P :<br>1b   | Project                | R : Rese            | earch C            | Credits              |            |            |        | <u> </u> |  |  |  |
| <b>OBJECTIVES</b> processes in the | S: The see 21st ce  | student<br>entury du | will learn<br>le to incre     | concept<br>asing in  | terconne         | rapid ch<br>ectivity a | ange to<br>and smar | technol<br>t autom | ogy, indus<br>ation. | tries, and | societal j | patter | ns and   |  |  |  |
| OURSE OUTO                         | COMES               | S (COs)              | •                             |                      |                  |                        |                     |                    |                      |            |            |        |          |  |  |  |
| CO1                                | Descri              | be Indus             | try 4.0 an                    | d scope              | for India        | an Indus               | try                 |                    |                      |            |            |        |          |  |  |  |
| CO2                                | Demor               | nstrate co           | onceptual                     | framewo              | ork and i        | road mag               | p of Indu           | ustry 4.0          | )                    |            |            |        |          |  |  |  |
| CO3                                | Descri              | be Robo              | tic techno                    | logy and             | l Augme          | ented rea              | lity for I          | Industry           | 4.0                  |            |            |        |          |  |  |  |
| CO4                                | Demor               | istrate o            | bstacle and                   | d framev             | work cor         | nditions               | for Indu            | istry 4.0          |                      |            |            |        |          |  |  |  |
| CO5                                | Unders              | stand the            | Role of A                     | Augment              | ed Reali         | ity Indus              | stry 4.0            |                    |                      |            |            |        |          |  |  |  |
| Mapping of Co                      | ourse O             | utcome               | s with Pro                    | ogram (              | Outcome          | es (POs)               |                     |                    |                      | -          | <u>.</u>   |        |          |  |  |  |
| Cos/Pos                            | <b>PO1</b>          | PO2                  | PO3                           | PO4                  | PO5              | <b>PO6</b>             | PO7                 | PO8                | PO9                  | PO10       | PO11       | P      | 012      |  |  |  |
| <b>CO1</b>                         | 1                   |                      | 1                             |                      |                  | 2                      | 2                   | 2                  | 2                    | 2          | 2          | 2      |          |  |  |  |
| CO2                                | 1                   |                      | 1                             |                      |                  | 2                      | 2                   | 2                  | 2                    | 2          | 2          | 2      |          |  |  |  |
| <b>CO3</b>                         | 2                   | 2                    | 2                             | 2                    | 2                | 2                      | 2                   | 2                  | 2                    | 2          | 2          | 2      |          |  |  |  |
| <b>CO4</b>                         | 1                   | 2                    | 2                             | 1                    | 2                | 1                      | 1                   | 1                  |                      | 1          | 2          | 2      |          |  |  |  |
| CO5                                | 1                   | 1                    | 1                             | 1                    | 1                | 1                      | 1                   | 1                  | 1                    | 1          | 1          | 1      |          |  |  |  |
| Cos / PSOs                         | PS                  | 01                   | PSO                           | 02                   | PS               | 603                    | PS                  | 504                |                      |            |            |        |          |  |  |  |
| CO1                                |                     |                      |                               |                      | 2                |                        | 1                   |                    |                      |            |            |        |          |  |  |  |
| CO2                                |                     |                      |                               |                      | 2                |                        | 1                   |                    |                      |            |            |        |          |  |  |  |
| CO3                                |                     |                      |                               |                      | 2                |                        | 1                   |                    |                      |            |            |        |          |  |  |  |
| CO4                                |                     |                      |                               |                      | 2                |                        | 1                   |                    |                      |            |            |        |          |  |  |  |
| CO5                                |                     |                      |                               |                      | 2                |                        | 1                   |                    |                      |            |            |        |          |  |  |  |
| 3/2/1 indicates S                  | Strengtl            | h of Cor             | relation                      | 3- High              | n, 2- Me         | dium, 1                | -Low                |                    |                      |            |            |        |          |  |  |  |
| Category                           | Basic Science       | Engineering Science  | Humanities and social Science | Program Core         | Program elective | Open Elective          | Inter Disciplinary  | Skill Component    | Practical /Project   |            |            |        |          |  |  |  |
|                                    |                     |                      |                               |                      |                  |                        |                     |                    |                      |            |            |        |          |  |  |  |



| Subject Code: | Subject Name: INDUSTRY 4.0 | Ty/Lb/ | L | Τ/  | P/R | С |
|---------------|----------------------------|--------|---|-----|-----|---|
|               |                            | ETL    |   | SLr |     |   |
| EBME22OE7     | Pre requisite: NIL         | Ту     | 3 | 0/0 | 0/0 | 3 |

## **Unit-1: Introduction to Industry 4.0**

Introduction, core idea of Industry 4.0, origin concept of industry 4.0, Industry 4.0 production system, current state of industry 4.0, Technologies, How is India preparing for Industry 4.0

# **Unit-2: A Conceptual Framework for Industry 4.0**

Introduction, Main Concepts and Components of Industry 4.0, State of Art, Supportive Technologies, Proposed Framework for Industry 4.0.

## **Unit-3: Technology Roadmap for Industry 4.0**

Introduction, Proposed Framework for Technology Roadmap, Strategy Phase, Strategy Phase, New Product and Process Development Phase.

## Unit-4: Advances in Robotics in the Era of Industry 4.0

Introduction, Recent Technological Components of Robots- Advanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly.

# Unit-5: The Role of Augmented Reality in the Age of Industry 4.0

Introduction, AR Hardware and Software Technology, Industrial Applications of AR: Obstacles and Framework Conditions for Industry 4.0-Lack of A Digital Strategy alongside Resource Scarcity, Lack of standards and poor data security, Financing conditions, availability of skilled workers, comprehensive broadband infra- structure, state support, legal framework, protection of corporate data, liability, handling personal data.

#### Total No. of Periods : 45

9

9

9

9

9

#### **Reference Books:**

- 1. Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing the Digital Transformation".
- 2. Bartodziej, Christoph Jan, "The Concept Industry 4.0".
- 3. Klaus Schwab, "The Fourth Industrial Revolution".
- 4. Christian Schröder, "The Challenges of Industry 4.0 for Small and Medium-sized Enterprises".

List of Open Source Software/learning website: 1. www.nptel.ac.in/

D G Γ\_ Κ. EDUCATIONAL AND RESEARCH INSTITUTE MED NIVERSITY D 0 BI E U University with Graded Autonomy Status (An ISO 21001 : 2018 Certified Institution)

| SubjectCode:   | S   | ubject      | Nam            | e :      | VIRT         | UAL        | AN         | D            | Ty/Lb/                          | L        | <b>T</b> / | P/R      | С       |  |  |  |
|--|---|-------------|----------------|----------|--------------|------------|------------|--------------|---------------------------------|----------|------------|----------|---------|--|--|--|
|  | Α   | UGM         | ENTED          | REA      | LITY         |            |            |              | ETL                             |          | S.Lr       |          |         |  |  |  |
| EBME22OE8  | Р   | rerequ      | isite: NI      | Ĺ        |              |            |            |              | Ту                              | 3        | 0/0        | 0/0      | 3       |  |  |  |
| L:LectureT:Tuto  | rial  | SLr:        | Supervise      | edLear   | ningP:       | Project    | R:Rese     | archC:       | Credits                         | 1        |            |          |         |  |  |  |
| T/L/ETL:Theory   | /Lab/E  | Embedd      | edTheor        | yandLa   | ıb           |            |            |              |                                 |          |            |          |         |  |  |  |
| <b>OBJECTIVE:O</b>   | BJEC  | TIVE:       | The stuc       | lents w  | ill lear     | n          |            |              |                                 |          |            |          |         |  |  |  |
| To introduce   | the re  | elevanc     | e of this      | course   | to the       | e existi   | ng tech    | nology       | through de                      | emonstra | tions, ca  | ase stud | ies and |  |  |  |
| applications   | ations with a futuristic vision along with socio-economic impact and issues<br>derstand virtual reality, augmented reality and using them to build Biomedical engineering a |             |                |          |              |            |            |              |                                 |          |            |          |         |  |  |  |
| • To understand virtual reality, augmented reality and using them to build Biomedical engineering ap |   |             |                |          |              |            |            |              |                                 |          |            |          |         |  |  |  |
| COURSEOUTCOMES(COs) : The students will be able to   |   |             |                |          |              |            |            |              |                                 |          |            |          |         |  |  |  |
| CO1  | Unde  | rstand t    | the physi      | cal prir | nciples      | of VR      | & AR       |              |                                 |          |            |          |         |  |  |  |
| CO2  | Creat   | e a con     | nfortable,     | high-p   | berform      | nance V    | R appl     | ication      | using Unit                      | У        |            |          |         |  |  |  |
| CO3  | Analy   | se and      | understa       | nd the   | workir       | ng of va   | arious s   | tate of      | ate of the art VR & AR devices. |          |            |          |         |  |  |  |
| CO4  | Anal  | yse &       | Design         | n a sy   | vstem        | or pro     | to me      | et given     | specific                        | ations   | with r     | ealistic |         |  |  |  |
|  | engir   | neering     | ; constra      | ints     |              |            |            |              |                                 |          |            |          |         |  |  |  |
| CO5 Create and deploy a VR & AR application.   |   |             |                |          |              |            |            |              |                                 |          |            |          |         |  |  |  |
| Mapping of Cou   | irse O  | utcome      | es with P      | rograi   | n Out        | comes      | (POs)      | 1            | 1                               | 1        | 1          | T        |         |  |  |  |
| COs/POs  | PO1   | PO2         | PO3            | PO4      | PO5          | PO6        | <b>PO7</b> | <b>PO8</b>   | PO9                             | PO10     | PO11       | PO12     |         |  |  |  |
| CO1  | 3   | 3           | 3              | 3        | 2            | 3          | 1          | 2            | 3                               | 2        | 3          |          | 3       |  |  |  |
| CO2  | 3   | 3           | 3              | 3        | 3            | 3          | 1          | 3            | 2                               | 2        | 3          |          | 3       |  |  |  |
| CO3  | 3   | 3           | 3              | 3        | 3            | 3          | 1          | 2            | 3                               | 3        | 3          |          | 3       |  |  |  |
| CO4  | 3   | 3           | 3              | 3        | 3            | 3          | 1          | 2            | 3                               | 3        | 2          |          | 3       |  |  |  |
| CO5  | 3   | 2           | 3              | 2        | 3            | 3          | 1          | 2            | 3                               | 3        | 2          | •        | 3       |  |  |  |
| COs /PSOs  | <u>Р</u>  | <u>801</u>  | PS 2           | 02       | Р            | <u>803</u> | ľ          | <u>2804</u>  |                                 |          |            |          |         |  |  |  |
|  |   | 2           | 3              |          |              | 3          | •          | 2            |                                 |          |            |          |         |  |  |  |
|  | -   | )<br>2      | 3              |          |              | 3          | •          | 3            |                                 |          |            |          |         |  |  |  |
| CO3  |   | ,<br>,      | 3              |          |              | 3          | •          | 2            |                                 |          |            |          |         |  |  |  |
|  |   | ,<br>,      | 3              |          | •            | 5<br>2     | •          | 5<br>7       |                                 |          |            |          |         |  |  |  |
| CU5<br>3/2/1 indicates St  | renath  | 2<br>Dof Co | J<br>rrelation | 3. Н     | igh 2-       | 5<br>Mediı | um 1.I     | 5<br>.0W     |                                 |          |            |          |         |  |  |  |
|  | rengu   |             |                | <u> </u> | 1g11, 2-     | Witcuit    | , 1-1      | 2011         |                                 |          |            |          |         |  |  |  |
|  |   |             |                |          |              |            | ury        | nt           | ct                              |          |            |          |         |  |  |  |
|  | ce  |             | nd<br>e        | e        |              | e          | lina       | one          | roje                            |          |            |          |         |  |  |  |
|  | ien   | ng          | es a<br>enc    | Cor      | ш            | ctiv       | scip       | ubo          | I/J                             |          |            |          |         |  |  |  |
| iteg<br>v  | c S   | eeri<br>ce  | miti<br>Sci    | am (     | igra<br>tive | Ele        | Di         | C            | tica                            |          |            |          |         |  |  |  |
| or,  | asio  | ienc        | uma<br>cial    | 3gr      | Prc<br>lect  | ben        | nter       | kill         | ract                            |          |            |          |         |  |  |  |
|  | В   | En<br>Sc    | Hı<br>so(      | Pr       | e            | , of       | I          | $\mathbf{v}$ | <u>д</u>                        |          |            |          |         |  |  |  |
|  |   |             |                |          |              | <b>√</b>   |            |              |                                 |          |            |          |         |  |  |  |
|  |   |             |                |          |              |            |            |              |                                 |          |            |          |         |  |  |  |



| SubjectCode: | Subject Name: VIRTUAL AND | Ту /   | L | Т     | <b>P/ R</b> | С |
|--------------|---------------------------|--------|---|-------|-------------|---|
|              | AUGMENTED REALITY         | Lb/ETL |   | /S.Lr |             |   |
| EBME22OE8    | Prerequisite: NIL         | Ту     | 3 | 0/0   | 0/0         | 3 |

# **UNIT I INTRODUCTION**

The three I's of virtual reality-commercial VR technology and the five classic components of a VR system -Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.

# **UNIT II VR DEVELOPMENT PROCESS**

Geometric modeling - kinematics modeling - physical modeling - behaviour modeling - model Management.

# UNIT III CNTENT CREATION CONSIDERATION FOR VR

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment

# UNIT IV VR ON THE WEB & VR ON THE MOBILE

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)- frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android -cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics

# **UNIT V APPLICATIONS OF VR & AR**

Mechanical applications-Robotics applications- Advanced Real time Tracking- other applications- games, movies, simulations.

# **TEXT BOOKS:**

C. Burdea& Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & 1. Sons, Inc., 2008

2.Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA.

# **REFERENCES:**

1. Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg& Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN:9780321883575

2. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability), Steve Aukstakalnis, Addison-Wesley Professional; 1 edition, 2016.

3. The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything, Robert Scoble&Shel Israel, Patrick Brewster Press; 1 edition, 2016.

Total No. of Periods : 45

0

9

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# OPEN ELECTIVE LABS



| Subject Cod     | e: Sub<br>EN  | oject Na<br>GINES      | me: I<br>AND ST                  | NTERI<br>'EAM I | NAL CO<br>LAB    | OMBU          | STION              | Ty              | / Lb/              | L   | T<br>S.Li | / P/ ] | R       | С      |  |  |  |
|-----------------|---------------|------------------------|----------------------------------|-----------------|------------------|---------------|--------------------|-----------------|--------------------|-----|-----------|--------|---------|--------|--|--|--|
| EBME22OL        | 1             |                        |                                  |                 |                  |               |                    | E               | TL                 |     |           |        |         |        |  |  |  |
|                 | Pr            | erequis                | ite: Nil                         |                 |                  |               |                    | 1               | Lb                 | 0   | 0/0       | 3/0    | )       | 1      |  |  |  |
| L : Lecture T   | : Tutor       | ial SL                 | r : Super                        | vised L         | earning          | g P : Pro     | oject R            | : Resear        | ch C:              | Cre | edits     |        |         |        |  |  |  |
| T/L/ETL : Th    | eory/La       | ab/Emb                 | edded Th                         | neory ar        | nd Lab           |               | -                  |                 |                    |     |           |        |         |        |  |  |  |
| OBJECTIVI       | ES: The       | e studen               | t will lea                       | rn              |                  |               |                    |                 |                    |     |           |        |         |        |  |  |  |
| • To ev         | valuate       | the perf               | ormance                          | of stear        | n turbin         | IC engi       | ines.              |                 |                    |     |           |        |         |        |  |  |  |
| COURSE O        | UTCO          | MES (C                 | COs): (3                         | <b>3- 5</b> )   |                  |               |                    |                 |                    |     |           |        |         |        |  |  |  |
| CO1             | Unders        | tand the o             | concept of                       | working         | and perf         | of steam      | m turbines         |                 |                    |     |           |        |         |        |  |  |  |
| CO2             | Analyz        | e the peri             | formance a                       | nd heat b       | balance te       | st of IC o    | engines            | es              |                    |     |           |        |         |        |  |  |  |
| CO3             | Determ        | ine and I              | Draw perfo                       | ormance         | character        | istics cur    | rve of IC          | engines         |                    |     |           |        |         |        |  |  |  |
| CO4             | Descri        | be work                | ting of ste                      | am gene         | erators, C       | Condens       | er and t           | urbines         |                    |     |           |        |         |        |  |  |  |
| CO5             | Analyz        | e the perf             | formance c                       | haracteri       | stics of s       | steam gei     | nerator            |                 |                    |     |           |        |         |        |  |  |  |
| Mapping of      | Course        | Outco                  | mes with                         | Progra          | am Out           | tcomes        | (Pos)              | 1               | 1                  |     |           | 1      | r —     |        |  |  |  |
| Cos/Pos         | PO1           | PO2                    | PO3                              | PO4             | PO5              | PO6           | PO7                | PO8             | P O                | 9   | PO10      | PO11   | P<br>12 | O<br>2 |  |  |  |
| CO1             | 3             | 2                      |                                  | 2               | 1                |               | 2                  |                 |                    |     |           |        |         |        |  |  |  |
| CO2             | 3             | 1                      |                                  | 2               |                  |               | 2                  |                 |                    |     |           |        |         |        |  |  |  |
| CO3             | 2             |                        |                                  | 3               |                  |               | 3                  |                 |                    |     |           |        |         |        |  |  |  |
| CO4             | 3             | 1                      |                                  | 2               |                  |               | 2                  |                 |                    |     |           |        |         |        |  |  |  |
| CO5             | Μ             |                        |                                  | 3               |                  |               | 3                  |                 |                    |     |           |        |         |        |  |  |  |
| Cos / PSOs      | ]             | PSO1                   | F                                | PSO2            | ]                | PSO3          |                    | PSO4            |                    |     |           |        |         |        |  |  |  |
| CO1             |               | 3                      | 2                                |                 |                  |               |                    |                 |                    |     |           |        |         |        |  |  |  |
| CO2             | ź             | 2                      | 2                                |                 |                  |               |                    |                 |                    |     |           |        |         |        |  |  |  |
| CO3             | ,<br>,        | 2                      | 2                                |                 |                  |               |                    |                 |                    |     |           |        |         |        |  |  |  |
| CO4             |               | 2                      | 2                                |                 |                  |               |                    |                 |                    |     |           |        |         |        |  |  |  |
| CO5             |               | 2                      | 2                                |                 |                  |               |                    |                 |                    |     |           |        |         |        |  |  |  |
| 3/2/1 indicates | Strengt       | h of Coi               | rrelation                        | 3- Hig          | h, 2- Me         | edium, 1      | l-Low              | Г               | r                  |     |           | 1      |         |        |  |  |  |
| Category        | Basic Science | Engineering<br>Science | Humanities and social<br>Science | Program Core    | Program elective | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |     |           |        |         |        |  |  |  |
| <b>–</b>        |               |                        |                                  |                 |                  |               |                    |                 |                    |     |           |        |         |        |  |  |  |



| Subject Code:<br>FBME22OL1 | Subject Name : INTERNAL COMBUSTION<br>ENGINES & STEAM LAB | Ty / Lb/<br>ETL | L | T /<br>S.Lr | P/ R | C |
|----------------------------|---|-----------------|---|-------------|------|---|
|                            | Prerequisite: Nil   | Lb              | 0 | 0/0         | 3/0  | 1 |

## LIST OF EXPERIMENTS:

- 1. Study of IC engines components and loading devices.
- 2. Valve timing and port timing diagrams of 2stroke and 4stroke petrol and diesel engines
- 3. Performance test on single cylinder 4-stroke petrol engine.
- 4. Performance test on single cylinder 4-stroke diesel engine.
- 5. Heat balance test on 4-stroke single cylinder diesel engine.
- 6. Study of steam generators, Condenser and turbines.
- 7. Performance test on a steam generator

| EDUCATIONAL AND RESEARCH INSTITUTE          | Solution Wirk op 50 |
|---|---------------------|
| DEEMED TO BE UNIVERSITY                     | * * * *             |
| University with Graded Autonomy Status      |                     |
| (An ISO 21001 : 2018 Certified Institution) |                     |

| Subject Code:   | : 1      | Subject I  | Name: (     | COMPU     | TER A      | IDED D    | ESIGN      | &        | Ty/Lb/       | T        | <b>T</b> / | D/D      | C  |  |  |
|-----------------|----------|------------|-------------|-----------|------------|-----------|------------|----------|--------------|----------|------------|----------|----|--|--|
| EDMEAOLA        | 5        | SIMULA     | TION LA     | AB        |            |           |            |          | ETL          | L        | SLr        | 1/K      | C  |  |  |
| EBME22OL2       | ]        | Prerequi   | site:       |           |            |           |            |          | Lb           | 0        | 0/0        | 3/0      | 1  |  |  |
| L : Lecture T : | Tutoria  | I SLr:     | Supervis    | ed Learr  | ing P:     | Project   | R : Rese   | earch C: | Credits      | 1 1      |            |          |    |  |  |
| T/L/ETL : The   | ory/Lat  | /Embedo    | led Theor   | y and La  | ıb         |           |            |          |              |          |            |          |    |  |  |
| OBJECTIVE       | S: The   | student v  | vill        |           |            |           |            |          |              |          |            |          |    |  |  |
| • G             | et pract | ical know  | vledge thro | ough pra  | ctice on   | CNC M     | lachines   | and rela | ated softwa  | are      |            |          |    |  |  |
| OURSE OUT       | COME     | S (COs)    | : The stu   | dent wi   | l be abl   | e to      |            |          |              |          |            |          |    |  |  |
| CO1             | Unde     | rstand the | e fundame   | entals of | design a   | nd draw   | rings (Le  | evel 2)  |              |          |            |          |    |  |  |
| CO2             | Unde     | rstand the | e different | comma     | nds in A   | uto CAI   | D/ Solid   | works o  | or CATIA     | Software | s(Level 2  | :)       |    |  |  |
| CO3             | Draw     | the macl   | hine parts, | assemb    | ly and d   | etailed d | rawing     | using so | oftwares (L  | level 4) |            |          |    |  |  |
| CO4             | Expo     | se to the  | numerical   | analysis  | s of desig | gned par  | t (Level   | vel 2)   |              |          |            |          |    |  |  |
| CO5             | Analy    | ze and in  | nterpret th | e design  | from th    | e FEA s   | oftware    | (Level 4 | 4)           |          |            |          |    |  |  |
| Mapping of C    | ourse (  | Outcome    | s with Pro  | ogram (   | Outcome    | es (POs)  | I          | 1        |              |          | 1          |          |    |  |  |
| Cos/Pos         | PO1      | PO2        | PO3         | PO4       | PO5        | PO6       | <b>PO7</b> | PO8      | PO9          | PO10     | PO11       | POI      | 12 |  |  |
| CO1             | 2        | 3          | 3           | -         | 3          | 2         | 2          | 3        | 3            | 3        | 2          |          | 2  |  |  |
| CO2             | 3        | 3          | 3           | 3         | 3          | 2         | 2          | 3        | 3            | 3        | 2          | 1        | 2  |  |  |
| CO3             | 3        | 3          | 3           | 3         | 3          | 2         | 2          | 3        | 3            | 3        | 2          | 2        | 2  |  |  |
| CO4             | 3        | 3          | 3           | 3         | 3          | 2         | 2          | 3        | 3            | 3        | 2          | 1        | 2  |  |  |
| CO5             | 3        | 3          | 3           | 3         | 3          | 2         | 2          | 3        | 3            | 3        | 2          | -        | 2  |  |  |
| Cos / PSOs      | PS       | 501        | PSC         | 02        | PS         | 03        | PS         | 504      |              |          |            |          |    |  |  |
| CO1             |          | 3          | 3           |           | 2 2        |           |            |          |              |          |            |          |    |  |  |
| CO2             |          | 3          | 3           |           | 2          |           | 3          |          |              |          |            |          |    |  |  |
| CO3             |          | 3          | 3           |           |            | 2         |            | 3        |              |          |            |          |    |  |  |
| CO4             |          | 3          | 3           |           | ,          | 2         |            | 3        |              |          |            |          |    |  |  |
| CO5             |          | 3          | 3           |           | ,          | 2         |            | 3        |              |          |            |          |    |  |  |
| 3/2/1 indicates | s Streng | gth of Co  | orrelation  | 3- Hig    | gh, 2- M   | edium, 1  | 1-Low      |          |              |          |            |          |    |  |  |
|                 |          |            | 0           |           |            |           |            |          |              |          |            |          |    |  |  |
|                 |          |            | Science     |           |            |           |            |          |              |          |            |          |    |  |  |
|                 |          | e          | ial S       |           |            |           |            |          |              |          |            |          |    |  |  |
| ory             |          | ienc       | soc         |           | tive       |           | ary        | nt       | ct           |          |            |          |    |  |  |
| tega            | ce       | Sci        | pun         | e         | lec        | e         | lina       | one      | roje         |          |            |          |    |  |  |
| Cai             | ien      | ng         | es a        | Cor       | me         | ctiv      | scip       | du       | I/P          |          |            |          |    |  |  |
|                 | c Sc     | eeri       | niti        | m         | gra        | Ele       | Di         | Co       | ica          |          |            |          |    |  |  |
|                 | asia     | gin        | ıma         | 31gc      | Prc        | nen       | nter       | kill     | ract         |          |            |          |    |  |  |
|                 | В        | En         | Hr          | Pr        |            | , ot      | Sl In      |          | Ъ,           |          |            | <u> </u> |    |  |  |
|                 |          |            |             |           |            | ✓         |            |          | $\checkmark$ |          |            |          |    |  |  |



| Subject Code:<br>EBME22OL2 | Subject Name : COMPUTER AIDED DESIGN & SIMULATION LAB | Ty/Lb/E<br>TL | L | T/<br>SLr | P/R | С |
|----------------------------|---|---------------|---|-----------|-----|---|
|                            | Prerequisite:   | Lb            | 0 | 0/0       | 3/0 | 1 |

#### List of Experiments

#### 1. CAD LAB

Introduction to computer Aided Design and Drafting Packages.

2D - Drawing using Auto CAD/ Solid works or CATIA Software

2D sectional views, part drawing, assembly drawing, detailed drawing.

Dimensioning, annotations, symbols - Welding, Surface finish, threads, Text, Bill of Materials, Title Block.

Exercises – Knuckle joint, Gib & Cotter joint, Screw Jack, Foot step bearing.

Orthographic views, Isometric views.

Solid modeling features-Boolean operations.

#### 2.SIMULATION LAB

Simulation of Mechanical Components and Linkages using CATIA/FEA Software



|  |   |                        | Periyar E.V | /.R. High R | oad, Madu  | iravoyal, C | hennai-95  | . Tamilna | du, India.  | <u>г_ г</u> | [    |             | 1 - |  |
|--|---|------------------------|-------------|-------------|------------|-------------|------------|-----------|-------------|-------------|------|-------------|-----|--|
| Subject Code   | : Su  | bject N                | Name: E     | NGINE       | ERING      | HET MET     | ROLO       | GY        | Ty / Lb/    | L           | T /  | <b>P/ R</b> | С   |  |
|  |   |                        | LAE         | 5           |            |             |            |           | ETL         |             | S.Lr |             |     |  |
| EBME22OL3  |   | ••                     |             |             |            |             |            |           | <b></b>     | •           | 0.40 | 2/0         | 1   |  |
| X X X  |   |                        |             |             |            |             |            |           |             |             | 0/0  | 3/0         |     |  |
| L: Lecture T:  | Tutoria   | I SLr:                 | Supervis    | ed Leari    | ning P : 1 | Project I   | R : Rese   | arch C:   | Credits     |             |      |             |     |  |
| 1/L/EIL: The   | ory/Lab   | Embed                  | ded Theor   | ry and L    | ad         |             |            |           |             |             |      |             |     |  |
| OBJECTIVES   | :<br>. Ctudor   | 40 mill 1              | 0.000       |             |            |             |            |           |             |             |      |             |     |  |
|  | . Studen  | its will i<br>ilor moo | surement    | method      |            |             |            |           |             |             |      |             |     |  |
| Calibrat   | Calibration of measuring instruments  |                        |             |             |            |             |            |           |             |             |      |             |     |  |
| <ul> <li>Micro structures of various ferrous and non ferrous materials using microscopes.</li> </ul> |   |                        |             |             |            |             |            |           |             |             |      |             |     |  |
| Heat tree  | atment  | nrocesse               | es of mater | rials       |            | as mater    | iuis usiii | 5 mero    | scopes.     |             |      |             |     |  |
| - fieut de   |   | p1000550               | is of mate  | liuis.      |            |             |            |           |             |             |      |             |     |  |
| Course outcomes (cos) : The Student will be able to  |   |                        |             |             |            |             |            |           |             |             |      |             |     |  |
| CO1  | CO1 Gain practical knowledge about the linear and angular measurements (Level 3)  |                        |             |             |            |             |            |           |             |             |      |             |     |  |
| CO2  | Demon   | strate th              | e differen  | t types o   | of form r  | neasure     | ments (L   | evel 3)   |             | ,           |      |             |     |  |
| CO3  | Unders  | tand the               | various n   | nethods (   | of prepa   | ration fo   | or micros  | structur  | e analysis. | (Level 2    | )    |             |     |  |
| CO4  | Analyze and identify the microstructures of metals (Level 4)                      |                        |             |             |            |             |            |           |             |             |      |             |     |  |
| CO5  | Measure and analyze the hardness of the materials after heat treatments (Level 4) |                        |             |             |            |             |            |           |             |             |      |             |     |  |
| Mapping of C   | ourse C   | Outcome                | es with Pr  | ogram       | Outcom     | es (Pos)    |            |           |             |             |      |             |     |  |
| Cos/Pos  | PO1   | PO2                    | PO3         | PO4         | PO5        | PO6         | PO7        | PO8       | PO9         | PO10        | PO11 | PO          | 12  |  |
| CO1  | 3   | 2                      | 2           | -           | 3          | 3           | 2          | 2         | 3           | 2           | 2    |             | 2   |  |
| CO2  | 3   | 2                      | 2           | -           | 3          | 3           | 2          | 2         | 3           | 2           | 2    |             | 2   |  |
| CO3  | 3   | 3                      | 2           | 2           | 2          | 2           | 2          | 2         | 3           | 3           | 2    |             | 2   |  |
| CO4  | 3   | 3                      | 2           | 2           | 2          | 2           | 2          | 2         | 3           | 3           | 2    |             | 2   |  |
| CO5  | 3   | 3                      | 2           | 2           | 2          | 2           | 2          | 2         | 3           | 3           | 2    |             | 2   |  |
| Cos / PSOs   |   | PSO1                   |             | PSO2        |            | PSO3        |            | PSO4      |             |             |      |             |     |  |
| CO1  |   | 3                      | 3           |             |            | 2           |            | 3         |             |             |      |             |     |  |
| CO2  |   | 3                      | 3           |             |            | 2           |            | 3         |             |             |      |             |     |  |
| CO3  |   | 3                      | 3           |             | ,          | 2           |            | 2         |             |             |      |             |     |  |
| CO4  | 3   | 3                      | 3           |             | ,          | 2           |            | 2         |             |             |      |             |     |  |
| CO5  |   | 3                      | 3           |             | ,          | 2           |            | 2         |             |             |      |             |     |  |
|  |   |                        |             |             |            |             |            |           |             |             |      |             |     |  |
|  |   |                        |             |             |            |             |            |           |             |             |      |             |     |  |
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|  |   |                        | soc         |             | tive       |             | ary        | nt        | sct         |             |      |             |     |  |
|  | ce  |                        | pu          | n)          | lec        | Ø           | lina       | one       | 'Oje        |             |      |             |     |  |
|  | ene   | ഖ                      | s a         | Ore         | ne         | tiv         | cip        | npc       | /P1         |             |      |             |     |  |
|  | Sci   | erii                   | itie        | n C         | rai        | llec        | Dis        | Cor       | cal         |             |      |             |     |  |
| ~  | sic   | ine                    | nce         | rai         | rog        | п           | er I       | II (      | icti        |             |      |             |     |  |
| or   | Ba  | ing                    | lun<br>cie  | rog         | P          | be          | Int        | Ski       | Prɛ         |             |      |             |     |  |
| lteg   |   | ШS                     | ЗЦN         |             |            |             |            |           | ✓           |             | -    |             |     |  |
| Ca   |   |                        |             |             |            |             |            |           |             |             |      |             |     |  |
|  |   |                        |             |             |            |             |            |           |             |             |      |             |     |  |



| Subject Code: | Subject Name: ENGINEERING METROLOGY | Ty / Lb/ | L | Τ /  | <b>P/ R</b> | C |
|---------------|-------------------------------------|----------|---|------|-------------|---|
| EBME22OL3     | LAB                                 | ETL      |   | S.Lr |             |   |
|               | Prerequisite: Nil                   | Lb       | 0 | /0   | 3/0         | 1 |

#### LIST OF EXPERIMENTS

- 1. Measurement of Dimensions using Vernier Height Gauge
- 2. Measurement of Dimensions using Vernier Depth Micrometer
- 3. Measurement of Gear Nomenclature using Gear Tooth Vernier
- 4. Angular Measurement using Vernier Height Gauge and Sine Bar
- 5. Angular Measurement using Sine Bar, Slip Gauge and Dial Gauge
- 6. Thread Measurement using Profile Projector
- 7. Measurement of Dimensions using Tool Makers Microscope
- 8. Angular measurement using Bevel Protractor
  - 9. Calibration of Dial Gauge using Slip Gauge
  - 10. Flatness of given work piece using Autocollimator



| Subject Code:   | Subj  | ect Name            | :<br>AUT                      | OMAT         | TONL             | AR            |                    |                 | Ty/Lb/             | L        | T/        | P/R    | С  |
|---|---|---------------------|-------------------------------|--------------|------------------|---------------|--------------------|-----------------|--------------------|----------|-----------|--------|----|
| EBME22OL4   |   |                     |                               |              |                  |               |                    |                 | ETL                |          | SLr       |        |    |
|   | Prer  | Prerequisite: NIL   |                               |              |                  |               |                    |                 | Lb                 | 0        | 0/0       | 3/0    | 1  |
| L : Lecture T :<br>T/L/ETL : Theor  | L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits<br>T/L/ETL : Theory/Lab/Embedded Theory and Lab |                     |                               |              |                  |               |                    |                 |                    |          |           |        |    |
| <b>OBJECTIVES</b> :   | The st  | tudent w            | ill learn                     |              |                  |               |                    |                 |                    |          |           |        |    |
| <ul> <li>To practice simple programs on microprocessors and micro controllers.</li> <li>To design and implement pneumatic and hydraulic circuits with automation studio software and with kits</li> </ul> |   |                     |                               |              |                  |               |                    |                 |                    |          |           |        |    |
| OURSE OUTCOMES (COs) :  |   |                     |                               |              |                  |               |                    |                 |                    |          |           |        |    |
| CO1   | Write Simple programs on microprocessors and micro controllers.   |                     |                               |              |                  |               |                    |                 |                    |          |           |        |    |
| CO2   | Ι   | Design a            | nd implei                     | nent hy      | draulic          | circuits      | s with a           | utomati         | on studio          | software | e and wit | h kit  |    |
| CO3   | Ι   | Design a            | nd implei                     | nent pn      | eumatio          | c circui      | ts with a          | automa          | tion studio        | o softwa | e and w   | th kit |    |
| CO4   | ŀ   | Knowled             | ge of ind                     | ustrial 1    | obots            |               |                    |                 |                    |          |           |        |    |
| CO5   | Knowledge in PLC trainer kit  |                     |                               |              |                  |               |                    |                 |                    |          |           |        |    |
| Mapping of Cou  | urse Ou   | tcomes w            | ith Progra                    | m Outco      | omes (PC         | )s)           | -                  |                 |                    | <u>.</u> | -         |        |    |
| Cos/Pos   | PO1   | PO2                 | PO3                           | PO4          | PO5              | PO6           | PO7                | PO8             | PO9                | PO10     | PO11      | PO     | 12 |
| CO1   | 1   |                     | 3                             |              | 3                |               |                    |                 |                    |          |           |        | 3  |
| CO2   | 1   |                     | 3                             |              | 3                |               |                    |                 |                    |          |           |        | 3  |
| CO3   | 1   |                     | 3                             |              | 3                |               |                    |                 |                    |          |           |        | 3  |
| CO4   | 1   |                     | 1                             |              | 1                |               |                    |                 |                    |          |           |        | 3  |
| CO5   | 1   |                     | 1                             |              | 2                |               |                    |                 |                    |          |           |        | 3  |
| Cos / PSOs  | P   | 501                 | PSC                           | 02           | PSO3 PSO4        |               |                    | SO4             |                    |          |           |        |    |
| C01   |   | 1                   | 3                             |              | 3 3              |               | 3                  |                 |                    |          |           |        |    |
| CO2   |   | 3                   | 3                             |              |                  | 3             |                    | 3               |                    |          |           |        |    |
| CO3   |   | 3                   | 3                             |              |                  | 3             |                    | 3               |                    |          |           |        |    |
| CO4   |   | 3                   | 3                             |              |                  | 3             |                    | 3               |                    |          |           |        |    |
| CO5   |   | 1                   | 3                             |              |                  | 3             |                    | 3               |                    |          |           |        |    |
| Category  | Basic Science   | Engineering Science | Humanities and social Science | Program Core | Program elective | Open Elective | Inter Disciplinary | Skill Component | Practical /Project |          |           |        |    |
|   |   |                     |                               |              |                  |               |                    |                 |                    |          |           |        |    |



| Subject Code: | Subject Name : AUTOMATION LAB | Ty/Lb/ | L | Τ/  | P/R | С |
|---------------|-------------------------------|--------|---|-----|-----|---|
| EBME22OL4     |                               | ETL    |   | SLr |     |   |
|               | Prerequisite: NIL             | Lb     | 0 | 0/0 | 3/0 | 1 |

#### LIST OF EXPERIMENTS:

- 1. Exercises in PLC Trainer Kit.
- 2. Exercises in Pneumatic / Hydraulic Trainer Kit.
- 3. Exercises in Electro Pneumatic kit.
- 4. Exercises in Industrial Robot.
- 5. Exercises in microprocessors and micro controllers.
- 6. Design of pneumatic and hydraulic circuits using Automation Studio software.



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|--|----------|

| SubjectCode:   | S  | ubject       | Nam         | e :     | VIRT    | UAL      | AN         | D       | Ty/Lb/      | L           | T/        | P/R      | С       |
|--|--|--------------|-------------|---------|---------|----------|------------|---------|-------------|-------------|-----------|----------|---------|
| EBME22OL5  | A  |              |             |         |         | LAB      |            |         | ETL         |             | S.Lr      |          |         |
|  | P  | rerequ       | isite: NI   |         |         |          |            |         | Lb          | 0           | 0/0       | 3/0      | 1       |
| L:LectureT:Tuto  | rial   | SLr:S        | Supervise   | edLeari | ningP:H | ProjectF | R:Resea    | archC:0 | Credits     |             |           |          |         |
| T/L/ETL:Theory   | /Lab/E   | mbedd        | edTheory    | vandLa  | b       |          |            |         |             |             |           |          |         |
| OBJECTIVE: (   | <b>)BJE(</b>   | CTIVE        | Thestude    | entswil | llearn  |          |            |         |             |             |           |          |         |
| To introduce   | e the re   | elevance     | e of this   | course  | to the  | existin  | ig techi   | nology  | through de  | emonstra    | tions, ca | ise stud | ies and |
| <ul> <li>To understand virtual reality, augmented reality and using them to build Biomedical engineering applications</li> </ul> |  |              |             |         |         |          |            |         |             |             |           |          | ions    |
| COURSEOUTCOMES(COs) : The students will be able to   |  |              |             |         |         |          |            |         |             |             |           |          |         |
| CO1     Understand the seting of Unity and Visual Studio for VR development  |  |              |             |         |         |          |            |         |             |             |           |          |         |
| CO2  | Demoi  | nstrate t    | he worki    | ng of H | HTC V   | ive and  | Googl      | e Card  | board       |             |           |          |         |
| CO3  | Apply  | the kno      | wledge o    | of VR a | & AR o  | on chang | ge the c   | olour a | and texture | of Game     | object.   |          |         |
| CO4  | Create an immersive environment for living room tennis court             |              |             |         |         |          |            |         |             |             |           |          |         |
| CO5  | Apply the knowledge of assembly of Gear box and tailstock using VR & AR. |              |             |         |         |          |            |         |             |             |           |          |         |
| Mapping of Cou   | rseOu  | tcomes       | withPro     | gram(   | Jutcon  | nes (PC  | Ds)        |         |             |             |           |          |         |
| COs/POs  | PO1  | PO2          | PO3         | PO4     | PO5     | PO6      | <b>PO7</b> | PO8     | PO9         | <b>PO10</b> | PO11      | PO12     |         |
| CO1  | 3  | 3            | 3           | 3       | 2       | 3        | 1          | 2       | 3           | 2           | 3         | 3        | 3       |
| CO2  | 3  | 3            | 3           | 3       | 3       | 3        | 1          | 3       | 2           | 2           | 3         | 2        | 3       |
| CO3  | 3  | 3            | 3           | 3       | 3       | 3        | 1          | 2       | 3           | 3           | 3         |          | 3       |
| CO4  | 3  | 3            | 3           | 3       | 3       | 3        | 1          | 2       | 3           | 3           | 2         |          | 3       |
| CO5  | 3  | 2            | 3           | 2       | 3       | 3        | 1          | 2       | 3           | 3           | 2         | 3        | 3       |
| COs /PSOs  | P  | SO1          | PS          | 02      | P       | SO3      | P          | SO4     |             |             |           |          |         |
| CO1  |  | 3            | 3           |         |         | 3        |            | 3       |             |             |           |          |         |
| CO2  | Í  | 3            | 3           |         |         | 3        | í          | 3       |             |             |           |          |         |
| CO3  |  | 3            | 3           |         |         | 3        |            | 3       |             |             |           |          |         |
| <u>CO4</u>   |  | 3            | 3           |         |         | 3        |            | 3       |             |             |           |          |         |
| <u>C05</u>   |  | 2            | 3           |         |         | 3        |            | 5       |             |             |           |          |         |
|  |  |              | al          |         |         |          |            |         |             |             |           |          |         |
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|  | ee   |              | pud 8       | Ð       | lect    | e        | lina       | onei    | oje         |             |           |          |         |
| ory  | ien  | ng           | es a        | Cor     | me      | ctiv     | scip       | npo     | I/P         |             |           |          |         |
| Iteg   | c Sc   | eeri<br>ce   | niti<br>ce  | am      | gra     | Ele      | Di         | CO      | tica        |             |           |          |         |
| Ca   | asi  | ngin<br>iene | uma<br>ien( | ogr     | Prc     | pen      | nter       | ikill   | rac         |             |           |          |         |
|  |  | Er           | Hı<br>Sc    | Ρr      |         | Ō        | Π          |         |             |             |           |          |         |
|  |  |              |             |         |         | ľ        |            |         |             |             |           |          |         |
|  |  |              |             |         |         |          |            |         |             |             |           |          |         |



| Subject        | Subject Name: VIRTUAL REALITY AND | Ту /   | L | Т     | <b>P/ R</b> | С |
|----------------|-----------------------------------|--------|---|-------|-------------|---|
| -              | AUGMENTED REALITY LAB             | Lb/ETL |   | /S.Lr |             |   |
| Code:EBME22OL5 | Prerequisite: NIL                 | Lb     | 0 | 3/0   | 3/0         | 1 |
|                |                                   |        |   |       |             |   |

#### List of Experiments

- 1. Installation of Unity and Visual Studio, setting up Unity for VR development
- 2. Demonstration of the working of HTC Vive
- 3. Demonstration of the working of Google Card board
- 4. Develop a scene in Unity that includes a cube, plane and sphere
- 5. Change the colour and material of Game object
- 6. Change the texture of Game object
- 7. Create an immersive environment (living room)
- 8. Create an immersive environment (tennis court)
- 9. Assembly of Gear box using VR & AR
- 10. Assembly of tailstock using VR & AR