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FACULTY OF ENGINEERING AND TECHNOLOGY

OUTCOME BASED EDUCATION

Curriculum and Syllabus

B.Tech (Mechanical Engineering)
(Full Time)

2022

DEPARTMENT OF MECHANICAL ENGINEERING

DECLARATION

I, **Dr.K.Rajan** Professor and Head of Mechanical Engineering Department, hereby declare that this copy of the syllabus (B.Tech– Mechanical Engineering Full time 2022 Regulation-Page No. 01-238) is the final version which is being taught in the class and uploaded in our University website. I assure that the Syllabus available in our University website is verified and found correct. The Curriculum and Syllabi have been approved by our Academic Council/Vice Chancellor.

Date: **Signature**

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 Component	Description	No. of Courses	Credits	Total	Credit Weight age (%)	Contact hours
Basic Science	Theory	6	22	28	17	240
	Lab					90
	ETL	2	6			120
Engineering Science	Theory	0		03	1.8	60
	Lab	0				
	ETL	1	3			
Humanities and Social Science	Theory	3	3	10	6.0	90
	Lab	1	1			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/ Project / Orientation to Entre& Project Lab		1 2 1	1 10 1	12	7.2	15 90 30
Others if any	The Indian Constitution/Environmental Science	1	0	0		15
	TOTAL	**68**	**166**	**166**	**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

Table 2: Revision/modification done in syllabus content:

S. No	Course (Subject) Code	Course (Subject) Name	Concept/ topic if any, removed in current Curriculum	Concept/topic added in the new curriculum	% of Revision/ Modification done
1.	EBME22007	Thermal Engineering	Unit-IV- Cetane and Octane numbers of fuels, Combustion, Knocking and Detonation, Scavenging, Valve and port timing diagrams, Fuel supply, Ignition, Cooling and Lubrication System.– Performance & Testing– Heat balance calculations.	Unit-IV- 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.	20%
2.	EBME22ET1	Engineering Metrology	Unit –I & Unit-II Combined	Unit-I& Unit-II Combined- legal metrology- Calibration - Interchangeability and selective assembly	40%
			Unit-III changed as Unit-II: **Form measurement**	Unit-II-**Form measurement**- internal and External screw threads- Measurements of various elements of thread, Best size wire – Two and three wire method. Gears - Constant chord method - Base tangent method. Surface Finish: Surface topography definitions - Measurement of Surface Texture - Methods - Evaluation of Surface finish.	
			Unit-V: **Measurement of Power, Flow and Temperature- Introduced as new Unit**	**UNIT V: MEASUREMENT OF POWER, FLOW AND TEMPERATURE** Force, torque, power :-mechanical, pneumatic, hydraulic and electrical type-Flow measurement: Venturi, orifice, rotameter, pitot tube – Temperature: bimetallic strip, pressure thermometers, thermocouples, electrical resistance thermister.	
3	EBME22010	Design of Machine Elements-I	Unit-I Content expanded.	**<u>The following topics are newly included</u>** **UNIT- I**: Design for Variable loading –Gerber line, Goodman's line, and Soderberg's Line.- **Unit-II:** Keys- different types of keys- Design of Keys, keyways, failures of keys **Unit-III:** Functions of springs- applications- spring materials-	50%

				Belleville springs (disc) and torsion Spring **Unit-IV:** Threaded fasteners-stress in screwed threads, Bolted joints including eccentric loading-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:** Lubrication in journal bearings - Types of fly wheels-Design of flywheels involving stresses in rim and arm	
4	EBME22ET2	Manufacturing Technology-II	**UNIT- V: POWDER METALLURGY AND PRECISION ENGINEERING** Powder metallurgy – production of metal powders, compaction, sintering, selective laser sintering, finishing of sintered parts. Precision machining and micro machining – diamond turning of parts to nanometer accuracy, stereo microlithography, machining of micronized components	**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	**20%**
5	EBME22011	Heat and Mass Transfer		Unit-IV: Heat exchangers-Classifications, parallel, counter and cross flow- Fouling factors- LMTD and NTU methods Unit-V: **Basic Concepts** Equimolar counter diffusion – isothermal evaporation. **Convective Mass Transfer** Sherwood number, Schmidt number, Stanton number- mass transfer coefficients- Laminar, turbulent and Laminar-turbulent conditions.	20%
6	EBME22013	Design of Machine Elements-II	**Uint-V: DESIGN OF SIMPLE MECHANISMS** Design of Ratchet and pawl mechanism, Geneva mechanism.	The following topics are newly included **UNIT II:** Tooth stresses –Dynamic effects-Fatigue strength-Factor of Safety-Gear materials- Equivalent number of teeth – Forces for helical gears. **UNIT- V: CLUTCHES AND BRAKES**	30%

				Design of plate clutches –Cone clutches – Centrifugal clutches- Electromagnetic clutches. Band and Block brakes- External shoe brakes – Internal expanding shoe brake.	
7	EBEC22IDX	Microprocessor Architecture and Embedded Programming		New course has been introduced	100%
8	EBMA22008	Mathematics-IV (Probability and 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 Lab		New course has been introduced	100%
11	EBME22ET3	Virtual and Augmented Reality		New course has been introduced	100%
12	EBME22E01 (ELECTIVE)	Advanced IC Engines	UNIT IV: **ALTERNATIVE FUELS** **UNIT V: RECENT TRENDS**	Included in UNIT IV Flexible fuel vehicles- modifications-merits and demerits UNIT V: Hybrid electrical vehicles – series, parallel and series, parallel configuration – Design – Drive train, sizing of components. Fuel cells-types-construction and working.	20%
13	EBME22E02	Electric and Hybrid vehicles		New Elective course has been introduced	
14	EBME22E03	Automobile Engineering		Shifted from programme core to programme Elective	
15	EBME22E15	Design Thinking and Innovation		New Elective course has been introduced	
16	EBME22E19	Additive manufacturing		New Elective course has been introduced	
17	EBME22E23	System Modelling and Simulation		New Elective course has been introduced	
18	EBME22E29	Block chain Technology		New Elective course has been 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 Courses	Value added courses	Life skill	Electives	Inter Disciplinary	Focus on employability/ entrepreneurship/ skill development.
1	Microprocessor Architecture and Embedded Programming	Yes				Yes	Yes
2	Mathematics-IV (Probability and Statistics)	Yes					Yes
3	Artificial Intelligence and Machine Learning	Yes				Yes	Yes
4	Artificial Intelligence and Machine 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 Building) (Internal Evaluation)			Yes			Yes
10	Technical Skill II (Internal Evaluation)		Yes	Yes			Yes
11	Soft Skill II (Qualitative and Quantitative Skills)(Internal Evaluation)			Yes			Yes
12	Mini Project/In plant 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 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

DEPARTMENT OF MECHANICAL ENGINEERING

B.Tech. Mechanical Engineering (Full Time)

Curriculum – 2022 Regulation

	SEMESTER I							
S.NO.	**Course Code**	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/SLr**	**P/R**	**C**	**Category**
1	EBEN22001	Technical English	**Ty**	**2**	**0/0**	**0/0**	**2**	**HS**
2	EBMA22001	Mathematics – I	**Ty**	**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 Engineering	**ETL**	**2**	**0/0**	**2/0**	**3**	**ES**
6	EBCC22I01	Orientation to 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/ETL/IE**	**L**	**T/SLr**	**P/R**	**C**	**Category**
1	EBMA22003	Mathematics – II	Ty	3	1/0	0/0	4	BS
2	EBPH22002	Engineering Mechanics	Ty	3	0/0	0/0	3	BS/PC
3	EBCH22002	Industrial Chemistry	Ty	3	0/0	0/0	3	BS
4	EBME22001	Engineering Graphics	Ty	2	0/0	2/0	3	ES/PC
5	EBME22002	Engineering Metallurgy	Ty	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 (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

	SEMESTER III							
S.NO.	**Course Code**	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/SLr**	**P/R**	**C**	**Category**
1	EBMA22005	Mathematics –III for Mechanical and Civil Engineers	**Ty**	**3**	**1/0**	**0/0**	**4**	**BS**
2	EBME22003	Engineering Thermodynamics	**Ty**	**3**	**1/0**	**0/0**	**4**	**PC**
3	EBME22004	Manufacturing Technology- I	**Ty**	**3**	**0/0**	**0/0**	**3**	**PC**
4	EBCE22ID5	Fluid Mechanics and Machinery	**Ty**	**3**	**0/0**	**0/0**	**3**	**ID**
5	EBEC22ET3	Microprocessor Architecture and Embedded Programming	**ETL**	**2**	**0/0**	**2/0**	**3**	**ID**
6	EBME22005	Machine Drawing	**Ty**	**2**	**0/0**	**2/0**	**3**	**PC**
7	EBCC22ET1	Universal human values: 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 Code**	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/SLr**	**P/R**	**C**	**Category**
1	EBMA22008	Statistical and Numerical Methods	**Ty**	**3**	**1/0**	**0/0**	**4**	**BS**
2	EBME22006	Strength of Materials	**Ty**	**3**	**1/0**	**0/0**	**4**	**PC**
3	EBME22007	Mechanics of Machine-I	**Ty**	**3**	**1/0**	**0/0**	**4**	**PC**
4	EBCS22ID5	Artificial Intelligence and Machine Learning	**Ty**	**3**	**0/0**	**0/0**	**3**	**ID**
5	EBME22ET2	Engineering Metrology	**ETL**	**2**	**0/0**	**2/0**	**3**	**PC**
6	EBCC22I04/ EBCC22I05	The Indian Constitution/ The Indian Traditional Knowledge **(Audit Course)**	**IE**	**2**	**0/0**	**0/0**	**0**	**ID**
PRACTICALS*								
1	EBME22L03	Strength of Materials Lab	**Lb**	**0**	**0/0**	**3/0**	**1**	**PC**
2	EBCS22IL4	Artificial Intelligence and Machine Learning Lab	**Lb**	**0**	**0/0**	**3/0**	**1**	**ID**
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**	

SEMESTER V								
S.NO.	**Course Code**	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/SLr**	**P/R**	**C**	**Category**
1	EBME22008	Thermal Engineering	**Ty**	**3**	**0/0**	**0/0**	**3**	**PC**
2	EBME22009	Mechanics of Machine-II	**Ty**	**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	**Ty**	**3**	**0/0**	**0/0**	**3**	**PE**
5	EBXX22OEX	Open Elective I	**Ty**	**3**	**0/0**	**0/0**	**3**	**ID**
6	EBOL22I01	Online course **NPTEL/SWAYAM/Any MOOC**	**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**
Credits Sub Total							**20**	

SEMESTER VI								
S.NO.	**Course Code**	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/SLr**	**P/R**	**C**	**Category**
1	EBME22010	Heat and Mass Transfer	**Ty**	**3**	**1/0**	**0/0**	**4**	**PC**
2	EBME22011	CAD,CAM&CIM	**Ty**	**3**	**0/0**	**0/0**	**3**	**PC**
3	EBME22012	Design of Machine Elements-I	**Ty**	**3**	**1/0**	**0/0**	**4**	**PC**
4	EBME22EXX	Program Elective II	**Ty**	**3**	**0/0**	**0/0**	**3**	**PE**
5	EBXX22OEX	Open Elective II	**Ty**	**3**	**0/0**	**0/0**	**3**	**ID**
PRACTICALS*								
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 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**
Credits Sub 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

SEMESTER VII								
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL/IE**	**L**	**T/ S.Lr**	**P/R**	**C**	**Category**
1	EBME22013	Industrial Automation	**Ty**	**3**	**0/0**	**0/0**	**3**	PC
2	EBME22EXX	Program Elective III	**Ty**	**3**	**0/0**	**0/0**	**3**	PE
3	EBME22014	Design of Machine Elements-II	**Ty**	**3**	**1/0**	**0/0**	**4**	**PC**
4	EBME22015	Finite Element Methods	**Ty**	**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**	P
5	EBFL22IXX	Foreign Language	**IE**	**1**	**0/0**	**1/0**	**1**	HS
						Credits Sub Total	**23**	

VIII SEMESTER								
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL/IE**	**L**	**T/ S.Lr**	**P/R**	**C**	**Category**
1	EBCC22ID1	Engineering Economics and Industrial Management	**Ty**	**3**	**0/0**	**0/0**	**3**	ID
2	EBME22EXX	Program Elective IV	**Ty**	**3**	**0/0**	**0/0**	**3**	PE
3	EBME22EXX	Program Elective V	**Ty**	**3**	**0/0**	**0/0**	**3**	PE
PRACTICALS*								
1	EBME22L10	Project Phase – II	**Lb**	**0**	**0/0**	**12/12**	**8**	P
						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

PROGRAM ELECTIVE –I & V								
S.NO.	SUBJECT CODE	SUBJECT NAME Elective: Thermal Engineering	Ty/Lb /ETL/IE	L	T/ SLr	P/R	C	Category
1	EBME22E01	Advanced IC Engines	Ty	3	0/0	0/0	3	PE
2	EBME22E02	Electric and Hybrid vehicles	Ty	3	0/0	0/0	3	PE
3	EBME22E03	Automobile Engineering	Ty	3	0/0	0/0	3	PE
4	EBME22E04	Sustainable Energy	Ty	3	0/0	0/0	3	PE
5	EBME22E05	Gas Dynamics and Jet Propulsion	Ty	3	0/0	0/0	3	PE
6	EBME22E06	Refrigeration and Air Conditioning	Ty	3	0/0	0/0	3	PE
7	EBME22E07	Computational Fluid Dynamics	Ty	3	0/0	0/0	3	PE
8	EBME22E08	Turbo Machines	Ty	3	0/0	0/0	3	PE
PROGRAM ELECTIVE –II								
S.NO.	SUBJECT CODE	SUBJECT NAME Elective: Design Engineering	Ty/Lb /ETL/IE	L	T/ SLr	P/R	C	Category
1	EBME22E09	Mechanical Vibrations	Ty	3	0/0	0/0	3	PE
2	EBME22E10	Design of Production Tools	Ty	3	0/0	0/0	3	PE
3	EBME22E11	Design of Material Handling Equipments	Ty	3	0/0	0/0	3	PE
4	EBME22E12	Applied Tribology	Ty	3	0/0	0/0	3	PE
5	EBME22E13	Design for Manufacture and Assembly	Ty	3	0/0	0/0	3	PE
6	EBME22E14	Mechanics of Fracture	Ty	3	0/0	0/0	3	PE
7	EBME22E15	Design Thinking and Innovation	Ty	3	0/0	0/0	3	PE
PROGRAM ELECTIVE –III								
S.NO.	SUBJECT CODE	SUBJECT NAME Elective: Manufacturing Engineering	Ty/Lb /ETL/IE	L	T/ SLr	P/R	C	Category
1	EBME22E16	Industrial Robotics	Ty	3	0/0	0/0	3	PE
2	EBME22E17	Non-Conventional Machining Techniques	Ty	3	0/0	0/0	3	PE
3	EBME22E18	Process planning and cost estimation	Ty	3	0/0	0/0	3	PE
4	EBME22E19	Additive manufacturing	Ty	3	0/0	0/0	3	PE
5	EBME22E20	Flexible Manufacturing Systems	Ty	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 CODE	SUBJECT NAME Elective: Industrial Engineering	Ty/Lb /ETL	L	T/ SLr	P/R	C	Category
1	EBME22E22	Enterprise Resource Planning	Ty	3	0/0	0/0	3	PE
2	EBME22E23	System Modeling and Simulation	Ty	3	0/0	0/0	3	PE
3	EBME22E24	Total Quality Management	Ty	3	0/0	0/0	3	PE
4	EBME22E25	Facilities Planning and Design	Ty	3	0/0	0/0	3	PE
5	EBME22E26	Quality Engineering	Ty	3	0/0	0/0	3	PE
6	EBME22E27	Industry 4.0	Ty	3	0/0	0/0	3	PE
7	EBME22E28	Supply Chain Management	Ty	3	0/0	0/0	3	PE
8	EBME22E29	Block chain Technology	Ty	3	0/0	0/0	3	PE

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

OPEN ELECTIVE-I&II								
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ ETL	L	T/ SLr	P/R	C	Category
1	EBME22OE1	Industrial Engineering	Ty	3	0/0	0/0	3	OE
2	EBME22OE2	Refrigeration and Air conditioning	Ty	3	0/0	0/0	3	OE
3	EBME22OE3	Automobile Engineering	Ty	3	0/0	0/0	3	OE
4	EBME22OE4	Industrial Robotics	Ty	3	0/0	0/0	3	OE
5	EBME22OE5	Sustainable Energy	Ty	3	0/0	0/0	3	OE
6	EBME22OE6	Composite Materials	Ty	3	0/0	0/0	3	OE
7	EBME22OE7	Industry 4.0	Ty	3	0/0	0/0	3	OE
8	EBME22OE8	Virtual and Augmented Reality	Ty	3	0/0	0/0	3	OE

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

OPEN ELECTIVE LAB*								
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ ETL	L	T/ SLr	P/R	C	Category
1	EBME22OL1	Internal Combustion Engines Lab and Steam Turbine	Lb	0	0/0	3/0	1	OL
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 Reality Lab	Lb	0	0/0	3/0	1	OL

Open electives offered to Mechanical Engineering Students

COMPUTER SCIENCE AND ENGINEERING								
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb /ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**	**Category**
1	EBCS22OE1	Cyber security & Forensics	Ty	3	0/0	0/0	3	**OE**
2	EBCS22OE2	Artificial Intelligence	Ty	3	0/0	0/0	3	**OE**
3	EBCS22OE3	Data Base Concepts	Ty	3	0/0	0/0	3	**OE**
4	EBCS22OE4	Software Engineering	Ty	3	0/0	0/0	3	**OE**
INFORMATION TECHNOLOGY								
S.NO.	**SUBJECT CODE**	**SUBJECT NAME Elective: Design Engineering**	**Ty/Lb /ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**	**Category**
1	EBIT22OE1	Web Design	Ty	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	Ty	3	0/0	0/0	3	**OE**
4	EBIT22OE4	Introduction to Multimedia	Ty	3	0/0	0/0	3	**OE**
ELECTRONICS AND COMMUNICATION ENGINEERING								
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb /ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**	**Category**
1	EBEC22OE1	Internet of Things and its Applications	Ty	3	0/0	0/0	3	**OE**
2	EBEC22OE2	Cellular Mobile communication	Ty	3	0/0	0/0	3	**OE**
3	EBEC22OE3	Satellite and its Applications	Ty	3	0/0	0/0	3	**OE**
4	EBEC22OE4	Fundamentals of Sensors	Ty	3	0/0	0/0	3	**OE**
5	EBEC22OE5	Microprocessor Based System Design	Ty	3	0/0	0/0	3	**OE**
6	EBEC22OE6	Industry 4.0 Concepts	Ty	3	0/0	0/0	3	**OE**
ELECTRICAL AND ELECTRONICS ENGINEERING								
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb /ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**	**Category**
1	EBEE22OE1	Electrical Safety for Engineers	Ty	3	0/0	0/0	3	**OE**
2	EBEE22OE2	Energy Conservation Techniques	Ty	3	0/0	0/0	3	**OE**
3	EBEE22OE3	Electric Vehicle Technology	Ty	3	0/0	0/0	3	**OE**
4	EBEE22OE4	Biomedical Instrumentation	Ty	3	0/0	0/0	3	**OE**
5	EBEE22OE5	Industrial Instrumentation	Ty	3	0/0	0/0	3	**OE**
6	EBEE22OE6	Solar Energy Conversion System	Ty	3	0/0	0/0	3	**OE**
7	EBEE22OE7	Wind Energy Conversion System	Ty	3	0/0	0/0	3	**OE**
8	EBEE22OE8	Energy Storage Technology	Ty	3	0/0	0/0	3	**OE**

9	EBEE22OE9	Electrical Machines	Ty	3	0/0	0/0	3	**OE**
CIVIL ENGINEERING								
S.NO.	**SUBJECT CODE**	**SUBJECT NAME Elective: Design Engineering**	**Ty/Lb /ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**	**Category**
1	EBCE22OE1	Water Pollution and Its management	Ty	3	0/0	0/0	3	**OE**
2	EBCE22OE2	Air Pollution Control	Ty	3	0/0	0/0	3	**OE**
3	EBCE22OE3	Green Building and Vastu Concepts	Ty	3	0/0	0/0	3	**OE**
4	EBCE22OE4	Climate Change and Sustainable Development	Ty	3	0/0	0/0	3	**OE**
5	EBCE22OE5	Intelligent Transportation Systems	Ty	3	0/0	0/0	3	**OE**
6	EBCE22OE6	Environment, Health and Safety in Industries	Ty	3	0/0	0/0	3	**OE**
7	EBCE22OE7	Industrial Pollution Prevention and Cleaner Production	Ty	3	0/0	0/0	3	**OE**
8	EBCE22OE8	Fundamentals of nano science	Ty	3	0/0	0/0	3	**OE**
BIOTECHNOLOGY								
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb /ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**	**Category**
1	EBBT22OE1	Food and Nutrition	Ty	3	0/0	0/0	3	**OE**
2	EBBT22OE2	Human Physiology	Ty	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 Diagnostics	Ty	3	0/0	0/0	3	**OE**
6	EBBT22OE6	Basic Bioinformatics	Ty	3	0/0	0/0	3	**OE**
CHEMICAL ENGINEERING								
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb /ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**	**Category**
1	EBCT22OE1	Fundamentals of Nanoscience	Ty	3	0/0	0/0	3	**OE**
2	EBCT22OE2	Electrochemical Engineering	Ty	3	0/0	0/0	3	**OE**
3	EBCT22OE3	Alternative Fuels And Energy System	Ty	3	0/0	0/0	3	**OE**
4	EBCT22OE4	Petrochemical Unit Processes	Ty	3	0/0	0/0	3	**OE**
5	EBCT22OE5	Principles of Desalination Technologies	Ty	3	0/0	0/0	3	**OE**
6	EBCT22OE6	Piping Design Engineering	Ty	3	0/0	0/0	3	**OE**
7	EBCT22OE7	E- Waste Management	Ty	3	0/0	0/0	3	**OE**
Dr APJ Abdul Kalam Center For Research								
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb /ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**	**Category**
1	EBMG22OE1	Technical Entrepreneurship	Ty	3	0/0	0/0	3	**OE**

Open Labs offered to Mechanical Engineering Students

COMPUTER SCIENCE AND ENGINEERING								
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb /ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**	**Category**
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 CODE**	**SUBJECT NAME**	**Ty/Lb /ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**	**Category**
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**
ELECTRONICS AND COMMUNICATION ENGINEERING								
S.NO.	**SUBJECT CODE**	**SUBJECT NAME Elective: Design Engineering**	**Ty/Lb /ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**	**Category**
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**
ELECTRICAL AND ELECTRONICS ENGINEERING								
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb /ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**	**Category**
1	EBEE22OL1	Transducer Lab	Lb	0	0/0	3/0	1	**OL**
2	EBEE22OL2	PLC and SCADA Lab	Lb	0	0/0	3/0	1	**OL**
3	EBEE22OL3	Electrical Maintenance Lab	Lb	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**
CIVIL ENGINEERING								
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb /ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**	**Category**
1	EBCE22OL1	Building Drawing Practice using Auto CADD	Lb	0	0/0	3/0	1	**OL**
2	EBCE22OL2	Geographical Information System And Mapping Lab	Lb	0	0/0	3/0	1	**OL**
3	EBCE22OL3	Environmental Engineering Laboratory	Lb	0	0/0	3/0	1	**OL**

BIOTECHNOLOGY								
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**	**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 CODE**	**SUBJECT NAME**	**Ty/Lb/ ETL**	**L**	**T/ 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 Code	Subject Name : TECHNICAL ENGLISH	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
EBEN22001	Prerequisite : Pass in Plus 2 English	**Ty**	**2**	**0/0**	**0/0**	**2**

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 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)

Students completing this course 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	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/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								1	1	3	1	3
CO2		1						1	1	3	1	3
CO3	1	1						1	1	3	1	3
CO4		1						1	2	2	1	3
CO5	1	1						1	2	3	1	3

COs/PSOs	PSO1	PSO2	PSO3	PSO4	
CO1					
CO2					
CO3					
CO4					
CO5					

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 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 : TECHNICAL ENGLISH	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
EBEN22001	Prerequisite :Pass in Plus 2 English	Ty	2	0/0	0/0	2

Unit I Vocabulary Development: **6**

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

Unit II Grammar **6**

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

Unit III Reading **6**

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.

Unit IV Writing **6**

Jumbled sentences- paragraph writing coherence devices- discourse markers. Essay writing- Letter writing, Informal and formal: seeking permission to undergo practical training, letter to an editor of a newspaper complaining about civic problems and suggesting suitable solutions

Unit V Visual Aids in Communication **6**

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, M. Chandrasena 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*.

Subject Code : EBMA22001	Subject Name : MATHEMATICS – I	Ty/Lb /ETL	L	T/ SLr	P/R	C
	Prerequisite : None	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

- Apply the Basic concepts in Algebra
- Use the Basic concepts in Matrices
- Identify and solve problems in Trigonometry
- Understand the Basic concepts in Differentiation
- Apply the Basic concepts in Functions of Several variables

COURSE OUTCOMES (Cos) : (3 – 5)

Students completing the course were able to

CO1	Find the summation of the given series of binomial, exponential & logarithmic
CO2	Transform a non – diagonal matrix into an equivalent diagonal matrix using orthogonal transformation.
CO3	Find expansion of trigonometric function into an infinite series and to separate a complex function into real and imaginary parts.
CO4	Apply knowledge and concepts in finding the derivative of given function and to find the maxima / Minima of the given function.
CO5	Evaluate the partial / total differentiation and maxima / minima of a function of several variables.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**			**1**							**2**
CO2	**3**	**3**			**1**							**2**
CO3	**3**	**3**			**1**							**2**
CO4	**3**	**3**	1		**1**							**2**
CO5	**3**	**3**	1		1							**2**

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 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 : EBMA22001	Subject Name : MATHEMATICS – I	Ty/Lb /ETL	L	T/ SLr	P/R	C
	Prerequisite : None	Ty	3	1/0	0/0	4

UNIT I ALGEBRA **12**

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

UNIT II MATRICES **12**

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 **12**

Expansions of Sin n□ , Cos n□ in powers of Sin□ and Cos□ – Expansion of Tan n□ – Expansions of Sin^n□ and Cos^n□ in terms of Sines and Cosines of multiples of □ – Hyperbolic functions – Separation into real and imaginary parts.

UNIT IV DIFFERENTIATION **12**

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 **12**

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

Text &Reference Books:

1) Kreyszig E., *Advanced Engineering Mathematics (10th ed.)*, John Wiley & Sons, (2011).
2) Grewal B.S., *Higher Engineering Mathematics*, Khanna Publishers, (2012).
3) John Bird, *Basic Engineering Mathematics (5th 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 (4th Revised ed.)*,S.Chand& Co., Publishers, New Delhi (2000).
6) John Bird, *Higher Engineering Mathematics (5th ed.)*, Elsevier Ltd, (2006).

Subject Code EBPH22ET1	Subject Name :ENGINEERING PHYSICS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite :Higher Sec. Physics	ETL	2	0/0	2/0	3

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

- Outline the relation between Science, Engineering & Technology.
- Demonstrate competency in understanding basic concepts.
- Apply fundamental laws of Physics in Engineering & Technology.
- To identify & solve problems using physics concepts.
- Produce and present activities associated with the course through effective technical communication

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Demonstrate competency in understanding basic concepts.
CO2	Utilize scientific methods for formal investigations & demonstrate competency with experimental methods and verify the concept to content knowledge.
CO3	Identify and provide solutions for engineering problems.
CO4	Relate the technical concepts to day to day life and to practical situations.
CO5	Think analytically to interpret concepts.

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	1										2	
CO2	3	3		2								2	
CO3	3	3	2									2	
CO4	3	1	2	2								2	
CO5	3	3	2	2								2	

COs/PSOs	PSO1	PSO 2	PSO 3	PSO 4
CO1				
CO2				
CO3				
CO4				
CO5				

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 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 EBPH22ET1	Subject Name : ENGINEERING PHYSICS	Ty/Lb /ETL	L	T/ SL r	P/R	C
	Prerequisite : Higher Sec. Physics	**ETL**	**2**	**0/0**	**2/0**	**3**

UNIT I PROPERTIES OF MATTER **9**

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 **9**

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 **9**

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 **9**

UNIT IV LASER

Laser principle and characteristics - amplification of light by population inversion - properties of laser beams: mono-chromaticity, coherence, directionality and brightness - different types of lasers - Ruby laser-Nd-YAG laser-He-Ne laser-CO_2 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 **9**

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, 25th edition, 2012
2. R. Murugeshan, Electricity and Magnetism, S.Chand Publications, 10th 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

Subject Code EBCH22ET1	Subject Name ENGINEERING CHEMISTRY	Ty/Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite :Higher Sec. Chemistry	ETL	2	0/0	2/0	3

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 deduce practical application of theoretical concepts
To provide and insight into fundamental concepts of chemical thermodynamics
To articulate the water treatment methods
To impart the knowledge in electrical conductance and EMF
To create awareness about the modern Nano composites along with concepts of polymers
To introduce analytical tools for characterization techniques.

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Apply relevant instrumentation techniques to solve complex problems
CO2	Recall the fundamentals and demonstrate by understanding the first principles of Engineering sciences.
CO3	Examine the appropriate techniques to interpret data to provide valid conclusion
CO4	Demonstrate the collaboration of science and Engineering to recognize the need for life long learning.
CO5	Analyse the impact of contextual knowledge to access the health and society issues.

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	3							1
CO2	3	3										2
CO3	3	3	1	2	3							1
CO4	3	3	1	3					3	2		3
CO5	3	3	1	2		2	3			1		1

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1					
CO2					
CO3					
CO4					
CO5					

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 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 : EBCH22ET1	Subject Name : ENGINEERING CHEMISTRY	Ty/Lb /ETL	L	T/ SLr	P/R	C
	Prerequisite : None	ETL	2	0/0	2/0	3

UNIT -I CHEMICAL THERMODYNAMICS 9

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 **9**

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 **9**

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^H using these electrode.

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

5. Determination of redox potentials using potentiometry

UNIT -VPOLYMERS AND NANO COMPOSITES **9**

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

Total No. of periods: 45

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)

Subject Code EBEE22ET1	Subject Name :BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	Ty/Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite : None	**ETL**	**2**	**0/0**	**2/0**	**3**

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

- Understand the concepts of circuit elements, circuit laws and coupled circuits.
- Gain information on measurement of electrical parameters.
- Acquire knowledge on conventional &non-conventional energy production.
- Identify basic theoretical principles behind the working of modern electronic gadgets.
- Demonstrate digital electronic circuits and assemble simple devices.

COURSE OUTCOMES (Cos)
Students completing this course were able to

CO1	Compute the electric circuit parameters for simple problems
CO2	Elaborate the concepts of Electrical machines and measurement principles
CO3	Identify conventional and Non-conventional Electrical power Generation, Transmission and Distribution
CO4	Analyze the working principles and characteristics of analog electronic devices
CO5	Understand basics of digital electronics and solving problems and design combinational circuits

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3								1
CO2	3	3	3	2								1
CO3	3	2	3	2								1
CO4	3	2	2	2								1
CO5	3	2	3	2								1

COs/PSOs	PSO1	PSO2	PSO3	PSO4
CO1				3
CO2				3
CO3				3
CO4				3
CO5				3

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 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 : EBEE22ET1	Subject Name : BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite : None	ETL	2	0/0	2/0	3

UNIT I ELECTRIC CIRCUITS 9

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

Lab Components – Measurement of Electrical Quantities

UNIT II MACHINES & MEASURING INSTRUMENTS 9

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 9

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 9

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 9

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

Subject Code EBCC22I01	Subject Name :ORIENTATION TO ENTREPRENEURSHIP & PROJECT LAB	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite : None	**IE**	**1**	**0/0**	**1/0**	**1**

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

- Understand how entrepreneurship Education transforms individuals into successful leaders.
- Identify individual potential &S have career dreams
- Understand difference between ideas & opportunities
- Identify components & create action plan.
- Use brainstorming in a group to generate ideas.

COURSE OUTCOMES (Cos)
Students completing this course were able to

CO1	Develop a Business plan & improve ability to recognize business opportunity
CO2	Do a self-analysis to build an entrepreneurial career.
CO3	Articulate an effective elevator pitch.
CO4	Analyze the local market environment & demonstrate the ability to find an attractive market
CO5	Identify the required skills for entrepreneurship & develop

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2		2	2	2	3	2
CO2						3		3	3	3	3	2
CO3						3		3	3	3	3	2
CO4						2		3	2	2	3	2
CO5						2		3	2	2	3	2

COs/PSOs	PSO1	PSO2	PSO3	PSO4
CO1				3
CO2				3
CO3				3
CO4				3
CO5				3

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 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 : EBCC22I01	Subject Name : ORIENTATION TO ENTREPRENEURSHIP	Ty/Lb /ETL/IE	L	T/ SLr	P/R	C
	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 entrepreneurshipchanged 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: EBCS22ET1	C PROGRAMMING AND MS OFFICE TOOLS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Nil	ETL	1	0/0	2/0	2

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 :

The student should be made to:

- learn a programming language.
- learn problem solving techniques.
- write programs in C and to solve the problems.
- familiarize the students in preparation of documents and presentations with office automation tools.

COURSE OUTCOMES (COs) :After Completing the course, the student can be able to

CO1	Understand and trace the execution of programs written in C language.
CO2	Write the C code for a given algorithm.
CO3	Apply Arrays and Functions concepts to write Programs
CO4	Apply Structures and pointers concepts for writing Programs
CO5	To perform documentation , accounting operations and presentation skills

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2			3						1	2
CO2	2	3	2		3						1	2
CO3	2	3	2		3						1	2
CO4	2	3	2		3						1	2
CO5		1			3						2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1				3
CO2				3
CO3				3
CO4				3
CO5				3

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
							✓					

Subject Code: EBCS22ET1	C PROGRAMMING AND MS OFFICE TOOLS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Nil	**ETL**	**1**	**0/0**	**2/0**	**2**

UNIT I INTRODUCTION **6**

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 **6**

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 **6**

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 **6**

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 **6**

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

SEMESTER II

Subject Code: EBMA22003	Subject Name : MATHEMATICS-II	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Higher secondary Mathematics	Ty	3	1/0	0/0	4

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 :

The student should be made to:

To be able to understand basic concepts in integration
To understand the concepts in multiple integrals
To use the basic concepts in ordinary differential equations
To be able to apply concepts of analytical geometry
To be able to understand the basic concept of vector calculus

COURSE OUTCOMES (COs) :

CO1	Integrate the given function by using methods of integration and to find the area under curve and the volume of a solid by revaluation
CO2	Evaluate the multiple integrals /area/volume and to change the order of integration
CO3	Apply concepts in Ordinary Differential equations and to solveeulers differential equation
CO4	Find equation of planes, lines and sphere and shortest distance between skew lines
CO5	Verify green/stokes/gauss divergence theorem

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	1		**1**							**2**
CO2	**3**	**3**	1	1	**1**							**2**
CO3	**3**	**3**	1	1	**1**							**2**
CO4	**3**	**3**	2	1	**1**							**2**
CO5	**3**	**3**	2	2	1							**2**

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1				
CO2				
CO3				
CO4				
CO5				

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
	√											

Subject Code : EBMA22003	Subject Name : MATHEMATICS – II	Ty/Lb /ETL	L	T/ SLr	P/R	C
	Prerequisite : None	**Ty**	**3**	**1/0**	**0/0**	**4**

1. INTEGRATION **12**

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 **12**

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 **12**

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 **12**

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

5. VECTOR CALCULUS **12**

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 (10th ed.)*, John Wiley & Sons, (2011).
2) Grewal B.S., *Higher Engineering Mathematics*, Khanna Publishers, (2012).
3) John Bird, *Basic Engineering Mathematics (5th 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 (4th Revised ed.)*, S.Chand& Co., Publishers, New Delhi (2000).
6) John Bird, *Higher Engineering Mathematics (5th ed.)*, Elsevier Ltd, (2006).

Subject Code: EBPH22002	Subject Name : ENGINEERING MECHANICS (FOR AUTO, MECH, CIVIL &ROBOTICS)	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Physics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- Basic principles of stress, strain and elastic constants.
- To draw shear force and bending moment diagram
- To find deflection of beams.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Articulate a strong foundation in understanding kinematics & Kinetics
CO2	Identify and use the fundamentals of mechanics, static and dynamic equilibrium
CO3	Enhance the problem solving skill in statics and dynamics
CO4	Develop analytical skills to identify different types of motion
CO5	Articulate models to acquire knowledge on mathematical, analytical skills

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2									1
CO2	3	3	2									1
CO3	3	3	2	1								1
CO4	3	3	2	1								1
CO5	3	3	3	1								1

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1		3		
CO2		3		
CO3		3		
CO4		3		
CO5		3		

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBPH22002	Subject Name : ENGINEERING MECHANICS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Physics	Ty	3	0/0	0/0	3

UNIT I STATICS OF PARTICLE **9**

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 **9**

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 **9**

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 **9**

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 **9**

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.

Total No. of Periods: 45

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., 3rd 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*

Subject Code **EBCH22002**	Subject Name :**INDUSTRIAL CHEMISTRY**	**Ty/Lb/ ETL**	**L**	**T/SLr**	**P/R**	**C**
	Prerequisite :Engg. Chemistry	**Ty**	**3**	**0/0**	**0/0**	**3**

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

OBJECTIVES :

1.Tounderstand and apply the basic concepts of fuels and combustion in automobiles.
2. To analyze the moisture and protein in food through physical and chemical methods.
3.To detect the industrial development aiming at job creators.
4.To demonstrate the operations of pulp and paper Industry.
5. To illustrate the fundamentals of industrial wastewater treatment.

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	**Reproduce the understanding of industry oriented chemical science**
CO2	**Analyze the solutions for industrybased problems for sustainable development following professional ethics.**
CO3	**Apply appropriate techniques for industrial development as a resource of life long learning.**
CO4	**Develop the reasoning nature by the knowledge acquired to assess the health and safety issues.**
CO5	**Describe the tools used to apply the engineering knowledge**

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1			1							2
CO2	2	3	2	1		2	3	2				2
CO3	2	2	2	1	2		1					2
CO4	2	3	1	1		3	2	2				2
CO5	2	1			3							2

COs/PSOs	PSO1	PSO2	PSO3	PSO4
CO1				3
CO2				3
CO3				3
CO4				3
CO5				3

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 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 **EBCH22002**	Subject Name :**INDUSTRIAL CHEMISTRY**	**Ty/Lb/ ETL**	**L**	**T/SLr**	**P/R**	**C**
	Prerequisite :Engineering Chemistry	**Ty**	**2**	**0/1**	**0/0**	**3**

UNIT – 1 FUELS & COMBUSTION **9**

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 **9**

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 **9**

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

UNIT – 4 BUSINESS CHEMICALS **9**

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

UNIT – 5 INDUSTRIAL WASTES AND TREATMENT PROCESS **9**

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.

Total No. of Periods: 45

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*, 2nd Edition, Volume 8, Noyes Publications, William Andrew Publishing, LLC.

Subject Code	Subject Name : ENGINEERING GRAPHICS	Ty/Lb/ ETL	L	T/SLr	P/R	C
EBME22001	Prerequisite : None	Ty	2	0/0	2/0	3

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 acquire knowledge in geometrical drawing.
- To expose the students in computer aided drafting**.**

COURSE OUTCOMES (Cos)
Students completing this course were able to

CO1	Utilize the concept of Engineering Graphics Techniques to draft letters, Numbers, Dimensioning in Indian Standards
CO2	Demonstrate the drafting practice visualization and projection skills useful for conveying ideas in engineering applications.
CO3	Identify basic sketching techniques of engineering equipments
CO4	Demonstrate the projections of Points, Lines, Planes and Solids. And
CO5	Draw the sectional view of simple building drawing.

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**			**1**					**1**		**1**
CO2	**3**	**3**	**2**		**2**					**1**		**1**
CO3	**3**	**3**	**1**		**1**					**1**		**1**
CO4	**3**	**3**	**2**		**2**					**1**		**1**
CO5	**3**	**3**	**3**		**2**					**1**		**1**

COs/PSOs	PSO1	PSO2	PSO3	PSO4
CO1		2		
CO2		2		
CO3		**3**		
CO4		**3**		
CO5		**3**		

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 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 EBME22001	Subject Name : ENGINEERING GRAPHICS	Ty/Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite : None	Ty	2	0/0	2/0	3

CONCEPTS AND CONVENTIONS (Not for examination) **5**

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 I PROJECTION OF POINTS, LINES AND PLANE SURFACES **12**

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – projection of polygonal surface and circular lamina in simple position only.

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 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, cylinders, 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. Bhatt, N.D. and Panchal, V.M. (2014) Engineering Drawing Charotar Publishing House
2. Gopalakrishnan, K.R. (2014) Engineering Drawing (Vol.I& II Combined) Subhas Stores, Bangalore.
3. Natrajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.
4. Venugopal K. and Prabhu Raja V., “Engineering Graphics", New Age International (P) Limited, 2008.

Subject Code: EBME22002	Subject Name : ENGINEERING METALLURGY	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Physics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To understand different materials and their metallurgical properties.

COURSE OUTCOMES (COs) : (3- 5) Students will be able to

CO1	Understand the fundamentals of materials and characterization (Level 2)
CO2	Comprehend the properties and applications of ferrous and non ferrous metals (Level 2)
CO3	Demonstration about phase diagrams and applying the fundamentals of Heat treatment (Level 3)
CO4	Analyzing and comparing the mechanisms behind deformation ,strengthening and failure of metals (Level L4)
CO5	Evaluation and selection of Metals ,Non metals and newer materials (Level L5)

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	1							1
CO2	2	1	2	1	-							1
CO3	3	3	3	3	2							1
CO4	3	3	3	3	3							1
CO5	2	3	2	2	2							1

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1		2	1					
CO2		2	2					
CO3		3	2					
CO4		3	2					
CO5		2	2					

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22002	Subject Name : ENGINEERING METALLURGY	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite:	Ty	3	0/0	0/0	3

UNIT- I: CRYSTALLOGRAPHY AND STRENGTHENING MECHANISMS **9**

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 **9**

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 **9**

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 **9**

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 **9**

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

Total No. of Periods: 45

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.*

Subject Code EBCC22I02	Subject Name : COMMUNICATIVE ENGLISH LAB	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Pass in Plus 2 English	IE	1	0/0	1/0	1

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 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/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								1		3	1	3
CO2								1		3	1	3
CO3								1		3	1	3
CO4								1		2	1	3
CO5								1		3	1	3

COs/PSOs	PSO1	PSO2	PSO3	PSO4
CO1				
CO2				
CO3				
CO4				
CO5				

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 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 **EBCC22I02**	Subject Name : **COMMUNICATIVE ENGLISH LAB**	**Ty/Lb/ ETL/IE**	**L**	**T/SLr**	**P/R**	**C**
	Prerequisite :Pass in Plus 2 English	**IE**	**1**	**0/0**	**1/0**	**1**

UNIT I LISTENING **3**

Authentic audios and videos

Prescribed Book: English Pronunciation in use – Mark Hancock,

UNIT IISPEAKING **3**

Individual- Solo: Self introduction, Describing, anchoring, welcome address, vote of thanks,

Pair & Group: Role play- formal -informal, narrating stories, film review, analyzing newspaper headings and reports, interpreting Advertisement pamphlets

Group discussion, mock interviews, formal presentation, power point presentation

Prescribed Book: J. C. Richards with J. Hull &S.Proctor, Interchange, Cambridge University Press, 2015.

UNIT III READING **3**

Extensive, focused reading,

Strategies for effective reading - Reading comprehensions – Note making- summarizing- paraphrasing, Review

Suggested reading: Short stories, news paper reports, film reviews

UNIT IV WRITING **3**

Extensive writing practices – note taking, Cognitive and meta cognitive strategies to inculcate a sense of organizing ideas into coherent sentences and paragraphs, Formal letters, Business letters. Resume with covering letter

UNIT VNON VERBAL COMMUNICATION/ CHARTS, DIAGRAMS AND TABLE **3**

Interpretation of charts Flow chart, pie chart, bar diagram, table, tree diagram, etc.

Total No. of Periods: 15

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

Subject Code: EBCS22ET2	PYTHON PROGRAMMING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: C Programming and MS office tools	ETL	1	0/0	2/0	2

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

OBJECTIVE : The student should be made to:

- Develop a basic understanding of *programming* and the *Python programming* language
- Write programs in Python to solve real world problems
- See the value of *programming* in a variety of different disciplines, especially as it relates in engineering.

COURSE OUTCOMES (COs) :After Completing the course, the student can be able to

CO1	Remember the syntax and semantics of python programming language
CO2	Understand how functional and operations are to be utilized
CO3	Applythe fundamental programming constructs like variables, conditional logic, looping, and functions to build basic programs
CO4	design object-oriented programs with Python classes
CO5	Apply the knowledge to solve various real world problems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					3						2	2
CO2					3						2	2
CO3					3						3	2
CO4					3						3	2
CO5					3						2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1				2
CO2				2
CO3				2
CO4				2
CO5				2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
		✓										

EBCS22ET2	**PYTHON PROGRAMMING**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: C Programming and MS office tools	**ETL**	**1**	**0/0**	**2/0**	**2**

UNIT I: INTRODUCTION **9**

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 **9**

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 **9**

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

UNIT IV:LISTS, TUPLES, DICTIONARIES **9**

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 **9**

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.

Subject Code: EBCC22I03	Subject Name: ENVIRONMENTAL SCIENCE (Audit course)	Ty/Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite: Engineering Chemistry	**IE**	**1**	**0/0**	**0/0**	**NC**

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 acquire knowledge of the Environment and Ecosystem & Biodiversity
- To acquire knowledge of the different types of Environmental pollution
- To know more about Natural Resources
- To gain understanding of social issues and the Environment
- To attain familiarity of human population and Environment

COURSE OUTCOMES (COs): (3 – 5)
Students completing the course were able to

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	Identify its problems and concerns climate change, global warming, acid rain, ozone layer depletion etc.,
CO5	Explain family welfare programmes and role of information technology in human health and environment

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8		PO9	PO10	PO11	PO12
CO1	2	1	2			2	3						1
CO2	2	2	2			2	3						1
CO3	2	2	2			2	3						1
CO4	2	3	2			2	3						1
CO5	1	1	2			2	3	2					1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives		Practical / Project	Internships / Technical Skills	Soft Skills
			✓							

Subject Code: EBCC22I03	Subject Name: ENVIRONMENTAL SCIENCE	Ty/Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite: Engineering Chemistry	**AUDIT 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).

References

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

SEMESTER III

Subject Code: EBMA22005	Subject Name : Mathematics III for Mechanical and Civil Engineers	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
	Prerequisite: Mathematics I & II	**Ty**	**3**	**1/0**	**0/0**	**4**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Basic mathematical tools and techniques which emphasize the development of rigorous logical thinking and analytical skills.
- Theory and applications of partial differential equation, its applications, Fourier series, transforms and Laplace transformation.

COURSE OUTCOMES (COs) : (3- 5) The students will be able to

CO1	Understand the concepts of Partial Differential equations
CO2	Determine the Fourier series solutions
CO3	Apply the concepts of PDE in Wave and Heat problems
CO4	Apply Laplace transforms in Engineering problems
CO5	Apply Fourier transforms in Engineering problems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	1	1	1							**1**
CO2	3	3	**2**	2	2							**1**
CO3	**3**	**3**	**3**	2	**2**							**1**
CO4	**3**	**3**	**2**	2	**2**							**1**
CO5	**3**	**3**	**2**	2	2							**1**

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	**3**	**2**	**1**	3				
CO2	**2**	**2**	**1**	3				
CO3	**2**	**2**	**2**	3				
CO4	**2**	**1**	**1**	3				
CO5	**2**	**2**	**2**	3				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBMA22005	Subject Name : Mathematics III for Mechanical and Civil Engineers	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Mathematics I & II	Ty	3	1/0	0/0	4

UNIT- I: PARTIAL DIFFERENTIAL EQUATIONS **12**

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 **12**

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 **12**

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 **12**

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 **12**

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

Total No. of Periods : 60

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 (9th ed.), John Wiley & Sons.
3) Grewal B.S. (2012), Higher Engineering Mathematics, Khanna Publishers.

Subject Code: EBME22003	Subject Name : ENGINEERING THERMODYNAMICS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Physics	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial S Lr : Supervised Learning P : Practical R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: OBJECTIVE: The students will learn

- The fundamentals of thermodynamics and thermodynamic relations
- Properties of Steam and its applications.
- Different thermodynamic cycles

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand the basic concepts and laws of thermodynamics.(Level 1&2)
CO2	Apply the first and second law of thermodynamics to the engineering processes and devices.(Level 3)
CO3	Understand the concepts of entropy and its engineering applications.(Level 2)
CO4	Apply the properties of pure substances in various applications. (Level 3)
CO5	Analyze the thermal performance of various power cycles.(Level 4)

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	2	-	-	-	-	2	3
CO2	3	3	2	-	2	-	-	-	-	-	-	2
CO3	3	2	3	1	3	2	-	-	-	-	2	2
CO4	3	3	3	2	3	-	-	-	-	-	-	2
CO5	3	3	2	2	3	3	-	-	-	-	2	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	2	2	3				
CO2	3	2	-	2				
CO3	2	3	2	2				
CO4	3	3	-	2				
CO5	3	3	2	2				

3/2/1 indicates Strength of Correlation: 3- High, 2- Medium, 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: EBME22003	Subject Name : ENGINEERING THERMODYNAMICS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Physics	Ty	3	1/0	0/0	4

UNIT- I: BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS **12**

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 **12**

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 **12**

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 **12**

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

UNIT- V: THERMODYNAMIC RELATIONS **12**

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, 8th edition.

REFERENCES

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

Subject Code: EBME22004	Subject Name: MANUFACTURING TECHNOLOGY - I	Ty/Lb/ETL	L	T/S Lr	P/R	C
	Prerequisite: NIL	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial S Lr : Supervised Learning P : Practical R : Research C: Credits
Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The purpose of study is to

- Impart knowledge in various manufacturing processes for metals and plastics
- Select the appropriate manufacturing process based on the application.

COURSE OUTCOMES (COs) : The student will be able to

CO1	Understand the various manufacturing processes for metals. (Level 2)
CO2	Demonstrate the operation of various manufacturing processes (Level 3)
CO3	Expose to advanced methods of manufacturing (Level 2)
CO4	Recommend the suitable manufacturing process depending on the requirement(Level 4)
CO5	Describe the manufacturing of plastic components/Products and their applications. (Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12
CO1	3	2	1	-	2	3	2	3	3	3	2	2
CO2	3	2	1	-	2	3	2	3	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 / PSOs	PSO1	PSO2	PSO3	PSO4
CO1				2
CO2	2	2	3	2
CO3	2	2	3	2
CO4	2	2	3	2
CO5	2	2	3	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Science	Engineering	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
				✓								

Subject Code: EBME22004	Subject Name : MANUFACTURING TECHNOLOGY - I	Ty/Lb /ETL	L	T/ SLr	P/R	C
	Prerequisite: NIL	Ty	3	0/0	0/0	3

UNIT- I: METAL CASTING PROCESSES **9**

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 **9**

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 **10**

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 **9**

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 **8**

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 ,7th edition.

REFERENCES

1) *Rao P.N. (2007), "Manufacturing Technology - Foundry Forging & Welding", Tata McGraw Hill Publishing Co., New Delhi, 2nd 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.*

Subject Code:	Subject Name : FLUID MECHANICS AND MACHINERY	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBCE22ID5	Prerequisite: Engineering Physics & Mathematics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Practical R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The students will learn

- The basic properties of fluids.
- Flow behaviour in various sections with basic equations
- Working principles of hydraulic pumps and turbines

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand the various properties of fluids.(Level 1&**2**)
CO2	Apply the basic concepts of fluid flow behavior in various sections and solve simple problems..(Level **3**)
CO3	Analyse the behaviors of fluid flow through circular conduits..(Level **4**)
CO4	Acquire the knowledge of construction and working principles of hydraulic turbines and pumps..(Level **2**)
CO5	Analyze the performance of hydraulic turbines and pumps.(Level **4**)

Mapping of Course Outcomes with Program Outcomes (POs):

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1										1
CO2	3	3	2	1								1
CO3	3	3	2	2								1
CO4	3	2	1	1								1
CO5	3	3	2	2								1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1				2
CO2	2	1		2
CO3	3	1		2
CO4	3	1		2
CO5	3	1		2

3/2/1 indicates Strength of Correlation: 3- High, 2- Medium, 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: EBCE22ID5	Subject Name : FLUID MECHANICS AND MACHINERY	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Physics	Ty	3	0/0	0/0	3

UNIT- I: PROPERTIES OF FLUIDS **7**

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 **9**

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 **9**

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 **10**

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 **10**

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.

Total No. of Periods : 45

TEXT BOOKS

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., 9th 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.

Subject Code: EBEC22ET3	Subject Name : MICROPROCESSOR ARCHITECTURE AND EMBEDDED SYSTEMS	T / L/ ETL	L	T/SLr	P/R	C
	Prerequisite: Basic Electrical and Electronics Engineering	ETL	2	0/0	2/0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To study the architecture, addressing modes and assembly level programming of microprocessor.
- To understand the concepts of different peripherals and their applications
- To learn the functions of 8051 microcontroller.
- To know the fundamentals of embedded Systems

COURSE OUTCOMES (COs) : The students will be able to

CO1	Write assembly language program in 8085 and 8086 and understand the design of processors.
CO2	Show their ability to interface peripherals with microprocessors
CO3	To learn the functions of 8051 microcontroller
CO4	Understand the fundamentals of embedded system
CO5	Demonstrate the applications of embedded system.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	3							2
CO2	3	3	3	2	3							2
CO3	3	2	1	1	2							2
CO4	3	2	1	1	2							2
CO5	3	3	3	2	3							3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	3		3
CO2	2 2	3	1	3
CO3	2	2		3
CO4	3	2		3
CO5	3	3	2	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBEC22ET3	Subject Name : MICROPROCESSOR ARCHITECTURE AND EMBEDDED SYSTEMS	T / L/ ETL	L	T/SLr	P/R	C
	Prerequisite: Basic Electrical and Electronics Engineering	ETL	2	0/0	2/0	3

UNIT I INTEL 8 BIT, 16 BIT MICROPROCESSORS **9**

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.

UNIT II PERIPHERAL INTERFACING **9**

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 **9**

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 **9**

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 **9**

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:

1. Krishna Kant, "*Microprocessors and Microcontrollers, Architecture, programming and system design using 8*

2. 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:

1. Kenneth J. Ayala, "The 8086 Microprocessor: Programming & Interfacing the PC",Delmar Publishers, 2007.

2. Arnold S. Berger, "Embedded Systems Design- an Introduction to Processes, Tools & Techniques", CMP books, 2002

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

Subject Code: EBME22005	Subject Name: MACHINE DRAWING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basic Engineering Graphics	**Ty**	**2**	**0/0**	**2/0**	**3**

L : Lecture T : Tutorial S Lr : Supervised Learning P : Practical R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The purpose of study is to impart knowledge in fundamentals of machine drawing and assembly drawings.

COURSE OUTCOMES (COs) : The student will be able to

CO1	Understand the code of practice and BIS specification of basic machine elements. (Level 2)
CO2	Apply the fundamentals of machine drawing like fits, limits and tolerance analysis in manufacturing (Level 3)
CO3	Assemble the various machine parts of IC Engine components, Tail stock, Cotter Joint, Screw jack etc.(Level 6)
CO4	Sketch the isometric view and orthographic view of various machine parts . (Level 3)
CO5	Employ CAD tools to convert part drawing into orthographic views. (Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3			2	1					2	1
CO2	3	3	2	2	2	2			1		2	1
CO3	3	3	3	3	3	2	2	3	2	2	2	1
CO4	3	3	3	3	3	2	1	3	2	2		1
CO5	3	3			3	2		2			2	1

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	**2**
CO2	3	2	2	**2**
CO3	3	3	2	**2**
CO4	3	3	3	**2**
CO5	3	3	2	**2**

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22005	Subject Name : MACHINE DRAWING	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Graphics	Ty	2	0/0	2/0	3

UNIT- I - DRAWING STANDARDS **6**

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 **9**

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 **24**

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

Subject Code: EBCC22ET1	Subject Name : Universal Human Values: Understanding Harmony	T / L/ ETL/ IE	L	T / S.Lr	P/ R	C
	Prerequisite:	ETL	1	0/0	2/0	2

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

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

COURSE OUTCOMES (COs) : (3- 5): The students will be able to

CO1	Relate self and surroundings and identify responsibility in life
CO2	Associate human relationship and nature to handle problems and provide sustainable solutions
CO3	Develop critical ability and engage in reflective and independent Thinking
CO4	Show commitment towards understanding of values
CO5	Apply Human values in day to day setting in real life

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1	1		2	1		1	1		2
CO2			2	2	1	2	3	1		2		2
CO3			1	1	1	2			1	2		3
CO4			2		1	1	1	3	1	1		3
CO5			1			2	1	2	1	1		3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	
CO2	2	2	3	
CO3	3	2	2	
CO4	3	1	2	
CO5	2	2	1	

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBCC22ET1	Subject Name UNIVERSAL HUMAN VALUES	T / L/ ETL/IE	L	T / S.Lr	P/ R	C
	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*

Subject Code: EBME22L01	Subject Name: MANUFACTURING TECHNOLOGY LAB - I	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Manufacturing Technology - I	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial S Lr : Supervised Learning P : Practical R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- To impart practical exposure and skill in metal cutting processes of Lathe and Drilling machine.

COURSE OUTCOMES (COs) : The Students will be able to

CO1	Understand the operations of basic metal cutting process machines
CO2	Acquire skill in basic operations in metal cutting process machines
CO3	Practical skill in setting mechanism and process parameters for specific operations
CO4	Understand and prepare the moulds based on the need
CO5	Practical skill in welding operations

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2			2			1			2	**2**
CO2	2	2	1		3			1			2	**2**
CO3	2	3	2	2	3			1			2	**2**
CO4	2	2	2	2	2	1		1			2	**2**
CO5	2	2	2		3	1	2	1			2	**2**

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	2	**2**	**2**
CO2	2	2	**2**	**2**
CO3	2	3	**2**	**2**
CO4	2	2	**2**	**2**
CO5	2	2	**2**	**2**

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22L01	Name: MANUFACTURING TECHNOLOGYLAB - I	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
	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

Subject Code: EBME22L02	Subject Name : ENGINEERING METALLURGY LAB	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Metallurgy	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To impart knowledge and skill about microstructure and heat treatment processes
- Experimental methods of finding mechanical properties of materials

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COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the basic concept of specimen preparation for microstructure analysis
CO2	Describe the Time temperature transformation diagram (TTT) of different metals
CO3	Analyse the microstructure of non ferrous materials
CO4	Analyse the microstructure of ferrous materials
CO5	Determine the hardness of different materials

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		2	2			1			2	**3**
CO2	3	3	1	2	2			1			2	**3**
CO3	2	3	1	3	2			1			2	**3**
CO4	2	3	1	3	2			1			2	**3**
CO5	2	2		2	3			1			2	**3**

Cos / PSOs	PSO1	PSO2	PSO3	PSO4								
CO1	2	2	2									
CO2	2	2	2									
CO3	2	2	2									
CO4	2	2	2									
CO5	2	3	2									

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22L02	**Subject Name : ENGINEERING METALLURGY LAB**	**Ty/Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
	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

Total No. of Periods: 45

Subject Code: EBCE22IL4	Subject Name : FLUID MECHANICS AND MACHINERY LAB	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Fluid Mechanics and Machinery	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Different Methods of flow measurements
- To study the characteristics of hydraulic pumps.
- To study the characteristics of hydraulic turbines.

COURSE OUTCOMES (COs) :

CO1	Understand the concept of different methods of flow measurements
CO2	Determine the coefficient of discharge of Orifice and Venturimeter
CO3	Determine the friction factor for the pipes
CO4	Draw and analyze the performance characteristics curves of jet pump, gear pump, reciprocating pumps and centrifugal pumps
CO5	Draw and analyze the performance characteristics curves of hydraulic turbines

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		2	2			1			2	
CO2	3	3	1	3	3			1			2	
CO3	2	3		2	3			1			2	
CO4	2	3	2	3	3			1			2	
CO5	2	3	2	3	3			1			2	

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	
CO2	3	2	2	
CO3	3	3	2	
CO4	3	3	2	**3**
CO5	3	3	2	**3**

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBCE22IL4	Subject Name : FLUID MECHANICS AND MACHINERY LAB	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	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.

Total No. of Periods: 45

SEMESTER IV

Subject Code	Subject Name	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
EBMA22008	**:STATISTICAL AND NUMERICAL METHODS (FOR MECHANICAL AND CIVIL ENGINEERS)**					
	Prerequisite: First year Engineering Mathematics	**Ty**	**3**	**1/0**	**0/0**	**4**

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL : 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 Probability
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

CO1	Analyze Statistical data
CO2	Understand probability theory
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)

COs/POs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12
CO1	**3**	**3**	**1**	**2**	**1**							**1**
CO2	**3**	**3**	**1**	**1**								**1**
CO3	**3**	**3**	**2**	**2**	**2**							**1**
CO4	**2**	**3**	**2**	**2**	**2**							**1**
CO5	**3**	**2**	**2**	**2**	**1**							**1**

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	**2**		
CO2	1	**1**		
CO3	2	**1**		
CO4	2	**1**		
CO5	2	1		

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 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 :	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
EBMA22008	**STATISTICAL AND NUMERICAL METHODS (FOR MECHANICAL AND CIVIL ENGINEERS)**					
	Prerequisite: First year Engineering Mathematics	**Ty**	**3**	**1/0**	**0/0**	**4**

UNIT I BASICS OF STATISTICS **12**

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 **12**

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 **12**

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 **12**

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).
6) Kandasamy P., Thilagavathy, Gunavathy K., *Numerical Methods (Vol.IV)*, S.Chand& Co., (2008).

Subject Code: EBME22006	Subject Name : STRENGTH OF MATERIALS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Mechanics	**Ty**	**3**	**1/0**	**0/0**	**4**

L : Lecture T : Tutorial SLr : Supervised Learning P : Practical R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: **The student will learn**

- Basic principles of stress, strain and elastic constants
- To draw shear force and bending moment diagrams
- to find deflection of beams

COURSE OUTCOMES (COs) : The student will be able to

CO1	Understand the concepts of mechanics of solids (Level 2)
CO2	Analyze the stresses involved due to different types of loading (Level 4)
CO3	Apply the different theories of mechanics (Level 3)
CO4	Derive the expression for deflection and bending moment (Level 4)
CO5	Use mathematical approach to analyze the stresses involved (Level 4)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2				2		1			2	2
CO2	3	3	2		2			1				2
CO3	3	2			3	2		1			2	2
CO4	3	3	3	2	3			1			1	2
CO5	3	3	2	2	3	3		1			2	2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2
CO2	3	2	1	2
CO3	3	3	2	2
CO4	3	3	1	2
CO5	3	3	2	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
			✓								

Subject Code: EBME22006	Subject Name : STRENGTH OF MATERIALS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Mechanics	Ty	3	1/0	0/0	4

UNIT- I: STRESS, STRAIN AND DEFORMATION OF SOLIDS **12**

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 **12**

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 12

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 **12**

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 **12**

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.*

Subject Code: EBME22007	Subject Name: MECHANICS OF MACHINES-I	T / L/ ETL	L	T / S. Lr	P/ R	C
	Pre requisite: Engineering Mechanics	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial S Lr : Supervised Learning P : Practical R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The purpose of study is to understand and apply the different concepts of mechanics.

COURSE OUTCOMES (COs) : The student will be able to

CO1	Understand the fundamental concepts of mechanism and their applications. (Level 2)
CO2	Analyze the different links of a mechanism. (Level 4)
CO3	Draw the displacement, velocity and acceleration for different mechanisms. (Level 3)
CO4	Compare the different types of rigid transmission systems and their applications. (Level 3)
CO5	Illustrate the various frictions in machine drives. (Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1		2	2					1	2
CO2	3	3	2		2	2					1	2
CO3	3	2	3	2		2					1	2
CO4	3	3	3	2	2	2					1	2
CO5	3	3	3	3	3	2					1	2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4			
CO1		3					
CO2		3					
CO3		3					
CO4		3					
CO5		3					

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
			✓								

Subject Code: EBME22007	Subject Name : MECHANICS OF MACHINES -I	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Mechanics, Strength of Materials	Ty	3	1/0	0/0	4

UNIT I BASICS OF MECHANISMS 12

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 12

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 12

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 12

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 12

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 ,5th 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.*

Subject Code: EBCS22ID5	Subject Name : ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	Ty / Lb/ ETL	L	T/ S.Lr	P/ R	C
	Prerequisite: Mathematics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and machine learning

COURSE OUTCOMES (COs) : Students will:

CO1	Understand different types of AI agents and know various AI search algorithms
CO2	Apply knowledge representation, reasoning, and machine learning techniques to real-world problems in terms of data management
CO3	Analyse the statistical data for decision making
CO4	Describe the concepts in machine learning
CO5	Apply knowledge of AI in robotics

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3							1
CO2	3	3	3	3	3							2
CO3	3	3	2	2	2							1
CO4	3	3	2	2	3							1
CO5	3	3	3	3	3							2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	3		3
CO2	2	3	1	3
CO3	1	2		3
CO4	1	3		3
CO5	2	3	1	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 : ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
EBCS22ID5	Prerequisite: Mathematics	Ty	3	0/0	0/0	3

UNIT 1: INTRODUCTION OF AI AND ML **9**

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 **9**

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 **9**

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

UNIT 4: MACHINE LEARNING **9**

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 **9**

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.

Subject Code: EBME22ET2	Subject Name: ENGINEERING METROLOGY	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Physics	ETL	2	0/0	2/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Technique of measurement using different types of precision measuring instruments

OURSE OUTCOMES (COs) :

CO1	Understand the fundamentals of precision measurements (Level 2)
CO2	Gain theoretical and practical knowledge about the linear and angular measurements (Level 3)
CO3	Demonstrate the different types of form measurements (Level 3)
CO4	Select the appropriate precision measuring instrument based on the component drawing (Level 4)
CO5	Exposed to the recent advancement in metrology (Level 2)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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								2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4			
CO1		2	2				
CO2		2	2				
CO3		2	2				
CO4		2	2				
CO5		2	2				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 : ENGINEERING METROLOGY	Ty/Lb/ ETL	L	T/ SLr	P/ R	C
EBME22ET2	Prerequisite: Engineering Physics	ETL	2	0/0	2/0	3

UNIT- I: INTRODUCTION TO METROGY **10**

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,
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 **10**

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.

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Lab Components:

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

UNIT- III: LASER METROLOGY **7**

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 **9**

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 **9**

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..

Total No. of Periods: 45

TEXT BOOK

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

REFERENCES

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

Subject Code: EBCC22I04	Subject Name : THE INDIAN CONSTITUTION (Audit course)	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
	Prerequisite: NIL	IE	2	0/0	0/0	0

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: CreditsT/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To provide an overview of the history of the making of Indian Constitution
- To understand the preamble and the basic structures of the Constitution.
- To Know the fundamental rights, duties and the directive principles of state policy
- To understand the functionality of the legislature , the executive and the judiciary

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Understand the history of making of Indian Constitution
CO2	Understand the preamble and the basic structures of the Constitution
CO3	Describe the fundamental rights, duties and the directive principles of state policy
CO4	Describe the Emergency powers of the government
CO5	Understand the Special Provisions for Jammu and Kashmir, Nagaland and Other Regions and Amendments

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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 / PSOs	PSO1	PSO2	PSO3
CO1	1	1	2
CO2	1	1	2
CO3	1	1	2
CO4	1	1	2
CO5	1	1	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBCC22I04	Subject Name : THE INDIAN CONSTITUTION (Audit course)	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
	Prerequisite: NIL	IE	2	0/0	0/0	0

UNIT 1 **3**

The History of the Making of Indian Constitution, Preamble and the Basic Structures

UNIT 2 **3**

Fundamental Rights and Duties , Directive Principles of State Policy

UNIT 3 **3**

Legislature, Executive and Judiciary

UNIT 4 **3**

Emergency Powers

UNIT 5 **3**

Special Provisions for Jammu and Kashmir, Nagaland and Other Regions, Amendments

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, Oxford University Press, New Delhi, 2008.*
2. *Granville Austin, The Indian Constitution: Cornerstone of a Nation, Oxford University Press, Oxford, 1966.*
3. *Zoya Hassan, E. Sridharan and R. Sudarshan (eds), India's Living Constitution: Ideas,Practices, Controversies, Permanent Black, New Delhi, 2002*
4. *Subhash C. Kashyap, Our Constitution, National Book Trust, New Delhi, 2011.*

Subject Code: EBCC22I05	Subject Name : THE INDIAN TRADITIONAL KNOWLEDGE (Audit course)	Ty/Lb/ ETL/I E	L	T/ SLr	P/R	C
	Prerequisite: NIL	**IE**	**2**	**0/0**	**0/0**	**0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the Pre- colonial and Colonial Period, Indian Traditional Knowledge System
- To understand the Traditional Medicine, Traditional Production and Construction Technology
- To Know the History of Physics and Chemistry, Traditional Art and Architecture and Vastu Shashtra, Astronomy and Astrology
- To understand the Origin of Mathematics, Aviation Technology in Ancient India, Crafts and Trade in Ancient India

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Understand the Pre- colonial and Colonial Period, Indian Traditional Knowledge System
CO2	Describe the Traditional Medicine, Traditional Production and Construction Technology
CO3	Understand the history of Physics and Chemistry, Traditional Art and Architecture and Vastu Shashtra, Astronomy and Astrology
CO4	Understand the Origin of Mathematics, Aviation Technology in Ancient India, Crafts and Trade in Ancient India
CO5	Understand the TKS and the Contemporary World, Indian union and IT Revolution

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3	3	1		2				2		1
CO2		3	3	1		2				2		1
CO3		3	3	1		2				2		1
CO4		3	3	1		2				2		1
CO5		3	3	1		2				2		1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	
CO2	1	1	2	
CO3	1	1	2	
CO4	1	1	2	
CO5	1	1	2	

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

	Basic Science	Engineering	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical			
Category							✓					

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

UNIT I **3**

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

UNIT II **3**

Traditional Medicine, Traditional Production and Construction Technology

UNIT III **3**

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

UNIT IV **3**

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

UNIT V **3**

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, 1st Edition, Delhi University (North Campus)
2. Dr.A.K.Ghosh (2011), Traditional Knowledge of Household Products

Subject Code: EBME22L03	Subject Name : STRENGTH OF MATERIALS LAB	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Metallurgy	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To determine the mechanical properties of steel rod using Universal testing machine
- To test the hardness of steel, CAOPPER and Aluminium

COURSE OUTCOMES (COs) : The student will be able to	
CO1	Understand the stress strain diagram of steel rod. (Level 2)
CO2	Determine the Hardness testing of Steel, Copper and Aluminium
CO3	Estimate the Spring constant, under Tension and Compression
CO4	Estimate the notch toughness of steel using Izod impact testing machine
CO5	Study the mechanical properties of Steel and Cast iron specimen using Universal testing machine.

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		2	2			1			2	3
CO2	3	2		2	2			1			2	3
CO3	2	2		2	2			1			2	2
CO4	2	3	1	2	2			1			2	2
CO5	3	3	1	3	2	3	2	2			2	3

Cos / PSOs	PSO1	PSO2	PSO3	PSO4								
CO1	2	2	2	2								
CO2	3	3	2	2								
CO3	2	2	2	2								
CO4	2	2	2	2								
CO5	2	2	2	2								

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22L03	Subject Name : STRENGTH OF MATERIALS LAB	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	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.

Total No. of Periods: 45

Subject Code: EBCS22IL4	Subject Name : ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB	Ty / Lb/ ETL	L	T/ S.Lr	P/ R	C
	Prerequisite: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and machine learning

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	Demonstrate the working of the decision tree based ID3 algorithm
CO3	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file.
CO4	Apply EM algorithm to cluster a set of data stored in a .CSV file
CO5	Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set using Java/Python ML library.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2			3			1			2	2
CO2	2	3	2	2	3			1			2	3
CO3	2	3	2	2	3			1			2	3
CO4	2	3	2	3	3			1			2	3
CO5	2	3	2	2	3			1			2	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	3
CO2	2	3	2	3
CO3	3	3	2	3
CO4	2	3	2	3
CO5	2	3	2	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBCS22IL4	Subject Name : ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	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.
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Total No. of Periods: 45

Subject Code: EBME22I01	Subject Name: TECHNICAL SKILL-I	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
	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

SubjecCode: EBCC22I06	Subject Name: SOFT SKILLS I-EMPLYABILITY SKILL	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
	Pre requisite: None	IE	0	0/0	2/0	1

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will

- To create awareness in students, various top companies helping them improve their skill set matrix, leading to develop a positive frame of mind.
- To help students be aware of various techniques of candidate recruitment and help them prepare CV's and resume.
- To help student how to face various types of interview, preparing for HR, technical interviews.
- To help students improve their verbal reading, narration and presentation skills by performs various mock sessions.

COURSE OUTCOMES (COs) :

CO1	Be aware of various top companies leading to improvement in skills amongst them.
CO2	Be aware of various candidate recruitment techniques like group discussion, interviews and be able to prepare CV's and resumes.
CO3	Prepare for different types of interviews and be prepared for HR and technical interviews.
CO4	Improve their verbal, written and other skills by performing mock sessions.
CO5	Participation of group discussion and aptitude tests

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	2	2	3	2	3	3	3
CO2	1	1	1	1	1	2	2	3	2	3	3	3
CO3	1	1	1	1	1	2	2	3	2	3	3	3
CO4	1	1	1	1	1	2	2	3	2	3	3	3
CO5	1	1	1	1	1	2	2	3	2	3	3	3

Cos / PSOs	PSO1	PSO 2	PSO3	PSO4				
CO1								
CO2								
CO3								
CO4								
CO5								

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBCC22I06	Subject Name : SOFT SKILLS I-EMPLYABILITY SKILL	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
	Prerequisite: None	**IE**	**0**	**0/0**	**2/0**	**1**

UNIT I **6**

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

UNIT II **6**

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

UNIT III **6**

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.

UNIT IV **6**

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

UNIT V **6**

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

SEMESTER V

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

L : Lecture T : Tutorial SLr : Supervised Learning P : Practical R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: **The student will learn**

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into the analysis of cyclic process.
- To apply the thermodynamic concepts into various thermal applications like, IC engines Steam turbines, Gas Turbines.

COURSE OUTCOMES (COs) : The student will be able to

CO1	Demonstrate the working principles of steam generators, condensers and nozzles and solve the problems.(Level3)
CO2	Analyze the performance of single and multistage air compressors and gas turbines.(Level 4)
CO3	Construct the velocity diagram of steam turbine and determine its performance.(Level 3)
CO4	Acquire the knowledge of IC engines and estimate the performance parameters. (Level 2)
CO5	Understand the analyze the different refrigeration and air conditioning system. (Level 2& 4)

Mapping of Course Outcomes with Program Outcomes (Pos)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	3	2	2			2		1		1	2	
CO2	3	3	2	2	1	2					1	2	
CO3	3	3	2	3	2						1	2	
CO4	3	2	2	2		2	2		2		1	2	
CO5	3	2	2	3	2	2	2		2		1	2	

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3			2				
CO2	3			2				
CO3	3			2				
CO4	3			2				
CO5	3			2				

3/2/1 indicates Strength of Correlation: 3- High, 2- Medium, 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: EBME22008	Subject Name : THERMAL ENGINEERING	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Thermodynamics	Ty	3	0/0	0/0	3

UNIT- I: STEAM GENERATORS, CONDENSERS AND NOZZLE **9**

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 ratio-effect of friction.

UNIT- II: AIR COMPRESSORS AND GAS TURBINES **9**

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 **9**

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

UNIT- IV: INTERNAL COMBUSTION ENGINES **9**

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 **9**

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, 4th edition.

Subject Code: EBME22009	Subject Name : MECHANICS OF MACHINES –II	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering Mechanics, Mechanics of Machine-I	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Practical R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The purpose of study is to understand and apply the dynamic analysis of machineries.

COURSE OUTCOMES (COs) : The student will be able to

CO1	Understand the force analysis of reciprocating mechanisms and its application. (Level 2).
CO2	Classify the vibratory systems and identify the equations of different mechanical systems. (level 3)
CO3	Solve the problems of the vibratory systems. (Level 3).
CO4	Demonstrate the dynamic balancing of rotating and reciprocating masses.(level 3)
CO5	Distinguish the different speed governors and their characteristic curves (level 4).

Mapping of Course Outcomes with Program Outcomes (Pos)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2								2
CO2	3	3	2	2								2
CO3	3	3	2	2								2
CO4	3	3	3	2								2
CO5	3	3	2	2								2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1		3		
CO2		3		
CO3		3		
CO4		3		
CO5		3		

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22009	Subject Name : MECHANICS OF MACHINES –II	Ty/Lb/ ETL	L	T/ SLr	P/ R	C
	Prerequisite: Engineering Mechanics, Mechanics of Machine-I	Ty	3	1/0	0/0	4

UNIT I FORCE ANALYSIS AND FLYWHEELS 12

Static force analysis of mechanisms – D ' Alembert's 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 12

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

UNIT III FREE VIBRATION 12

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 12

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 12

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.*

Subject Code: EBME22ET3	Subject Name : MANUFACTURING TECHNOLOGY - II	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Manufacturing Technology - I	ETL	2	0/0	2/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To impart knowledge and skill in metal cutting process and smart manufacturing technology

.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the concepts of metal cutting and related information (Level 2)
CO2	Acquire skill in special purpose machines (Level 4)
CO3	Select appropriate method of manufacturing based on the requirement (Level 4)
CO4	Understand the concepts and applications of smart manufacturing (Level 3)
CO5	Acquire skill in smart manufacturing techniques (Level 4)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1							2
CO2	3	3	3	2	3							2
CO3	3	3	3	2	2							2
CO4	3	2	2	2	3		1					2
CO5	3	3	3	3	3		1					2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1		3	3					
CO2		3	3					
CO3		3	3					
CO4		3	3					
CO5		3	3					

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 : MANUFACTURING TECHNOLOGY - II	T / L/ ETL	L	T / S.Lr	P/ R	C
EBME22ET3	Prerequisite: Manufacturing Technology - I	ETL	2	0/0	2/0	3

UNIT- I: THEORY OF METAL CUTTING **9**

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 **10**

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 **10**

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 **8**

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 **9**

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

Total No. of Periods: 45

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.

Subject Code: EBOL22I01	Subject Name: ONLINE COURSE NPTEL/SWAYAM/Any MOOC APPROVED BY AICTE/UGC	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	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: EBME22L04	Subject Name: DYNAMICS LAB	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Mechanics of Machines-I &II	**Lb**	**0**	**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

OBJECTIVES: The student will learn
- Working of simple mechanisms
- To find natural frequency of vibrating system at different models

COURSE OUTCOMES (COs) : The student will be able to

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**		2	**2**			**1**			**2**	**2**
CO2	**2**	**3**	1	3	**2**			**1**			**2**	**2**
CO3	**2**	**3**	1	3	**2**			**1**			**2**	**2**
CO4	**2**	**3**	2	2	**2**			**1**			**2**	**2**
CO5	**2**	**3**	2	3	**2**			**1**			**2**	**2**

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	**2**	**2**	**2**	**3**				
CO2	**2**	**2**	**2**	**3**				
CO3	**2**	**2**	**2**	**3**				
CO4	**2**	**2**	**2**	**3**				
CO5	**2**	**2**	**2**	**3**				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 : DYNAMICS LAB	T / L/ ETL	L	T / S.Lr	P/ R	C
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

Total No. of Periods: 45

Subject Code:	Subject Name : THERMAL ENGINEERING LAB-I	T / L/ ETL	L	T / S.Lr	P/ R	C
EBME22L05	Prerequisite: Thermodynamics and ThermalEngineering	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- To evaluate the performance of steam turbines and IC engines.

COURSE OUTCOMES (COs) :

CO1	Understand the concept of working and performance of steam turbines
CO2	Analyze the performance and heat balance test of IC engines
CO3	Determine and Draw performance characteristics curve of IC engines
CO4	Determine 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 different fuels

Mapping of Course 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						2	
CO2	3	3	1	3	2						2	
CO3	2	3	2	3	2						2	
CO4	2	3	2	3	2						2	
CO5	2	3	2	3	2	1	1	1			2	
Cos / PSOs	PSO1		PSO2		PSO3		PSO4					
CO1	2		2		2							
CO2	2		2		2							
CO3	2		2		2							
CO4	2		2		2							
CO5	2		2		1							

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22L05	Subject Name : THERMAL ENGINEERING LAB-I	T / L/ ETL	L	T / S.Lr	P/ R	C
	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.

Total No. of Periods: 45

Subject Code: EBME22I02	Subject Name: TECHNICAL SKILL-II	T / L/ ETL/IE	L	T / S.Lr	P/ R	C
	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

Subject Code: EBME22010	Subject Name : HEAT AND MASS TRANSFER	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Thermodynamics	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Concept and modes of heat and mass transfer.
- Concept of various heat transfer correlations and their engineering calculations.
- Concept and types of heat exchangers

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the knowledge of Conduction heat transfer and its applications.
CO2	Apply the concept of forced and free convection heat transfer and its applications.
CO3	Explore the applications of radiation heat transfer.
CO4	Understand the knowledge of phase change heat transfer and heat exchangers in engineering applications.
CO5	Apply the mass transfer concepts in real-time applications.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1							**2**
CO2	3	3	2	2	2							**2**
CO3	3	2	2	1	1							**2**
CO4	2	3	2	2	2							**2**
CO5	3	3	2	2	2							**2**

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	**3**			
CO2	**3**			
CO3	**3**			
CO4	**3**			
CO5	**2**			

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Open Electives	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
				✓								

Subject Code: EBME22010	Subject Name : HEAT AND MASS TRANSFER	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Thermodynamics	Ty	3	1/0	0/0	4

UNIT- I: CONDUCTION **13**

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 **13**

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

UNIT- III: RADIATION **12**

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 **12**

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 **10**

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, 4th edition.
3) R.K.Rajput (2007) "Heat and Mass transfer", Chand Publishers

REFERENCES

1) J.P.Holman (2001) "Heat transfer", McGraw Hill Book Company, 9th 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.

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

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To provide an overview of how computers are being used in design, development of Manufacturing plans and manufacture
- To understand the need for integration of CAD,CAM and CIM

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the concepts and uses of various CAD devices (Level 2)
CO2	Apply various CAD modeling techniques (Level 3)
CO3	Understand the CNC machines and integeration of CAD/CAM (Level 2)
CO4	Analyze and write down part programming for lathe and milling operations (Level 4)
CO5	Apply group technology and computer aided process planning and understand the FMS concept and functions (Level 3)

Mapping of Course with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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							

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	3						
CO2	3	3						
CO3	3	3						
CO4	3	3						
CO5	3	3						

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22011	Subject Name : CAD,CAM & CIM	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Design of Machine Elements, Manufacturing Technology	**Ty**	**3**	**0/0**	**0/0**	**3**

UNIT- I INTRODUCTION **9**

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 **9**

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 **9**

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 **9**

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 **9**

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.

Total No. of Periods: 45

TEXT BOOKS

1) Chris McMohan and Jimmie Browne, *"CAD/CAM"*, Addison Wesley Publications, 2nd 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

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

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.

COURSE OUTCOMES (COs) : The Students will be able to

CO1	Understand and perform the failure analysis based on theories of failure. (Level 2)
CO2	Develop design thinking process and define the problem. (Level 6)
CO3	Design the machine elements like Shafts, Keys, Couplings and Bearings. (Level 6)
CO4	Select the appropriate type of spring based on the requirements. (Level 5)
CO5	Compare the various types of fasteners on strength and application aspects. (Level 4)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1					2	2
CO2	3	3	3		2							2
CO3	3	3	3	3		2					2	2
CO4	3	3	3		3	2					2	2
CO5	3	3	3	1	3	2		2			2	2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1		3	2	
CO2		3	2	
CO3		3	2	
CO4		3	2	
CO5		3	2	

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22012	Subject Name : DESIGN OF MACHINE ELEMENTS - I	Ty/Lb/ ETL	L	T/ SLr	P/R	C
Prerequisite:	**Engineering Mechanics, Strength of Materials, Mechanics of Machines -I**	**Ty**	**3**	**1/0**	**0/0**	**4**

UNIT- I: INTRODUCTION TO DESIGN OF MACHINE ELEMENTS **12**

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 **12**

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 **12**

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 **12**

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 **12**

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.
2. Shigley, J.E., Charles, R.M. and Richard, G.B., Mechanical Engineering Design, 7th ed., McGraw-Hill,
3. 2004.

Subject Code: EBME22L06	Subject Name : THERMAL ENGINEERING LAB-II	Ty/Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite: Thermal Engineering , Heat and Mass Transfer	**Lb**	**0**	**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

OBJECTIVES: The student will learn

- To evaluate the performance of air compressor, air blower and refrigeration and air conditioning systems.
- To determine the properties of different liquid fuels.
- 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	Determine the emissivity of a grey body. (Level 3)
CO4	Estimate the thermal conductivity of an insulating material and composite wall. (Level 4)
CO5	Measure the effectiveness of pinfin and parallel and counter flow heat exchanger. (Level 3)

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	3	2						2	1
CO2	2	2		2	2						2	1
CO3	2	2		2	2						2	2
CO4	2	3	2	3	3						2	1
CO5	2	3	2	3	2						2	1

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3			
CO2	3			
CO3	3			
CO4	3			
CO5	3			

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22L06	Subject Name : THERMAL ENGINEERING LAB-II	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Thermal Engineering , Heat and Mass 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..

Total No. of Periods : 45

Subject Code: EBME22L07	Subject Name: CAD/CAM LAB	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Pre requisite: CAD/CAM/CIM, Machine Drawing	Lb	0	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

OBJECTIVES: The student will

- Get practical knowledge through practice on CNC Machines and related software

OURSE OUTCOMES (COs) :

CO1	Understand the concepts of metal cutting and related information (Level 2)
CO2	Acquire skill in special purpose machines (Level 4)
CO3	Select appropriate method of manufacturing based on the requirement (Level 4)
CO4	Understand the concepts and applications of powder metallurgy (Level 3)
CO5	Expose to various advanced manufacturing processes of precision components (Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1							1
CO2	3	3	3	2	3							1
CO3	3	3	3	2	2						2	1
CO4	3	2	2	1	1							1
CO5	3	3	3	3	3						2	1

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1		3	3	2				
CO2		3	3	2				
CO3		3	3	2				
CO4		3	3	2				
CO5		3	3	2				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
				✓					✓			

Subject Code: EBME22L07	Subject Name : CAD / CAM LAB	Ty/Lb/ETL	L	T/SLr	P/R	C
	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

Total No. of Periods: 45

Subject Code: EBCC22I07	Subject: SOFT SKILLS II -QUALITATIVE AND QUANTITATIVE SKILLS	T / L/ ETL/I E	L	T / S.Lr	P/ R	C
	Prerequisite: Basic Mathematics.	**IE**	**0**	**0/0**	**2/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To bring behavioural patterns of students.
- To train them for corporate culture.
- To create self awareness.
- To build confidence.

To train the students for facing the interviews and develop interpersonal relationship.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Recognize and apply arithmetic knowledge in a variety of contexts.
CO2	Ability to identify and critically evaluate philosophical arguments and defend them from criticism.
CO3	Gain the skill in solving H.C.F & L.C.M – Problem and Profit & Loss problems.
CO4	Gain the skill in solving the problems in Permutations & Combinations
CO5	Data Interpretation using different graphs.

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2						1	1	1	2	**3**
CO2		2				2	2	1	2	1	2	**1**
CO3	2	2						1	1	1	2	**3**
CO4	2	2						1	1	1	2	**3**
CO5	2	3		1				1	2	1	2	**1**

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1			
CO2	1			
CO3	1			
CO4	1			
CO5	1			

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBCC22I07	Subject: SOFT SKILLS II - QUALITATIVE AND QUANTITATIVE SKILLS	T / L/ ETL/I E	L	T / S.Lr	P/ R	C
	Prerequisite: Basic Mathematics.	IE	0	0/0	2/0	1

UNIT I Logical Reasoning I **6**

Logical Statements – Arguments – Assumptions – Courses of Action.

UNIT II Logical Reasoning II **6**

Logical conclusions – Deriving conclusions from passages – Theme detection.

UNIT III Arithmetical Reasoning I **6**

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

UNIT IV Arithmetical Reasoning II **6**

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

UNIT V Data Interpretation **6**

Tabulation – Bar graphs – Pie graphs – Line graphs.

Total No of Periods: 30

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).*

Subject Code: EBME22I03	Subject Name: TECHNICAL SKILL-III	T / L/ ETL/IE	L	T / S.Lr	P/ R	C
	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: EBME22I04	Subject Name : MINI-PROJECT /INTERNSHIP	T / L/ ETL/IE	L	T / S.Lr	P/ R	C
		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: EBME22013	Subject Name: INDUSTRIAL AUTOMATION	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Pre requisite: Manufacturing Technology-I & II, Electrical and Electronics Engineering	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will gain

- knowledge in hydraulic, pneumatic and mechatronics system in Automation.

OURSE OUTCOMES (COs) :

CO1	Understand Pneumatic and hydraulic principles, components and functions (Level 2)
CO2	Analyze and Design the Pneumatic and hydraulic circuits for automation (Level 4)
CO3	Recognise the various components of mechatronics system (Level 2)
CO4	Discuss the various actuation systems and System models in automation (Level 3)
CO5	Design the Mechatronic system for the required automation (Level 4)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1						2	**2**
CO2	3	3	3	3	3						2	**2**
CO3	3	3	2	2	2						2	**2**
CO4	3	3	3	3	2						1	**2**
CO5	3	3	3	3	2						1	**2**

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	**3**
CO2	3	2	1	**3**
CO3	2	2	2	**3**
CO4	3	3	1	**3**
CO5	3	2	2	**3**

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22013	Subject Name : INDUSTRIAL AUTOMATION	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Pre requisite: Manufacturing Technology-I & II, Electrical and Electronics Engineering	Ty	3	0/0	0/0	3

UNIT- I BASIC PRINCIPLES OF HYDRAULICS AND PNEUMATICS **8**

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 **10**

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 **8**

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 **8**

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 **11**

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.

Total No. of Periods: 45

TEXT BOOKS

1) S.Ilango and V.Soundarrajan ,(2011) "*Introduction to Hydraulics and Pneumatics"*,Prentice hall india,2nd 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, 7th edition.

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

Subject Code: EBME22014	Subject Name: DESIGN OF MACHINE ELEMENTS - II	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Design of Machine Elements - I	**Ty**	**3**	**1/0**	**0/0**	**4**

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional andstrength requirements.

COURSE OUTCOMES (COs) :

CO1	Understand the design principles and selection procedures of flexible drives such as belts, ropes, chains and sprockets
CO2	Apply design procedures to analyze and design spur and helical gears based on strength and wear considerations.
CO3	Design bevel gears and worm gear drives by considering forces, stresses and efficiency requirements.
CO4	Develop speed reducer layouts using geometric progression, ray diagrams and kinematic arrangement of gears
CO5	Evaluate the performance and suitability of various clutches and braking systems for mechanical applications.

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	-	-	-	-	-	1	**2**
CO2	3	3	3	2	3	-	-	-	-	-	1	**2**
CO3	3	3	3	2	3	-	-	-	-	-	1	**2**
CO4	3	2	3	2	2	-					2	**2**
CO5	2	3	2	2	2	1					2	**2**

Cos / PSOs	PSO1	PSO 2	PSO3	PSO4
CO1		3	1	
CO2		3	1	
CO3		3	1	
CO4		3	2	
CO5		3	3	

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22014	Subject Name : DESIGN OF MACHINE ELEMENTS - II	Ty/Lb /ETL	L	T/ SLr	P/R	C
	Prerequisite: Design of Machine Elements - I	Ty	3	1/0	0/0	4

UNIT 1 DESIGN OF FLEXIBLE DRIVES **12**

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 **12**

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.

UNIT 3 BEVEL AND WORM GEARS **12**

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 **12**

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 **12**

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

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.

Subject Code: EBME22015	Subject Name: FINITE ELEMENT ANALYSIS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Strength of Materials, Design of Machine Elements-I	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Fundamentals of finite element analysis and their applications.
- Method of solving one, two and iso-parametric elements.

OURSE OUTCOMES (COs) :

CO1	Understand the basic concepts in Finite Element Method. (Level 2)
CO2	Identify the application and characteristics of Finite Element Analysis elements. (Level 2)
CO3	Develop the element characteristic equations and generation of global equations. (Level 6)
CO4	Analyze the suitable boundary conditions to a global equation of FEA elements. (Level 4)
CO5	Apply FEA software to analyze the machine elements. (Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2							2
CO2	3	3	2	2	2							2
CO3	3	3	3	2	2							2
CO4	3	3	3	2	2							2
CO5	3	3	3	2	2							2

Cos / PSOs	PSO1	PSO 2	PSO3	PSO4
CO1	2	2		3
CO2	2	2	2	3
CO3	3	3	2	3
CO4	3	2	1	3
CO5	3	2	2	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22015	Subject Name : FINITE ELEMENT ANALYSIS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Strength of Materials, Design of Machine Elements-I	Ty	3	1/0	0/0	4

UNIT- I INTRODUCTION **9**

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 **9**

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 **9**

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 **9**

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 TOPICS **9**

Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions – Serendipity elements – Numerical integration - Matrix solution techniques – Solutions 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.

Total No. of Periods: 45

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.*

Subject Code: EBME22ET4	Subject Name :VIRTUAL REALITY AND AUGMENTED REALITY	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: Manufacturing Technology, CAD|CAM, Thermal Engg.	ETL	2	0/0	2/0	3

L:LectureT:Tutorial SLr:SupervisedLearningP:ProjectR:ResearchC:Credits

T/L/ETL:Theory/Lab/EmbeddedTheoryandLab

OBJECTIVE:OBJECTIVE: The students will learn

- To introduce the relevance of this course to the existing technology through demonstrations, case studies and applications with a futuristic vision along with socio-economic impact and issues
- To understand virtual reality, augmented reality and using them to build Biomedical engineering applications

COURSEOUTCOMES(COs) : The students will be able to

CO1	Understand the physical principles of VR & AR
CO2	Create a comfortable, high-performance VR application using Unity
CO3	Analyze and understand the working of various state of the art VR & AR devices.
CO4	Analyze & Design a system or process to meet given specifications with realistic engineering constraints
CO5	Create and deploy a VR & AR application.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1		1	2							1
CO2	2	3	3	2	3				1	2		2
CO3	2	3	1	2	2							1
CO4	3	3	3	3	3				1	1	2	2
CO5	2	2	3	2	3				2	2	1	2

COs /PSOs	PSO1	PSO2	PSO3	PSO4
CO1		3		2
CO2		3	1	2
CO3		3		2
CO4		3	2	2
CO5		3	2	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22ET4	Subject Name: VIRTUAL REALITY AND AUGMENTED REALITY	Ty / Lb/ETL	L	T /S.Lr	P/ R	C
	Prerequisite: Manufacturing Technology, CAD|CAM, Thermal Engg.	ETL	2	0/0	2/0	3

UNIT I INTRODUCTION **9**

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 **9**

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 **9**

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 **9**

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.

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

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To get practical knowledge of modeling of various machine parts using Auto CAD and other modeling software.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the Basics of CAD Modeling Package
CO2	Draw the 2D diagram, part drawing and assembly drawing using Auto CAD
CO3	Understand the knowledge on design packages (Solid works and CATIA Software's)
CO4	Ability to draw the various machine parts using CATIA Software.
CO5	Analyze the material properties and deflections in Ansys Software

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1			3			1			2	**2**
CO2	2	2	2		3			1			2	**2**
CO3	2	2	1		3			1			2	**2**
CO4	2	2	2	1	3			1			2	**2**
CO5	2	3	2	3	3			1			2	**2**

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	**2**	**2**	**2**	
CO2	**2**	**2**	**2**	
CO3	**2**	**2**	**2**	
CO4	**2**	**2**	**2**	
CO5	**3**	**3**	**3**	

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22L08	Subject Name : DESIGN AND SIMULATION LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ 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

Total No. of Periods:45

Subject Code: EBME22L09	Subject Name: INDUSTRIAL AUTOMATION LAB	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Pre requisite: Industrial automation	Lb	0	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

OBJECTIVES: The student will learn

- To practice simple programs on microprocessors and micro controllers.
- To design and implement pneumatic and hydraulic circuits with automation studio software andwith kits

OURSE OUTCOMES (COs) :

CO1	Recognize the various components of Hydraulics and Pneumatic circuits (Level 2)
CO2	Design and implement hydraulic circuits with automation studio software and kit (Level 4)
CO3	Design and implement pneumatic circuits with automation studio software and kit (Level 4)
CO4	Understand the concepts and applications of robots (Level 2)
CO5	Write programming for controllers in automation (Level 4)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1			2			1			2	2
CO2	2	3	2	2	3			1			2	2
CO3	2	3	2	2	3			1			2	2
CO4	2	2	1		2			1			2	2
CO5	2	3	2	2	3			1			2	2

Cos / PSOs	PSO1	PSO 2	PSO3	PSO4
CO1	2	2	2	3
CO2	2	3	2	3
CO3	2	3	2	3
CO4	2	2	2	3
CO5	2	3	2	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22L09	Subject Name : INDUSTRIAL AUTOMATION LAB	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	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.

Total No. of Periods: 45

Subject Code: EBME22I05	Subject Name: PROJECT PHASE-I	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
	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: EBFL22IXX	Subject Name : FOREIGN LANGUAGE	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
	Pre Requisite: Nil	IE	1	0/0	1/0	1

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: CreditsT/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The main objective of this course is to equip the students with one foreign language which will enable them forhigher studies/professional career abroad

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students will gain the knowledge of identifying phonetics of all the letters in one foreign language
CO2	Students will gain the knowledge of reading small words and in one foreign language
CO3	Students will gain the knowledge of writing skill in one foreign language.
CO4	Students will gain the knowledge of reading skill in one foreign language
CO5	Students will gain the knowledge of spoken skill in one foreign language

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										3		2
CO2										3		2
CO3									2	3		2
CO4										3		2
CO5									3	3		2

COs / PSOs	PSO1	PSO 2	PSO3	PSO4
CO1				
CO2				
CO3				
CO4				
CO5				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBFL22IXX	Subject Name : FOREIGN LANGUAGE	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
	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: EBCC22ID1	Subject Name : ENGINEERING ECONOMICS AND INDUSTRIAL MANAGEMENT	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Nil	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab./Embedded Theory and Lab.

OBJECTIVE: The student will learn:

- Concepts of industrial management and economics

COURSE OUTCOMES (COs) : The student will be able to

CO1	Understand the various concepts of organizations and economics related to it (Level 2)
CO2	Expose to the behavior of the human in the organization (Level 2)
CO3	Analyze the demand and supply patterns and costs related to it (Level 4)
CO4	Illustrate the various methods of production with cost effectiveness (Level 3)
CO5	Identify the effect of cost on macro economics (Level 2)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) & Program Specific Outcomes (PSOs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12
CO1	2	2	1	-		2					2	1
CO2	1	2	1	-		2				2	2	1
CO3	3	3	2	1		2					2	1
CO4	3	3	3	1		2					2	1
CO5	2	2	1	-		2				1	2	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1			2	3
CO2			2	3
CO3			2	3
CO4			2	3
CO5			2	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 : ENGINEERING ECONOMICS AND INDUSTRIAL MANAGEMENT	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
EBCC22ID1	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT - I Introduction to Management **9**

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 **9**

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 **9**

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 **9**

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 **9**

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

Total No. of Periods 45

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 - 7th 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*

Subject Code: EBME22L10	Subject Name: PROJECT PHASE-II	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	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

Subject Code: EBME22E01	Subject Name : ADVANCED IC ENGINES	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Thermodynamics and Thermal Engineering	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Practical R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The Student will learn

- Recent advancements of I.C Engines
- Various alternative fuels for I.C engines.

COURSE OUTCOMES (COs) : The Student will be able to

CO1	Understand and apply the knowledge of fuel injection systems and combustion process of IC engines.(Level 2&3)
CO2	Distinguish the types of combustion chambers used in CI engine.(Level 1)
CO3	Analyze the pollution formations mechanism and control in IC engines.(Level 4)
CO4	Understand and apply the knowledge of various alternative fuels in IC engines.(Level 2&3)
CO5	Apply the recent trends techniques in IC engines.(Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2							1	1
CO2	2	2	1	1							-	1
CO3	2	2	2	3	3	1	3	1			-	1
CO4	2	3	2	3	2	2	3	1			2	1
CO5	3	2	2	3	3	2	3	1			-	2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	2
CO2	2	1	1	2
CO3	2	2	2	2
CO4	2	2	2	2
CO5	2	1	1	2

3/2/1 indicates Strength of Correlation: 3- High, 2- Medium, 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: HBME22E01	Subject Name : ADVANCED IC ENGINES	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Thermodynamics and Thermal Engineering	Ty	3	0/0	0/0	3

UNIT- I: SPARK IGNITION ENGINES **9**

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 **9**

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 **9**

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 **9**

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 **9**

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

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: EBME22E02	Subject Name : ELECTRIC AND HYBRID VEHICLES	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
	Prerequisite: Basic Electrical and Electronics Engineering	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- Recent advancements of I.C Engines
- Various alternative fuels for I.C engines.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the electrical vehicles concepts and vehicle kinetics and dynamics
CO2	Design the battery pack for the types of electric vehicle based on its capacity
CO3	Understand the working of DC & AC electrical motors
CO4	Apply the knowledge of gears, differential and clutches to the transmission of electric vehicles
CO5	Design the drive train of hybrid vehicles

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	PSO2	PSO3	PSO4				
CO1	**3**	2		2				
CO2	3	**2**		2				
CO3	3	2		**2**				
CO4	**3**	**2**		2				
CO5	**3**	**2**		2				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 : ELECTRIC AND HYBRID VEHICLES	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
EBME22E02	Prerequisite: Basic Electrical and Electronics Engineering	Ty	3	0/0	0/0	3

UNIT I ELECTRIC VEHICLES 9

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

UNIT II BATTERY 9

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 9

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 9

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

UNIT V HYBRID ELECTRIC VEHICLES 9

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/

Subject Code: EBME22E03	Subject Name : AUTOMOBILE ENGINEERING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Thermodynamics and Thermal Engineering-I	T	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The student will learn

- Various automobile parts, power transmission from engine to various parts of the automobile, engine cooling, lubrication and also about various pollutants and its control.

.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Gain the knowledge of vehicle structures.(Level 2)
CO2	Apply the skill of auxiliary systems in IC engines.(Level 3)
CO3	Demonstrate the power transmissions systems.(Level 3)
CO4	Apply the knowledge of steering, brakes and suspension systems.(Level 3)
CO5	Understand the concept of the fuel cells and hybrid vehicles.(Level 2)

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	1	1	1	1	1	1	1
CO2	3	2	2	2	-	1	2	1	1	2	2	2
CO3	2	2	1	1	-	1	1	1	1	1	1	1
CO4	2	2	2	2	-	1	1	1	1	2	1	1
CO5	2	1	1	1	-	2	2	1	1	1	1	2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	2	1	1	2				
CO2	2	2	2	2				
CO3	2	1	1	2				
CO4	2	2	1	2				
CO5	1	1	2	3				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Subject Code: EBME22E03	Subject Name: AUTOMOBILE ENGINEERING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Thermodynamics and Thermal Engineering	T	3	0/0	0/0	3

UNIT- I: VEHICLE STRUCTURE AND ENGINES **9**

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 **9**

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 **9**

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

UNIT- IV: STEERING AND SUSPENSION SYSTEMS **9**

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 **9**

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.

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.

Subject Code: EBME22E04	Subject Name : SUSTAINABLE ENERGY	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Thermodynamics and Thermal Engineering	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: Students will learn

- The concept, principles and characteristics of different renewable energy systems.
- Energy conversion techniques

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the basic concepts of solar radiation and their utilizations. .(Level 2)
CO2	Apply the solar knowledge in various practical applications..(Level 3)
CO3	Carryout out constructions of different energy conversion techniques..(Level 2)
CO4	Explain the principles of energy conversion from earth and ocean..(Level 3)
CO5	Demonstrate the working of MHD and concept of Fuel cells..(Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	PSO2	PSO3	PSO4				
CO1	3	2	2	1				
CO2	3	2	2	2				
CO3	3	1	1	2				
CO4	3	1	1	1				
CO5	3	1	1	1				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22E04	Subject Name : SUSTAINABLE ENERGY	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Thermodynamics and Thermal Engineering	Ty	3	0/0	0/0	3

UNIT- I PRINCIPLES OF SOLAR RADIATION: **9**

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 **9**

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 **9**

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 **9**

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 **9**

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"

Subject Code: EBME22E05	Subject Name : GAS DYNAMICS AND JET PROPULSION	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Engineering Thermodynamics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Practical R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- The basic difference between incompressible and compressible flow.
- The phenomenon of shock waves and its effect on flow.
- Basic knowledge about jet propulsion and Rocket Propulsion.

COURSE OUTCOMES (COs) : The student will be able to

CO1	Gain the fundamental knowledge of compressible flow and its properties. (Level 2)
CO2	Solve the problems in constant and variable area ducts. (Level 3)
CO3	Analyze the flow properties in different ducts. (Level 4)
CO4	Understand the phenomenon of different shock waves and their effects. (Level 1&2)
CO5	Apply the knowledge of propulsions in rockets and jets. (Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	PSO2	PSO3	PSO4				
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 indicates Strength of Correlation: 3- High, 2- Medium, 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 : GAS DYNAMICS AND JET PROPULSION	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
EBME22E05	Prerequisite: Engineering Thermodynamics	Ty	3	0/0	0/0	3

UNIT- I: COMPRESSIBLE FLOW – FUNDAMENTALS **9**

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 **9**

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 **9**

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 **9**

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 **9**

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.*

Subject Code:	Subject Name : REFRIGERATION AND AIR CONDITIONING	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E06	Prerequisite: Thermodynamics, Thermal Engineering	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: Students will learn

- The working principle of refrigerators and air conditioning systems.
- Different cycles used in refrigeration.
- Alternate refrigerants to reduce global warming .

COURSE OUTCOMES (COs) : (3- 5)

CO1	Gain the basic knowledge of various refrigeration cycles and refrigerants..(Level 2)
CO2	Analyze the various refrigeration cycles using thermodynamic concepts..(Level 4)
CO3	Understand the design and working principles of various components of refrigeration and air-conditioning systems.(Level 2)
CO4	Apply the psychometric knowledge to calculate the cooling and heating load..(Level 3)
CO5	Understand the fundamental concepts of cryogenic engineering and low-temperature of properties of materials.(Level 2)

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3
CO2	3	3	3	3
CO3	3	2	2	2
CO4	3	3	3	3
CO5	3	2	2	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 : REFRIGERATION AND AIR CONDITIONING	Ty/Lb /ETL/IE	L	T/ SLr	P/R	C
EBME22E06	Prerequisite: Thermodynamics, Thermal Engineering	Ty	3	0/0	0/0	3

UNIT- I: REFRIGERATION CYCLES AND REFRIGERANTS **9**

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 **9**

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 **9**

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

UNIT- IV: PSYCHROMETRY & AIR CONDITIONING **9**

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 **9**

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.

Subject Code:	Subject Name : COMPUTATIONAL FLUID DYNAMICS	Ty/Lb /ETL/IE	L	T/ SLr	P/R	C
EBME22E07	Prerequisite: Thermodynamics, Heat and Mass transfer and Fluid Mechanics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: Students will learn

- Governing equation of fluid dynamics.
- Methods of solving the equations by Finite element and Finite Volume methods

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the fundamental knowledge of governing equations and boundary conditions.(Level 2)
CO2	Analyze the conduction problems using finite difference method.(Level 4)
CO3	Solve the fluid flow problems in diffusion using finite volume method.(Level3)
CO4	Apply the one dimensional equation to solve convection problems using finite volume method.(Level 3)
CO5	Calculate the fluid flow field using finite volume method .(Level 4)

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	PSO2	PSO3	PSO4
CO1	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 Strength of Correlation 3- High, 2- Medium, 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 : COMPUTATIONAL FLUID DYNAMICS	Ty/Lb /ETL/IE	L	T/ SLr	P/R	C
EBME22E07	Prerequisite: Thermodynamics, Heat and Mass transfer and Fluid Mechanics	Ty	3	0/0	0/0	3

UNIT- I: GOVERNING EQUATIONS AND BOUNDARY CONDITIONS **8**

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 **9**

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 **9**

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 **10**

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 **9**

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-Є) 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.*

Subject Code:	Subject Name : TURBO MACHINES	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E08	Prerequisite: Fluid Mechanics, Thermal Engineering	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The course aims at giving an overview of different types of turbo machinery used for energy transformation, such as pumps, fans, compressors, as well as hydraulic, steam and gas-turbines.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the concepts of turbo machines and its applications. (Level 2)
CO2	Analyze the performance of turbo machines using first law of thermodynamics. (Level 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 compressors (Level 2)
CO5	Calculate stage losses, stage efficiency and pressure ratio in axial flow and radial flow turbine . (Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	1	1	1	1	1	-	1
CO2	3	3	2	1	-	1	1	1	1	2	-	1
CO3	3	3	3	1	-	1	1	1	1	2	-	1
CO4	3	3	2	-	-	1	1	1	1	1	-	1
CO5	3	3	2	1	-	1	1	1	1	2	-	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1
CO2	3	2	2	1
CO3	3	2	2	1
CO4	3	2	2	1
CO5	3	2	2	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 : TURBO MACHINES	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E08	Prerequisite: Fluid Mechanics Thermal Engineering	Ty	3	0/0	0/0	3

UNIT- 1 INTRODUCTION **9**

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 **9**

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 **9**

Construction details, types, impeller flow losses, slip factor, diffuser analysis losses and performance curves.

UNIT- 4 AXIAL AND RADIAL FLOW COMPRESSORS **9**

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 **9**

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.

PROGRAM ELECTIVE
DESIGN ENGINEERING

Subject Code: EBME22E09	Subject Name: MECHANICAL VIBRATIONS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Pre requisite: Strength of materials; Mechanics of Machines- II.	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Multi degree of freedom system in different modes.
- Vibration measurement techniques.

OURSE OUTCOMES (COs) :

CO1	Understand the fundamentals of vibration systems. (Level 2)
CO2	Evaluate the Natural frequency of Longitudinal and Transverse vibration system. (Level 5)
CO3	Analyze the torsional vibration system at different modes.(Level 4)
CO4	Solve free, damped and forced vibration systems of single, Two and multi degree of freedom. (Level 3)
CO5	Acquire knowledge in various vibration measurement systems.(Level 2)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	PSO2	PSO3	PSO4				
CO1	3	2	2	1				
CO2	3	2	2	2				
CO3	3	2	2	2				
CO4	3	2	2	2				
CO5	3	2	2	1				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 : MECHANICAL VIBRATIONS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E09	Prerequisite: Strength of Materials, Mechanics of Machines-II	Ty	3	0/0	0/0	3

UNIT- I:INTRODUCTION **9**

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 **9**

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 **9**

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 **9**

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 **9**

Vibration monitoring-Data Acquisition- Vibration parameter selection – vibration sensors-accelerometers-Performance characteristics-sensor location-signal pre-amplification – vibration meters-vibration signatures-standards-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.*

Subject Code:	Subject Name: DESIGN OF PRODUCTION TOOLS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E10	Prerequisite: Manufacturing Technology, Design of machine elements	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- The design of jigs and fixtures.
- Different types of press tools and various elements of a press tools.
- To impart knowledge in basics, design and drawing of production tools

COURSE OUTCOMES (COs) :

CO1	Understand the different elements and principles of jigs and fixtures (Level 2)
CO2	Select and create a jig for a given component (Level 7)
CO3	Select and create a fixture for a given component (Level 7)
CO4	Understand the sheet metal operations, elements and die design process (Level 4)
CO5	Select and create a press tool for a given component (Level 7)

Mapping of Course 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	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	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3
CO2	3	3	2	3
CO3	3	3	2	3
CO4	3	2	2	3
CO5	3	3	2	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 : DESIGN OF PRODUCTION TOOLS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E10	Prerequisite: Manufacturing Technology, Design of machine elements	Ty	3	0/0	0/0	3

UNIT- I: LOCATING AND CLAMPING PRINCIPLES **9**

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 **9**

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 **9**

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 **9**

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 **9**

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.

Subject Code:	Subject Name : DESIGN OF MATERIAL HANDLING EQUIPMENTS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E11	Prerequisite: Design of Machine Elements.	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- Design of different types of material handling systems used for engineering and process industries.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the basic principles of material handling equipments. (Level 2)
CO2	Apply the design knowledge of various drives for material handling equipments. (Level 3)
CO3	Differentiate various types of material handling device based on application. (Level 4)
CO4	Design and application of Hoist, Cranes, Conveyors and Elevators. (Level 6)
CO5	Selection of material handling device for different applications. (Level 5)

Mapping of Course with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	PSO2	PSO3	PSO4				
CO1	3	3	3	2				
CO2	3	3	3	2				
CO3	3	3	3	2				
CO4	3	3	3	2				
CO5	3	3	3	2				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 : DESIGN OF MATERIAL HANDLING EQUIPMENTS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E11	Prerequisite: Design of Machine Elements.	Ty	3	0/0	0/0	3

UNIT- I: INTRODUCTION TO MATERIALS HANDLING EQUIPMENT **9**

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 **9**

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 **9**

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 **9**

Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

UNIT- V: ELEVATORS **9**

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*

Subject Code:	Subject Name : A P P L I E D TRIBOLOGY	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E12	Prerequisite: Engineering Mechanics, Fluid Mechanics and Machineries	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The student will learn

- To impart knowledge in the friction , wear and lubrication aspects of machine components.
- To understand the material properties which influence the tribological characteristics of surfaces.
- To understand the analytical behavior of different types bearings and design of bearings based on analytical /theoretical approach.

COURSE OUTCOMES (COs) : (3- 5) The student will able to

CO1	Understand the fundamental concepts of friction wear and surface treatments. (Level 2)
CO2	Apply the knowledge of wear and surface treatment in metals and non-metals. (Level 3
CO3	Expose to lubrication in hydrodynamic and hydrostatic bearings. (Level 2)
CO4	Analyze the theory of elasto-hydrodynamic lubrication. (Level 4)
CO5	Illustrate the behavior of tribological components using different working conditions. (Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	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
CO4	3	3	1	3	1	1	1	-	1	1	1	1
CO5	3	3	1	3	1	1	1	-	1	1	1	1

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	2	1	2				
CO2	3	2	1	2				
CO3	3	2	1	2				
CO4	3	2	1	2				
CO5	3	2	1	2				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
Category					✓							

Subject Code:	Subject Name : A P P L I E D TRIBOLOGY	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E12	Prerequisite: Engineering Mechanics, Fluid Mechanics and Machineries	Ty	3	0/0	0/0	3

UNIT- I - SURFACE INTERACTION AND FRICTION **9**

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 **9**

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 **9**

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 **9**

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 **9**

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*

Subject Code: EBME22E13	Subject Name: DESIGN FOR MANUFACTURE AND ASSEMBLY	Ty/Lb/ETL	L	T/SLr	P/R	C
	Pre requisite: Strength of Materials, Design of Machine Elements-I, Manufacturing Technology-I	T	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Practical R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The purpose of study is to impart the general design, manufacturing and assembly principles in ease of manufacturing.

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand the basic principles of Manufacturability. (Level 2)
CO2	Distinguish the various types of form design in casting, forging and machining. (Level 4)
CO3	Analyze and redesign the component for the ease of manufacturing. (Level 4)
CO4	Exposure to modern tool like Computer aided Design for Assembly. (Level 2)
CO5	Analyze and evaluate Design for assembly through case studies. (Level 4)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	1	2	2	1	2	2	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	3	2	2	1	2	3	2	2
CO5	3	3	3	2	2	2	2	1	2	2	2	2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	3	2	2				
CO2	3	3	2	2				
CO3	3	3	2	2				
CO4	3	3	2	2				
CO5	3	3	2	2				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 : DESIGN FOR MANUFACTURE AND ASSEMBLY	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E13	Prerequisite: Strength of Materials, Design of Machine Elements-I, Manufacturing Technology-I	Ty	3	0/0	0/0	3

UNIT- I: INTRODUCTION **9**

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 **9**

Production methods on form design - Casting considerations - Requirements and rules - Redesign of components for castings and Case studies.

UNIT- III: FORM DESIGN - FORGING **9**

Forging considerations - Requirements and rules - Redesign of components for forging and Case studies.

UNIT- IV: FORM DESIGN - MACHINING **9**

Machining considerations - Requirements and rules -Redesign of components for Machining and Case studies.

UNIT- V: DESIGN FOR ASSEMBLY METHODS **9**

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 Name: MECHANICS OF FRACTURE	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
EBME22E14	Pre requisite: Strength of Materials, Engineering Metallurgy	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Solid mechanics of cracked components of different modes by which these components fail under static and fatigue load conditions.

OURSE OUTCOMES (COs) : The student will be able to

CO1	Identify the various failure mechanisms in different materials. (Level 2)
CO2	Evaluate fracture toughness using linear fracture tests. (Level 5)
CO3	Apply the crack driving force in linear and non-linear materials. (Level 4)
CO4	Estimate 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	2	-	2	2	1	2
CO2	3	3	3	3	2	2	2	-	2	2	1	2
CO3	3	3	3	3	2	2	2	-	2	2	1	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	PSO1	PSO2	PSO3	PSO4
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 indicates Strength of Correlation 3- High, 2- Medium, 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 : MECHANICS OF FRACTURE	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
EBME22E14	Prerequisite: Strength of Materials, EngineeringMetallurgy	Ty	3	0/0	0/0	3

UNIT- I ELEMENTS OF SOLID MECHANICS **9**

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 **9**

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 **9**

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 **9**

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 **9**

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*

Subject Code:	Subject Name: DESIGN THINKING AND INNOVATION	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
EBME22E15	Pre requisite: N I L	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Solid mechanics of cracked components of different modes by which these components fail under static and fatigue load conditions.

OURSE OUTCOMES (COs) :

CO1	Understand the fundamental concepts of design thinking
CO2	Apply the knowledge of design thinking process in product development
CO3	Innovate the new idea for product creations
CO4	Develop the product design and strategies
CO5	Create a new business idea for a startup.

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	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	PSO1	PSO2	PSO3	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 Strength of Correlation 3- High, 2- Medium, 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: DESIGN THINKING AND INNOVATION	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
EBME22E15	Pre requisite: N I L	Ty	3	0/0	0/0	3

Unit I Introduction to Design Thinking **9**

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.

Unit II Design Thinking Process **9**

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 **9**

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 **9**

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 **9**

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

PROGRAM ELECTIVE
MANUFACTURING ENGINEERING

Subject Code:	Subject Name : INDUSTRIAL ROBOTICS	Ty/Lb/ETL	L	T/SLr	P/R	C
EBME22E16	Prerequisite: Industrial Automation	Ty	3	0/0	0/0	3

L : Lecture T : TutorialSLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: To give an understanding to the student with respect to:

- Basic components of an industrial robot and Sensors used in robots
- Robot programming methods and Robot applications

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COURSE OUTCOMES (COs) :

CO1	Understand the basic concepts of a robot (Level 2)
CO2	Identify and apply the different components and operation with respect to robot (Level 3)
CO3	Recognize the various types of sensors and machine vision concepts and its applications (Level 3)
CO4	Write programme for robot (Level 4)
CO5	Design the robot cell and state its applications (Level 4)

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	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 Strength of Correlation 3- High, 2- Medium, 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 : INDUSTRIAL ROBOTICS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E16	Prerequisite: Industrial Automation	Ty	3	0/0	0/0	3

UNIT- I:INTRODUCTION **9**

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 **9**

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 **9**

Range Sensing – Proximity Sensing – Touch sensing – Force and Torque Sensing. Introduction to Machine Vision – functions and applications.

UNIT- IV:ROBOT PROGRAMMING **9**

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 **9**

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.*

Subject Code:	Subject Name: NON-CONVENTIONAL MACHINING TECHNIQUES	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E17	Prerequisite: Manufacturing Technology I & II	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- To understand basics of Non conventional machining techniques
- To impart knowledge on various non conventional machining proces
- To know the applications of non conventional machining techniques in various fields

COURSE OUTCOMES (COs) :

CO1	Explain the principle, advantage and limitations of different Non conventional machining processes. (Level 2)
CO2	Compare the different non conventional processes for their capability (Level 4)
CO3	Understand the different process parameters and its effect on material removal (Level 2)
CO4	Incorporate the hybrid processes to take advantages of different processes (Level 4)
CO5	Identify and use a suitable machining process based on their requirement (Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	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 Strength of Correlation 3- High, 2- Medium, 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 : NON CONVENTIONAL MACHINING TECHNIQUES	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E17	Prerequisite: Manufacturing Technology I & II	Ty	3	0/0	0/0	3

UNIT- I: INTRODUCTION, ELECTRICAL DISCHARGE MACHINING **10**

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 **8**

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 **9**

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 **8**

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 **10**

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

TEXT BOOKS

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".*

Subject Code: EBME22E18	Subject Name: PROCESS PLANNING AND COST ESTIMATION	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: **Manufacturing Technology I & II**	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Process planning activities
- Various elements of cost of a product.
- Methods of computer aided process planning

COURSE OUTCOMES (COs) :

CO1	Understand the method of planning the various machining processes (Level 2)
CO2	Analyze and describe the step by step procedure for manufacturing (Level 4)
CO3	Apply computers for advanced process planning (Level 3)
CO4	Discuss the various cost involved in manufacturing of component or product (Level 2)
CO5	Evaluate and identify the economic method of manufacturing (Level 6)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	2	3	3	3	2	2
CO2	3	3	3	3	3	2	2	3	3	3	2	2
CO3	3	3	3	3	3	2	2	3	3	3	2	2
CO4	3	3	3	3	3	2	2	3	3	3	2	2
CO5	3	3	3	3	3	2	2	3	3	3	2	2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
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 Strength of Correlation 3- High, 2- Medium, 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 : PROCESS PLANNING AND COST ESTIMATION	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E18	Prerequisite: Manufacturing Technology I & II	Ty	3	0/0	0/0	3

UNIT- I: PROCESS PLANNING **9**

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 **9**

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 **9**

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 **9**

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 **9**

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.*

Subject Code: EBME22E19	Subject Name: ADDITIVE MANUFACTURING	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: **Manufacturing Technology I & II**	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- To understand the fundamental concepts of Additive Manufacturing (i.e. Rapid Prototyping) and 3-D printing, its advantages and limitations
- To classify various types of Additive Manufacturing Processes and know their working principle, advantages, limitations etc
- To have a holistic view of various applications of these technologies in relevant fields such as mechanical, Bio-medical, Aerospace, electronics etc

COURSE OUTCOMES (COs) :

CO1	Describe various CAD issues for 3D printing and rapid prototyping and related operations for STL model manipulation
CO2	Formulate and solve typical problems on reverse engineering for surface reconstruction from physical prototype models through digitizing and spline-based surface fitting.
CO3	Formulate and solve typical problems on reverse engineering for surface reconstruction from digitized mesh models through topological modelling and subdivision surface fitting.
CO4	Explain and summarize the principles and key characteristics of additive manufacturing technologies and commonly used 3D printing and additive manufacturing systems.
CO5	Describe and summarize typical rapid tooling processes for quick batch production of plastic and metal parts.

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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
CO5	2	2	3	3	2	2	-	-	2	2	-	2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	-
CO2	2	3	3	3
CO3	1	2	2	3
CO4	3	3	3	2
CO5	3	3	3	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Science	Engineering	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
					✓							

Subject Code: EBME22E19	Subject Name: ADDITIVE MANUFACTURING	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: **Manufacturing Technology I & II**	**Ty**	**3**	**0/0**	**0/0**	**3**

UNIT – I Introduction: **9**

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: **9**

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 and Disadvantages, 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: **9**

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: **9**

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: **9**

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

Subject Code:	Subject Name: FLEXIBLE MANUFACTURING SYSTEMS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E20	Prerequisite: Manufacturing Technology I & II; Industrial Automation; CAD/CAM	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- To understand the Modern manufacturing systems
- To understand the concepts and applications of flexible manufacturing systems

COURSE OUTCOMES (COs) :

CO1	Understand the concepts of flexible manufacturing systems (FMS) (Level 2)
CO2	Apply the use of computers in FMS (Level 3)
CO3	Apply the simulation and data base management in FMS (Level 3)
CO4	Justify the implementation of FMS (Level 4)
CO5	Understand the future factory with the application of FMS concepts (Level 2)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	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				

/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 : FLEXIBLE MANUFACTURING SYSTEMS	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E20	Prerequisite: Manufacturing Technology I & II; Industrial Automation; CAD/CAM	Ty	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 9

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 9

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 9

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.

Subject Code:	Subject Name: POWDER METALLURGY	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E21	Prerequisite: Materials Science; Engineering Metallurgy	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- To understand basics of powder metallurgy
- To expose various powder metallurgy techniques
- To know the application of powder metallurgy in various fields

COURSE OUTCOMES (COs) : The student will be able to

CO1	Understand the fundamentals of powder metallurgy (Level 2)
CO2	Interpret the characterization parameters of metal powders (Level 3)
CO3	Comparing the different manufacturing methods of components by powder metallurgy(Level 3)
CO4	Analyzing the different sintering theories (Level 4)
CO5	Differentiating and comparing different applications of powder metallurgy (Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	3
CO2	3	2	3	3
CO3	2	2	2	2
CO4	3	2	3	2
CO5	3	2	3	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 :POWDER METALLURGY	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E21	Prerequisite: Engineering Metallurgy	Ty	3	0/0	0/0	3

UNIT- I INTRODUCTION OF POWDER METALLURGY AND PRODUCTION OF METAL POWDERS **9**

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 **9**

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 **9**

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 **9**

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 **9**

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

PROGRAM ELECTIVE
INDUSTRIAL ENGINEERING

Subject Code: EBME22E22	Subject Name: ENTERPRISE RESOURCE PLANNING	Ty/Lb /ETL	L	T/ SLr	P/ R	C
	Pre requisite: Manufacturing Technology I & II; Application of Computer Science Engineering	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial S Lr : Supervised Learning P : Practical R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn:

- Building of business model for resource planning; Impact of IT in ERP

COURSE OUTCOMES (COs) : The student will be able to

CO1	Understand the concepts of ERP (Level 2)
CO2	Build the business Model and implement ERP (Level 4)
CO3	Understand the principles of organizational transformation (Level 2)
CO4	Examine the global Industrial Competition and use Information Technology (Level 4)
CO5	Describe the concepts of Supply Chain Management (Level 2)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	2	2	3	3	3	3	2
CO2	3	3	3	3	3	2	2	3	3	3	3	2
CO3	3	2	2	2	3	2	2	3	3	3	3	2
CO4	3	3	3	3	3	2	2	3	3	3	3	2
CO5	3	2	2	2	3	2	2	3	3	3	3	2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
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 Strength of Correlation 3- High, 2- Medium, 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 : ENTERPRISE RESOURCE PLANNING	Ty/Lb /ETL	L	T/ SLr	P/R	C
EBME22E22	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT- I: INTRODUCTION TO ERP **9**

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 **9**

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 **9**

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 **9**

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.

Subject Code:	Subject Name: SYSTEM MODELING AND SIMULATION	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E23	Pre requisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn:

- The basic system concept and definitions of system;
  Different techniques to model and to simulate various systems;
  Analyze a system and to make use of the information to improve the performance.

OURSE OUTCOMES (COs) : The students will be able to

CO1	Explain the system concept and apply functional modeling method to model the activities of a static system
CO2	Describe the behavior of a dynamic system and create an analogous model for a dynamic system;
CO3	Simulate the operation of a dynamic system and make improvement according to the simulation results.
CO4	Identify the distribution of data from the collected data
CO5	Create a model building and validate the performance of the model

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	PSO2	PSO3	PSO4				
CO1			2	2				
CO2			2	2				
CO3			2	2				
CO4			2	2				
CO5			2	2				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: SYSTEM MODELING AND SIMULATION	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E23	Pre requisite:	Ty	3	0/0	0/0	3

UNIT I Introduction **9**

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 **9**

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 **9**

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.

UNIT IV Input Modeling **9**

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 **9**

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 models,Calibration 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

Subject Code: EBME22E24	Subject Name: TOTAL QUALITY MANAGEMENT	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Pre requisite: Manufacturing Technology I & II	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Various Principles and Tools of TQM; ISO Standards

OURSE OUTCOMES (COs) :

CO1	Understand the various quality tools and techniques (Level 2)
CO2	Demonstrate the customer satisfaction techniques (Level 3)
CO3	Exposed to quality auditing systems and procedures (Level 2)
CO4	Implement TQM and TPM (Level 4)
CO5	Implement Kaizen and conduct FMEA. (Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1			2		1	2		2	3	2
CO2	3	1			2		3	2		2	3	3
CO3	3	1			2		1			2	3	3
CO4	3	1			2			2		2	3	2
CO5	3	2			2					2	3	3

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	2	2	3	3				
CO2	2	2	3	3				
CO3	2	2	3	3				
CO4	2	2	3	3				
CO5	2	2	3	3				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22E24	Subject Name : TOTAL QUALITY MANAGEMENT	Ty/Lb/ETL	L	T/SLr	P/R	C
	Prerequisite: Manufacturing Technology I & II	Ty	3	0/0	0/0	3

UNIT- I: INTRODUCTION **9**

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 **9**

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 **9**

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 **9**

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 **9**

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", (5th 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.*

Subject Code:	Subject Name : FACILITIES PLANNING AND DESIGN	Ty/Lb /ETL	L	T/ SLr	P/R	C
EBME22E25	Prerequisite: Manufacturing Technology-I& II	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab./Embedded Theory and Lab.

OBJECTIVES:

- The student will learn To explain project management for entrepreneurs

COURSE OUTCOMES (COs) : The student will be able to

CO1	Understand the need for Facilities requirement planning, selection of optimum location for the plant/plant layout/material handling system (Level 2)
CO2	Illustrate plant layout & material handling system (Level 3)
CO3	Compare the pros and cons of alternate locations for the plant, plant layouts & material handling systems (Level 4)
CO4	Critically examine/explore the options for plant location, layout & material handling system (Level 5)
CO5	Judge which option is better compared to the rest for: Plant location, Plant layout & material handling system (Level 4)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) & Program Specific Outcomes (PSOs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	3	2	1	2	3	1	1	1	1	2	2	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1
CO2	3	2	1	1
CO3	3	2	1	1
CO4	3	2	1	1
CO5	3`	2	1	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 : FACILITIES PLANNING AND DESIGN	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E25	Prerequisite: Manufacturing Technology-I& II	Ty	3	0/0	0/0	3

UNIT I: INTRODUCTION **5**

Facilities planning, significance, objectives, requirement, process, product and schedule design, need for layout study – types of layout

UNIT II: PLANT LOCATION **10**

Plant location analysis – factors, costs, location decisions – single facility location models, multi facility location models- set covering problem – warehouse location problems

UNIT III: LAYOUT DESIGN **10**

Design cycle – SLP procedure, nadler's ideal approach, flow and activity analysis, computerized layout planning procedure – ALDEP, CORELAP, CRAFT

UNIT IV: GROUP TECHNOLOGY AND LINE BALANCING **10**

Group technology – Production Flow analysis (PFA), ROC (Rank Order Clustering) – Line balancing, single, multi and mixed mode, parallel line and parallel station

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

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*

Subject Code: EBME22E26	Subject Name : QUALITY ENGINEERING	Ty/Lb/ETL	L	T/ SLr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab./Embedded Theory and Lab.

OBJECTIVE:

- The student will learn: Basic conceptual idea of Supply Chain Management systems and its internal structural systems; also focusedthe theory and applications of SCM Networks with simple case study

COURSE OUTCOMES (COs) : -

CO1	Recall/Explain basic Quality concepts, foundation for this course (Level 2)
CO2	Illustrate Control Charts for Variables/Attributes for real life scenarios (Level 3)
CO3	Examine Process Capability (Level 4)
CO2	Compare Sample Inspection systems (Level 4)
CO3	Recall/Explain TQM concepts, TQM tools (Level 2)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) & Program Specific Outcomes (PSOs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	-
CO2	3	2	2	1
CO3	3	2	2	1
CO2	3	2	2	1
CO3	3	2	2	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Science	Engineering	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
					✓							

Subject Code: EBME22E26	Subject Name : QUALITY ENGINEERING	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT I: QUALITY CONCEPTS **6**

Quality, History of Quality, Quality Control, Quality Assurance, Quality Costs, Optimum Quality, Opportunity Loss, Taguchi's Quality loss function

UNIT II: CONTROL CHARTS FOR VARIABLES & PROCESS CAPABILITY **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 **8**

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 **9**

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) **12**

Main Concepts of TQM, Quality Dimensions, TQM 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*

Subject Code:	Subject Name: INDUSTRY 4.0	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E27	Pre requisite: Manufacturing Technology I & II	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

OURSE OUTCOMES (COs) :

CO1	Describe Industry 4.0 and scope for Indian Industry
CO2	Demonstrate conceptual framework and road map of Industry 4.0
CO3	Describe Robotic technology and Augmented reality for Industry 4.0
CO4	Demonstrate obstacle and framework conditions for Industry 4.0
CO5	Understand the role of augmented reality in the age of Industry 4.0

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1		PSO2		PSO3		PSO4					
CO1					2		1					
CO2					2		1					
CO3					2		1					
CO4					2		1					
CO5					2		1					

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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/ ETL	L	T/ SLr	P/R	C
EBME22E27	Pre requisite: Manufacturing Technology I & II	Ty	3	0/0	0/0	3

Unit-1: Introduction to Industry 4.0 **9**

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 **9**

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 **9**

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 **9**

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 **9**

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/

Subject Code: HBME22E28	Subject Name: SUPPLY CHAIN MANAGEMENT	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Pre requisite: Manufacturing Technology I & II	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn Basic Conceptual idea of supply chain management system; Theory and application SCM networks with simple casestudy

OURSE OUTCOMES (COs) :

CO1	Understand the various concepts of supply chain management. (Level 2)
CO2	Analyze and decide the proper logistics. (Level 4)
CO3	Develop proper network to locate source and distribution centers at a optimal pricing. (Level 4)
CO4	Coordinate the supply chain management network. (Level 3)
CO5	Use information technology in supply chain management. (Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	1	2	2	-	2	2	1	2
CO2	3	3	3	1	3	2	2	3	3	3	3	2
CO3	3	3	3	1	3	2	2	3	3	3	3	2
CO4	3	2	2	-	2	2	2	3	3	3	2	2
CO5	3	2	2	-	3	2	2	2	3	3	2	2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	3	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 Strength of Correlation 3- High, 2- Medium, 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: EBME22E28	Subject Name : SUPPLY CHAIN MANAGEMENT	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: Manufacturing Technology I & II	Ty	3	0/0	0/0	3

UNIT- I: INTRODUCTION **9**

Definition of logistics and SCM: evolution, scope, importance& decision phases = drivers of SC performance and obstacles.

UNIT- II: LOGISTICS MANAGEMENT **9**

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 **9**

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 **9**

Supplier selection and Contracts - Design collaboration - Procurement process. Revenue management in supply chain

UNIT- V: COORDINATION AND TECHNOLOGY IN SUPPLY CHAIN **9**

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", (2nd 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", (2nd 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*

Subject Code: EBME22E29	Subject Name: BLOCK CHAIN TECHNOLOGY	Ty/Lb/ETL	L	T/ SLr	P/R	C
	Prerequisite: Nil	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab./Embedded Theory and Lab.

OBJECTIVE: The student will learn:

- Understand how blockchain systems (mainly Bitcoin and Ethereum) work, To securely interact with them,
- Design, build, and deploy smart contracts and distributed applications,
- Integrate ideas from blockchain technology into their own projects

COURSE OUTCOMES (COs) :

CO1	Understand the design principles of Bitcoin, Ethereum and Nakamoto consensus
CO2	Evaluate security, privacy, and efficiency of a given block chain system.
CO3	Explain the Simplified Payment Verification protocol.
CO2	Interact with a block chain system by sending and reading transactions.
CO3	Design, build, and deploy a distributed application.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) & Program Specific Outcomes (PSOs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2	1	1		1			2	2	3	2
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	PSO2	PSO3	PSO4
CO1			2	
CO2			2	
CO3			2	
CO2			2	
CO3			2	

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22E29	Subject Name : BLOCK CHAIN TECHNOLOGY	Ty/Lb/ETL	L	T/ SLr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

Unit I: Basics **9**

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 **9**

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 **9**

Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

Unit IV: Crypto currency **9**

History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin

Unit V: Crypto currency Regulation **9**

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

OPEN ELECTIVE SUBJECTS

Subject Code:	Subject Name: INDUSTRIAL ENGINEERING	Ty/Lb /ETL	L	T/ SLr	P/R	C
EBME22OE1	Pre requisite: NIL	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn:

- Various Techniques of work measurement; Details of plant layout and material handling devices; Basic concepts of ERP

OURSE OUTCOMES (COs) :

CO1	Expose to various concepts of Industrial engineering. (Level 2)
CO2	Select and Design the appropriate plant layout and associated material handling systems. (Level 4)
CO3	Analyze the work place and design suitable environment to provide comfort to the work. (Level 4)
CO4	Understand the various factors involved in fixing wages and incentives. (Level 2)
CO5	Plan the various resources of an enterprise. (Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	PSO2	PSO3	PSO4				
CO1	3	3	1	2				
CO2	3	3	2	3				
CO3	3	3	2	3				
CO4	3	3	1	2				
CO5	3	3	2	2				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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 : INDUSTRIAL ENGINEERING	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22OE1	Prerequisite: NIL	Ty	3	0/0	0/0	3

UNIT- I:WORK STUDY & WORK MEASUREMENT **9**

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 **9**

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 **9**

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 **9**

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) **9**

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.

Total No. of Periods : 45

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.*

Subject Code: BME22OE2	Subject Name : REFRIGERATION AND AIR CONDITIONING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: Students will learn

- The working principle of refrigerators and air conditioning systems.
- Different cycles used in refrigeration.
- Alternate refrigerants to reduce global warming **.**

COURSE OUTCOMES (COs) : (3- 5)

CO1	Gain the basic knowledge of various refrigeration cycles and refrigerants..(Level 2)
CO2	Analyze the various refrigeration cycles using thermodynamic concepts..(Level 4)
CO3	Understand the design and working principles of various components of refrigeration and air-conditioning systems.(Level 2)
CO4	Apply the psychrometry knowledge to calculate the cooling and heating load..(Level 3)
CO5	Understand the fundamental concepts of cryogenic engineering and low-temperature of properties of materials.(Level 2)

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	2		2		2		2		1	3	3	3
CO1	PSO1		PSO2		PSO3		PSO4					
CO2	3		3		3		3					
CO3	3		3		3		3					
CO4	3		2		2		2					
CO5	3		3		3		3					

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: BME22OE2	Subject Name : REFRIGERATION AND AIR CONDITIONING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT- I: REFRIGERATION CYCLES AND REFRIGERANTS **9**

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 **9**

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 **9**

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

UNIT- IV: PSYCHROMETRY & AIR CONDITIONING **9**

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 **9**

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.

Subject Code: BME22OE3	Subject Name : AUTOMOBILE ENGINEERING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The student will learn

- Various automobile parts, power transmission from engine to various parts of the automobile, enginecooling, lubrication and also about various pollutants and its control.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Gain the knowledge of vehicle structures.(Level 2)
CO2	Apply the skill of auxiliary systems in IC engines.(Level 3)
CO3	Demonstrate the power transmissions systems.(Level 3)
CO4	Apply the knowledge of steering, brakes, suspension and lighting systems.(Level 3)
CO5	Understand the concept of the fuel cells and hybrid vehicles.(Level 2)

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO2	PSO3	PSO4
CO1	3	2	2	2
CO2	3	2	2	2
CO3	3	2	2	2
CO4	3	2	2	2
CO5	3	2	1	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22OE3	Subject Name : AUTOMOBILEGINEERING	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT- I: VEHICLE STRUCTURE AND ENGINES **9**

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.

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 **9**

Clutches –single& multi plate Gear boxes-manual- sliding mesh- constant mesh- automatic transmission. Universal joints-propeller shaft Differential.

UNIT- IV: STEERING AND SUSPENSION SYSTEMS **9**

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 **9**

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.

Subject Code: EBME22OE4	Subject Name : INDUSTRIAL ROBOTICS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: **OBJECTIVES:** Students will learn

- Basic components of an industrial robot and Sensors used in robots
- Robot programming methods and Robot applications

COURSE OUTCOMES (COs) : (3- 5)	
CO1	Understand the basic concepts of a robot (Level 2)
CO2	Identify and apply the different components and operation with respect to robot (Level 3)
CO3	Recognize the various types of sensors and machine vision concepts and its applications (Level 3)
CO4	Write programme for robot (Level 4)
CO5	Design the robot cell and state its applications (Level 4)

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	PSO2	PSO3	PSO 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 Strength of Correlation 3- High, 2- Medium, 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: HBME22OE4	Subject Name : INDUSTRIAL ROBOTICS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	**Ty**	**3**	**0/0**	**0/0**	**3**

UNIT- I: INTRODUCTION **9**

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 **9**

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 **9**

Range Sensing – Proximity Sensing – Touch sensing – Force and Torque Sensing. Introduction to Machine Vision – functions and applications.

UNIT- IV:ROBOT PROGRAMMING **9**

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 **9**

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.*

Subject Code: EBME220E5	Subject Name : SUSTAINABLE ENERGY	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: NIL	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: Students will learn

- The concept, principles and characteristics of different renewable energy systems.
- Energy conversion techniques

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the basic concepts of solar radiation and their utilizations. .(Level 2)
CO2	Apply the solar knowledge in various practical applications..(Level 3)
CO3	Carryout out constructions of different energy conversion techniques..(Level 2)
CO4	Explain the principles of energy conversion from earth and ocean..(Level 3)
CO5	Demonstrate the working of MHD and concept of Fuel cells..(Level 3)

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1
CO2	3	2	2	2
CO3	3	1	1	2
CO4	3	1	1	1
CO5	3	1	1	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME220E5	Subject Name : SUSTAINABLE ENERGY	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: NIL	Ty	3	0/0	0/0	3

UNIT- I PRINCIPLES OF SOLAR RADIATION: **9**

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 **9**

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 **9**

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 **9**

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 **9**

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

5) Twidell & Weir, (2006) "Energy Sources", Taylor & Francis
6) Sukhame, (2009) "Solar Energy".
7) B.S.Magal Frank Kreith, (2010) "Solar Power Engineering"

Subject Code: HBME22OE6	Subject Name : COMPOSITE MATERIALS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: Students will learn

- Different composites and their manufacturing methods
- Design parameters of composites
- To gain knowledge in need and applications of composite materials

.

COURSE OUTCOMES (COs) : (3- 5) The student will be able to	
CO1	Understand the different composites and their manufacturing methods (Level 2)
CO2	Know the mechanics and performance of composite materials (Level 3)
CO3	Understand the design parameters of composites (Level 2)
CO4	Analyze and predict the failure in composites(Level 4)
CO5	Design and Manufacture composites using simple manufacturing techniques (Level 4)

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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**	**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 Strength of Correlation 3- High, 2- Medium, 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: HBME22OE6	Subject Name : COMPOSITE MATERIALS	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT- I: INTRODUCTION **9**

Limitations of Conventional Materials- Definition of Composite Materials- Types andCharacteristics Applications.

UNIT- II: MATERIALS **9**

Fibers- Materials- Fiber Reinforced Plastics- Thermo set Polymers- Coupling Agents, Fillers and Additives-Metal Matrix and Ceramics Composites.

UNIT- III: MANUFACTURING **9**

Fundamentals- bag moulding- compression moulding pultrusion- filament winding- other manufacturingprocess-quality inspection and non-destructive testing.

UNIT- IV: MECHANICS AND PERFORMANCE **9**

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 **9**

Failure Predictions- Design Considerations- Joint Design- Codes- Design Examples. Optimization of Laminated Composites- Application of FEM for Design.

Total No. of Periods:: 45

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:	Subject Name: INDUSTRY 4.0	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22OE7	Pre requisite: NIL	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn conceptualizes rapid change to technology, industries, and societal patterns and processes in the 21st century due to increasing interconnectivity and smart automation.

OURSE OUTCOMES (COs) :

CO1	Describe Industry 4.0 and scope for Indian Industry
CO2	Demonstrate conceptual framework and road map of Industry 4.0
CO3	Describe Robotic technology and Augmented reality for Industry 4.0
CO4	Demonstrate obstacle and framework conditions for Industry 4.0
CO5	Understand the Role of Augmented Reality Industry 4.0

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	PSO2	PSO3	PSO4
CO1			2	1
CO2			2	1
CO3			2	1
CO4			2	1
CO5			2	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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/ ETL	L	T/ SLr	P/R	C
EBME22OE7	Pre requisite: NIL	Ty	3	0/0	0/0	3

Unit-1: Introduction to Industry 4.0 **9**

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 **9**

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 **9**

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 **9**

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 **9**

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/

0.

Subject Code: EBME22OE8	Subject Name :VIRTUAL AND AUGMENTED REALITY	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: NIL	**Ty**	**3**	**0/0**	**0/0**	**3**

L:LectureT:Tutorial SLr:SupervisedLearningP:ProjectR:ResearchC:Credits

T/L/ETL:Theory/Lab/EmbeddedTheoryandLab

OBJECTIVE:OBJECTIVE: The students will learn

- To introduce the relevance of this course to the existing technology through demonstrations, case studies and applications with a futuristic vision along with socio-economic impact and issues
- To understand virtual reality, augmented reality and using them to build Biomedical engineering applications

COURSEOUTCOMES(COs) : The students will be able to

CO1	Understand the physical principles of VR & AR
CO2	Create a comfortable, high-performance VR application using Unity
CO3	Analyse and understand the working of various state of the art VR & AR devices.
CO4	Analyse & Design a system or process to meet given specifications with realistic engineering constraints
CO5	Create and deploy a VR & AR application.

Mapping of Course Outcomes 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	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	PSO1	PSO2	PSO3	PSO4				
CO1	3	3	3	3				
CO2	3	3	3	3				
CO3	3	3	3	3				
CO4	3	3	3	3				
CO5	2	3	3	3				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: EBME22OE8	Subject Name: VIRTUAL AND AUGMENTED REALITY	Ty / Lb/ETL	L	T /S.Lr	P/ R	C
	Prerequisite: NIL	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION **9**

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 **9**

Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model Management.

UNIT III CONTENT CREATION CONSIDERATION FOR VR **9**

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 **9**

JS-pros and cons-building blocks (Web VR, Web GL, 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.

Total No. of Periods : 45

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.

OPEN ELECTIVE
LABS

Subject Code: HBME22OL1	Subject Name : INTERNAL COMBUSTION ENGINES AND STEAM LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- To evaluate the performance of steam turbines and IC engines.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the concept of working and performance of steam turbines
CO2	Analyze the performance and heat balance test of IC engines
CO3	Determine and Draw performance characteristics curve of IC engines
CO4	Describe working of steam generators, Condenser and turbines
CO5	Analyze the performance characteristics of steam generator

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P O9	PO10	PO11	PO 12
CO1	**3**	**2**		**2**	**1**		**2**					
CO2	**3**	**1**		**2**			**2**					
CO3	**2**			**3**			**3**					
CO4	**3**	**1**		**2**			**2**					
CO5	**M**			**3**			**3**					

Cos / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**2**		
CO2	**2**	**2**		
CO3	**2**	**2**		
CO4	**2**	**2**		
CO5	**2**	**2**		

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 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: HBME22OL1	Subject Name : INTERNAL COMBUSTION ENGINES & STEAM LAB	Ty / Lb/ ETL	L	T / 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

Total No. of Periods:: 45

Subject Code: EBME22OL2	Subject Name : COMPUTER AIDED DESIGN & SIMULATION LAB	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite:	Lb	0	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

OBJECTIVES: The student will

- Get practical knowledge through practice on CNC Machines and related software

OURSE OUTCOMES (COs) : The student will be able to

CO1	Understand the fundamentals of design and drawings (Level 2)
CO2	Understand the different commands in Auto CAD/ Solid works or CATIA Software's(Level 2)
CO3	Draw the machine parts, assembly and detailed drawing using softwares (Level 4)
CO4	Expose to the numerical analysis of designed part (Level 2)
CO5	Analyze and interpret the design from the FEA software (Level 4)

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	-	3	2	2	3	3	3	2	2
CO2	3	3	3	3	3	2	2	3	3	3	2	2
CO3	3	3	3	3	3	2	2	3	3	3	2	2
CO4	3	3	3	3	3	2	2	3	3	3	2	2
CO5	3	3	3	3	3	2	2	3	3	3	2	2

Cos / PSOs	PSO1	PSO2	PSO3	PSO4				
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 Strength of Correlation 3- High, 2- Medium, 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: EBME22OL2	Subject Name : COMPUTER AIDED DESIGN & SIMULATION LAB	Ty/Lb/ETL	L	T/SLr	P/R	C
	Prerequisite:	Lb	0	0/0	3/0	1

List of Experiments

1. CAD LAB

i. Introduction to computer Aided Design and Drafting Packages.
ii. 2D – Drawing using Auto CAD/ Solid works or CATIA Software
iii. 2D sectional views, part drawing, assembly drawing, detailed drawing.
iv. Dimensioning, annotations, symbols – Welding, Surface finish, threads, Text, Bill of Materials, Title Block.
v. Exercises – Knuckle joint, Gib & Cotter joint, Screw Jack, Foot step bearing.
vi. Orthographic views, Isometric views.
vii. Solid modeling features-Boolean operations**.**

2.SIMULATION LAB

Simulation of Mechanical Components and Linkages using CATIA/FEA Software

Total No. of Periods: 45

Subject Code: EBME22OL3	Subject Name: ENGINEERING METROLOGY LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

OBJECTIVES: Students will learn

- Linear and angular measurement methods
- Calibration of measuring instruments
- Micro structures of various ferrous and non ferrous materials using microscopes.
- Heat treatment processes of materials.

Course outcomes (cos) : The Student will be able to	
CO1	Gain practical knowledge about the linear and angular measurements (Level 3)
CO2	Demonstrate the different types of form measurements (Level 3)
CO3	Understand the various methods of preparation for microstructure 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 Course 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	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	2	2				
CO5	3	3	2	2				

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
						✓			✓

Subject Code: EBME22OL3	Subject Name: ENGINEERING METROLOGY LAB	Ty / Lb/ ETL	L	T / S.Lr	P/ R	C
	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

Total No. of Periods: 45

Subject Code: EBME22OL4	Subject Name: AUTOMATION LAB	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite: NIL	**Lb**	**0**	**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

OBJECTIVES: The student will learn

- To practice simple programs on microprocessors and micro controllers.
- To design and implement pneumatic and hydraulic circuits with automation studio software andwith kits

OURSE OUTCOMES (COs) :

CO1	Write Simple programs on microprocessors and micro controllers.
CO2	Design and implement hydraulic circuits with automation studio software and with kit
CO3	Design and implement pneumatic circuits with automation studio software and with kit
CO4	Knowledge of industrial robots
CO5	Knowledge in PLC trainer kit

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	PSO1	PSO 2	PSO3	PSO4				
CO1	**1**	**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: EBME22OL4	Subject Name : AUTOMATION LAB	Ty/Lb/ ETL	L	T/ SLr	P/R	C
	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.

Total No. of Periods: 45

Subject Code: EBME22OL5	Subject Name :VIRTUAL AND AUGMENTED REALITY LAB	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
	Prerequisite: NIL	**Lb**	**0**	**0/0**	**3/0**	**1**

L:LectureT:Tutorial SLr:SupervisedLearningP:ProjectR:ResearchC:Credits

T/L/ETL:Theory/Lab/EmbeddedTheoryandLab

OBJECTIVE: OBJECTIVE: Thestudentswilllearn

- To introduce the relevance of this course to the existing technology through demonstrations, case studies and applications with a futuristic vision along with socio-economic impact and issues
- To understand virtual reality, augmented reality and using them to build Biomedical engineering applications

COURSEOUTCOMES(COs) : The students will be able to

CO1	Understand the seting of Unity and Visual Studio for VR development
CO2	Demonstrate the working of HTC Vive and Google Cardboard
CO3	Apply the knowledge of VR & AR on change the colour 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 ofCourseOutcomes withProgramOutcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	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	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3
CO2	3	3	3	3
CO3	3	3	3	3
CO4	3	3	3	3
CO5	2	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: EBME22OL5	Subject Name: VIRTUAL REALITY AND AUGMENTED REALITY LAB	Ty / Lb/ETL	L	T /S.Lr	P/ R	C
	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

Total No. of Periods: 45