

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

# FACULTY OF ENGINEERING AND TECHNOLOGY

# **OUTCOME BASED EDUCATION**

**Curriculum and Syllabus** 

B.Tech -Mechanical Engineering (Part Time)

2022

DEPARTMENT OF MECHANICAL ENGINEERING



# 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.



## 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 Revisio n/ Modifi
					cation 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 Unit-II-Form measurement- internal	
			Unit-III changed as Unit-II: Form measurement	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.	40%
			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.	The following topics are newly includedUNIT- I: Design for Variable loading –Gerber line, Goodman's line, and Soderberg's LineUnit-II: Keys- different types of keys- Design of Keys, keyways, failures of keys	50%



				<b>Unit-III:</b> Functions of springs- applications- spring materials- Belleville springs (disc) and torsion Spring <b>Unit-IV:</b> 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. <b>Unit-V:</b> Lubrication in journal bearings - Types of fly wheels- Design of flywheels involving stresses in rim and arm	
4	EBME22ET2	Manufacturing Technology-II	UNIT-V:POWDERMETALLURGYANDPRECISION ENGINEERINGPowdermetallurgy -productionofmetallurgy-productionofmetallurgy-productionofmetallurgy-productionofmetallurgy-productionofmetallurgy-productionofmetallurgy-powders,compaction,sintering,finishingsintering,finishingfinishingofsinteredparts.Precisionmachiningmachining-diamondturningturningofpartstonanometeraccuracy, stereomicrolithography,machiningmachiningofmicronizedcomponents	UNIT- V: SMART MANUFACTURING Industry 4.0, Cyber Physical system, IoT and Cloud computing for manufacturing, Digital manufacturing, Additive 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: <b>Basic Concepts</b> Equimolar counter diffusion – isothermal evaporation. <b>Convective Mass Transfer</b> Sherwood number, Schmidt number, Stanton number- mass transfer coefficients- Laminar, turbulent and Laminar-turbulent conditions.	20%
6	EBME22013	Design of Machine Elements-II	<b>Uint-V: DESIGN OF</b> <b>SIMPLE MECHANISMS</b> Design of Ratchet and pawl mechanism, Geneva mechanism.	The following topics are newly includedUNIT II: Tooth stresses –Dynamic effects-Fatigue strength-Factor of Safety-Gear materials- Equivalent number of teeth – Forces for helical gears.UNIT- V: CLUTCHES AND	30%



		021001.	2010 Cel	uneu msuu	ution)
Periyar	E.V.R. High	Road, Mad	luravoyal,	Chennai-95.	Tamilnadu, India.

				BRAKES	
				Design of plate clutches -Cone	
				clutches – Centrifugal clutches-	
				Electromagnetic clutches. Band and	
				Block brakes- External shoe brakes –	
				Internal expanding shoe brake.	
7	EBMA22008	Mathematics-		New course has been introduced	
		IV (Probability			100%
		and Statistics)			10070
8	EBCS22IDX	Artificial		New course has been introduced	
Ŭ		Intelligence			100%
		and Machine			10070
		L oorning			
0	EDCS22II V	Artificial		New source has been introduced	
9	EDCS22ILA	Intelligence		New course has been introduced	1000/
		Interligence			100%
		and Machine			
10		Learning Lab			1000/
10	EBME22ET3	Virtual and		New course has been introduced	100%
		Augmented			
11	EBME22E01	Advanced IC		Included in UNIT IV	
11	(ELECTIVE)	Engines		Elevible fuel vehicles	2004
	(ELECTIVE)	Lingines	ALIEKNAIIVE FUELS	riexible fuel vehicles-	20%
				modifications-merits and	
				demerits	
			UNIT V: RECENT		
			TRENDS	UNIT V: Hybrid electrical vehicles –	
				series, parallel and series, parallel	
				configuration – Design – Drive	
				train, sizing of components. Fuel	
				cells-types-construction and	
				working	
12	EBME22E02	Electric and		New Elective course has	
12		Hybrid vehicles		hoon introduced	
				been mitoduced	
13	EBME22E03	Automobile		Shifted from programme	
1.5		Engineering		core to programme Elective	
14	EDME22E15	Design Thinking		Now Elective course has	
14	EDIVIE22E13	and Innovation		new Elective course has	
17				New Florter 1	
15	EBME22E19	Additive		New Elective course has	
		manuracturning		been introduced	
	EBME22E23	System		New Elective course has been	
16		I woolelling and	1	introduced	
		Simulation		Introduced	
17	EDMEQQEQC	Simulation		New Elective course has been	
17	EBME22E29	Simulation Block chain		New Elective course has been	

## DEPARTMENT OF MECHANICAL ENGINEERING B.Tech. Mechanical Engineering (Part Time)Curriculum – 2022 Regulation

		I SEM	IESTER					
S.N	SUBJECT	SUBJECT NAME	Ty/	L	Τ/	P/R	С	Category
0.	CODE		Lb/		SLr			
			ETL/IE					
1	1 EBMA22005	Mathematics III for Mechanical	Т	2	1/0	0/0	4	DC
1		and Civil Engineers	ly	3	1/0			DS
2	EBPH22002	Engineering Mechanics	Ту	3	0/0	0/0	3	BS
3	EBME22004	Manufacturing Technology - I	Ту	3	0/0	0/0	3	РС
4	EBCE22ID5	Fluid Mechanics and Machinery	Ту	3	0/0	0/0	3	ID
5	EBCE22IL4	Fluid Mechanics and Machinery	Lb	0	0/0	3/0	1	ID
		Lab.						

**Credits Sub Total: 14** 

	II SEMESTER								
S.NO	SUBJECT	SUBJECT NAME	Ty/	L	<b>T</b> /	P/R	C	Category	
•	CODE		Lb/		SLr				
			ETL/IE						
1	EBME22002	Engineering Metallurgy	Ту	3	0/0	0/0	3	РС	
2	EBME22003	Engineering Thermodynamics	Ту	3	1/0	0/0	4	РС	
3	EBME22006	Strength of Materials	Ту	3	1/0	0/0	4	PC	
4	EBME22007	Mechanics of Machines -I	Ту	3	1/0	0/0	4	PC	
5	EBME22L02	Engineering Metallurgy Lab	Lb	0	0/0	3/0	1	PC	

**Credits Sub Total: 16** 

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** 

EDUCATIONAL AND RESEARCH INSTITUT	E NAAC
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		III SEM	IESTER					
S.NO.	SUBJECT	SUBJECT NAME	Ty/	L	Τ/	P/R	С	Catego
	CODE		Lb/		SLr			ry
			ETL/IE					
1	EBME22008	Thermal Engineering	Ту	3	0/0	0/0	3	РС
2	EBME22009	Mechanics of Machines -II	Ту	3	1/0	0/0	4	РС
3	EBME22012	Design of Machine Elements -I	Ту	3	1/0	0/0	4	РС
4	EBME22ET2	Engineering Metrology	ETL	2	0/0	2/0	3	РС
5	EBME22L04	Dynamics Lab	Lb	0	0	3/0	1	РС

## Credits Sub Total: 15

	IV SEMESTER						
SUBJECT	SUBJECT NAME	Ty/	L	Τ/	P/R	С	Catego
CODE		Lb/		SLr			ry
		ETL/IE					
	Design of Machine Elements -			1.0	0.40		DC
EBME22014	п	Ty	3	1/0	0/0	4	PC
EBME22013	Industrial Automation	Ту	3	0/0	0/0	3	PC
EBME22ET3	Manufacturing Technology-II	ETL	2	0/0	2/0	3	РС
			4	0/0	2/0	-	
EBME22EXX		Ту	3	0/0	0/0	3	РС
	Program Elective 1						
EBME22L06	Thermal Engineering Lab-II	LB	0	0/0	3/0	1	PC
	SUBJECT CODEEBME22014EBME22013EBME22ET3EBME22EXXEBME22EXX	IV SEMESTERSUBJECT CODESUBJECT NAMEDesign of Machine Elements - IIEBME22014IIEBME22013Industrial AutomationEBME22ET3Manufacturing Technology-IIEBME22EXXProgram Elective 1EBME22L06	IV SEMESTERSUBJECT CODESUBJECT NAMETy/ Lb/ ETL/IEBEBME22014Design of Machine Elements - IITyEBME22013Industrial AutomationTyEBME22ET3Manufacturing Technology-II Program Elective 1TyEBME22L06Thermal Engineering Lab-IILB	IV SEMESTERSUBJECT CODESUBJECT NAMETy/ Lb/ ETL/IELDesign of Machine Elements - IITy3EBME22014Industrial AutomationTy3EBME22ET3Manufacturing Technology-IIETL2EBME22EXXProgram Elective 1Ty3EBME22L06Thermal Engineering Lab-IILB0	IV SEMESTERSUBJECT CODESUBJECT NAMETy/ Lb/ Lb/ ETL/IEIDesign of Machine Elements - IITy3BME22014Industrial AutomationTy3EBME22ET3Manufacturing Technology-II Program Elective 1ETL2EBME22EXXProgram Elective 1Ty3EBME22L06Thermal Engineering Lab-IILB0	IV SEMESTERSUBJECT CODESUBJECT NAMETy/ Lb/ Lb/ ETL/IEIT/< SLrP/RBesign of Machine Elements - IITy31/00/0EBME22014Industrial AutomationTy30/00/0EBME22ET3Manufacturing Technology-IIETL20/02/0EBME22EXXProgram Elective 1Ty30/00/0EBME22L06Thermal Engineering Lab-IILB00/03/0	IV SEMESTERSUBJECT CODESUBJECT NAMETy/ Lb/ Lb/ ETL/IEIP/RCBME22014Design of Machine Elements - IITy31/00/04EBME22013Industrial AutomationTy30/00/03EBME22ET3Manufacturing Technology-IIETL20/02/03EBME22EXXProgram Elective 1Ty30/00/03EBME22L06Thermal Engineering Lab-IILB00/03/01

**Credits Sub Total: 14** 

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

	V SEMESTER								
S.NO.	SUBJECT	SUBJECT NAME	Ty/	L	Τ/	P/R	С	Category	
	CODE		Lb/		S.Lr				
			ETL/IE						
1	EBME22010	Heat and Mass Transfer	Ту	3	1/0	0/0	4	РС	
2	EBME22ET4	Virtual and Augmented Reality	ETL	2	0/0	2/0	3	РС	
3	EBCC22ID1	Engineering Economics and Industrial Management	Ту	3	0/0	0/0	3	ID	
4	EBME22EXX	Program Elective 2	Ту	3	0/0	0/0	3	PE	
5	EBME22L09	Industrial Automation Lab	Lb	0	0/0	3/0	1	PC	

	Credits Sub Total: 14							
		VI SEM	ESTER					
S.NO.	SUBJECT	SUBJECT NAME	Ty/	L	Τ/	P/R	С	Category
	CODE		Lb/		S.Lr			
			ETL					
1	EBME22011	CAD,CAM & CIM	Ту	3	0/0	0/0	3	PC
2	EBME22015	Finite Element Method	Ту	3	1/0	0/0	4	PC
3	EBME22EXX	Program Elective 3	Ту	3	0/0	0/0	3	PE
4	EBME22L07	CAD/CAM Lab	Lb	0	0/0	3/0	1	РС
5	EBME22I05	Project Phase – I	IE	0	0/0	3/3	2	Р

Credits Sub Total: 13

	VII SEMESTER												
S.NO.	SUBJECT	SUBJECT NAME	Ty/	L	Τ/	P/R	С	Category					
	CODE		Lb/		S.Lr								
			ETL										
1	EBME22EXX	Program Elective 4	Ту	3	0/0	0/0	3	PE					
2	EBME22EXX	Program Elective 5	Ту	3	0/0	0/0	3	PE					
3	EBME22L10	Project Phase – II	Lb	0	0/0	12/12	8	Р					

Credits Sub Total: 14

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



## LIST OF ELECTIVE SUBJECTS

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



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

## **CREDIT SUMMARY**

Semester: 1	:	14 Credits
Semester: 2	:	16 Credits
Semester: 3	:	15 Credits
Semester: 4	:	14 Credits
Semester: 5	:	14 Credits
Semester: 6	:	13 Credits
Semester: 7	:	14 Credits

## **TOTAL CREDITS: 100**



# **SEMESTER - I**

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

			Periyar E.	V.R. High R	oad, Madu	ravoyal, C	hennai-95.	. Tamilnad	u, India.			1		
Subject Code:	Sub	oject Na	me : Ma	athemat	ics III	for Me	chanical	1	Ty/Lb/	L	<b>T</b> /	P/R	C	
EBMA22005		and (	Civil Engi	ineers					ETL		SLr			
	Pre	erequisit	e: Math	ematics	I & II				Ту	3	1/0	0/0	4	
L : Lecture T :	Tutoria	1 SLr:	Supervis	ed Learr	ning P:	Project	R : Rese	earch C:	Credits	11			J	
T/L/ETL : The	ory/Lab	/Embed	ded Theor	ry and L	ab									
OBJECTIVE	S: The s	tudent v	vill learn											
Basic	mathem	latical to	ols and t	echnique	es which	n empha	asize the	develo	pment of 1	rigorou	is logica	l thinkin	ig and	
• Theory	v and an	ns.	ns of narti	ial differ	ential e	nuation	its annl	ications	Fourier se	eries t	ransform	s and L	anlace	
transfo	ormation	).	is of parts	iur unrei	entiar ex	quantum,	no uppi	reations	, i ourier s	c1103, 1	ransion	is und La	apiace	
COURSE OUTCOMES (COs) : ( 3- 5) The students will be able to														
CO1	Understand the concepts of Partial Differential equations													
CO2	Determi	Determine the Fourier series solutions												
CO3	Apply th	pply the concepts of PDE in Wave and Heat problems												
CO4	Apply L	pply Laplace transforms in Engineering problems												
CO5	Apply Fourier transforms in Engineering problems													
Mapping of Co	Course Outcomes with Program Outcomes (POs)													
COs/POs	PO1	PO2	PO3	PO4	PO5	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	PO1	.0 PO1	l1 P	012	
CO1	3	2	2	3	3	1	1	2	2	1	1	L	2	
CO2	2	2	1	3	1	2	1	2	3	1	1	1	2	
CO3	3	2	1	3	2	3	2	1	1	2	1		3	
<u>CO4</u>	3	2	1	2	1	3	2	1	1	1	]		2	
CO5	3	3	1	2	1		2		1	2		2	3	
COs / PSOs	PS	501	PS	02	PS	03	PS	504						
CO1		2	-	1		1 3								
CO2		2		1		1		3						
CO3		2		1		1		3						
CO4		2	-	1		1		3						
CO5		2		1		1		3						
			_											
			ocia		ve		2		L L					
L.	0		d sc		sctiv		nar	nent	jeci					
ego	ence	ad	s an	ore	ı ele	ive	ilqi	Iodi	Pro					
Cat	Scie	erin	ities	n C	ram	lect	Disc	Con	cal					
	sic	inee	nani nce	gran	rog	пE	er I	III C	nctic					
	Ba	Eng Scie	Hun Scie	Pro§	Ч	Ope	Int	Sk	Prí					
	√													

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

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

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

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

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

## UNIT- III: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

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

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

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

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

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

## TEXT BOOKS

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

## REFERENCES

- 1) Singaravelu (2009), Transforms and Partial Differential Equations, Meenakshi Agency.
- 2) Kreyszig E. (2011), Advanced Engineering Mathematics ( $\hat{9}^{th}$  ed.), John Wiley & Sons.
- 3) Grewal B.S. (2012), Higher Engineering Mathematics, Khanna Publishers.

# TE A+

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## Total No. of Periods : 60

12

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

			Periyar E.V	.R. High Road,	Madur	avoyal, Cl	hennai-95.	Tamilnad	lu, India.							
Subject Code	e: S	ubject Na	ame : $\overline{EN}$	GINEERIN	NG M		NICS		Ty/Lb/		<b>T</b> /	P/R	С			
EBDU33004	,	(	FOR AUTC	, месн, с <b>г</b>	VIL &	KORO	1105)		ETL		SLr					
LDF <b>H</b> 22002	<sup>2</sup> P	rerequisi	te: Engine	eering Phys	sics				Ту	3	0/0	0/0	3			
L : Lecture T	: Tutor	ial SLr :	Supervise	d Learning	P : I	Project	R : Rese	earch C	: Credits	<u> </u>			<u> </u>			
T/L/ETL : Th	neory/La	ab/Embed	ded Theory	y and Lab												
OBJECTIVI	E:															
• E	Basic pri	nciples of	stress, str	ain and elas	tic co	onstants										
[`•	o draw	shear forc	e and bend	ding momen	nt dia	gram										
• 1				TTCOMES		(2)	5)									
<u>CO1</u>	Articu	LO Late a str	ong found	lation in u	) (CU	(3): (3)	- 5) a kinen	natics &	- Kinetics							
	Anticu				luers	anum	g killeli		e Killeties							
CO2	Identi	fy and us	e the fund	lamentals of	of me	echanic	es, static	c and d	ynamic eq	luilibriu	m					
CO3	Enhan	ce the pr	oblem sol	ving skill	in sta	tics an	nd dynai	mics								
<u>CO4</u>	Devel	Develop analytical skills to identify different types of motion														
		Develop analytical skills to identify different types of motion														
CO5	Articulate models to acquire knowledge on mathematical, analytical skills															
		Ma	pping of (	Course Out	come	es with	Program	m Outo	omes (PO	s)						
Cos/Pos	PO	l PO2	PO3	PO4	PO	PO6	<b>PO7</b>	PO8	<b>PO9</b>	PO10	PO11	PO	12			
					5											
<u>CO1</u>	3	3	2	2	2	1	1			2			1			
<u>CO2</u>	3	3	1	2	2	1	1	1	1	2	1		1			
<u>CO3</u>	3	3	3	3	2	2	2	1	2	2	1		1			
<u>C04</u>	3	3	3 2	3	$\frac{2}{2}$	2	1	1	3	$\frac{2}{2}$			1			
Cos / PSOs		2 PSO1		$\frac{2}{2}$		PSO3	I PS	<u>1</u> SO4	2		1					
CO1		3	150	3		1	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	s Streng	gth of Co	relation	3- High, 2	- Me	dium, 1	1-Low		•		•					
			cial		e											
			l so		ctiv		nary	ent	ect							
	nce	50	anc	ore	ele	ve	plir	noq	Proj							
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Subject Code:	Subject Name : ENGINEERING MECHANICS	Ty/Lb/	L	Τ/	P/R	С
EDD1122002		ETL		SLr		
EBPH22002	Prerequisite: Engineering Physics	Ту	3	0/0	0/0	3

## UNIT I STATICS OF PARTICLE

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

## UNIT II PROPERTIES OF SURFACE AND SOLIDS

EDUCAT

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

## UNIT IIIFRICTION

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

## UNITIVDYNAMICS OF PARTICLES

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

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

## UNITV DYNAMICS OF RIGID BODIES

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

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

## **TEXT BOOKS & REFERENCE BOOKS**

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

20

## Total No. of Periods: 45

9.

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Subject	t Cod	e: Si	ubject N	ame: MA	CHNOL	OGY - I	Ty/Lb /FTI	L	T/ SIr	P/ P	С			
EBME	22004		rerequis	ite: NIL							3	0/0	0/0	3
L : Lect	ure T	: Tutori	al S L	r : Superv	ised Lea	rning P	: Practio	cal R : R	Research	C: Credits	11	1	I	
Ty/Lb/E	ETL :	Theory/	Lab/Em	bedded Tl	neory an	d Lab								
OBJEC	TIV	ES: The	e purpose	e of study	is to	<b>C</b> (		c	. 1	1 1 /				
	•	Impart Select	the appr	dge in var	10us mai anufactu	ring pro	ing proc	esses 101	e applica	tion				
COURS	SE O	UTCON	MES (CO	Os) : The	student	will be	able to		e applied					
CO1	U	nderstan	d the var	rious man	ufacturir	ng proce	sses for	metals. (	Level 2)					
CO2	De	emonstra	ate the o	peration o	f variou	s manufa	acturing	processe	es (Level	3)				
CO3	Ех	xpose to	advance	d method	s of man	ufacturi	ng (Leve	el 2)						
CO4	Re	ecomme	nd the su	iitable ma	nufactur	ing proc	ess depe	ending of	n the req	uirement(Le	evel 4)			
CO5	De	escribe t	he manu	facturing	of plasti	c compo	onents/P	roducts a	nd their	applications	. (Leve	13)		
Mapping of Course Outcomes with Program Outcomes (POs)														
Cos/Pos		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO11	PO1	2
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	1
CO5		3	2	1	-	2	3	3	3	3	3	2	2	1
Cos / PSC	Os	PS	601	PSO	02	PS	603	PS	504					
CO1		,	3	3		3 2								
CO2		,	3	3	1		3	2						
CO3			3	3		3		2						
CO4			3	3			3		2					
CO5		í	3	3			3		2					
3/2/1 indi	icates	s Streng	th of Co	orrelation	3- Hi	gh, 2- M	ledium,	1-Low		-1			1	
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		ce		nd e			e		oner	ojec				
		cien	ng	es a lenc		В	ctiv	nary	unpo	l /Pı				
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	tegoi	Basi	Ingir	Huma ocial	rogr Core	Pro	Den	Inte Disc	Skil	Prac				
i	Cai		<u> ш</u> х	м на N										
					<ul> <li>✓</li> </ul>									

Subject Code:	Subject Name : MANUFACTURING TECHNOLOGY - I	Ty/Lb	L	Τ/	P/R	С
EBME22004		/ETL/IE		SLr		
	Prerequisite: NIL	Ту	3	0/0	0/0	3

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

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

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

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

## UNIT- III: METAL JOINING PROCESSES

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

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

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

## UNIT- V: PROCESSING OF PLASTIC MATERIALS

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

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

## TEXT BOOKS

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

## REFERENCES

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



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Subject Cod	e: Su	Subject Name : FLUID MECHANICS AND MACHINERY							Ty/Lb/ FTL	L	T/ SLr	P/R	С
EBCE22ID5	Pi	ereanisi	te: Engir	neering	Physics					3	0/0	0/0	3
L : Lecture T	: Tutoria	al SLr	: Supervis	ed Lear	ning P:	Practic	al R : R	esearch	C: Credits		0/0	0/0	
T/L/ETL : Th	neory/La	o/Embed	ded Theor	y and L	ab								
OBJECTIV	E: The s	tudents v	will learn										
• The l	basic pro	perties of	f fluids.										
• Flow	behavio	ur in vari	ious sectio	ons with	basic eq	luations							
Worl	king prin	ciples of	hydraulic	pumps a	and turb	ines							
COURSE O	UTCOM	IES (CO	s) : The s	tudents	will be	able to							
CO1	Underst	and the v	arious pro	perties of	of fluids	.(Level	1&2)						
CO2	Apply th	ne basic c	concepts o	f fluid f	low beh	aviour ii	n various	s sectio	ns and solv	e simple	problem	5(Lev	el <b>3</b> )
CO3	Analyse	the beha	viours of	fluid flo	w throu	gh circu	lar cond	uits(L	evel 4)				
CO4	Acquire	ire the knowledge of construction and working principles of hydraulic turbines and pun							nd pump	s(Lev	el 2)		
CO5	Analyze	ze the performance of hydraulic turbines and pumps.(Level 4)											
Mapping of	Course	Outcome	es with Pr	ogram (	Outcom	es (POs	s):						
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PC	)12
CO1	3	1	2	2	2	2	2	2	1	2	-	,	3
CO2	3	3	3	3	2	2	2	2	1	3	-		2
CO3	3	3	2	2	2	2	2	2	1	3	-		2
CO4	3	2	3	2	2	2	2	2	1	2	-		3
CO5	3	2	3	2	2	2	2	2	1	3	-		1
COs / PSOs	P	501	PSC	)2	PS	03	PS	04					
CO1		3	2		-	2		2					
CO2		3	2		4	2		2					
CO3		3	2		-	2		2					
CO4		3	2			2		2					
CO5		3	2			2		2					
3/2/1 indicat	es Stren	gth of Co	orrelation	<b>3- H</b> i	igh, 2- N	<u>ledium</u>	<u>, 1-Low</u>				1		
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/IE	L	T/ SLr	P/R	С
	Prerequisite: Engineering Physics	Ту	3	0/0	0/0	3

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

DUCAT

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

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

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

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

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

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

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

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

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

## **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., 9<sup>th</sup> edition
  3) Streeter V.L. and Wylie E.B. (1983), "Fluid Mechanics", McGraw Hill.
- 4) Ramamirtham S. (1988), "Fluid Mechanics, Hydraulics and Fluid Machines", Dhanpat Rai & Sons, Delhi.
- 5) Yunus.A.Cengel, Robert H.Turner., "Thermal-Fluid Sciences", Tata McGraw Hill.





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Subject Code:		bject CHINI	Name ERV LAF	: FLU	JID N	<b>IECHA</b>	NICS	AND	Ty/Lb/	L	T/	P/R	C
EBCE22IL4	IVIT			,					ETL		SLr		
	Pre	erequisi	te: Fluid	Mecha	nics and	l Machi	nery		Lb	0	0/0	3/0	1
L : Lecture T : T	utoria	SLr :	Supervise	ed Learr	ing P:	Project	R : Rese	arch C	Credits				
T/L/ETL : Theor	y/Lab	/Embed	ded Theor	y and L	ab								
OBJECTIVES:	The s	tudent w	vill learn	•									
• Differen	t Meth	ods of f	low meas	urement	S								
To study	the ch	naracteri	stics of h	ydraulic	pumps.								
To study	the ch	naracteri	stics of h	ydraulic	turbines	5.							
COURSE OUT	COM	ES (CO	s) :										
CO1	U	nderstar	nd the con	cept of o	lifferent	method	s of flow	v measu	urements				
CO2	D	etermine	e the coef	ficient of	of discha	rge of C	Drifice a	nd Ven	urimeter				
CO3	D	etermine	e the frict	ion facto	or for the	e pipes							
CO4	D	raw and	analyze	the per	formanc	e chara	cteristics	s curves	s of jet p	ump, gea	r pump,	recipro	cating
	pı	imps an	d centrifu	gal pum	ps								
CO5	D	raw and	analyze t	he perfe	ormance	charact	eristics of	curves	of hydrau	ilic turbii	nes		
Mapping of Cot	Irse U	utcome	s with Pr	ogram (	Jutcom	es (Pos)	DO7	DOQ	DOO	<b>DO10</b>	<b>DO11</b>	<b>DO</b>	10
	2	PO2	2	P04	P05	2	PO/	PUð	P09	POIU	POII	PO.	12
CO1	3	<u> </u>	4	2		4	L	2	1				
CO2 CO3	$\frac{3}{2}$	1	1	3			1	4	1				
CO4	-	3	-	2		2	-	2					
CO5		3		2		2		2					
Cos / PSOs	PS	01	PSC	$\overline{)2}$	PS	03	PS	504					
CO1		3				2							
CO2		3				2							
CO3	2	2				3							
CO4		3	2			2		3					
CO5		3	2			2		3					
3/2/1 indicates St	rengt	h of Coi	rrelation	3- Hig	gh, 2- M	edium,	1-Low	1		-			
			_										
			cia		/e		~						
~			1 so		ctiv		nary	ent	ject				
Cros	nce	5.0	anc	ore	ele	ve	plir	noq	Proj				
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Subject Code: EBCE22IL4	Subject Name : FLUID MECHANICS AND MACHINERY LAB	Ty/Lb/ ETL	L	T/ SLr	P/R	С
	Prerequisite: Fluid Mechanics and Machinery	Lb	0	0/0	3/0	1

## LIST OF EXPERIMENTS:

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

Total No. of Periods: 45



# **SEMESTER II**



()	An 150 210	101 : 2018 Ce	rtified instit	ution)	
yar E.V.R.	. High Road	, Maduravoyal	, Chennai-95.	Tamilnadu,	India.

		P	eriyar E.V.R	. High Ro	ad, Madu	ravoyal, C	Chennai-9	5. Tamiln	adu, India.	<u> </u>			~
Subject Code	: Su	bject Na	ame : EN	GINEE	RING N	ИЕТАL	LURG	Y	Ty/Lb/	L	<b>T</b> /	P/R	C
EBME22002	2								ETL		SLr		
	Pr	erequisi	te: Engin	eering (	Chemist	ry			Ту	3	0/0	0/0	3
L : Lecture T :	Tutoria	l SLr :	Supervise	ed Lear	ning P:	Project	R : Rese	earch C:	Credits	I			
T/L/ETL : The	eory/Lab	/Embed	ded Theor	y and L	ab								
OBJECTIVE	:												
To und	derstand	differen	t material	s and th	eir meta	llurgica	l propert	ties.					
COURSE OU	TCOM	ES (CO	(3.5)	) Stude	nts will	he ahle	to						
CO1	Understa	and the f	undament	als of m	aterials	and cha	aracteriz	ation (Le	evel 2)				
$CO^2$	Comprei	nend the	propertie	s and ar	nlicatio	ns of fer	rous and	1 non fer	rous meta	ls (Level	2)		
CO3	Demonst	ration a	bout phase	e diagra	ms and	applying	the fun	damenta	ls of Heat	treatme	nt (Level	3)	
CO4	Analyzir	ig and o	comparing	the m	echanisi	ns behi	nd defo	rmation	.strengthe	ening an	d failur	e of i	netals
	Level L	4)	r r c	2					,	0			
CO5	Evaluati	on and s	election of	f Metals	s ,Non n	netals an	d newer	materia	ls (Level I	L5)			
Mapping of C	Course C	utcome	s with Pr	ogram	Outcom	es (Pos)	)		-				
Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	<b>PO10</b>	PO11	PO	12
<u>CO1</u>	2	2	2	2	1	1	-	1	1	1	-		1
<u>CO2</u>	2	1	2	1	-	2	2	2	2	1	-		1
<u>CO3</u>	3	3	3	3	2	3	3	2	3	2	-		1
C04	3	3	3	3	3	3	3	2	3	2	-		1
$\frac{C05}{Cos/PSOs}$		<u> </u>		2		$\frac{2}{103}$		2	2	2	2		1
$\frac{C08/F508}{C01}$	15		130	52	r c	1	E C	1					
$CO_2$	-	)	$\frac{2}{2}$			$\frac{1}{2}$		1					
CO3	4	2	2			3		2					
CO4		3	2			3		3					
CO5		2	2			2		2					
3/2/1 indicates	Strengt	h of Co	rrelation	3- Hi	gh, 2- M	ledium,	1-Low						
			cial		e								
			soc		tiv		ary	snt	ect				
<i>kia</i>	Ice		put	ė	elec	è	olin	one	loi				
fegu	ien	ng	es s	Col	m	ctiv	scip	du	4				
Ca	SC	eeri. Se	niti če	Ē	gra	Ele	Di	ů ů	lca				
	asic	gine	ma enc	gr?	Pro	en	iter	kill	ract				
	В	En, Sci	Hu Sci	Prc		Op	In	S i	<u>r</u>				
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UNIT- I: CRYSTALLOGRAPHY AND STRENGTHENING MECHANISMS	

Subject Name : ENGINEERING METALLURGY

**Prerequisite: Engineering Chemistry** 

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**

EDUCATIO

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

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

## UNIT- III: HEAT TREATMENT AND TESTING

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

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

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

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

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

## TEXT BOOKS

Subject Code:

**EBME22002** 

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

## REFERENCES

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

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## Total No. of Periods: 45

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Subject Cod	le: Sul	Subject Name : ENGINEERING THERMODYNAMICS							Ty/Lb/	L	T/ SI r	P/R	С
EBME22003	Pre	ereanisi	te: Engin	eering ]	Physics				Tv	3	1/0	0/0	4
L : Lecture T :	Tutoria	S Lr	: Supervis	ed Leari	ning P:	Practica	al R:Re	esearch	C: Credits		1/0	0/0	-
T/L/ETL : The	eory/Lab	/Embedd	ied Theor	y and La	ab								
OBJECTIVE	: OBJE	CTIVE:	The stud	lents wi	ll learn								
• The funda	mentals	of therm	odynamic	s and th	ermodyr	namic re	ations						
• Properties	of Stean	n and its	applicatio	ons.									
• Different	hermody	ermodynamic cycles											
COURSE OU	TCOM	ES (CO	s): The st	tudents	will be a	able to							
CO1	Understand the basic concepts and laws of thermodynamics.(Level 1&2)												
CO2	Apply	Apply the first and second law of thermodynamics to the engineering processes and											
	devices	devices.(Level 3)											
CO3	Unders	Understand the concepts of entropy and its engineering applications.(Level 2)											
CO4	Apply	Apply the properties of pure substances in various applications. (Level 3)											
CO5	Analyz	Analyze the thermal performance of various power cycles.(Level 4)											
CO6	Unders	tand an	d apply t	he vario	ous ther	modyna	amics re	elations	in the eng	gineering	g process	es.(Le	evel
	2&3).												
Mapping of C	Course O	utcome	s with Pr	ogram (	Dutcom	es (POs)	)		-	•		T	
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1	.2
CO1	3	3	2	2	1	1	2	1	1	2	-		3
CO2	3	3	2	3	1	1	2	1	2	2	-		2
<u>CO3</u>	3	3	3	3	1	1	2	1	1	2	-	4	2
CO4	3	3	3	3		1	2		2	2	-		2
C05	3	3	3	3	<u> </u>	1	3	1	2	2	-		<u>)</u>
$CO_{0} / PSO_{0}$	<u>5</u>	01	3	3		1			2	2	-	4	2
COS/FSOS	r S	2	r.s(	)2	r5	05	r.s	2				-	
C02	-	3	2			)		<u> </u>					
CO3		3	2			<u>-</u> >		2					
CO4		3	2		2	2		2					
CO5		3	2			2		2					
CO6		3	2		2	2		2					
3/2/1 indicate	s Streng	th of Co	orrelation	3- Hi	gh, 2- N	Iedium,	1-Low		•	•			
			ial										
			soci		tive		ary	nt	sct				
	ce		pu	e	lec	e	lin	one	roje				
ory	ien	gu	es a	Cor	m e	ctiv	cip	du	e l				
teg	Sc	eri e	nitie e	m (	gra	Elec	Dis	Col	ical				
Ca	asic	ține enc	mai	gra	Pro	n I	ter	ili	act			1	
	Bí	Eng Scie	Huı Scia	Pro		Op(	In	Sţ	Pr			1	
				✓									



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

Dr. M.G.R.

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

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

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

## **UNIT- II: SECOND LAW OF THERMODYNAMICS**

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

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

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

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

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

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

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

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

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

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

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

## REFERENCES

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

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Subje	Subject Code: Subject MAT					e:S' S	TRENG	TH OF		Ty/Lb/ ETL	L	T/ SLr	P/R	С	
EBM	E <b>22006</b>	6	Pr	erequi	isite:	Engi	neering I	Mechan	ics		Ту	3	1/0	0/0	4
L:Leo	cture T	: Tuto	rial	SLr	: Sup	pervise	ed Learni	ng P:I	Practical	R : R	esearch C	: Credits		II	
T/L/E	TL : Th	neory/I <b>F</b> ∙ Th	_ab/	Embe	dded	Theor	y and La	b							
ODJE	• 1	Basic p	rinc	iples of	of stre	ess, sti	ain and e	elastic co	onstants						
	• ]	Го drav	v sh	ear for	rce ai	nd ben	ding mor	nent dia	igrams						
~~~~	• t	o find	defl	ection	of be	eams									
COU	RSE O	UTCO	M	£S (CC	<b>J</b> s) :	The s	tudent w	ill be a	ble to						
CO1		Under	stan	id the o	conce	epts of	mechani	cs of so	lids (Lev	vel 2)					
CO2		Analy	ze tl	he stre	sses	involv	ed due to	differe	nt types	of load	ling (Lev	el 4)			
CO3		Apply	the	differ	ent th	neories	s of mech	anics (L	Level 3)						
CO4		Derive	e the	e expre	essior	n for d	eflection	and ber	nding mo	oment (	(Level 4)				
CO5		Use mathematical approach to analyze the stresses involved (Level 4)													
		1	-	Ma	appir	ng of (	Course C	Outcome	es with I	rogra	m Outco	mes (PC	s)		
Cos/P	OS	PO1	I	202	PO	3 1	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3		3	3		2	3	2	2	2	3	3	2	2
CO2		3		3	3		2	3	2	2	2	3	3	2	2
CO3		3		3	3		2	3	2	2	2	3	3	2	2
CO4		3		3	3		2	3	2	2	2	3	3	2	2
CO5		3		3	3		2	3	2	2	2	3	3	2	2
Cos / I	PSOs	P	SO	1	PSO2		PSO3		P	SO4					
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 i	ndicat	es Stre	engt	th of C	Corre	lation	a 3- Hig	gh, 2- M	ledium,	1-Low					
										ent	ect				
	nce		0	and	lce			ve	ry	pone	Proj				
	Scie	rine		ities	cier	ч	ram /e	lecti	lina	Com	cal /				
	sic	inec	ence	nan	ial S	gran e	Prog	sn E	ter scip	ill C	actic				
	$\mathbf{Ba}$	Εno	Scie	Hur	soci	Pro	I ele	Ope	In1 Di	Sk	$\mathbf{P}_{\mathbf{n}}$				
					Γ	$\checkmark$									

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

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

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**

EDUCAT

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

## UNIT- III: TORSION OF SHAFTS AND SPRINGS

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

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

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

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

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

## Total No. of Periods: 60

## **TEXT BOOKS**

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

## **REFERENCES:**

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



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

Subject Code:	t	Sı	Subject Name: MECHANICS OF MACHINES-I									S-I	T / I ETL		L	T/ Lr	S.	P/ F	C C
EBME2	22007	Pı	e rec	quisite	e: En	gineer	ing I	Mech	anics				Ту		3		1/0	0/0	4
L : Lect T/L/ETI	ure T L : Th	: Tuto eory/I	rial .ab/E	S Lr mbed	: Sup ded 7	oerviseo Theory	d Lea and	arning Lab	g P:F	racti	cal	R : Re	esearch	C: Cı	redits	I			
OBJEC	TIVE	E <b>S</b> : T	ne pu	rpose	of st	udy is t	to un	dersta	and an	d app	ply tl	he diff	ferent c	oncep	ts of r	necha	anics.		
COURS	SE OU	UTCC	MES	5 (CO	s):	The st	uden	t will	l be at	ole to	)								
CO1		Unde	Understand the fundamental concepts of mechanism and their applications. (Level 2)																
CO2		Anal	Analyze the different links of a mechanism. (Level 4)																
CO3		Draw	Draw the displacement, velocity and acceleration for different mechanisms. (Level 3)																
CO4		Com	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	5	<b>PO1</b>	PO	02	PO	3 PC	<b>)</b>	PO	5 P	06	PC	)7	PO8	PO9	P P	010	PO	11	PO12
CO1		3		3	2		2	-		1		1	-	1		2	1		2
CO2		3		3	2		3	2 1		1	1		-	1		2	1		2
CO3		3		3	2		3	2		1		1	-	1		2	1	-	2
CO4		3		3	2		3	2		1		1	-	1		2	1	-	2
CO5		3		3	2		2	2		1		1	-	1		2	1		2
Cos / PS	SOs	]	PSO1			PSO2			PSO3 I		PSC	04							
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 in	dicate	es Stro	ength	of Co	orrel	ation	3-1	High,	2- Me	ediur	n, 1-	Low							
							d i			×			t			T			
Basic Science			Engineering Science	Humanities and	social Science	Program Core	Drooram alactiv		Open Elective	Inter Disciplinar	4	Skill Component	Practical /Project						
						✓													

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

Subject Code:	oject Code: Subject Name : MECHANICS OF MACHINES -I			T/ SLr	P/R	С
EBNIE22007	Prerequisite: Engineering Mechanics, Strength of Materials	Ту	3	1/0	0/0	4

#### **BASICS OF MECHANISMS UNIT I**

EDUCAT

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

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

## UNIT III KINEMATICS OF CAM MECHANISMS

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

#### **UNIT IV GEARS AND GEAR TRAINS**

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

## UNIT V FRICTION IN MACHINE ELEMENTS

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

## **TEXT BOOKS:**

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

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

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

## REFERENCES

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

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

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

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

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

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Subject Code:	ubject Code: Subject Name : ENGINEERING METALLURGY									L	Τ/	P/R	С	
EBME22L02	LA	B							ETL		SLr			
	Pr	erequisi	te: Mater	ial Scier	ice, Eng	ineerin	g Metall	urgy	Lb	0	0/0	3/0	1	
L : Lecture T :	Tutoria	I SLr :	Supervise	d Learn	ing P:1	Project 1	R : Rese	arch C:	Credits					
T/L/ETL : The	ory/Lab	/Embedd	led Theory	y and La	b									
OBJECTIVE	:													
• To imp	<ul> <li>To impart knowledge and skill about microstructure and heat treatment processes</li> <li>Experimental methods of finding mechanical properties of materials</li> </ul>													
<ul> <li>Experimental methods of finding mechanical properties of materials</li> <li>.</li> </ul>														
COURSE OUTCOMES (COs) : ( 3- 5)														
CO1	Understand the basic concept of specimen preparation for microstructure analysis													
CO2	Descri	be the Ti	me tempe	rature tra	ansform	ation dia	ıgram (T	TT) of o	lifferent m	etals				
CO3	Analys	Analyse the microstructure of non ferrous materials												
CO4	Analys	e the mi	icrostructu	re of fe	rrous m	aterials								
CO5	CO5 Determine the hardness of different materials													
Mapping of Course Outcomes with Program Outcomes (Pos)														
Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7 PO8</b>		PO9	PO10	PO11	PC	)12	
CO1	1		3						2			_	3	
CO2	1		3						2			_	3	
CO3	1		3						2				3	
CO4	1		3						2				3	
CO5	1		3						2				3	
Cos / PSOs	PS	501	PSC	D2 PSO3 PS			504	PSO5			_			
CO1		1	2		3									
CO2		1	2		3									
CO3		1	2		3									
CO4		1	2			3						_		
CO5		1	2			3								
3/2/1 indicates	Strengt	h of Cor	relation	3- Hig	h, 2- Me	dium, 1	-Low							
Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project					



Subject Code:	Subject Name : ENGINEERING METALLURGY LAB	Ty/Lb/ ETL	L	T/ SLr	P/R	С
	Prerequisite: Material Science, 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


# **SEMESTER III**



Subject C	ode:	Subjec	t Name TH	: ERMA	L ENG	INEEI	RING		Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME220	008	Prere	quisite	Engine	ering 7	Therm	odynai	nics	Tv	3	0/0	0/0	3
L : Lecture	e T : Tutor	ial SL	r : Supe	rvised L	earning	$\mathbf{g} \mathbf{P} : \mathbf{P}$	ractical	R : Rese	earch C: C	redits	0/ 0	0/0	
T/L/ETL :	Theory/La	ab/Embe	edded T	heory a	nd Lab								
OBJECT	IVE: The	student	will lea	arn			ŝ	.1					
• 10	o integrate	the cond	cepts, la	iws and	method	lologie	s from	the first c	ourse in th	hermodyn	amics in	to the an	alysis of
• To	apply the	ss. thermo	dvnam	ic conce	nts into	vario	us them	mal annli	cations lik	e IC enc	rines Ste	am turhi	nes Gas
Т	urbines.		aynann		pis mu	vano	us then	inar appri		c, ic che	sines bie		103, Ods
COURSE		MES (C	$O_{\rm S}$ ) · 7	The stuc	lent wi	l he al	ole to						
COURSE CO1	Demonstr	ate the v	vorking	princip	les of st	eam ge	enerator	rs. conder	sers and r	ozzles ar	nd solve	the	
001	problems.	(Level3)	)	pinoip				,•••••••					
CO2	Analyze tl	he perfo	rmance	of singl	e and n	nultista	ge air c	ompresso	ors and gas	turbines.	(Level 4	)	
CO3	Construct	truct the velocity diagram of steam turbine and determine its performance.(Level 3)											
CO4	Acquire the	ne know	ledge of	f IC eng	ines and	d estim	ate the	performa	nce param	eters. (Le	evel 2)		
CO5	Understan	d the an	alyze tł	ne differ	ent refr	igeratio	on and a	air condit	ioning syst	tem. (Lev	rel 2& 4)		
~~ ~~ ~		Mapping of Course Outcomes with Program Outcomes (Pos)											
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	COs/P	Os	PO1	PO2	PO3	PO4	PO5
$\frac{CO1}{CO2}$	3	3	2	2	1	1	COL		3	3	2	2	
$CO_2$	3	3	2	2	1	1	C02		3	3	2	2	1 1
C03	3	2	2	2	1	2	C03		3	$\frac{3}{2}$	2	2	1
C05	3	2	2	2	1	2	C07		3	2	2	2	1
COs /	PSC	<u> </u>	 PS	502	PS	03		PSO4		_	_	_	
PSOs													
CO1	3			2	, , , , , , , , , , , , , , , , , , ,	2		2					
CO2	3			2		2		2					
CO3	3			2		2		2					
CO4	3			3		2		3					
CO5	3			3		2	<u> </u>	3					
3/2/1 indi	cates Strei	ngth of (	Correla	ation 3	8- High	<u>, 2- Me</u>	edium,	1-Low	Γ	1			<u> </u>
				ocial		ve		x					
	Category Basic Science Engineering Science Humanities and s Science Program Core Program electi Open Elective Inter Disciplinar Skill Componen Skill Componen												
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Subject Code: EBME22008	Subject Name : THERMAL ENGINEERING	Ty/Lb/ ETL	L	T/ SLr	P/R	С
	Prerequisite: Engineering Thermodynamics	Ту	3	0/0	0/0	3

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

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

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

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

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

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

### **UNIT- III: STEAM TURBINES**

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

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

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

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

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

### Total No. of Periods: 45

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

### **TEXT BOOKS**

- 1) Rajput R. K., (2012) "Thermal Engineering", Laxmi Publications (P) Ltd.
- 2) C. P. Kothandaraman and S. Domkundwar, (2004) *"Thermodynamics and Thermal Engineering"* Dhanpat Rai & Co. (P) Ltd.

### REFERENCES

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

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Subject Code	: Su	Subject Name : MECHANICS OF MACHINES –II $T/L/$ $L$ $T/$ $P/$ $C$ ETLSLD											
FBME22009									EIL		<b>3.</b> L	r K	
	Pro	erequisi	te: Engin	eering N	Aechani	ics, Stre	ength of		Ту	3	1/0	0/0	4
		terial	<u> </u>	1.7	· D			1					
L : Lecture T :	Tutoria	I SLr:	Supervise	ed Learn	ing P:	Practica	I R : Re	esearch	C: Credits				
T/L/ETL : The	ory/Lab	/Embedd	ded Theor	y and La	ab								
OBJECTIVE	: The pu	irpose of	f study is	to under	stand an	d apply	the dyna	amic an	alysis of n	nachii	neries	•	
COURSE OU	TCOM	<b>DMES</b> (COs) : The student will be able to Understand the force analysis of reciprocating mechanisms and its application. (Level 2)											
<u>CO1</u>	U	Understand the force analysis of reciprocating mechanisms and its application. (Level 2).											
CO2	C	Classify the vibratory systems and identify the equations of different mechanical systems. $(1 - 12)$											
	.)	(level 3) Solve the problems of the vibratory systems (Level 3)											
<u>CO3</u>		Solve the problems of the vibratory systems. (Level 3). Demonstrate the dynamic balancing of rotating and reciprocating masses (level 3)											
<u>CO4</u>		Demonstrate the dynamic balancing of rotating and reciprocating masses. (level 3)											
005	D	Mapping of Course Outcomes with Program Outcomes (Pos)											
	DO1	Mapping of Course Outcomes with Program Outcomes (Pos)											
COS/POS	POI 2	PO2	2	P04	2	PU0 1	PO/	<u>PUð</u>	P09	PU	10	2	P012
	3	3	2	2	2	1	2	1	2		2	2	2
	3	3	3	2	2	2	2	2	2	-	2	2	2
	3	3	3	2	2	2	2	2	2	-	2	2	2
C04	3	3	3	2	2	2	2	2	2	-	2	2	2
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C0S/PSUS	rs	2	150	)2	P5	03	rs	204					
		2	2			L		<u> </u>					
$CO_2$		2	2			<u>2</u> )		<u> </u>					
		2	2			<u>2</u> )		<u> </u>					
C04		2	2			<u>2</u> )		<u> </u>					
$\frac{2}{3}$	Strong	5 th of Co	<u>4</u> prolotion	3 Ц;	ah 2 N	<u>-</u> Iodium		4					
5/2/1 mulcates	soueng			<b>3- III</b>	gii, 2- iv	leuluin	, 1-L0w						
Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project				
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### ISO 21001 : 2018 Certified Institution Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

Subject Code: EBME22009	Subject Name : MECHANICS OF MACHINES –II	Ty/Lb/ ETL	L	T/ SLr	P/ R	С
	Prerequisite: Engineering Mechanics, Strength of Material	Ту	3	1/0	0/0	4

### UNIT I FORCE ANALYSIS AND FLYWHEELS

EDUCATI

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

### UNIT II BALANCING

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

### UNIT III **FREE VIBRATION**

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

#### **UNIT IV FORCED VIBRATION**

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

#### UNIT V **MECHANISMS FOR CONTROL**

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

## **TEXT BOOKS:**

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

### **REFERENCES**

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

2. Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", Affiliated East-

Press Pvt.Ltd., New Delhi, 1988.

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

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**Total No. of Periods:** 



12



EBME22012 ETL SLr	
Prerequisite: Strength of Materials 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	
<b>OBJECTIVES</b> : The student will learn	
• To understand the principles involved in evaluating the shape and dimensions of a component to	o satisfy
functional and strength requirements.	
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         PO11	PO12
CO1         3         3         2         3         2         2         2         2	2
CO2         3         3         3         2         3         2         2         2         2         2	2
CO3         3         3         2         3         2         2         2         2         2	2
CO4         3         3         3         2         3         2         2         2         2         2	2
CO5         3         3         3         2         3         2         2         2         2         2	2
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	
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active III and III and III and III and III and III and IIII and IIIII and IIII and III and III and III and III and III and IIII a	
Pro   Dec   Pro   Bi     Pro   Operation   Pro   Bi	



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

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

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

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**

EDUCAT

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

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

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

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

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

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

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

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

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

### **TEXT BOOKS**

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

### **REFERENCE BOOK:**

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





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

Subject Code:         Subject Name: ENGINEERING METROLOGY         Ty/Lb/ ETL         T/ ETL         T/ SL         P/R SL         C           FEBME22E72 Prerequisite: Engineering Physics         E         E         0/0         2/0         3           L: Lecture T: Tutorial TL/ETL: Theory/Lab/Embedded Theory and Lab         SLr: Supervised Learning P: Project R: Research C: Credits         0/0         0/0         2/0         3           OBJECTIVES: The student will learn rutering of measurement using different types of precision measurements (Level 2)         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0         0/0			F	ر) Periyar E.V.R	an 190 2 . High Ro	ad, Madu	ravoyal, C	Chennai-9	5. Tamiln	adu, India.				
EBMI22E12     Prerequisite: Engineering Physics     ETI.     2     0/0     2/0     3       L: Lecture T: Tutorial     S.L T: Supervised Learning     P: Project R: Research C: Credits     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     5     6     6     7     7     7     7     7     7     7     7     7     7     7     7     7     7     7     7     7     7     7     7     7	Subject Code:		Subject	Name: E	NGINE	ERING	METR	OLOG	Y	Ty/Lb/ ETL	L	T/ SLr	P/R	С
L: Lecture T: Tutorial S Lr : Supervised Learning P: Project R : Research C: Credits         TL-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)         CO4       Select the appropriate precision measuring instrument based on the component drawing (Level 4)         CO5       Exposed to the recent advancement in metrology (Level 2)         C04       Select the appropriate precision measure (POs)         Co3       2       2       -         C04       Select the appropriate precision measure (POs)       FOG         Co4       Select the appropriate precision measure (POs)       Co3         Co5       3       2       2       3       2       2       2         C04       3       2       2       -       3       3       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2	EBME22E12	Prer	equisite	: Enginee	ring Ph	ysics				ETL	2	0/0	2/0	3
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       Period of the fundamentals of precision measurements (Level 3):         CO4       Select the appropriate precision measuring instrument based on the component drawing (Level 4):         CO5       PO1       PO2       PO4       PO5       PO8       PO9       PO10       PO11       PO12         CO4       Select the appropriate precision measuring instrument based on the component drawing (Level 4)         CO5       For PO1       PO8       PO7       PO8       PO10       PO11       PO10       PO11       PO12       PO10       PO11       PO10       PO11       PO10       PO11       PO10       PO11       PO10 <t< td=""><td>L : Lecture T : T/L/ETL : The</td><td>Tutorial</td><td>l S Lr /Embedd</td><td>: Supervis ded Theory</td><td>ed Learn y and La</td><td>ning P : b</td><td>Project</td><td>R : Rese</td><td>earch C:</td><td>Credits</td><td>_II</td><td></td><td></td><td></td></t<>	L : Lecture T : T/L/ETL : The	Tutorial	l S Lr /Embedd	: Supervis ded Theory	ed Learn y and La	ning P : b	Project	R : Rese	earch C:	Credits	_II			
• Technique of measurement using different types of precision measuring instruments   OURSE OUTCONFES (CO8) :   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 2)   CO4 Select the appropriate precision measurements (Level 2)   CO4 PO4 PO6 PO7 PO8 PO10 PO11 PO12   CO4 Select the appropriate precision measurements (Level 2)   Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cospan="4">Cos	OBJECTIVE	S: The s	student v	vill learn										
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 measurements (Level 3)         CO4       Select the appropriate precision measurements (Level 2)         Mapping of Course Outcomes with Program Outcomes (POS)         Cos/Pos       PO1       PO1       PO10       PO11       PO12         CO4       Sale       PO7       PO8       PO10       PO11       PO12         CO4       Sale       PO9       PO10       PO11       PO12         CO1       3       2       2       2         CO4       Sale       PO10       PO11       PO10       PO11       PO12       CO2       3       3 <td>• Te</td> <td>chnique</td> <td>of meas</td> <td>surement u</td> <td>sing dif</td> <td>ferent ty</td> <td>pes of p</td> <td>recision</td> <td>measuri</td> <td>ng instrun</td> <td>nents</td> <td></td> <td></td> <td></td>	• Te	chnique	of meas	surement u	sing dif	ferent ty	pes of p	recision	measuri	ng instrun	nents			
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	OURSE OUT	COME	S (COs)	:										
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)         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12           Co1         3         2         2         -         3         3         2         2         3         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2 <td>CO1</td> <td>Un</td> <td>derstand</td> <td>l the funda</td> <td>amentals</td> <td>of prec</td> <td>ision me</td> <td>easureme</td> <td>ents ( Le</td> <td>vel 2)</td> <td></td> <td></td> <td></td> <td></td>	CO1	Un	derstand	l the funda	amentals	of prec	ision me	easureme	ents ( Le	vel 2)				
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	CO2	Ga	in theor	etical and	practica	l knowle	dge abo	out the lin	near and	angular n	neasureme	ents (Leve	el 3)	
$ \begin{array}{ c c c c c c c c } \hline CO4 & Select the appropriate precision measuring instrument based on the component drawing (Level 4) \\ \hline CO5 & Exposed to the recent advancement in metrology (Level 2) \\ \hline Mapping of Current Subsection to the recent advancement in metrology (Level 2) \\ \hline Mapping of Current Subsection to the recent advancement in metrology (Level 2) \\ \hline Mapping of Current Subsection to the recent advancement in metrology (Level 2) \\ \hline CO5 & PO1 & PO2 & PO3 & PO4 & PO5 & PO6 & PO7 & PO8 & PO9 & PO10 & PO11 & PO12 \\ \hline CO6 & 3 & 2 & 2 & - & 3 & 3 & 2 & 2 & 3 & 2 & 2 & 2 \\ \hline CO2 & 3 & 2 & 2 & - & 3 & 3 & 2 & 2 & 3 & 2 & 2 & 2 \\ \hline CO3 & 3 & 2 & 2 & - & 3 & 3 & 2 & 2 & 3 & 2 & 2 & 2 \\ \hline CO4 & 3 & 2 & 2 & - & 3 & 3 & 2 & 2 & 3 & 2 & 2 & 2 \\ \hline CO5 & 3 & 2 & 2 & - & 3 & 3 & 2 & 2 & 3 & 2 & 2 & 2 \\ \hline CO4 & 3 & 3 & 2 & 2 & - & 3 & 1 & 0 & 1 & 0 \\ \hline CO1 & 3^{-1} & 3^{-1} & 2^{-1} & 2^{-1} & 3^{-1} & 1 & 0 & 1 \\ \hline CO2 & 3^{-1} & 3^{-1} & 3^{-1} & 2^{-1} & 3^{-1} & 1 & 0 & 1 & 0 \\ \hline CO3 & 3^{-1} & 3^{-1} & 2^{-1} & 3^{-1} & 1 & 0 & 1 & 0 & 0 \\ \hline CO4 & 3^{-1} & 3^{-1} & 3^{-1} & 2^{-1} & 3^{-1} & 1 & 0 & 0 & 0 \\ \hline CO5 & 3^{-1} & 3^{-1} & 3^{-1} & 2^{-1} & 3^{-1} & 1 & 0 & 0 & 0 \\ \hline CO4 & 3^{-1} & 3^{-1} & 3^{-1} & 2^{-1} & 3^{-1} & 0 & 0 & 0 & 0 \\ \hline CO5 & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 0 & 0 & 0 & 0 & 0 \\ \hline CO5 & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 0 & 0 & 0 & 0 & 0 \\ \hline CO5 & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 0 & 0 & 0 & 0 & 0 \\ \hline CO5 & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 0 & 0 & 0 & 0 & 0 \\ \hline CO5 & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 0 & 0 & 0 & 0 & 0 \\ \hline CO5 & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 0 & 0 & 0 & 0 & 0 \\ \hline CO5 & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 0 & 0 & 0 & 0 \\ \hline CO5 & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 0 & 0 & 0 & 0 \\ \hline CO6 & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 0 & 0 & 0 & 0 & 0 \\ \hline CO6 & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 0 & 0 & 0 & 0 \\ \hline CO6 & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 3^{-1} & 0 & 0 & 0 & 0 \\ \hline CO6 & 3^{-1} & 3^{-1} &$	CO3	De	monstra	te the diffe	erent typ	bes of for	rm meas	suremen	ts (Level	13)				
Exposed to the recent advancement in metrology (Level 2)           Mapping of Course Outcomes with Program Outcomes (POs)         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12           Cos/Pos         PO1         3         2         2         -         3         3         2         2         3         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2	CO4	Sel	lect the a	appropriate	e precisi	on meas	uring in	strumen	t based o	on the con	ponent di	awing (L	evel 4	)
Mapping of Course Outcomes with Program Outcomes (POs)           Cos/Pos         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12           Cos/Pos         O1         3         2         2         -         3         3         2         2         3         2         2         2         3         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2	CO5	Ex	posed to	the recen	t advanc	ement in	n metrol	ogy (Le	vel 2)		_	-		
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Mapping of C	ourse O	utcome	s with Pro	ogram (	Outcome	es (POs)	)						
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO	12
CO2       3       2       2       -       3       3       2       2       3       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2       2 <th2< th=""> <th2< th=""> <th2< th=""></th2<></th2<></th2<>	CO1	3	2	2	-	3	3	2	2	3	2	2		2
CO3         3         2         2         -         3         3         2         2         3         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         3         2         3         2         3         2         3         2         3         2         2         3         2         3         2         3         2         3         2         3         2         3         2         3         2	CO2	3	2	2	-	3	3	2	2	3	2	2		2
CO4         3         2         2         -         3         3         2         2         3         2         2         3         2         2         3         2         2         2         3         2         2         2         3         2         2         3         2         2         2         3         2         2         3         2         2         2         3         2         2         3         2         2         2         3         2         2         2         3         2         2         3         2         2         3         2         3         2         3         2         3         2         3         3         2         3         3         2         3         3         2         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3	CO3	3	2	2	-	3	3	2	2	3	2	2		2
CO5         3         2         2         -         3         3         2         2         3         2         2         2           Cos / PSOs         PSOI         PSO2         PSO3         PSO4                 2         3         2         2         3         2         2         3         2         3         2         3         2         3         3         2         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3	CO4	3	2	2	-	3	3	2	2	3	2	2		2
Cos / PSOs         PSO1         PSO2         PSO3         PSO4         Image: Cost of the cost	CO5	3	2	2	-	3	3	2	2	3	2	2		2
CO1       3       3       2       2       1         CO2       3       3       2       3       3       2       3         CO3       3       3       2       3       3       2       3       1         CO4       3       3       2       3       3       2       3       1         CO4       3       3       2       3       3       2       3       1         CO5       3       3       2       3       3       2       3       1         J2/1 indicates Strength of Correlation       3- High, 2- Medium, 1-Low       And social Science       Basic Science       Basic Science       Basic Science       Basic Science         J2/21 indicates Strength of Correlation       3- High, 2- Medium, 1-Low       And social Science       And social Science       And social Science       And social Science         Lactical / Droject       J       J       J       J       J       J       J       J       J       J       J       J       J       J       J       J       J       J       J       J       J       J       J       J       J       J       J       J       J       <	Cos / PSOs	PS	01	PSC	)2	PS	03	PS	504					
Constrained       Science       Scince       Science       Science <td>CO1</td> <td></td> <td>3</td> <td>3</td> <td></td> <td>,</td> <td>2</td> <td></td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td>	CO1		3	3		,	2		2					
CO3       3       2       3       2       3         CO3       3       3       2       3       2       600         CO3       3       3       2       3       3       2       3         CO3       3       3       2       3       3       2       3       4         CO3       3       3       2       3       3       2       3       3         3/2/1 indicates Strength of Correlation       3- High, 2- Medium, 1-Low       A       A       A       A       A       Basic Science       Basic Science       Basic Science       Basic Science       Basic Science       B       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A	CO2		3	3		,	2		3					
CO4     3     3     2     3       CO5     3     3     2     3       J2/1 indicates Strength of Correlation     3- High, 2- Medium, 1-Low         Line     Basic       Skill     Cose     Science       Basic     Scinconce       Basic<	CO3		3	3			2		3					
COS       3       3       2       3       6       6       6       7         3/2/1 indicates Strength of Correlation       3- High, 2- Medium, 1-Low       Category       Category       Category         Volume       Lingineering       Science       Basic Science       Basic Science       Basic Science       Basic Science       Category         Violand       Program Core       Program Core       Value       Value       Value       Value       Value       Value         Projection       Skill Component       Value       Value </td <td>CO4</td> <td></td> <td>3</td> <td>3</td> <td></td> <td></td> <td>2</td> <td></td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td>	CO4		3	3			2		3					
3/2/1 indicates Strength of Correlation       3- High, 5- Medium, 1-Fom         Category       Basic Science       Basic Science         Program Core       Program Core       Program core         Inter Disciplinary       Analysis       Science         Program Core       Analysis       Science         Skill Component       N       Fractical / Project	CO5	-	3	3			2		3					
Category         Basic Science         Basic Science         Engineering Science         Humanities and social Science <ul> <li>Program Core</li> <li>Program clective</li> <li>Open Elective</li> <li>Inter Disciplinary</li> <li>Skill Component</li> <li>Practical /Project</li> </ul>	3/2/1 indicates	Strengt	h of Cor	relation	3- Hig	h, 2- Me	dium, 1	l-Low						
	Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project				

## **TEXT BOOK**

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

### 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.

3. Measurement of Dimensions using Vernier Depth Micrometer 4. Angular Measurement using Vernier Height Gauge and Sine Bar

2. Measurement of Dimensions using Vernier Height Gauge

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

- Types - Causes- Calibration - Interchangeability and selective assembly

EDUCAT

- 5. Angular measurement using Bevel Protractor
- 6.Calibration of Dial Gauge using Slip Gauge
- 7.Flatness of given work piece using Autocollimator

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

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

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

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

### Lab Components:

1. Measurement of Gear Nomenclature using Gear Tooth Vernier

2. Thread Measurement using Profile Projector

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

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

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

Co-ordinate Measuring Machine (CMM) - Constructional features - Types - Applications of CMM - CNC applications - Computer Aided Inspection (CAI) - Machine Vision - Applications in Metrology. Lab Components:

1. Measurement of Dimensions using Tool Makers Microscope

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

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

Total No. of Periods : 45

10

9

7

9

46



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

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

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

### **UNIT- I: INTRODUCTION TO METROGY** Basic concepts-Need for measurement - legal metrology-Precision and Accuracy - Reliability - Errors in Measurements

Telescope - Sine Bar - Bevel Protractor.

LAB COMPONENTS:



Subject Code:	: Subj	ject Nan	ne:	DYNA	MICS	LAB			T / L/	L	T / SLr	P/ R	C
EBME22L04									EIL		<b>3.1</b> 21		
	Prer	equisite	: Mechai	nics of A	Machine	es-II			Lb	0	0/0	3/0	1
L : Lecture T :	Tutoria	l S Lr	: Supervis	ed Lear	ning P :	Project	R : Rese	earch C:	Credits				
T/L/ETL : The	ory/Lab	/Embed	ded Theor	y and La	ıb								
OBJECTIVE	S: The s	student v	will learn										
• Worki	ng of sir	nple me	chanisms	oting	stom of a	lifforont	modala						
	TCOM	ES (CO)	(cy of viol) s) • The st	udent v	vill be al	nierem de to	models						
COL	Gain kn	owledge	e in kinem	atics and	1 Dynam	vics of N	lachiner	v (Level	2)				
	Charact	erize the	e dynamic	properti	es of con	nponent	or equi	pments (	Level 4)				
CO3	Analyze	e the vib	ration cha	racteristi	cs (Leve	$\frac{1}{2}$	i or equi	pinents (					
CO4	Apply v	arious p	rinciples f	or dynai	nic solu	tions (Le	evel 3)						
CO5	Illustrat	e the me	thod of st	atic and	dynamic	balanci	ng of m	asses (L	evel 4)				
Mapping of C	ourse C	Outcome	s with Pr	ogram (	Jutcome	es (POs)			,				
Cos/Pos	PO1	PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12											
CO1	3	3	3	3	3	2	2	2	3	3	2		2
CO2	3	3	3	3	3	2	2	2	3	3	2		2
CO3	3	3	3	2	3	2	2	2	3	3	2		2
CO4	3	3	3	2	3	2	2	2	3	3	2		2
CO5	3	3	3	2	3	2	2	2	3	3	2		2
Cos / PSOs	PS	501	PS	02	PS	03	PS	504					
CO1		3	3			2		3					
CO2		3	3			2		3					
CO3		3	3			2		3					
CO4		3	3			2		3					
CO5		3	3	1		2		3					
3/2/1 indicates	Strengt	h of Co	rrelation	3- Hig	h, 2- Me	edium, 1	l-Low		1	1	1		
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gor		cier	l so		ctiv		nary	ent	ject				
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Subject Code:	Subject Name :	T / L/	L	Τ /	<b>P/ R</b>	C
	DYNAMICS LAB	ETL		S.Lr		
EBME22L04	Prerequisite: Mechanics of Machines-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



# **SEMESTER IV**



Subject Code:	Subj	ect Name	e: DESIGN	OF MA	CHINE	ELEME	NTS - I	[	Ty/Lb/	L	T/ SI r	P/R	С
EBME22014	Pror	anisite	Strength	of Mat	erials T	Design o	f Mach	ine	EIL		SLI		
	Elem	ents - I	Strength	01 11140	ci iais, L	csign 0	i wiach	inic	Ту	3	1/0	0/0	4
L : Lecture T : T/L/ETL : Theor	Tutoria y/Lab/E	l S Lr : mbedded	Supervise Theory and	d Learni d Lab	ng P:H	Project R	R : Resea	arch C: (	Credits	II	I		
<b>OBJECTIVES</b> :	<b>OBJECTIVES</b> : 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 OUT	COMES	5 (COs) :											
CO1	Underst	and and	perform t	he failur	e analys	is based	on theo	ries of fa	ailure. (Lev	vel 2)			
CO2	Develop	evelop design thinking process and define the problem. (Level 6)											
CO3	Design	esign the machine elements like Shafts, Keys, Couplings and Bearings. (Level 6)											
CO4	Select t	he appro	priate type	e of sprin	ng based	l on the	requiren	nents. (L	.evel 5)				
CO5	Compai	e the va	rious type	s of faste	eners on	strength	n and ap	plication	aspects. (	Level 4)			
Mapping of Cou	urse Ou	$\begin{array}{c c c c c c c c c c c c c c c c c c c $											
Cos/Pos			PO3	P04	P05	P06	P07	P08	P09	P010	POII	POI	2
	3	3	3	2	3	3	2	2	2	2	2	2	2
	3	3	3	2	3	3	2	2	2	2	2	4	2
	3	3	3	2	3	3	2	2	2	2	2	4	<u> </u>
C04	3	3	3	2	3	3	2	2	2	2	2	2	2
	<u>Э</u> 	<b>3</b>	J DS(	<u>4</u>	J DS	3	Э — — — — — — — — — — — — — — — — — — —	<u>2</u>	2	2		4	
C01	10	2	150	)4	15	2	1,	ייי ז					
		3 3	3		•	3 2		2					
CO2		3	3		•	3		2					
CO4		3	3			3		2					
CO5		3	3			3		2					
3/2/1 indicates S	Strengt	- h of Cor	relation	3- Hig	h. 2- Me	dium. 1	l-Low	-					
				- 8	, .	,							
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	С
	Prerequisite: Strength of Materials, Design of Machine Elements - I	Ту	3	1/0	0/0	4

### **UNIT 1 DESIGN OF FLEXIBLE DRIVES**

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

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**

Straight bevel gear: Tooth terminology- Design of pair of straight bevel gears - Tooth forces and stresses Worm Gear: Merits and demerits- Terminology. Design of the worm and gear - Forces and stresses, efficiency.

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

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

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

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

### Total No. of Periods 60

12

12

12

12

12

**\*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



(An IS	0 21001 : 2018	Certified Instit	ution)
ar E.V.R. High	Road, Maduravo	val, Chennai-95.	Tamilnadu, Indi

Subject Code: EBME22013         Subject Name: INDUSTRIAL AUTOMATION         Ty/Lb/ ETL         L         T/         P/R           FEBME22013         Pre requisite: Manufacturing Technology-I & II, T/LFTL: Theory/Lab/Embedded Theory and Lab         Ty         3         0/0         0/0           L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits T/LFTL: Theory/Lab/Embedded Theory and Lab         Ty         3         0/0         0/0           OBJECTIVES: The student will gain • knowledge in hydraulic, pneumatic and mechatronics system in Automation.         OURSE OUTCOMES (COS):         CO1         Understand Pneumatic and hydraulic circuits for automation (Level 4)         CO3           CO3         Recognize the various components of mechatronic system (Level 2)         CO4         Discuss the various actuation systems and System models in automation (Level 3)         CO5           CO4         Discuss the various components of mechatronic system (Level 2)         CO4         Ourse Outcomes with Program Outcomes (POs)         V           Co37         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12           CO4         3         3         2         3         3         2         3         3         3         2           CO5 <t< th=""><th colspan="10">Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.</th></t<>	Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.													
EDSME 2013       Pre requisite: Manufacturing Technology-I & II,       Ty       3       0/0       0/0         L: Lecture T: Tutorial S Lr: Supervised Learning P: Project R: Research C: Credits       T/L/ETL.: Theory/Lab/Embedded Theory and Lab       000       000         OBJECTIVES: The student will gain       •       knowledge in hydraulic, preumatic and mechatronics system in Automation.       000         OURSE OUTCOMES (COS):       CO1       Understand Pneumatic and hydraulic circuits for automation (Level 2)       000         C01       Understand Pneumatic and hydraulic circuits for automation (Level 3)       000       000         C03       Recognize the various components of mechatronics system models in automation (Level 3)       000       000         C04       Discuss the various actuation system for the required automation (Level 3)       000       001       001         C05       P01       P02       P03       P04       P05       P06       P07       P08       P09       P010       P011       P012         C01       3       3       2       3       3       3       3       3       3       2         C03       3       3       2       3       3       3       3       2       3       3       3       2       3       3	Subject Code:	:	Subjec	t Name: I	NDUST	'RIAL A	UTOM	IATION	1	Ty/Lb/ ETL	L	T/ SLr	P/R	С
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 (CO8) : CO1 Understand Pneumatic and hydraulic principles, components and functions (Level 2) CO2 Analyze and Design the Pneumatic and hydraulic circuits for automation (Level 3) CO3 Recognize the various actuation systems and System models in automation (Level 3) CO4 Discuss the various actuation systems for the required automation (Level 4) Mapping of Course Outcomes with Program Outcomes (POs) Co5 Design the Mechatronic system for the required automation (Level 4) Mapping of Course Outcomes with Program Outcomes (POs) Co6 Out 3 3 2 2 3 3 2 3 3 3 3 2 2 3 3 3 3 2 2 3 3 3 3 3 2 2 003 3 3 2 2 3 3 3 3	EBME22013	Preı	equisite	e: Manufa	cturing	Techno	ology-I d	& II,		Ту	3	0/0	0/0	3
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 (CO8) :         CO1       Understand Pneumatic and hydraulic principles, components of nutomation (Level 2)         CO2       Analyze and Design the Pneumatic and hydraulic circuits for automation (Level 2)         CO3       Recognize the various actuation systems and System models in automation (Level 3)         CO4       Discuss the various actuation system for the required automation (Level 4)         Mapping of Course Outcomes with Program Outcomes (POS)         CO2       PO1       PO2       PO3       PO4       PO5       PO6       PO7       PO8       PO9       PO10       PO11       PO12         CO2       3       3       2       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       2 <t< th=""><th>L : Lecture T :</th><th>Tutorial</th><th>S Lr</th><th>: Supervis</th><th>ed Lear</th><th>ning P :</th><th>Project</th><th>R : Rese</th><th>earch C:</th><th>Credits</th><th></th><th></th><th></th><th></th></t<>	L : Lecture T :	Tutorial	S Lr	: Supervis	ed Lear	ning P :	Project	R : Rese	earch C:	Credits				
OBJECTIVES: The student will gain <ul></ul>	T/L/ETL : The	ory/Lab	/Embedo	led Theory	y and La	ıb								
OURSE OUTCOMES (COs):         Outcome of the inclusion of the inclusion of the inclusion.         OURSE OUTCOMES (COs):           C01         Understand Pneumatic and hydraulic principles, components and functions (Level 2)         CO2         Analyze and Design the Pneumatic and hydraulic circuits for automation (Level 4)           C03         Recognize the various actuation system soft soft mechatronics system (Level 2)         CO4         Discuss the various actuation systems and System models in automation (Level 3)           C05         Design the Mechatronic system for the required automation (Level 4)         Mapping of Course Outcomes with Program Outcomes (PO5)         PO6         PO7         PO8         PO9         PO11         PO12           C01         3         3         2         3         3         2         3         3         3         3         2           C01         3         3         2         2         3         3         2         3         3         3         2           C02         3         3         2         2         3         3         2         3         3         3         2           C03         3         3         2         2         3         3         3         2         3         3         3         2           <	<b>OBJECTIVES</b>	S: The s	tudent v	vill gain	imatic a	nd mech	atronics	system	in Autor	nation				
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         Recognize the various components of mechatronics system (Level 2)           CO4         Discuss the various components of mechatronics system (Level 2)           CO5         Design the Mechatronic system for the required automation (Level 3)           CO5         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12           CO3         3         3         2         2         3         3         2         3         3         3         3         3         2         3         3         3         3         2         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         2         3         3         3         2         3         3         <	OURSE OUT	COME	1000000000000000000000000000000000000	:		nu meen		system	III / Iutol	nation.				
CO2         Analyze and Design the Pneumatic and hydraulic circuits for automation (Level 4)           CO2         Analyze and Design the Pneumatic and hydraulic circuits for automation (Level 4)           CO4         Discuss the various actuation systems and System models in automation (Level 3)           CO4         Discuss the various actuation systems and System models in automation (Level 3)           Mapping of Course Outcomes with Program Outcomes (POs)           Cos/Pos         PO1         PO2         PO3         PO6         PO7         PO8         PO10         PO11         PO12           CO2         3         3         2         CO3           CO3         PO3         PO6         PO7         PO8         PO10         PO11         PO10         PO11         PO10	CO1	Underst	and Pne	umatic and	1 hydrau	lic princ	ciples co	omponer	nts and fi	inctions (	Level 2)			
CO3         Recognize 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)         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12           Cos/Pos         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12           Cos/Pos         PO1         PO2         PO3         3         2         3         3         3         3         3         2           Co3         3         3         2         2         3         3         2         3         3         3         2           Co3         3         3         2         2         3         3         2         3         3         3         2           Co3         3         3         2         3         3         2         3         3         3         2           Co4 <td>CO2</td> <td>Analyze</td> <td>and De</td> <td>sign the P</td> <td>neumati</td> <td><math>\frac{1}{c}</math> and hy</td> <td>draulic</td> <td>circuits f</td> <td>for auton</td> <td>nation (Le</td> <td><math>\frac{1}{(vel 4)}</math></td> <td></td> <td></td> <td></td>	CO2	Analyze	and De	sign the P	neumati	$\frac{1}{c}$ and hy	draulic	circuits f	for auton	nation (Le	$\frac{1}{(vel 4)}$			
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         3         3         2         3         3         3         3         3         2           CO2         3         3         2         2         3         3         2         3         3         3         3         3         2           CO3         3         3         2         2         3         3         2         3         3         3         2           CO4         3         3         2         2         3         3         2         3         3         3         2           CO5         3         3         3         2         3         2         3         2         3         2         3         2         3         2	CO3	Recogni	ize the v	arious con	nponent	s of mec	hatronic	s system	n (Level	2)				
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           Cos/Pos         PO1         3         3         2         2         3         3         2         3         3         3         3         3         2         3         3         3         3         2         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3	CO4	Discuss	Discuss the various actuation systems and System models in automation (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         3         2         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         2         3         3         3	CO5	Design	the Mec	hatronic sy	stem fo	r the req	uired au	itomatio	n (Level	4)	,			
Cos/Pos         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PO12           CO1         3         3         2         2         3         3         2         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3	Mapping of C	oping of Course Outcomes with Program Outcomes (POs)												
CO1         3         3         2         2         3         3         2         3         3         3         3         3         2         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3	Cos/Pos	PO1	PO2	PO3	PO4	PO5	<b>PO6</b>	PO7	PO8	PO9	<b>PO10</b>	PO11	PO	12
CO2         3         3         3         3         3         3         3         2         3         3         3         3         2           CO3         3         3         2         2         3         3         2         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3 <th>CO1</th> <th>3</th> <th>3</th> <th>2</th> <th>2</th> <th>3</th> <th>3</th> <th>2</th> <th>3</th> <th>3</th> <th>3</th> <th>3</th> <th>2</th> <th>2</th>	CO1	3	3	2	2	3	3	2	3	3	3	3	2	2
CO3         3         3         2         2         3         3         2         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3	CO2	3	3	3	3	3	3	2	3	3	3	3	2	2
CO4         3         3         2         2         3         3         2         3         3         3         3         2           CO5         3         3         3         3         3         3         3         2         3         3         3         3         3         2         3         3         3         3         3         2         3         3         3         3         3         2         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3 <td>CO3</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td>3</td> <td>3</td> <td>2</td> <td>3</td> <td>3</td> <td>3</td> <td>3</td> <td>2</td> <td>2</td>	CO3	3	3	2	2	3	3	2	3	3	3	3	2	2
CO5         3         3         3         3         3         3         2         3         3         3         3         2           Cos / PSOs         PSO1         PSO2         PSO3         PSO4                                                                                                    <	CO4	3	3	2	2	3	3	2	3	3	3	3	2	2
Cos / PSOs         PSO1         PSO2         PSO3         PSO4         Image: Cost of the state of the sta	CO5	3	3	3	3	3	3	2	3	3	3	3	2	2
CO1       3       3       2       3       1       1         CO2       3       3       2       3       3       2       3       1       1         CO3       3       3       2       3       3       2       3       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1 <td< td=""><td>Cos / PSOs</td><td>PS</td><td>01</td><td>PSC</td><td>)2</td><td>PS</td><td>03</td><td>PS</td><td>504</td><td></td><td></td><td></td><td></td><td></td></td<>	Cos / PSOs	PS	01	PSC	)2	PS	03	PS	504					
CO2       3       3       2       3       3       2       3         CO3       3       3       2       3       3       2       3       1         CO4       3       3       2       3       3       2       3       3       2       3       1         CO4       3       3       2       3       3       2       3       3       2       6       6       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1	CO1		3	3		2	2		3					
CO3       3       3       2       3       3       2       3         CO4       3       3       2       3       3       2       3       3       2       3       3       2       3       3       2       3       3       2       3       3       2       3       3       3       2       3       3       3       2       3       3       3       2       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3 </td <td>CO2</td> <td>•</td> <td>3</td> <td>3</td> <td></td> <td>2</td> <td>2</td> <td></td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td>	CO2	•	3	3		2	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         Jobs     Basic Science       Skill Component     Program elective       Program Core     A       Open Elective     A       Program Core     A         A     A         Basic Science       Basic Science         Basic Science         Cot         B         Cot         B         Cot         B         B         B         B         Cot         B         Cot         B         B         B         B         Cot         Cot            Cot         Cot            Cot             Cot             Cot                Cot             Co <td>CO3</td> <td>4</td> <td>3</td> <td>3</td> <td></td> <td>2</td> <td>2</td> <td></td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td>	CO3	4	3	3		2	2		3					
Category 3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low Program Core Basic Science Basic	CO4	-	3	3		2	2		3					
3/2/1 indicates Strength of Correlation 3- High' 5- Medium' 1- Fow Engineering Science Basic Science Basic Science Basic Science Basic Science Basic Science Program Core Program elective Program core Program core Pr	CO5		3	3		2	2		3					
Category         Category         Basic Science         Engineering Science         Humanities and social Science         Program Core         Program Core         Program Core         Skill Component         Practical /Project	3/2/1 indicates	Strengt	h of Cor	relation	3- Hig	h, 2- Me	dium, 1	-Low						
	Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project				



Subject Code:	Subject Name : INDUSTRIAL AUTOMATION	Ty/Lb/	L	Τ/	P/R	C
EDME22012		ETL		SLr		
EBME22013	Pre requisite: Manufacturing Technology-I & II	Ту	3	0/0	0/0	3

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

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

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

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

### UNIT-III MECHATRONICS, SENSORS AND TRANSDUCERS

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

### UNIT- IV ACTUATION SYSTEM AND SYSTEM MODELS

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

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

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

### TEXT BOOKS

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

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

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

### REFERENCES

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

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

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

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

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

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

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# 11

Total No. of Periods: 45



Subject Code:	Sub	Subject Name : MANUFACTURING TECHNOLOGY							Ty/Lb/	/ L	<b>T</b> /	P/R	C
Ермеээета									ETL		SLr		
EDNIE22EIS	Prer	equisite	: Manufa	cturing	Techno	ology - I			ETL	2	0/0	2/0	3
L : Lecture T :	Tutoria	1 SLr:	Supervis	ed Learr	ning P:	Project	R : Rese	arch C: C	Credits				
T/L/ETL : The	ory/Lat	/Embed	ded Theor	y and L	ab								
OBJECTIVE													
• To imp	oart kno	wledge a	and skill ii	n metal c	cutting p	rocess a	ind smar	t manufa	cturing tec	chnology	7		
COURSE OU	TCOM	ES (CO	s):(3-5)	)									
CO1 U	Jnderst	and the c	concepts o	f metal o	cutting a	nd relat	ed infor	mation's	(Level 2)				
CO2	Acquire skill in special purpose machines (Level 4)												
CO3 5	Select aj	opropriat	te method	of manu	ufacturin	ig based	d on the	requirem	ent (Level	4)			
CO4 t	Understand the concepts and applications of smart manufacturing (Level 3)												
CO5 4	Acquire	skill in s	smart man	ufacturi	ng techr	iques (	Level 4)						
C /D	<b>DO1</b>		pping of (	Course (	Outcom	es with	Progra	m Outco	mes (POs	) DO10	<b>DO11</b>		12
COS/POS	2	PO2	PU3	PO4	P05	P06	PO/	2	P09	2		PO.	12
CO1	<u> </u>	3	2	-	$\frac{2}{2}$	3	3	$\frac{2}{2}$	3	$\frac{2}{2}$	$\frac{2}{2}$		2
CO2	3	3	3	-	2	3	3	2	3	2	2	,	2
CO4	3	3	$\frac{3}{2}$	_	3	3	3	2	3	2	2	,	<u>-</u> 2
CO5	3	3	2	-	3	3	3	2	3	2	2		2
Cos / PSOs	PS	01	PSC	02	PS	03	PS	504	PSO5				
CO1		3	3			2		3					
CO2		3	3			2		3					
CO3		3	3			2		3					
CO4		3	3			3		3					
CO5	~	3	3			3		3					
3/2/1 indicates	Strengt	h of Co	rrelation	3- Hig	gh, 2- M	edium,	1-Low		г г		Т		
Category	Basic Science	Engineering Science	Humanities and social Science	▲ Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project				

litive manufacturing: Simple components design, slicing and fabrication using FDM machin Total No.
<b>XT BOOKS</b>
S. K. Hajra Choudry, S. K. Bose, (2010) "Elements of Workshop Technology -Volume I & II promoters.
P. C. Sharma, (2008) "A text book of Production Engineering", S. Chand and Co. Ltd., IV Ed
Masoud Soroush, Michael Baldea, Thomas F. Edgar (2020) "Smart Manufacturing" Elsevier
TERENCES
H.M.T, (1990) "Production Technology – Handbook", TMH.
Richara R. Kibbe, John E. Neely, Roland O. Meyer and Warrent T. White, (2009) "Machine T Practices", VI Edition, Prentice Hall of India.
N. K. Mehta, (2012) "Machine Tool Design and NC", Tata McGraw Hill Publishing Co. Ltd. Jaeger R.C, (1988) "Introduction to microelectronics fabrication", Addison Wesley pub. Co., C. Elanchezian, M. Vijayan, (2004) "Machine Tools" Anuradha Publications.
P Took Machanical Engineering 2022 Pagulation

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. <b>UNIT- II: SPECIAL PURPOSE MACHINES-I</b> Shaper, Planer, slotter: Specification - Types - Mechanism – Calculations Boring: Specification - Types - Operations - Boring tool - Jig Boring machine. Broaching: Specification - Types - Tool nomenclature - Broaching process.	10
Lab Components	
<ul> <li>Shaping, and Slotting Practice: Cutting key ways and dove tail hexagonal machining using Shaper, In keyway using slotter</li> <li>UNIT- III: SPECIAL PURPOSE MACHINES-II</li> <li>Milling: Specification - Types - Cutter nomenclature - Types of cutter - Milling processes - Indexing – Cam and thread milling.</li> <li>Grinding: Types of grinding machine - Designation and selection of grinding wheel - Bonds –</li> </ul>	ternal 10
Reconditioning of grinding wheel – Lapping, honing and super finishing.	
Lab Components	
Grinding Practice: Cylindrical grinding, Surface grinding.	
Milling Practice: Hexagonal milling, Contour milling	
UNIT- IV: GEAR CUTTING MACHINES Kinematics of gear shaping and gear hobbing - Gear generation principles specifications – Cutters - Bevel geargenerator - Gear finishing methods. Lab Components	8
Machining of helical gear using hobbing machine, Spur gear milling UNIT- V: SMART MANUFACTURING Industry 4.0, Cyber Physical system, IoT and Cloud computing for manufacturing, Digital manufacturing, Additive manufacturing, Sustainable manufacturing, advanced simulation, Augmented reality	9
Lab Components         Additive manufacturing: Simple components design, slicing and fabrication using FDM machine         Total No. of Per	riods: 45
<ul> <li>TEXT BOOKS</li> <li>1) S. K. Hajra Choudry, S. K. Bose, (2010) "Elements of Workshop Technology -Volume I &amp; II". Met promoters.</li> </ul>	dia
<ol> <li>P. C. Sharma, (2008) "A text book of Production Engineering", S. Chand and Co. Ltd., IV Edition.</li> <li>Masoud Soroush, Michael Baldea, Thomas F. Edgar (2020) "Smart Manufacturing" Elsevier Science <i>REFERENCES</i></li> </ol>	ce.
2) H.M.T, (1990) "Production Technology – Handbook", TMH.	
3) Richara R. Kibbe, John E. Neely, Roland O. Meyer and Warrent T. White, (2009) "Machine Tool Practices". VI Edition. Prentice Hall of India.	

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Prerequisite: Manufacturing Technology - I

Subject Name : MANUFACTURING TECHNOLOGY - II

EDUCATIONAL

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

Subject Code:

EBME22ET3

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Subject Code	: Subject Name : THERMAL ENGINEERING LAB					B-II	Ty/Lb/ ETL	L	T/SLr	P/R	С		
EBME22L06	Pr Tr	erequisi ansfer	te: Thern	nal Eng	ineering	g , Heat	and Ma	ISS	Lb	0	0/0	3/0	1
L : Lecture T	: Tutor	ial S.	Lr : Supe	rvised I	earnin	$\mathbf{g} \mathbf{P} : \mathbf{P}$	roject R	: Resea	arch C: C	redits			
T/L/ETL : Th	eory/L	ab/Emb	edded Th	eory ar	nd Lab								
OBJECTIVES: • To eval • To dete • To stud	<ul> <li>OBJECTIVES: The student will learn</li> <li>To evaluate the performance of air compressor, air blower and refrigeration and air conditioning systems.</li> <li>To determine the properties of different liquid fuels.</li> <li>To study the different modes of heat transfer.</li> </ul>												
COURSE O	UTCO.	TCOMES (COs) : ( 3- 5)											
	Calcula	Calculate the performance of air compressor and blower and						and COP	of a refrig	geration	n system. (	Level 3	)
CO2	Determine the flash, fire point and viscosities of different oils							oils (Le	evel 3)				
CO3	Determ	etermine the emissivity of a grey body. (Level 3)											
CO4	Estimate the thermal conductivity of an insulating material a								mposite w	all. (Le	evel 4)		
CO5	Measur	easure the effectiveness of pinfin and parallel and counter flow heat exchanger. (Level 3)											
Mapping of	Course	Outcon	mes with	Progra	am Out	tcomes	(Pos)	DOO		<b>DO</b> 1(			10
Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	) PO11	PO	12
$\frac{CO1}{CO2}$	3	3	1	1	1	1	1	$\frac{2}{2}$	2	2	2		1 1
$CO_2$	3	3	2	2	1	2	2	2	2	2	2		2
CO4	3	3	2	2	2	2	2	2	2	2	2		1
CO5	3	3	2	2	2	2	2	2	2	2	2		1
Cos / PSOs		3	3		,	2		2	2	2	2	,	2
CO1		3	2		,	2		2					
CO2		3	2		,	2		2					
CO3		3	2		,	2		3					
CO4		3	2		,	2		2					
CO5		3	2		,	2		3					
3/2/1 indicates	Strengt	h of Co	relation	3- Hig	gh, 2- M	edium,	1-Low						
egory	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project				
Cate						V							



Subject Code:	Subject Name : THERMAL ENGINEERING LAB-II	Ty/Lb/ ETL	L	T/ SLr	P/R	С
EBME22L00	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



# **SEMESTER V**



Subject Code	: Su	bject Na	ame : HE	AT AN	D MAS	S TRAI	NSFER		Ty/Lb/	L	<b>T</b> /	P/R	C
-		-							<b>ETL</b>		SLr		
EBME22010	Pre	erequisi	te: Engir	neering	Therm	odynan	nics		Ту	3	1/0	0/0	4
L : Lecture T :	Tutoria	l S Lr	: Supervis	ed Lear	ning P:	Project	R : Res	earch (	C: Credits				<u> </u>
T/L/ETL : The	ory/Lab	/Embed	ded Theor	y and L	ab								
OBJECTIVE	S: The s	tudent v	vill learn		_								
Conce     Conce	pt and m	nodes of	heat and i	mass tra	nsfer.	thair or	nginggrir		ulations				
Conce     Conce	oncept of various near transfer correlations and then engineering calculations.												
COURSE OU	TCOMES (COs) : ( 3- 5)												
CO1	Unders	Understand the knowledge of Conduction heat transfer and its applications. (Level 2)											
CO2	Apply t	Apply the concept of forced and free convection heat transf							nd its applic	ations.	(Level	3)	
CO3	Explore the applications of radiation heat transfer. (Level 3												
CO4	Unders	nderstand the knowledge of phase change heat transfer and heat exchangers in engineering											
	applications. (Level 2)												
CO5	Apply the mass transfer concepts in real-time applications. (Level 3)												
Mapping of C	Course O	utcome	es with Pr	ogram (	Outcom	es (POs	3)		-				
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO	11 I	2012
CO1	3	3	2	1	2	1	2	1	1	1		-	2
CO2	3	3	2	2	2	1	1	1	2	2		-	2
CO3	2	3	2	1	2	2	2	1	1	2		•	2
C04	3	2	1		2							•	2
$CO_{\rm S}$ / PSO <sub>S</sub>	J DS	<u> </u>		<u> </u>				1	<u>2</u>			•	2
CO1	15	2	150	J2	15	<u>03</u>	10	3					
CO2		, R	2			2		3					
CO3		3	2			2		3					
CO4		3	2		2	2		3					
CO5	с.,	3	2		2	2		2					
3/2/1 indicates	Strengt	h of Co	rrelation	3- Hig	gh, 2- M	edium,	1-Low	T		1			
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(An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

Subject Code:	Subject Name : HEAT AND MASS TRANSFER	Ty/Lb/	L	Τ/	P/R	С	
EDME22010		ETL		SLr			
EBME22010	Prerequisite: Engineering Thermodynamics	Ту	3	1/0	0/0	4	

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

EDUCAT

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

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

Basic Concepts – Boundary Layer Concept – Types of Convection – Forced Convection-External Flowover 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**

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

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

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

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

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

**Basic Concepts** 

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

### **Convective Mass Transfer**

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

### Total No. of Periods : 60

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

### **TEXT BOOKS**

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

### REFERENCES

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

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

SubjectCode:		ubject UGM	Nam ENTED	e :V	IRTU JTV	JAL	AN	D	Ty/	Lb/ T	L	T/	P/R	С
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T/L/ETL:Theory/	Lab/E	mbedd	edTheory	vandLab	iigi .i i	ojeen	.Resea	iene.	.creu	11.5				
<b>OBJECTIVE:O</b>	BJEC'	TIVE:	Thestude	ntswillle	earn									
• To introduce	the re	levance	e of this	course t	o the e	existing	g techr	ology	y thro	ough de	monstrat	ions, ca	ase stud	ies and
applications v	with a	futurist	ic vision	along w	ith soc	io-eco	nomic	impac	ct and	1 issues				
• To understand	d virtu	al reali	ty, augm	ented rea	ality an	id using	g them	to bu	iild B	lomedic	al engin	eering a	applicati	ons
COURSEOUTC	OME	S(COs	): The st	tudents	will be	able t	0							
CO1	Under	rstand t	he physic	cal princ	iples o	f VR &	k AR							
CO2	Create	ate a comfortable, high-performance VR application using Unity												
CO3	Analy	ze and	understa	nd the w	orking	g of var	ious st	ate of	f the	art VR &	k AR de	vices.		
CO4	Analy engin	yze & eering	Design constra	n a sys ints	tem c	or pro	cess t	o me	eet g	given s	pecifica	ations	with r	ealistic
CO5	Create	e and d	eploy a V	/R & AF	R appli	cation.								
Mapping of Cou	rse Ou	itcome	s with P	rogram	Outco	mes (I	POs)			<b>D</b> 00	<b>D</b> 040	<b>D</b> 04	<b>D</b> 044	
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	P	<b>'08</b>	PO9	PO10	PO1 1	PO12	
CO1	3	3	3	3	2	3	1		2	3	2	3		}
CO2	3	3	3	3	3	3	1		3	2	2	3		\$
CO3	3	3	3	3	3	3	1		2	3	3	3		\$
CO4	3	3	3	3	3	3	1		2	3	3	2		\$
CO5	3	2	3	2	3	3	1		2	3	3	2	3	3
COs /PSOs	<u>P</u>	<u>SO1</u>	PS	02	P	<u>SO3</u>	F	<u>2804</u>						
COI		5	3	5		3		3						
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				<u> </u>										



Subject Code:	Subject Name: VIRTUAL AND AUGMENTED	Ту/	L	Т	<b>P/ R</b>	С
	REALITY	Lb/ETL		/S.Lr		
EBME22ET4	Prerequisite: Basic computer knowledge	ETL	2	0/0	2/0	3

### UNIT I INTRODUCTION

The three I's of virtual reality-commercial VR technology and the five classic components of a VR system – Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.

### Lab components:

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

2.Demonstration of the working of HTC Vive

### **UNIT II VR DEVELOPMENT PROCESS**

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

1.Demonstration of the working of Google Cardboard

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

### UNIT III CNTENT CREATION CONSIDERATION FOR VR

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

### Lab components:

1. Change the colour and material of Game object

2. Change the texture of Game object

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

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

### Lab components:

1.Create an immersive environment (living room)

2. Create an immersive environment (tennis court)

### UNIT V APPLICATIONS OF VR &AR

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

### Lab components:

1. Assembly of Gear box using VR & AR

2. Assembly of tailstock using VR & AR

### **TEXT BOOKS:**

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

### **REFERENCES:**

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

2. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR

(Usability), Steve Aukstakalnis, Addison-Wesley Professional; 1 edition, 2016.

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

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Subject Code: EBCC22ID1	Subje AND	ect Nam INDUST	ne : EN FRIAL N	NGINE /IANA(	ERING GEMEN	ECON	IOMICS	Ty/Lb/ ETL	L	T/ SLr	P/R	С
	Prere	quisite:	Nil					Ту	3	0/0	0/0	3
L : Lecture T : T	utorial	SLr : S	Supervis	ed Lear	ning P:	Project	R : Resea	arch C: Cre	edits			
T/L/ETL : Theor	ry/Lab./	Embedd	ed Theo	ry and l	Lab.							
OBJECTIVE: 7	The stuc Concep	lent will ts of ind	learn: ustrial n	nanagen	nent and	leconom	nics					
COURSE OUTC	COMES	5 (COs)	: The st	udent v	vill be a	ble to						
CO1	Unders	tand the	various	concep	ts of org	anizatio	ns and ec	onomics re	lated to i	t (Level 2)		
CO2	Expose	to the b	ehavior	of the h	uman in	the orga	anization	(Level 2)				
СОЗ	Analyz	e the der	nand an	d supply	y pattern	ns and co	osts relate	d to it (Lev	/el 4)			
CO4	Illustrat	ustrate the various methods of production with cost effectiveness (Level 3)										
CO5	Identify	entify the effect of cost on macro economics (Level 2)										
Mapping of Cou	urse Ou	e 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	-	3	2	-	3	3	3	3	2
CO2	2	2	2	-	3	2	-	3	3	3	-	2
CO3	2	2	2	-	3	2	-	2	3	3	3	2
CO4	2	2	2	-	3	2	-	2	3	3	3	2
CO5	2	2	2	-	3	2	-	2	3	3	3	2
COs / PSOs	PS	501	PS	02	PS	603	PSO4					
CO1		2	3	;	4	3	3					
CO2		2	3	3	-	3	3					
CO3		2	3	3	, ,	3	3					
CO4		2	3	3	í	3	3					
CO5		2	3	3	, ,	3	3					
3/2/1 indicates St	rength	of Corr	elation	<b>3- Hi</b>	gh, 2- M	ledium,	1-Low			•		L
Category	Basic Science	Engineerin g Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			

EBCC22ID1	Prerequisite: Nil	Ту	3	0/0	0/0
UNIT - I	Introduction to Management				

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.

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# UNIT - II Managing Organizational Behavior

EDUCATIO

Subject Name : ENGINEERING ECONOMICS

AND INDUSTRIAL MANAGEMENT

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

# **UNIT – III Demand & Supply Analysis**

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

# **UNIT IV Theory of Production**

**Subject Code:** 

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

## **UNIT V Macro Economic Concepts**

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

# **REFERENCE BOOKS:**

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



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/Lab/En	nbedded	Theory and	l Lab									
The stu	ident w	ill learn	· •			1		11				
<ul> <li>To design and implement pneumatic and hydraulic circuits with automation studio software and</li> </ul>												
with kits												
OURSE OUTCOMES (COs) :												
ecogniz	ze the v	arious con	nponents	s of Hyd	raulics a	and Pneu	imatic c	ircuits (Le	vel 2)			
esign a	nd impl	ement hyo	draulic c	ircuits v	studio so	oftware an	d kit (Lev	vel 4)				
esign a	nd impl	ement pne	eumatic	circuits	studio s	software an	nd kit (Le	evel 4)				
Indersta	and the o	$\frac{\text{concepts a}}{c}$	nd appli	cations	of robot	ts (Leve	12)					
rite pr	e programming for controllers in automation (Level 4) Outcomes with Program Outcomes (POs)											
PO1	Outcomes with Program Outcomes (POs)											
3	3	2	2	3	3	2	3	3	3	3		2
3	3	3	3	3	3	2	3	3	3	3		2
3	3	3	3	3	3	2	3	3	3	3		2
3	3	2	2	3	3	2	3	3	3	3		2
3	3	3	3	3	3	2	3	3	3	3		2
PS	01	PSC	)2	PS	03	P	504					
3	1	3		2	2		3					
3		3		2	2		3					
3		3		2	2		3					
3		3		2	2		3					
3		3			2		3					
trength	of Cor	relation	3- Hig	h, 2- Me	dium, 1	-Low	<u> </u>		T			
Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project				
	Subject Pre references of the study of the	Subject Name  Pre requisite:  Futorial S Lr : Lab/Embedded  The student w ctice simple p design and ir kits  MES (COs) : ecognize the v esign and impl nderstand the o Vrite programm se Outcomes w PO1 PO2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Introduction in the student Name:         INDU         Pre requisite: Industria         Colspan="2">Colspan="2"Colspan="2"Colspan="2	Subject Name: INDUSTRL Pre requisite: Industrial autom Futorial S Lr : Supervised Learnin Lab/Embedded Theory and Lab The student will learn ctice simple programs on micr design and implement pneum tits MES (COs) : ecognize the various components esign and implement pneumatic nderstand the concepts and appli rite programming for controllers se Outcomes with Program Outco PO1 PO2 PO3 PO4 3 3 2 2 3 3 3 3 3 3 3 3 3 3 3 PSO1 PSO2 3 3 3 3	Subject Name: INDUSTRIAL AU Pre requisite: Industrial automation Cutorial S Lr : Supervised Learning P : F Lab/Embedded Theory and Lab The student will learn ctice simple programs on microprocess design and implement pneumatic and kits MES (COs) : ecognize the various components of Hyd esign and implement pneumatic circuits w esign and implement program Outcomes (PO PO1 PO2 PO3 PO4 PO5 3 3 2 2 3 3 3 3 3 3 3 3 3 2 2 3 3 3 3 2 2 3 3 3 3 2 2 3 3 3 3 3 3 PSO1 PSO2 PS 3 3 3 2 3 3 3 3 2 4 3 3 3 3 2 5 3 3 3 2 5 3 5 3 6 3 7 3 7 3 7 3 7 3 7 3 7 3 7 3 7	Subject Name: INDUSTRIAL AUTOMA Pre requisite: Industrial automation Tutorial S Lr : Supervised Learning P : Project R Lab/Embedded Theory and Lab The student will learn ctice simple programs on microprocessors and design and implement pneumatic and hydra t kits MES (COs) : ecognize the various components of Hydraulics a esign and implement pneumatic circuits with autor design and implement pneumatic circuits with autor rite programming for controllers in automation ( se Outcomes with Program Outcomes (POs) PO1 PO2 PO3 PO4 PO5 PO6 3 3 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 2 2 3 3 3 3 3 3 2 2 3 3 3 3 3 3 3 3 2 2 3 3 3 3 3 3 3 3 3 3 3 PSO1 PSO2 PSO3 3 3 3 2 2 3 3 3 3 2 2 3 3 3 3 2 2 3 3 3 2 2 3 3 3 3 3 2 2 3 3 3 2 2 3 3 3 3 2 3 3 3 3 3	Subject Name:         INDUSTRIAL AUTOMATION         Pre requisite: Industrial automation         Tutorial S Lr : Supervised Learning P : Project R : Reseat Lab/Embedded Theory and Lab         The student will learn         Citice simple programs on microprocessors and microprocessors and microprocessors and microprocessors and implement pneumatic and hydraulic cit kits         MES (COs) :         ecognize the various components of Hydraulics and Pnet esign and implement pneumatic circuits with automation inderstand the concepts and applications of robots (Level 4 se Outcomes with Program Outcomes (POs)         PO1       PO2       PO3       PO4       PO5       PO6       PO7         3       3       2       3       3       2       3       2         3       3       2       3       3       2       3       2         3       3       3       3       3       2       3       3       2         3       3       3       3       3       3       2       3       3       2         3       3       3       3       3       3       2       3       2       3       2       3       3       2       3       3       2       3       3	Subject Name:         INDUSTRIAL AUTOMATION LAB         Pre requisite: Industrial automation         Futorial S Lr : Supervised Learning P : Project R : Research C: C         Clab/Embedded Theory and Lab         The student will learn         citice simple programs on microprocessors and micro control         design and implement pneumatic and hydraulic circuits v         NUMERICAL Structure in the interview of the student will learn         Complement programs on microprocessors and micro control         design and implement pneumatic and hydraulics and Pneumatic circuits with automation studio st	Subject Name:       Ty/Lb/ ETL         Pre requisite:       Industrial automation       Lb         Putorial S Lr : Supervised Learning P : Project R : Research C: Credits Lab/Embedded Theory and Lab       Lb         Cutorial S Lr : Supervised Learning P: Project R : Research C: Credits Lab/Embedded Theory and Lab       Lb         The student will learn tice simple programs on microprocessors and micro controllers. design and implement pneumatic and hydraulic circuits with autoration tick its       State Cost (Level 2)         MES (COs) :       ecognize the various components of Hydraulics and Pneumatic circuits (Level 2) rifte programming for controllers in automation (Level 2)       State Cost (Level 2)         rifte programming for controllers in automation (Level 4)       State Cost (Level 2)       State Cost (Level 2)         Se Outcomes with Program Outcomes (POs)       PO9       3       3       2       3       3         So 3       3       3       3       3       3       3       3       3         So 1       PSO1       PSO2       PSO3       PSO4       State Cost (Level 2)       3         3       3       3       2       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3<	Subject Name:INDUSTRIAL AUTOMATION LABTy/Lb/ ETLL ETLIndustrial automationLub 0Lutrial S Lr : Supervised Learning P : Project R : Research C: Credits Lab/Embedded Theory and LabThe student will learn trice simple programs on microprocessors and micro controllers. design and implement pneumatic and hydraulic circuits with automation s k itsMES (COs) : ecognize the various components of Hydraulics and Pneumatic circuits (Level 2) esign and implement pneumatic circuits with automation studio software and kit (Leve esign and implement pneumatic circuits with automation studio software and kit (Leve esign and implement pneumatic circuits with automation studio software and kit (Leve esign and implement pneumatic circuits with automation studio software and kit (Leve esign and implement pneumatic circuits with automation studio software and kit (Leve esign and implement pneumatic circuits with automation (Level 2) /rite programming for controllers in automation (Level 2) /rite programming for controllers in automation (Level 2)  PO1PO1PO2PO3PO4PO5PO6PO7PO8 PO9PO1033233333333323333332333332333332333323233323233323233	Subject Name:Ty/Lb/ LTINDUSTRIAL AUTOMATION LABTy/Lb/ ETLLT/ SLrPre requisite: Industrial automationLb00/0Outorial S Lr : Supervised Learning P : Project R : Research C: Credits Lab/Embedded Theory and LabThe student will learnctice simple programs on microprocessors and micro controllers. design and implement pneumatic and hydraulic circuits with automation studio software and kit (Level 2)esign and implement pneumatic circuits with automation studio software and kit (Level 4)esign and implement pneumatic circuits with automation studio software and kit (Level 4)esign and implement pneumatic circuits with automation studio software and kit (Level 4)esign and implement pneumatic circuits with automation studio software and kit (Level 4)set Outcomes with Program Outcomes (POs)PO1PO2PSO2PSO3PSO43333331Under colspan="4">Colspan="4">Colspan="4">CreditsColspan="4">Colspan="4">Colspan="4">Colspan="4">Colspan="4">CreditsColspan="4">Colspan="4">Colspan="4">Colspan="4">Colspan="4">Colspan="4">Colspan="4">Colspan="4">Colspan="4">Colspan="4"Colspan="4">Colspan="4">Colspan="	Subject Name:Ty/Lb/Ty/Lb/Ty/Lb/Ty/Lb/Ty/Lb/Ty/Lb/Ty/Lb/Ty/Lb/Ty/Lb/SLPrerequisite: Industrial automationLb00/03/0Prerequisite: Industrial automationLb00/03/0Prerequisite: Industrial automationLb00/03/0Lbb00/03/0Lab/Embedded Theory and LabThe student will learntice simple programs on microprocessors and micro controllers.design and implement pneumatic circuits with automation studio software and kit (Level 4)ecognize the various components of Hydraulics and Pneumatic circuits (Level 2)esign and implement hydraulic circuits with automation studio software and kit (Level 4)ecognize the various controllers in automation (Level 4) <tr< td=""></tr<>



Subject Code:	Subject Name : INDUSTRIAL AUTOMATION LAB	Ty/Lb/	L	Τ/	P/R	С
EDME221.00		ETL		SLr		
EBNIE22L09	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



# **SEMESTER VI**



Subject Name + CAD CAM & CIM	Tr/I h/	<b>T</b> /
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Subject Code	: Su	bject Na	ame : CAD,CAM & CIM					Ty/Lb/ ETL	L	T/ SLr	P/R	С	
EBME22011	Pr Ma	erequisi anufactu	te: Design pring Tec	1 of Ma hnology	Iachine Elements, gy				Ту	3	0/0	0/0	3
L : Lecture T :	: Tutoria	l S.Lr	: Supervis	ed Lear	ning P :	Project	R : Res	earch C	: Credits				
T/L/ETL : The	eory/Lab	/Embed	ded Theor	y and L	ab								
OBJE	CTIVE	:											
To pro	ovide an	overvie	w of how	comput	ers are b	being us	ed in de	sign, de	evelopmen	t of Ma	nufacturir	ıg plan	s and
manuf	facture	the need	1 for into	rotion o	fCAD	TAM on	4 CIM						
• 10 uii	uerstanu	the need	i tor integ	ration 0	I CAD,		u Chvi						
			COUR	SE OUT	ГСОМЕ	ES (COs	s) : ( <b>3-</b> 5	5)					
CO1	Underst	and the	concepts a	ind uses	of vario	ous CAE	) devices	s (Level	2)				
CO2	Apply v	arious C	CAD mode	ling tecl	hniques	(Level 3	3)						
CO3	Underst	and the	CNC mac	hines an	d intege	ration o	f CAD/0	CAM (L	level 2)				
CO4	Analyze	nalyze and write down part programming for lathe and milling ope								(Level 4	)		
CO5	Apply g	ply group technology and computer aided process planning and understand the FMS concept and ctions (Level 3)											
	function	Actions (Level 3) Manning of Course with Program Outcomes (Pos)											
Cag/Dag	DO1	DO1	Mappi	ng of Co	Durse wi	th Prog	gram Ou	itcomes	S (Pos)	<b>DO10</b>	<b>DO11</b>	DO	10
	PU1 2	PO2	PO3	P04	PU5	PU0	PU/	PUð	P09	POIU	POII	PO	12
	3	3	$\frac{2}{2}$		3								
CO2	3	3	2		3								
CO4	3	3	2		3								
CO5	3	3	2		3								
Cos / PSOs	PS	01	- PS(	)2	PS	03	PS	504					
CO1			3	- }		3		2					
CO2			3	;		3		2					
CO3			3	;		3		2					
CO4			3	;		3		2					
CO5			3	<b>;</b>		3		2					
3/2/1 indicates	Strengt	h of Co	rrelation	3- Hig	gh, 2- M	edium,	1-Low			-			
Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project				
				Ť									

# CAD CAM & CIM . ....

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Subject Code:	Code: Subject Name : CAD,CAM & CIM		L	17 SLr	P/R	C
EDWIE22011	Prerequisite: Design of Machine Elements, Manufacturing Technology	Ту	3	0/0	0/0	3

### **UNIT- I INTRODUCTION**

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

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

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

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

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

EDUCAT

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

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

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

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

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

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

## **TEXT BOOKS**

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

## **REFERENCE BOOKS**

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

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

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

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

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Subject Code: EBME22015	Subje	ect Nam	e: FINIT	E ELEN	MENT N	METHO	)D		Ty/Lb/ ETL	L	T/ SLr	P/R	С
	Prere	quisite: S	Strength of	Material	s, Desigr	of Mach	nine Elen	nents-I	Ту	3	1/0	0/0	4
L : Lecture T : Tu T/L/ETL : Theory	itorial S y/Lab/Er	S Lr : Sup nbedded	pervised Le Theory and	arning F 1 Lab	P: Project	t R : Res	earch C:	Credits					
<b>OBJECTIVES</b> :	The stud	dent will	learn										
Fundame	entals of	finite ele	ement analy	ysis and t	heir appli	ications.							
• Method (	OI SOIVII	ig one, t	wo and iso-	-parameu	ne eleme	ints.							
OURSE OUTCO	OMES (	COs):											
CO1 [	Jndersta	and the b	pasic conc	epts in F	Finite Ele	ement N	lethod. (	Level 2	)				
CO2	O2     Identify the application and characteristics of Finite Element Analysis elements. (Level 2)												
CO3 []	Develop	the eler	nent chara	acteristic	equatio	ns and g	generatio	on of glo	bal equation	ons. (Lev	el 6)		
CO4	Analyze	the suit	able boun	dary con	ditions t	to a glob	oal equat	ion of F	EA element	nts. (Leve	el 4)		
CO5	Apply F	EA soft	ware to an	alyze th	e machii	ne eleme	ents. (Le	evel 3)					
Mapping of Cou	rse Out	comes w	ith Progra	m Outco	mes (PO	s)	1	1		1			
Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1	2
CO1	3	3	3	2	2	2	1	1	2	2	1	2	2
CO2	3	3	3	3	2	2	1	1	2	2	1	2	2
CO3	3	3	3	3	2	2	1	1	2	2	1	2	2
CO4	3	3	3	3	2	2	1	1	2	2	1	2	2
CO5	3	3	3	3	3	2	1	1	2	2	1	2	2
Cos / PSOs	PS	01	PSC	02	PS	03	PS	504					
CO1	3	3	3			2		3					
CO2	3	3	3			2		3					
CO3	3	3	3		2	2		3					
CO4	3	3	3		2	2		3					
CO5	3	3	3		4	2		3					
3/2/1 indicates S	trengtl	ı of Cor	relation	3- Hig	h, 2- Me	dium, 1	-Low						
Category	Basic Science	Engineering Science	Humanities and social Science	Program Core		Open Elective	Inter Disciplinary	Skill Component	Practical /Project				



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

### **UNIT-I INTRODUCTION**

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

### **UNIT- II ONE-DIMENSIONAL PROBLEMS**

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

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

Second Order 2D Equations involving Scalar Variable Functions - Variational formulation - Finite Element formulation - Triangular elements and Quadrilateral elements- Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems - Torsion of Non circular shafts. 12

### UNIT- IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS

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

**UNIT- V ISOPARAMETRIC FORMULATION AND ADVANCED TOPICS** 12 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. **TEXT BOOKS: Total No. of Periods: 60** 

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

### **REFERENCES:**

- 1. Logan, D.L., "A first Subject in Finite Element Method", Thomson Asia Pvt. Ltd., 2002.
- Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and 2. 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.

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Subject Code: EBME22L07		Subject Name: CAD/CAM LAB							Ty/Lb/ ETL	L	T/ SLr	P/R	С	
	uisite: CAD/CAM/CIM, Machine Drawing					ng	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										<u> </u>				
<b>OBJECTIVES</b> : 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	Acq	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	PO	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	<b>PO8</b>	PO9	<b>PO10</b>	PO11	PO	12	
CO1	3	3	2	-	2	3	3	2	3	2	2		2	
CO2	3	3	3	-	2	3	3	2	3	2	2		2	
CO3	3	3	3	-	2	3	3	2	3	2	2		2	
CO4	3	3	2	-	3	3	3	2	3	2	2		2	
CO5	3	3	2	-	3	3	3	2	3	2	2		2	
Cos / PSOs		PSO1	PS	02	PS	03	PSO4							
CO1	CO1 3		3		2		3							
CO2	)2 3		3		2		3							
CO3	03 3		3		2		3							
CO4		3		3		3	3							
CO5		3		3		3	3							
H/M/L indic	ates St	rength of	Correlati	on H-	High, M	I- Medi	um, L-L	<b>JOW</b>						
Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project					
	Ba	Eng	Hun	► Pro		Ope	Int	Sk	Pr					



Subject Code: EBME22L07	Subject Name : CAD / CAM LAB	Ty/Lb/E TL	L	T/ SLr	P/R	С
	Prerequisite: CAD,CAM&CIM, Machine Drawing	Lb	0	0/0	3/0	1

### List of Experiments

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

Total No. of Periods: 45


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

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



## **SEMESTER VII**



Subject Code:	Subject Name: PROJECT PHASE-II	Ty/Lb/	L	Τ/	P/R	С
EBME22L10		ETL		SLr		
	Pre requisite: Project Phase-I	Lb	0	0/0	12/12	8
					1	

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 Co EBME22E	de: 01	Sul	bject Na	me: AD	VANC	ED IC F	ENGINI	ES		Ty/Lb/ ETL	L	T/ SLr	P/R	C
	•-	Pre En	erequisi	te: Thern	nodynai	nics and	d Ther	mal		Ту	3	0/0	0/0	3
L : Lecture	T : Tı	utorial	S Lr	: Supervis	ed Lear	ning P:	Practic	al R:R	lesearch	C: Credits	s i	l		
T/L/ETL : T	Theory	y/Lab	/Embed	ded Theor	y and L	ab								
OBJECTI	VE: T	The St	udent w	vill learn										
• Re	cent a	idvanc	cements	of I.C Er	igines									
			ES (CO	s) • The S	tudent	will he s	able to							
COURSE CO	Und	lerstar	$\frac{10}{10}$ and $a^{-1}$	pplv the k	nowledg	ze of fue	l iniecti	on syste	ms and	combustio	n proces	s of IC		
	engi	ines.(I	Level 28	k3)	c		5	5			1			
CO2	Dist	inguis	sh the ty	pes of cor	nbustior	n chamb	ers used	l in CI e	ngine.(I	Level 1)				
CO3	Ana	lyze t	he pollu	tion form	ations m	echanis	m and c	ontrol in	n IC eng	ines.(Leve	14)			
CO4	Und	lerstar	erstand and apply the knowledge of various alternative fuels in IC engines.(Level 2&3)											
CO5	App	ly the	recent	rends tecl										
Mapping o	f Cou	ırse O	utcome	s with Pr	ogram (	Outcom	es (POs	s)	1		1	1		
COs/POs	P	<b>PO</b> 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	POI	2
CO1		3 2 1 2					1	3	1	1	1	-		1
CO2		2	3	1	1	1	1	2	1	1	1	-		1
CO3		2	3	2	2	1	1	3	1	1	1	-		1
CO4		2	3	2	1	1	1	3	1	1	1	-		1
CO5		3	2	2	2	1	1	1	1	1	1	-	,	2
Cos / PSOs		PS	01	PSC	02	PS	03	PS	504					
CO1			3	2		2	2		2					
CO2			3	2		2	2		2					
CO3			3	2		2	2		2					
CO4		~~~	3	2			2		2					
CO5			3	2		2	2		2					
3/2/1 indic	cates	Strer	ngth of	Correlat	tion:	3- High	, 2- M	edium,	1-Low					
								ıry	nt	ct				
		nce	g nce ive					iplina	ponei	Proje				
ory		Scie	ŝuju	ties cier		ram ⁄e	lecti	Disci	om	al/				
tego	)	sic 2	nee nce	iani al S	ran	rogi ctiv	υEI	erD	11 C	ctic				
Cat		Bat	Ingi	Hum oci	rog Jore	P. P			Ski	Pra				



Subject Code:	Subject Name : ADVANCED IC ENGINES	Ty/Lb/	L	Τ/	P/R	С
		ETL		SLr		
EDNIE22EU1	Prerequisite: Thermodynamics and Thermal	Tv	3	0/0	0/0	3
	Engineering	ĨJ	5	0/0	0/0	3

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

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

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

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

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

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

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

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

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

Lean Burn Engines-Stratified Charge Engines-Homogeneous ChargeCompression 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.

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Subject Code:	Su	bject	Name :	E E	LECTR	IC A	ND H	YBRID	Ty/Lb/	L	T/	P/R	С
	V	EHICLI	ES					]	ETL/IE		SLr		
EBME22E02	Pr En	erequis Igineeri	ite: Ba ng	sic E	lectrica	l and	l Ele	ctronics	Ту	3	0/0	0/0	3
L : Lecture T : Tut	torial	l S Lr	: Supervis	sed Lear	ning P:	Project	t R : Re	search C:	Credits				
T/L/ETL : Theory	/Lab	/Embed	ded Theor	y and L	ab								
OBJECTIVE:	1		<u>fi a f</u>										
<ul> <li>Recent ad</li> <li>Various al</li> </ul>	ivano terna	cements	OF I.C Ef	igines engines									
	terne	ative fue	15 101 1.0	engines	•								
COURSE OUTC	OM	ES (CO	s) : ( 3- 5	)									
CO1	Un	derstand	the elect	rical vel	hicles co	oncepts	and veh	icle kinet	ics and dyn	amics			
CO2	De	sign the	battery p	ack for t	the types	of elec	tric veh	icle base	ed on its cap	acity			
CO3	Un	derstand	l the work	ting of I	<u>DC &amp; A</u>	C elect	rical n	notors					
CO4	Ap	ply the l	knowledg	e of gea	rs, diffei	rential a	nd clut	ches to th	e transmissi	ion of el	ectric ve	hicles	
CO5	De	sign the	drive trai	n of hył	orid vehi	cles							
Mapping of Cour	se O	utcome	s with Pr	ogram	Outcom	es (POs	s)		_				
COs/POs	P	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	12
	1												
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
<u>CO4</u>	2	2	2	2	3	2	3	2	2	2			1
C05	2	2 DSO1	2 DS(	$\frac{2}{2}$	3 DS	2	<u> </u>	2	2	2			1
C01		3	2	52	F3	05	1	2					
CO2		3	2	1				2					
CO3		3	2					2					
CO4		3	2					2					
CO5		3	2	1				2					
3/2/1 indicates Stre	engtl	h of Coi	relation	3- Hig	gh, 2- M	edium,	1-Low				1		
			I										
			oci		ve		y	<u> </u>	t				
	0		d se		scti		nar	Jen	jec				
	ence	50	an	ore	i ele	ive	ipli	Iodi	Pro				
	Scie	ining	ties	C	ram	ect	lisc	om	al				
~	iic 5	nee nce	nani	ran	log	υE	er L	II C	ctic				
jory	Bas	ingi ciei	Hum	rog	P	Ipei	Inté	Ski	Pra				
ateg	<u> </u>	ШN											
Ŭ													

Subject Code:	Subject Name :	ELECTRIC	AND HYBR	D Ty/Lb/	L	Τ/	P/R	С
	VEHICLES			ETL/IE		SLr		
EBME22E02	Prerequisite: Basic Engineering	Electrical	and Electron	cs Ty	3	0/0	0/0	3

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#### UNIT I ELECTRIC VEHICLES

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

#### **UNIT II BATTERY**

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

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

**DUCAT** 

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

#### UNIT IV ELECTRIC VEHICLE DRIVE TRAIN

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

#### **UNIT V HYBRID ELECTRIC VEHICLES**

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

#### **Text books:**

1. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2011.

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

#### **Reference Books:**

- 1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010.
- 2. Sandeep Dhameja, "Electric Vehicle Battery Systems", Newnes, 2000 .http://nptel.ac.in/courses/108103009/

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Subject Code:	Su	bject Na	ame :		JOINEI	DINC		T/L/	L	T/	<b>P/ R</b>	С		
EDNIE22E05	Pro	ereauisi	te: Thern	nodvnai	mics and	d Thern	nal		T	3	<u>5.Lr</u>	0	3	
	En	gineerin	ng-I								-			
L : Lecture T : Tu	torial	SLr : Su	pervised	Learning	g P:Pro	oject R	: Resear	ch C: C	credits					
T/L/ETL : Theory	/Lab/Ei	nbedded	l Theory a	und Lab										
<b>OBJECTIVE</b> : T	he stude	ent will	learn											
Various a	utomob	oile parts	s, power	transmis	sion fro	m engii	ne to va	rious p	arts of th	e automo	obile, eng	gine co	oling,	
lubricatio	n and ai	so abou	t various j	onutani	is and its	control	•							
COURSE OUTC	OMES	IES (COs) : ( 3- 5)												
CO1	Gain th	ne know	ledge of v	ehicle st	ructures	.(Level	2)							
CO2	Apply	the skill	of auxilia	ry syste	ms in IC	engine	s.(Level	3)						
CO3	Demor	onstrate the power transmissions systems.(Level 3)												
CO4	Apply	y the knowledge of steering, brakes and suspension systems.(Level 3)												
CO5	Unders	stand the concept of the fuel cells and hybrid vehicles.(Level 2)												
Mapping of Cour	rse Out	comes v	vith Prog	ram Ou	tcomes	(Pos)	DO7	DOQ	DOO	DO10	DO11	DO	10	
COS/POS	2	2	1	PO4	P05	1	PO/	PU8 1	P09	P010	POIT	1 PO.	12	
	2	2	1	1	-	1	1	1	1	1	-	1		
$CO_2$	<u> </u>	2			-	1		1	1		-			
C03	2	2	1	1	-	1		1	1	1	-		1	
C04	2	2	2	2	-	1	1	1		2	-	1		
COS	2	I	l	1	-	2	2	1	1	1	-	2		
Cos / PSOs	<u> </u>	$\frac{01}{2}$	PSC	)2	PS	03	PS	<u>504</u>						
	-	3	2		4	2		2						
CO2	•	3	2		4	2		2						
CO3		3	2		2	2		2						
CO4		3	2		4	2		2						
CO5		3	2		-	1		3						
H/M/L indicates	Streng	th of Co	rrelation	H-Hi	igh, M-	Mediun	n, L-Lo	w						
								Skil						
		~	ial					al S						
		nce	Soc		s			nnic						
2	s	cie	p		ive	ş	ject	Cecł						
00ge	nce	S S S	s ar	ore	llect	tive	Pro	L/S						
Cate	cie	erin	iitie 2S	n C	лE	llec	al /	hips	ills					
	ic S	jine	nan Ence	grai	grai	sn E	ctic	rns	t Sk					
	Bas	Eng	Hur Scie	Pro	Pro	Opé	Pra	Inte	Sof					
Γ Γ					✓									

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Subject Code:	Subject Name: AUTOMOBILE ENGINEERING	T / L/ ETL	L	T / S.Lr	P/ R	С
EDNIE22E05	Prerequisite: Thermodynamics and Thermal Engineering	Т	3	0/0	0/0	3

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

DUCAT

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

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

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

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

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

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

Principle of steering-steering geometry and wheel alignment-steering linkages-steering gear boxes-power steering. Wheel and tyre construction-type and specification-tyre wear and causes-front axles arrangements. Suspension system-need and types-independent systems-coil-leaf spring-torsion bar-shock absorbers-air suspension.

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

Auto Electrical Components and Alternative Power Plants. Brake -need -types-mechanical-hydraulic-pneumaticpower brake-trouble shooting of brakes. Principles of modern electrical systems-battery-dynamo- starting motorlighting- 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.



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Subject Code:	Sub	bject Name : SUSTAINABLE ENERGY							Ty/Lb/	L	Τ/	P/R	С
									ETL		SLr		
EBME22E04	Pre Eng	requisit	e: Therm	odynar	nics and	l Therr	nal		Ту	3	0/0	0/0	3
L : Lecture T :	Tutoria	l S Lr	: Supervis	ed Lear	ning P :	Project	R : Res	earch C:	Credits				
T/L/ETL : The	eory/Lab	/Embed	ded Theor	y and L	ab								
OBJECTIVE	S: Stude	ents will	learn										
• The co	oncept, p	rinciple	s and char	acteristi	cs of dif	ferent r	enewabl	e energy	systems.				
• Energy	y conver	sion tec	hniques										
COURSE OU	TCOM	ES (CO	s):(3-5)	)	1 1	• .•	1.1.		/1	1.0			
	Understa	ind the t	basic conc	epts of s	solar rad	1ation ai	nd their i		$\frac{1}{1}$ (Leve	12)			
CO2 4	Apply th	e solar l	cnowledge	e in var	ious prac	ctical ap	plication	ns(Leve	el 3)	2			
03	Carryout	arryout out constructions of different energy conversion technic							les(Level	2)			
CO4	Explain the principles of energy conversion from earth						earth and	l ocean	(Level 3)				
CO5	Demonstrate the working of MHD and concept of Fue					Fuel cel	ls(Leve	el 3)					
Mapping of C	Course Outcomes with Program Outcomes (POs)												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	12
CO1	3	2	1	1	1	2	2	2	1	1	-	2	
CO2	3	2	2	2	1	2	2	2	1	2	2	2	
CO3	3	2	2	1	1	1	1	2	1	1	1	2	
CO4	3	2	2	2	1	1	1	2	1	2	-	1	
CO5	3	2	2	1	1	1	1	1	1	1	-	1	
COs / PSOs	PS		PSC	02	PS	03	PS	1					
<u>CO1</u>		3	2			2		1					
C02		5	2			2		2					
$CO_{4}$		2	1			1		<u> </u>					
C05	-	3	1			1 1		<u>1</u> 1					
3/2/1 indicates	Strengt	h of Co	rrelation	3- Hig	. 2- M	edium.	1-Low	1					
itegory	Category Basic Science Engineering Science Humanities and social Science Program Core				Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project				
Ca					Ţ								



Subject Code:	Subject Name :	SUSTAINABLE ENI	ERGY		Ty/Lb/	L	Т/	P/R	С
EBME22E04					ETL		SLr		
	Prerequisite: Engineering	Thermodynamics	and	Thermal	Ту	3	0/0	0/0	3

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

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

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

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

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

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

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

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

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

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

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

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

#### Total No. of Periods : 45

#### **TEXT BOOKS**

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

#### REFERENCES

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

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

Subject Code	: Su PR	bject Na OPULS	ame : GA SION	S DYN	AMICS		Ty/Lb/ ETL	L	T/ SLr	P/R	C		
<b>EBME22E05</b>	Pro	erequisi	te: Engi	neering	Therm	odynan	nics		Ty	3	0/0	0/0	3
L : Lecture T :	Tutoria	l S Lr	: Supervis	ed Lear	ning P:	Practic	al R:R	esearch	C: Credits	<u> </u>			
T/L/ETL : The	eory/Lab	/Embed	ded Theor	y and L	ab								
OBJECTIVE	S: The s	student	will learn	l									
• The ba	asic diffe	erence be	etween ind	compres	sible an	d compr	essible f	low.					
• The pl	henomen	on of sh	lock wave	s and its	s effect o	on flow.							
Basic	knowle	dge abo	ut jet prop	oulsion a	and Rocl	ket Prop	ulsion.						
COURSE OU	TCOM	<u>ES (CO</u>	<u>s) : The s</u>	tudent	will be a	ble to	CI	1		1.0			
COI	Gain th	e fundar	nental kno	owledge	of com	pressible	$\frac{1}{1}$ flow ar	nd its pr	operties. (I	Level 2)			
CO2	Solve ti	ne proble	ems in coi	istant ar	$\frac{10}{6}$ variat	ble area	$\frac{\text{ducts.}(1)}{1}$	Level 3)					
03	Analyze	e the flo	w propert	les in di	fferent d	ucts. (L	evel 4)						
CO4	Underst	tand the	phenome	non of d	lifferent	shock w	vaves and	d their e	effects. (Le	vel 1&2	2)		
CO5	Apply t	he know	ledge of	propuls	sions in 1	rockets a	and jets.	(Level	3)				
Mapping of C	Course C	utcome	s with Pr	ogram	Outcom	es (POs	s)	1		1			
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	12
CO1	3	2	2	2	1	1	1	1	1	2			1
CO2	3	2	2	2	1	1	1	1	1	2			1
CO3	3	2	2	2	2	1	1	1	1	2			1
CO4	3	2	2	2	1	1	1	1	1	2			1
CO5	3	2	2	2	1	2	2	2	1	2			1
COs / PSOs	PS	01	PSC	02	PS	03	PS	504					
CO1		3	2			2		2					
CO2		3	2			2		2					
CO3		3	2		1	2		2					
CO4		3	2		1	2		2					
CO5	í.	3	2			2		2					
3/2/1 indicat	es Strei	ngth of	Correlat	tion:	3- High	n, 2- Me	edium,	1-Low	,	•			
Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project				

eemed to be Universit	DEEMED TO BE UNIVERSITY	**
STRIVE TO EXCEL	University with Graded Autonomy Status	
	(An ISO 21001 : 2018 Certified Institution)	
	Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.	

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

#### UNIT- I: COMPRESSIBLE FLOW – FUNDAMENTALS

EDUCAT

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

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

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

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

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

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

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

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

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

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

#### Total No. of Periods: 45

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

#### TEXT BOOK

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

#### REFERENCES

1) Patrick & William, (1997) "Fundamentals Of Compressible Flow", McGraw Hill-Inc.

2) Ganesan.V, (2010) "Gas Turbines", Tata McGraw Hill Publishing Company, New Delhi.



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Subject Code:		Subjec	t Name (	: REFI	RIGERA FIONIN	ATION NG	AND A	AIR	Ty/Lb/ ETL	L	T/ SLr	P/R	С
EBME22E06	Pr	erequisi	te: Thern	nodyna	mics, Tl	hermal	Enginee	ring	Ту	3	0/0	0/0	3
L : Lecture T :	Tutoria	1 SLr:	Supervis	ed Learr	ning P:	Project	R : Rese	arch C:	Credits	I		1	
T/L/ETL : The	eory/Lab	/Embed	ded Theor	y and L	ab								
• The w • Differe • Altern	CTIVE orking p ent cycle ate refri	S: Stude rinciple es used i gerants t	ents will le of refrige n refrigera o reduce g	earn rators an ation. global w	nd air co varming	onditioni •	ng syste	ms.					
COURSE OU	тсом	ES (CO	s):(3-5)	)									
CO1	Gain the	basic kr	nowledge	of vario	us refrig	geration	cycles a	nd refrig	gerants(L	evel 2)			
CO2	Analyze	the vari	ous refrig	eration of	cycles us	sing the	modyna	mic con	cepts(Le	vel 4)			
CO3	Understa systems.	and the d (Level 2	lesign and	workin	g princi	ples of v	arious c	ompone	ents of refr	igeratior	and air-	conditi	oning
CO4	Apply th	e psychi	rometry k	nowledg	ge to cal	culate th	e coolin	g and he	eating load	I(Level	3)		
CO5	Understa materials	erstand the fundamental concepts of cryogenic engineering and low-temperature of properties of rials. (Level 2)											
Mapping of C	Course C	Outcome	s with Pr	ogram	Outcom	es (POs	5)						
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PC	012
CO1	3	2	2	2	1	3	3	3	2	2	-		3
CO2	2	3	3	3	2	2	2	2	2	3	-		2
CO3	3	2	2	2	1	2	2	2	2	2	-		3
CO4	2	2	2	2	1	2	2	2	2	3	-		2
CO5	2	3	3	3	2	2	2	2	2	3	-		2
COs / PSOs	PS	601	PSC	02	PS	503	PS	504					
CO1		3	3			3		3					
CO2		3	3			3		3					
CO3		3	2			2		2					
CO4		3	3			3		3					
C05		3	2			2		2					
egory	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project				
Cat					<b>√</b>								

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

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

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

EDUCAT

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

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

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

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

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

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

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

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

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

### TEXT BOOKS

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

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

#### REFERENCES

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



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### Total No. of Periods : 45



Subject Code:		Subjec	et Name	: CO	OMPUT	TATION	NAL I	LUID	T	y/Lb	L	Τ/	P/R	С
				DYNA	WIIC5				/ <b>E</b> 7	ΓL/IE		SLr		
EBME22E07	Pr tra	erequisi ansfer a	te: Ther nd Fluid	modyna Mechar	umics, H nics	leat and	d Mass			Ту	3	0/0	0/0	3
L : Lecture T	: Tutoria	al S Lr	: Supervis	ed Lear	ning P :	Project	R : Re	search	C: (	Credits				
T/L/ETL : The	eory/Lab	o/Embed	ded Theor	y and L	ab									
OBJECTIVE	S: Stud	ents will	learn											
•	Gove	rning equ	uation of f	luid dyn	amics.	• •		<b>T! !</b>	• •					
•	Metho	ods of so	lving the e	equation	is by Fin	ite elem	ent and	Finite	Vo	lume meth	ods			
COURSE OU	JTCOM	IES (CO	s): (3-5)	)										
CO1	Underst	and the f	undament	al know	ledge of	f govern	ing equ	ations	and	boundary	condit	ions.(Lev	el 2)	
CO2	Analyze	the con	duction pr	oblems	using fi	nite diffe	erence r	nethod	.(Le	evel 4)				
CO3	Solve th	e fluid fl	low proble	ems in d	iffusion	using f	inite vo	lume n	neth	od.(Level	3)			
CO4	Apply th	he one di	mensiona	l equation	on to so	lve conv	vection	problei	ns ı	using finit	e volu	me metho	d.(Lev	/el 3)
CO5	Calculat	te the flu	id flow fi	eld usin	g finite	volume	method	.(Leve	el 4)					
Mapping of C	Course (	Dutcome	es with Pr	ogram	Outcom	es (POs	;)							
COs/POs	PO1	01 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	PS	501	PSC	02	PS	603	P	SO4						
CO1		3	2			2		2						
CO2		3	3		, í	2		3						
CO3		3	3			2		3						
C04		3	3		-	2		3	_			_		
COS	Street of	3 th of Cou	3	2 11:		2	1 T	3						
3/2/1 Indicates	Strengt	in or Co	rrelation	3- Hig	gn, 2- M	ealum,	1-LOW							
			al											
			soci		ive		Ŋ	Jt	ct					
	e		s pr		ect		ina	ner	oje					
	enc	50	s ai	ore	n el	tive	cipl	odu	/Pr					
	Sci	erir	itie	пС	rar	llec	Disc	Con	cal					
×	sic	ine	nan ince	grai	rog	пЕ	er I	ill (	ıcti					
gor	Ba	Eng	Hun Scie	Pro	Щ	Dpe	Int	Sk	$\Pr$					
ate					✓				-					
C														

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

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

Basics of computational fluid dynamics - Governing equations of fluid dynamics - Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent-Kinetic Energy Equations – Mathematical behavior of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

#### **UNIT- II: FINITE DIFFERENCE METHOD**

Derivation of finite difference equations - Simple Methods - General Methods for first and second order accuracy – solution methods for finite difference equations – Elliptic equations – Iterative solution Methods – Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations.

#### **UNIT- III: FINITE VOLUME METHOD (FVM) FOR DIFFUSION**

Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank – Nicolson and fully implicit schemes.

#### **UNIT- IV: FINITE VOLUME METHOD FOR CONVECTION DIFFUSION**

Steady one-dimensional convection and diffusion - Central, upwind differencing schemes-properties of discretization schemes - Conservativeness, Boundedness, Trasnportiveness, Hybrid, Power-law, QUICK Schemes.

#### **UNIT- V: CALCULATION FLOW FIELD BY FVM**

Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections - Pressure Correction equation, SIMPLE algorithm and its variants. Turbulence models, mixing length model, Two equation  $(k-\varepsilon)$  models – High and low Reynolds number models

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

#### **TEXT BOOKS**

1) Ghoshdastidar, P.S., (1998) "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd.

2) Versteeg, H.K., and Malalasekera, W., (1998) "An Introduction to Computational Fluid Dynamics: The finite volume Method", Longman.

#### REFERENCES

1) Patankar, S.V. (2004) "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation.

2) Muralidhar, K., and Sundararajan, T., (1995) "Computations Fluid Flow and Heat Transfer", Narosa Publishing House, NewDelhi.

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Subject Code:	Su	ıbject Na	ame : TU	RBO N	IACHI	NES			Ty/Lb/	L	T/ SI n	P/R	С		
	D	oroquis	to Fluid	Machar	nios Th	armal			EIL		SLr				
EBME22E08		rerequisi	ite: riula	wiechai	nes, 11	lermai			Ту	3	0/0	0/0	3		
	E	ngineeri	ng												
L : Lecture T	: Tutoria	al SLr	: Supervis	ed Leari	ning P:	Project	R : Rese	earch C:	Credits				-		
T/L/ETL : The	eory/Lal	o/Embed	ded Theor	ry and L	ab										
OBJECTIVE	The c	course ai	ims at gi	ving an	overvie	ew of o	different	types	of turbo i	machin	ery used	for en	ergy		
transformation	n, such a	s pumps	, fans, cor	npresso	rs, as we	ell as hy	draulic, s	steam ar	nd gas-turb	ines.					
COURSE OU	TCON	IES (CO	(3-5)	) of truth o			40 omnlig	ationa (	(Larval 2)						
COI	Unders	stand the	concepts	of turbo	machin	es and 1	ts applic	ations. (	Level 2)						
CO2	Analyz	the per	rformance	of turbo	o machir	nes usin	g first la	w of the	ermodynam	nics. (L	evel 4)				
CO3	Solve t	olve the turbo machines problems using velocity triangle concepts. (Level 3)													
CO4	Unders	iderstand the working principles of centrifugal and axial flow and radial flow compressors (Level 2)													
CO5	Calcul	lculate stage losses, stage efficiency and pressure ratio in axial flow and radial flow turbine . (Level 3)													
Mapping of C	Course (	Outcome	es with Pr	ogram	Outcom	es (PO	s)								
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	12		
CO1	3	2	1	-	-	1	1	1	1	1	-	1			
<u>CO2</u>	3	3	2	1	-	1	1	1	1	2	-	1			
CO3	3	3	3	1	-		1		1	2	-	1			
C04	3	3	2	-	-	1					-	1			
$CO_{S}$	3 • • • •	<u> </u>		1	- DS			<u> </u>	1	2	-	1			
CO1	1,	3	15	02	10	2 2	I K	1							
CO2		3	2	r		2		1							
CO3		3	2	·		2		1							
CO4		3	2			2		1							
CO5		3	2			2		1							
3/2/1 indicates	Streng	th of Co	rrelation	3- Hig	gh, 2- M	ledium,	1-Low	,							
			al la												
			oci		ve		<u>y</u>	ţ	÷						
ory	e		s pu		ecti		inar	nen	ojec						
tego	enc	ß	s ar	ore	n el	tive	lqic	odu	/Pro						
Cat	Sci	erir e	e e	D U	gran	Elec	Disc	Con	cal						
	Isic	gine	nan ence	grai	rog	n E	ter ]	ill (	acti						
	Βε	Eng	Hur Scie	Pro		Opé	In	Sk	Pr						
					✓										

### DUCAT tified Institutio Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

Subject Code:	Subject Name : TURBO MACHINES	Ty/Lb/	L	Τ/	P/R	С
		ETL		SLr		
EBME22E08	Prerequisite: Fluid Mechanics Thermal Engineering	Ту	3	0/0	0/0	3

#### **UNIT-1 INTRODUCTION**

Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification, Application of first and second laws of thermodynamics to turbo machines.

#### **UNIT-2 ENERGY EXCHANGE IN TURBOMACHINES**

Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor.

#### **UNIT-3 CENTRIFUGAL COMPRESSORS**

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

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

Axial and radial flow compressors and pumps- general analysis, Effect of blade discharge angle on performance, Theoretical head – capacity relationship.

#### **UNIT-5 AXIAL AND RADIAL FLOW TURBINES**

Velocity diagrams, losses and coefficients, blade design principles, testing and performance characteristics.

#### Total No. of Periods 45

#### **TEXT BOOKS:**

1. Gas Turbine, V.Ganesan, Tata McGraw Hill Co. Ltd., 3rd edition, 2010

2. Turbines, Compressors & Fans, S. M. Yahya, Tata McGraw HillCo. Ltd., 2nd edition, 2002

#### **REFERENCE BOOKS:**

2. D. G. Shepherd, "Principals of Turbo machines", the Macmillan Company (1964).

3., S. L.Dixon, "Fluid Mechanics & Thermodynamics of Turbo machines", Elsevier (2005).

4. B.K.Venkanna, "Turbomachine", PHI, New Delhi 2009.

5. M. S. Govindgouda and A. M.Nagaraj, "A Text Book of Turbomachines", , M. M. Publications, 4Th Ed, 2008.

6. V. Kadambi and Manohar Prasad, "An Introduction to Energy Conversion, Volume III, Turbo machinery", New Age International Publishers, reprint 2008.

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## PROGRAM ELECTIVE DESIGN ENGINEERING



Subject Code: EBME22E09	Subj	Subject Name: MECHANICAL VIBRATIONS							Ty/Lb/ ETL	L	T/ SLr	P/R	С		
	Pre r	equisite	: Strengt	th of n	naterial	s; Mec	hanics	of	Ту	3	0/0	0/0	3		
L · Lecture T · 7	Futorial	<u>S Lr</u>	· Supervis	ed Lear	ning P ·	Project	R · Rese	earch C <sup>.</sup>	Credits						
T/L/ETL : Theo	ory/Lab	/Embedd	led Theory	y and La	.b	110,000	1111100		creatio						
OBJECTIVES	: The s	tudent v	vill learn												
Multi d	egree of	f freedoi	n system i	in differe	ent mode	es.									
Vibratio	on meas	suremen	t techniqu	es.											
OURSE OUTC	COMES	5 (COs)	:												
CO1	Jnderst	and the	fundament	tals of vi	bration	systems	. (Level	2)							
CO2	Evaluate	e the Na	tural frequ	ency of	Longitu	j dinal an	d Transv	verse vit	oration sys	tem. (Lev	vel 5)				
CO3	Analyze	nalyze the torsional vibration system at different modes.(Level 4)													
CO4 5	Solve fr	ee, damj	ped and fo	rced vib	ration sy	ystems o	of single,	, Two an	ıd multi de	egree of fi	reedom. (I	Level	3)		
<b>CO5</b>	Acquire	knowle	dge in var	ious vib	ration m	easurem	ent syst	ems.(Le	vel 2)						
Mapping of Co	ourse O	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	PS	01	PSC	02	PS	03	PS	<b>504</b>							
CO1		3	2			2		1							
CO2		3	2		2	2		2							
CO3		3	2		2	2		2							
CO4		3	2		2	2		2							
CO5		3	2		2	2		1							
3/2/1 indicates S	trengtl	h of Cor	relation	3- Hig	h, 2- Me	edium, 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/	L	Τ/	P/R	С
		ETL		SLr		
EBME22E09	Prerequisite: Strength of Materials, Mechanics of Machines-II	Ту	3	0/0	0/0	3

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

Relevance of and need for vibration Analysis- Mathematical Modelling of Vibrating Systems – Discrete and Continuous Systems – Review of Single degree of Freedom Systems – Free and Forced Vibrations, Various Damping Models

#### **UNIT- II: TWO DEGREE-OF-FREEDOM SYSTEMS**

General Solution to Free vibration problem-Damped Free Vibration, Forced Vibration of un-damped System – Dynamic Vibration Absorbers-Technical Applications.

#### **UNIT- III:MULTI-DEGREE OF FREEDOM SYSTEMS**

Free and Forced Vibrations of multi-degree of freedom systems in longitudinal, torsional and lateral modes – Matrix methods of solution – normal modes – orthogonal principle- energy methods, Introduction to vibration of plates.

#### **UNIT- IV: CONTINOUS SYSTEMS**

Torsional vibrations – Longitudinal vibrations of rods – Transverse vibrations of beams- Governing equations of motion – Natural frequencies and normal modes – energy methods.

#### **UNIT- V:VIBRATION MEASUREMENT**

Vibration monitoring-Data Acquisition- Vibration parameter selection – vibration sensors-accelerometers-Performance characteristics-sensor location-signal pre-amplification – vibration meters-vibration signaturesstandards-vibration testing equipment-in-site, Balancing of rotors.

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

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#### **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:	Subj	ect Nan	ne: DESIC	GN OF 1	PRODU	CTION	TOOL	S	Ty/Lb/	L	Τ/	P/R	С
									ETL		SLr		
EBME22E10	Prer macl	equisite hine eler	: Manufa nents	cturing	Techno	logy, D	esign of		Ту	3	0/0	0/0	3
L : Lecture T :	Tutoria	l S Lr	: Supervis	ed Leari	ning P:	Project	R : Rese	arch C:	Credits				
T/L/ETL : The	orv/Lab	/Embedo	led Theor	v and La	ab								
OBJECTIVES	S: The s	student v	vill learn	) 4110 20									
• The dea	sign of j	jigs and	fixtures.										
Differe	ent types	s of press	s tools and	l various	elemen	ts of a p	ress tool	s.					
• To imp	rcom	wledge 1	$\frac{n \text{ basics, } c}{n}$	lesign ai	nd drawi	ng of pr	oduction	1 tools					
COURSE OU	Underst	and the	oj. different e	lemente	and priv	ncinles	of jigs an	d fivtur	es (Level '	2)			
	Select a	nd creat	e a jig for	a given	compon	ent (Ley	vel 7)	u IIxtui	es (Level 2	-)			
CO2 CO3	Select a	nd creat	e a fixture	for a gi	ven com	ponent	$\frac{1}{(\text{Level 7})}$	)					
CO4	Underst	and the	sheet meta	al operat	ions, ele	ments a	nd die de	, esign pr	ocess (Lev	vel 4)			
CO5	Select a	nd creat	e a press te	ool for a	given c	ompone	ent (Leve	el 7)		- /			
Mapping of Co	ourse O	utcome	s with Pro	ogram (	Jutcome	es (POs)	)						
Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	2
CO1	3	2	2	-	3	3	2	2	3	2	3		2
CO2	3	3	3	3	3	3	2	2	3	2	3		2
CO3	3	3	3	3	3	3	2	2	3	2	3		2
CO4	3	2	2	-	3	3	2	2	3	2	3		2
CO5	3	3	3	3	3	3	2	2	3	2	3		2
Cos / PSOs	PS	01	PSC	02	PS	503	PS	504					
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 S	Strengt	h of Cor	relation	3- Hig	h, 2- Me	edium, 1	1-Low	1		-			
			ce										
			cier										
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B. Tech Mechanical Engineering - 2022 Regulation



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

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

OBJECTIVES of tool design- Function and advantages of Jigs and fixtures, Basic elements-principles of location .Locating methods and devices, Principles of clamping Mechanical actuation, pneumatic and hydraulic actuation. Standard parts, Drill bushes and Jig buttons, Tolerances and materials used.

#### **UNIT-II: JIGS**

Design and development of jigs and fixtures for given component- Types of Jigs -Post, Turnover, Channel, latch, box, pot, angular post jigs, Indexing jigs, automatic drill jigs- rack and pinion operated air operated jigs - Design and drawing of channel, box, indexing and angular post jigs

#### UNIT- III: FIXTURES

General principles of milling, Lathe, boring, broaching and grinding fixtures and shaping fixtures .Assembly, Inspection and Welding fixtures, Modular fixtures. Design and drawing of turning, milling and grinding fixtures

#### **UNIT- IV: PRESS WORKING**

Press Working Terminologies - operations ,Types of presses , press accessories , Computation of press capacity , Strip layout , Material Utilization , Shearing action ,Clearances ,Press Work Materials , Center of pressure, recent trends in tool design- computer Aids for sheet metal forming Analysis

#### UNIT- V: ELEMENTS OF CUTTING, BENDING, FORMING AND DRAWING DIES

Design of various elements of dies, Die Block, Punch holder, Die set, Stops, Strippers, Pilots - Selection of Standard parts. Design and drawing of simple blanking, piercing, compound and progressive dies.

#### Total No. of Periods: 45

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#### 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:	Sub DE	ject Nan SIGN O	ne : F MATE	RIAL H	IANDL	ING E(	QUIPM	ENTS	Ty/Lb/ ETL	/ L	T/ SLr	P/R C
EBME22E11	Prei	requisite	: Design of Machine Elements.						Ту	3	0/0	0/0 3
L : Lecture T :	Tutoria	al S.Lr	: Supervi	sed Lear	ming P	: Projec	t R : Re	search C	C: Credits			
T/L/ETL : The	ory/Lab	o/Embed	ded Theo	ry and L	ab							
OBJECTIVE • De	: esign of	differen	t types of	materia	l handlir	ng syste	ms used	l for eng	ineering a	nd proce	ss industri	ies.
			COUR	RSE OU	TCOM	ES (CO	s) : ( 3-	5)				
<u>CO1</u>	Unders	stand the	basic prin	nciples c	of materi	al hand	ling equ	ipments	. (Level 2	() ~	1.0	
CO2	Apply	the desig	<u>n knowle</u>	edge of v	arious d	rives fo	r materi	ial handl	ing equip	ments. (1	Level 3)	
<u>CO3</u>	Differe	entiate va	rious typ	es of ma	$\frac{1}{C}$	ndling o	levice b	ased on	application	$\frac{\text{on. (Leve})}{6}$	14)	
C04 C05	Design Solooti	and app	torial han	I HOIST,	Cranes,	<u>Convey</u>	ors and	Elevato	rs. (Level	6)		
	pelecti	on of ma	Manni	ing of C	ourse w	ith Pro	n appile	utcome	1000000000000000000000000000000000000			
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	PS	501	PS	02	PS	503	P	SO4				
CO1		3		3		3		2		_		
CO2		3		3		3		2				
CO3		3		<u> </u>		3		2		_		
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CUS 3/2/1 indicator	Strong	5 th of Cou	relation	у 3 Ц;		3 Iodium	1 I ow	2				
5/2/1 mulcates	Streng			<u> </u>	gii, 2- w		1-LOW					
Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			

Page	101

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

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

Overview - consideration in material handling system design, ten principles of material handling. Types of material handling equipments-trolleys, industrial trucks, AGV, monorails and other rail guided vehicles, conveyors, cranes, hoists and elevators.

#### **UNIT- II: DESIGN OF HOISTS**

Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks - crane grabs lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types.

#### **UNIT- III: DRIVES OF HOISTING GEAR**

DUCAT

Hand and power drives - Travelling gear - Rail travelling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.

#### **UNIT- IV: CONVEYORS**

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

#### **UNIT- V: ELEVATORS**

Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.

#### Total No. of Periods: 45

**\*NOTE:** Use of Approved Data Book is permitted in examination

#### **TEXT BOOKS:**

- 1. Rudenko, N. (1970) Materials handling equipment. ELnvee Publishers
- 2. Mikell Groover, P. (2006) Automation, Production system and computer integrated Manufacturing. Second Edition. Prentice Hall of India Pvt. Ltd

#### REFERENCES

- 1. Alexandrov, M. (1981) Materials Handling Equipments. MIR Publishers
- 2. Boltzharol, A. (1958) Materials Handling Handbook. The Ronald Press Company
- 3. P.S.G. Tech, (2003) Design Data Book. Kalaikathir Achchagam
- 4. Lingaiah. K. and Narayana Iyengar, (1983) Machine Design Data Hand Book. Vol.1 & 2, Suma **Publishers**
- 5. Spivakovsy, A.O. and Dyachkov, V.K. (1985) Conveying Machines. Volumes I and II, MIR **Publishers**

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Subject Code:	5	Subject Na	ame : AF	PLIED	TRIBO	DLOGY	,		Ty/Lb/	L	T/ SI n	P/R	С
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EBME22E12	8	ind Mach	ineries	leering	vicciiaii	ics, 1 <sup>-</sup> iu	iu micci	lancs	Ту	3	0/0	0/0	3
L : Lecture T :	Tutor	ial SLr	: Supervis	ed Learn	ning P:	Project	R : Res	earch C:	Credits				
1/L/EIL: Inc	eory/L	ab/Embed	ded Theor	ry and L	ab								
	o imna	rt knowle	doe in the	friction	wear a	nd lubri	ication a	ispects (	of machine	compoi	nents		
• T	o unde	erstand the	material	propertie	es which	influen	ice the ti	ribologi	cal charact	eristics	of surface	es.	
• T	o und	erstand th	ne analyti	cal beh	avior of	differe	ent type	s beari	ngs and d	lesign c	of bearing	s base	d on
ar	nalytic	al /theoret	ical appro	oach.			• •		C	C			
COURSE OU	TCO	MES (CO	os) : ( 3- 5	) The st	udent w	ill able	to						
CO1	Unde	rstand the	fundamen	ntal conc	cepts of t	friction	wear an	d surfac	e treatmen	ts. (Lev	el 2)		
CO2	Appl	y the know	vledge of	wear and	d surface	e treatm	ent in m	etals an	d non-meta	als. (Lev	vel 3		
<u>CO3</u>	Expo	se to lubri	cation in l	hydrody	namic ar	nd hydro	ostatic b	earings.	(Level 2)				
CO4	Analy	ze the the	ory of ela	sto-hydi	rodynam	nc lubri	cation. (	Level 4	) 1_:			2)	
Mapping of C	urse (	Tate the be	with Proc	tribolog	tcomes (	ponents	s using c	interent	working c	condition	is. (Level	3)	
	PO1	PO2	PO3		PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	12
CO1	101	102	105	104	105	100	107	100	107	1010	1011	10	12
	3	2		2				-					<u> </u> 1
$CO_2$	3	3	1	3	1	1	1	-	1	1	1		<u>1</u> 1
C04	3	3	1		1	1	1	-	1	1	1		<u>1</u> 1
C05	3	3	1	3	1	1	1	-	1	1	1		<u>1</u> 1
Cos / PSOs	J	PSO1	PS	$\frac{1}{02}$	PS	03	P	- SO4	1		-		1
CO1	-	3	2	2	10	1	1,	2					
CO2		3	2	2		1		2					
CO3		3	2	2		1		2					
CO4		3	2	2	-	1		2					
CO5		3	2		-	1		2					
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Subject Code:	Subject Name : A P P L I E D TRIBOLOGY	Ty/Lb/	L	Τ/	P/R	С
		ETL		SLr		
EBME22E12	Prerequisite: Engineering Mechanics, Fluid Mechanics and Machineries	Ту	3	0/0	0/0	3

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

Topography of Surfaces – Surface features-Properties and measurement – Surface interaction –Adhesive Theory of Sliding Friction –Rolling Friction Friction properties of metallic and non-metallic materials.

#### UNIT- II WEAR AND SURFACE TREATMENT

Types of wear – Mechanism of various types of wear – Laws of wear – Theoretical wear models-Wear of Metals and Non-metals – Surface treatments – Surface modifications – surface coatings methods

#### UNIT- III LUBRICANTS AND LUBRICATION REGIMES

Lubricants and their physical properties- Viscosity and other properties of oils –Additives-and selection of Lubricants- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes.

#### UNIT- IV THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION

Reynolds Equation,-Assumptions and limitations-One and two dimensional Reynolds Equation-Reynolds and Somerfield boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic and Hydrostatic bearings.

#### UNIT- V HIGH PRESSURE CONTACTS

Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory-Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication

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

#### **TEXT BOOKS:**

1. Rabinowicz.E, "Friction and Wear of materials", John Willey & Sons , UK, 1995

2. Cameron, A. "Basic Lubrication Theory", Ellis Herward Ltd., UK, 1981

#### REFERENCES

1. Halling, J. (Editor) – "Principles of Tribology", Macmillian – 1984.

2. Williams J.A. "Engineering Tribology", Oxford Univ. Press, 1994.

3. S.K.Basu, S.N.Sengupta & B.B.Ahuja, "Fundamentals of Tribology", Prentice –Hall of India Pvt Ltd, New Delhi, 2005

4. G.W.Stachowiak & A.W.Batchelor, Engineering Tribology, Butterworth-Heinemann, UK, 2005

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Subject Code:	Subj DES	ect Nar IGN F(	ne: OR MAN	UFAC'	TURE	AND A	SSEM	BLY	T/L/ET L	L	T/ SLr	P/R	C
EBME22E13	Pre I Mac	requisit hine El	e: Streng ements-I	gth of M , Manu	laterial facturii	s, Desig ng Tech	gn of mology	-I	Т	3	0/0	0/0	3
L : Lecture T : T/L/ETL : The	Tutori ory/La	al SL b/Embe	r : Super dded The	vised Le ory and	earning l Lab	P : Prac	ctical R	: Rese	arch C: Cı	redits			
OBJECTIVE	<b>S</b> : The purpose of study is to impart the general design, manufacturing and assembly principles in												
ease of manufa		g.											
COURSE OU		AES (C)	Os): The	e studer	nts will	be able	to	(T1	2)				
	Disting	stand the	e basic pr	types of	f form d	logion ir	ability.	(Level	$\frac{2}{2}$	ohining	(Loval	1)	
CO2		ze and re	e various edesign th	e comp	onent fo	or the e	i castilig ase of m	g, lorgn	$\frac{11}{110}$ $\frac{11}{110}$ $\frac{11}{110}$	evel 4)	(Level )	+)	
CO4	Exposi	re to m	odern too	ol like C	ompute	r aided	Design	for Ass	embly (L	$\frac{(1 + 1)}{(1 + 1)}$			
CO5	Analyz	ze and e	valuate D	esign fo	or assen	bly through	ough ca	se studi	es. (Level	4)			
Mapping of C	ourse	Outcon	nes with	Prograi	m Outc	omes (I	POs)		× .	,			
Cos/Pos	<b>PO1</b>	PO2	PO3	PO4	PO5	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	PO9	PO10	PO11	PO	012
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	PS	01	PSC	02	PS	03	PS	<b>504</b>					
CO1	4	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	s Stren	gth of (	Correlati	on 3-	High, 2	- Medi	um, 1-I	JOW		-			
Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project				

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Subject Code:	Subject Name : DESIGN FOR MANUFACTURE AND ASSEMBLY	Ty/Lb/ ETL	L	T/ SLr	P/R	С
EBME22E13	Prerequisite: Manufacturing Technology-I	Ту	3	0/0	0/0	3

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

General design principles for manufacturability - strength and mechanical factors, Process capability - Feature tolerances - Geometric tolerances - Assembly limits -Datum features - Tolerance stacks.

#### **UNIT- II: FORM DESIGN - CASTING**

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

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

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

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

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

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

DUCAT

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.



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Subject Code:		Subject	t Name: 1	MECH	ANICS	OF FRA	ACTUR	E	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	С
EBME22E14		Pre re Enginee	equisite: ring Meta	Stre	ngth	of M	aterials,	,	Ту	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									1				
<b>OBJECTIVES</b>	S: The	student v	vill learn		to of dif	Forent	nodog h	hiol	a thaca con	nononto	fail und	m static	
• Solid I fatigue	load c	conditions		mponen		ierent i	nodes b	y which	i these con	iponents		er static	
OURSE OUT	COMI	ES (COs)	: The stu	ident wi	ill be ab	le to							
CO1	I	dentify th	ne various	failure	mechani	sms in c	lifferent	materia	als. (Level 2	2)			
CO2	I	Evaluate f	fracture to	ughness	s using li	near fra	cture tes	sts. (Lev	/el 5)				
CO3	I	Apply the	crack dri	ving for	ce in lin	ear and	non-line	ar mate	rials. (Leve	el 4)			
CO4	I	Estimate t	he life of	fatigue	crack gr	owth for	r both lir	near and	l nonlinear	material	s. (Level 3	3)	
CO5	I	Employ th	ne knowle	dge of f	racture r	nechani	cs in eng	gineerin	g application	on. (Leve	el 3)		
Mapping of Co	ourse	Outcome	s with Pr	ogram	Outcom	es (POs	;)						
Cos/Pos	<b>PO1</b>	PO2	PO3	<b>PO4</b>	PO5	<b>PO6</b>	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	2
CO1	3	3	3	3	2	2	2	-	2	$\frac{2}{2}$	1	2	; ,
CO2	3	3	3	3	2	2	2	-	2	2	1	2	, ,
CO4	3	3	3	3	2	2	2	_	2	$\frac{2}{2}$	1	2	2
CO5	3	3	3	3	2	2	2	_	2	2	1	2	2
Cos / PSOs	P	SO1	PSC	)2	PS	03	PS	504					
CO1		3	3		]	1		2					
CO2		3	3		]	1		2					
CO3		3	3		]	1		2					
CO4		3	3		1	l		2					
CO5	14 4	3	3	<b>TT</b> <sup>1</sup> 1 <i>4</i>		1		2					
3/2/1 indicates S	strengt	h of Corr	elation 3	- High, 2	2- Mediu	m, 1-Lo <sup>.</sup>	W						
Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project				
					<b>√</b>								

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Subject Code:	Subject Name : MECHANICS OF FRACTURE	Ty/Lb/	L	Τ/	P/R	С
<b>EBME22E14</b>		ETL/IE		SLr		
	Prerequisite: Strength of Materials, EngineeringMetallurgy	Ту	3	0/0	0/0	3

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#### UNIT- I ELEMENTS OF SOLID MECHANICS

**DUCAT** 

The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation - limit analysis – Airy's function – field equation for stress intensity factor.

#### UNIT- II STATIONARY CRACK UNDER STATIC LOADING

Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation - plastic zone size – Dugdaale model – determination of J integral and its relation to crack opening displacement.

#### UNIT- III ENERGY BALANCE AND CRACK GROWTH

Griffith analysis – stable and unstable crack growth –Dynamic energy balance – crack arrest mechanism –K1c test methods - R curves - determination of collapse load.

#### UNIT- IV FATIGUE CRACK GROWTH CURVE

Empirical relation describing crack growth law – life calculations for a given load amplitude – effects of changing the load spectrum -- rain flow method– external factors affecting the K1c values.- leak before break analysis.

#### **UNIT- V APPLICATIONS OF FRACTURE MECHANICS**

Crack Initiation under large scale yielding – thickness as a design parameter – mixed mode fractures - crack instability in thermal and residual stress fields - numerical methods

#### Total No. of Periods: 45

#### **TEXT BOOKS:**

- 1. David Broek, "Elementary Engineering Fracture Mechanics ", Fifthoff and Noerdhoff International Publisher, 1978.
- 2. 2. Kare Hellan, "Introduction of Fracture Mechanics", McGraw-Hill Book Company, 1985.

#### **REFERENCES:**

1. Preshant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, 1999.

2. John M.Barson and Stanely T.Rolfe Fatigue and fracture control in structures Prentice hall Inc. Englewood, 1977.

3. Tribikram Kundu, "Fundamentals of Fracture Mechanics", Ane Books Pvt. Ltd. New Delhi/ CRC Press, 2012



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Subject Code:	Subje INNC	ect N OVATIC	ame: N	DESIG	N T	HINKI	NG A	AND	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	С	
	Pre r	Pre requisite:						Ту	3	0/0	0/0	3		
EBME22E15		1 0 1	<u> </u>	1 7	· D	<b>D</b> : (	<b>D</b> D	1						
L : Lecture 1 : T/L/ETL : The	T/L/ETL : Theory/Lab/Embedded Theory and Lab													
OBJECTIVE	S: The	student v	will learn											
Solid     fatigue	• Solid mechanics of cracked components of different modes by which these components fail under static and fatigue load conditions.													
OURSE OUT	OURSE OUTCOMES (COs) :													
CO1	CO1 Understand the fundamental concepts of design thinking													
CO2	Apply the knowledge of design thinking process in produ								t developmen	nt				
CO3	Innovate the new idea for product creations													
CO4	Develop the product design and strategies													
CO5	CO5 Create a new business idea for a startup.													
Mapping of C	Course (	Outcome	s with Pro	ogram (	Outcome	es (POs)	)							
Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO	8 PO9	PO10	PO11	PO	12	
CO1	3	3	2	3	2	3	2			2		2		
CO2	3	3	2	3	2	3	2			2		2	2	
CO3	3	3	2	3	2	3	2			2		2		
CO4	3	3	2	3	2	3	2			2		2	2	
CO5	3	3	2	3	2	3	2			2		2		
Cos / PSOs	PSO1		PSO2		PSO3		PSO4							
CO1	CO1 2		3		3		2							
CO2	2		3		3		2							
CO3	2		3		3		2							
CO4	2		3		3		2							
CO5	2	2		3		3		2						
			Science											
Category	Basic Science	Engineering Science	Humanities and social S	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project					
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# Subject Code:Subject Name:DESIGNTHINKINGANDTy/Lb/LT/INNOVATIONETL/IESLr

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

#### Unit I Introduction to Design Thinking

Pre requisite:

EDUCAT

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**

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 developmentActivity: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**

**EBME22E15** 

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity. Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

#### **Unit IV Product Design**

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies. Activity: Importance of modeling, how to set specifications, Explaining their own product design.

#### Unit V Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business –Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes. Activity: How to market our own product, About maintenance, Reliability and plan for startup.

#### **Text Books**

- 1. Change by design, Tim Brown, Harper Bollins (2009)
- 2. Design Thinking for Strategic Innovation, Idris Mootee, 2013, John Wiley & Sons.

#### **Reference Books**

- 1. Design Thinking in the Classroom by David Lee, Ulysses press
- 2. Design the Future, by Shrrutin N Shetty, Norton Press
- 3. Universal principles of design-William lidwell, kritinaholden, Jill butter.
- 4. The era of open innovation -chesbrough.H



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# **PROGRAM ELECTIVE MANUFACTURING ENGINEERING**

B.Tech Mechanical Engineering - 2022 Regulation



Subject Co	de:	Subje	ct Nam	e : IND	USTRIA	L ROE	BOTICS		Ty/Lb/E	L	Τ/	P/R	C
									TL		SLr		
EBME22	E16	Prere	quisite:	Industr	rial Auto	omation	1		Ту	3	0/0	0/0	3
L : Lecture	e T : Tuto	rialSLr :	Supervi	sed Lea	rning P :	Project	R : Res	earch C	C: Credits				
T/L/ETL : Theory/Lab/Embedded Theory and Lab													
OBJECT	IVES: To	give an	understa	nding to	the stu	dent wit	h respec	t to:					
• Ba	isic comp	c components of an industrial robot and Sensors used in robots											
• R0	bot prog	ramming	method	s and Ro	bot app	lications	5						
COURSE	OUTCO	OMES (C	<b>:</b> ( <b>O</b> s) :										
CO1	Underst	and the b	asic con	cepts of	a robot	(Level 2	2)						
CO2	Identify	and appl	y the dif	fferent c	ompone	nts and	operatio	n with	respect to r	obot (Lev	vel 3)		
CO3	Recogn	ize the va	rious ty	pes of se	ensors an	nd mach	ine visio	on conc	epts and its	applicat	ions (Lev	el 3)	
CO4	Write p	rogramm	e for rot	ot (Leve	$\frac{el 4}{2}$	tions (I	arva1 4)						
CO5 Manning	Design	e Outcor	cell and	State Its	s applica	LIONS (L	$\frac{\text{evel 4}}{\text{Pos}}$						
	PO1	PO2	PO	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	POI	12
005/105	101	102	3	104	105	100	107	100	10)	1010	1011	101	L <i>2</i>
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 /	PS	01	P	S	PS	03	Р	so					
PSUs		2	C	02 D		2		4					
		3		<u>3</u>		2		3					
$CO_2$		3		3	-	2		3					
$CO_4$		3		3		2		3					
C05		3		3		2		3					
$\frac{2}{2}$	tas Stran	$\frac{1}{\text{oth of } Co}$	rrelation	3 High	h 2 Ma	dium 1	Low	5					
5/2/1 mulea							-LOw						
			al										
			oci		ive		2	It	H				
	e		s bi		ecti		ina	ner	ojec				
<b>N</b>	enc	ad	s ar	ore	l el	ive	ipl	odi	Pro				
105	Scie	rin	ties	Ŭ	am	ect	isc	ШО	al /				
Iteg		ice le	ani	am	ogi	E	Ū.	IC	tic				
Ű	Bas	ngiı cier	lum	rogı	Pr	pen	Inte	Skil	Prac				
		ШŇ	Ň	<u>д</u>	<ul> <li>✓</li> </ul>	0					+	_	

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

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

Definition of a Robot – Basic Concepts – Robot components –manipulator-configurations –joints- degree of freedom. Types of Robot Drives – Basic Robot Motion types – Point to Point Control – Continuous Path Control.

### **UNIT- II: COMPONENTS AND OPERATIONS**

Basic Control System Concepts – open loop and closed loop control-Control System Analysis – Robot Actuation and Feed Back, Manipulators – Direct and Inverse Kinematics, Co-ordinate Transformation – Brief Robot Dynamics, Types of Robot and Effectors – Grippers – Tools as End Effectors – Robot / End Effort Interface.

### **UNIT- III:SENSING AND MACHINE VISION**

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

### **UNIT- IV:ROBOT PROGRAMMING**

Methods – Languages –programming for pick and place applications-palletizing. Capabilities and Limitation – Artificial Intelligence – Knowledge Representation – Search Techniques – AI and Robotics.

### UNIT- V:ROBOT CELL DESIGN AND APPLICATIONS

Robot cell design-types and control.

Applications of Robots –process applications in welding and painting – Assembly applications– Material Handling applications.

# Total No. of Periods : 45

# **TEXT BOOK**

1) K. S. Fu, R. C. Gonalez, C.S.G. Lee, "Robotics Control Sensing Vision and Intelligence", McGraw Hill International Edition, 10987.

### REFERENCES

- 1) Mikell P. Groover, Mitchell Weiss, (2008) "Industrial Robotics, Technology, Programming and Application", Tata McGraw Hill International Editions, 10986.
- 2) Richard D. Klafter, Thomas A. Chonieleswski and Michael Negin, (1989) "Robotic Engineering An Integrated Approach", Prentice Hall Inc., Englewoods Cliffs, NJ, USA, 109809.



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Subject Code	: Subject Name: NON-CONVENTIONAL MACHINING TECHNIQUES	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E1	7 Prerequisite: Manufacturing Technology I & II	Ту	3	0/0	0/0	3
L : Lecture T T/L/ETL : T	: Tutorial S Lr : Supervised Learning P : Project R : Research C neory/Lab/Embedded Theory and Lab	Credits				1
OBJECTIV	ES: The student will learn					
• ′	Fo understand basics of Non conventional machining techniques					
• ′	Fo impart knowledge on various non conventional machining proces	8				
• ′	Γο know the applications of non conventional machining techniques	in various	fields			
COURSE O	UTCOMES (COs) :					
CO1	Explain the principle, advantage and limitations of different Non con	ventional r	nachin	ing proces	ses. (Le	vel 2)
CO2	Compare the different non conventional processes for their capability	(Level 4)				
~~~			× 1	•		

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 o	f Course	Outcomes	with Program	Outcomes	(POs)

B or o	04150 0			8 0								
Cos/Pos	PO1	PO2	PO3	PO4	PO5	<b>PO6</b>	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	PS	01	PSC	)2	PS	03	PS	604				
CO1	3	3	3		,	2		3				
CO2	3	3	3		,	2		3				
CO3		3	3		,	2		3				
CO4	3	3	3		,	2		3				
CO5	3	3	3		,	2		3				
3/2/1 indicates	Strengtl	n of Cor	relation	3- Hig	h, 2- Me	edium, 1	l-Low					
Categ orv	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical / Project			

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

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

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

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**

Electro Chemical Machining Process - Principles - Equipments - Metal Removal Analysis - Tool Material -Insulation – Process Parameters – ECH, ECG Etc., – Applications.

# **UNIT- III: ELECTRON BEAM, LASER BEAM AND PLASMA ARC MACHINING**

EBM process - principle - Gun construction - vacuum and non-vacuum technique - applications. LBM process, principles, pumping processes, Types of Emission- Beam control – Applications.

# **UNIT- IV: ULTRASONIC MACHINING**

Ultrasonic Machining Processes - Working Principles - Transducers - Concentrators - Nodal Point Clamping -Feed Mechanism - Metal Removal Rate - Process Parameters - Applications.

# **UNIT- V: ABRASIVE, WATER JET AND HYBRID MACHINING**

AJM Processes – Principle – Equipment – Metal Removal Rate – Process Parameters – Applications. WJM Process – Principle – Equipment – Applications. Introduction to hybrid machining-Electro Chemical Discharge Machining, Abrasive electrical discharge grinding-Principle, advantages, limitations and applications.

# Total No. of Periods : 45

# 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".



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Subject Code:	Sı	ıbject N	ame: PR	OCESS ESTIMA	PLANN ATION	NING A	ND CO	ST	Ty/Lb/ ETL	L	T/ SLr	P/R	С
EBME22E18	Prore	anisito	Manufa	turing '	Technol	007 I &	Π		Tw	2	0/0	0/0	2
L · Lecture T · T	Futorial	SIr.	Supervis	ed Learr	$\frac{1}{1}$ $\frac{1}$	Project	R · Rese	arch C	<b>1 y</b> Credits	3	0/0	0/0	3
T/L/ETL : Theo	ory/Lab/	ab/Embedded Theory and Lab											
OBJECTIVES	: The s	tudent w	vill learn										
Process	plannii	ng activi	ties	dar of									
<ul> <li>Various</li> <li>Method</li> </ul>	s elements	nnuter a	st of a pro	duct. Ss plant	nina								
COURSE OUT	COM	ES (COs	():	255 pium	iiig								
CO1	Jnderst	and the r	nethod of	plannin	g the var	ious ma	chining	processe	es (Level 2	2)			
CO2	Analyze	and des	cribe the	step by s	tep proc	edure fo	or manuf	acturing	(Level 4)	,			
CO3	Apply co	omputer	s for adva	nced pro	cess pla	nning (I	Level 3)	0	,				
CO4	Discuss	the vario	ous cost in	volved i	in manuf	acturing	g of com	ponent c	or product	(Level 2)			
CO5 E	Evaluate	e and ide	ntify the e	economi	c metho	d of mar	nufacturi	ng (Lev	el 6)				
Mapping of Co	ourse O	utcomes	s with Pro	ogram ()	Outcome	s (POs)							
Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P	012
CO1	3	3	3	3	3	2	2	3	3	3	3		2
CO2	3	3	3	3	3	2	2	3	3	3	3		2
CO3	3	3	3	3	3	2	2	3	3	3	3		2
CO4	3	3	3	3	3	2	2	3	3	3	3		2
CO5	3	3	3	3	3	2	2	3	3	3	3		2
Cos / PSOs	PS	01	PSC	)2	PS	03	PS	<b>604</b>					
CO1	3	;	3		3	3		3					
CO2	3	;	3		3	3		3					
CO3	3	3	3		3	3		3					
CO4	3	3	3		3	3		3					
CO5	3	3	3		3	3		3					
3/2/1 indicates S	trengtl	n of Cor	relation	3- Hig	h, 2- Me	dium, 1	-Low			1			
Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Fractical /Froject				
					v								

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Subject Code:	Subject Name : PROCESS PLANNING AND COST ESTIMATION	Ty/Lb/ ETL	L	T/ SLr	P/R	С
<b>EBME22E18</b>	Prerequisite: Manufacturing Technology I & II	Ту	3	0/0	0/0	3

# **UNIT- I: PROCESS PLANNING**

Definition - OBJECTIVES - Scope - approaches to process planning- Process planning activities - Finished part requirements- operating sequences- machine selection –material selection parameters- Set of documents for process planning- Developing manufacturing logic and knowledge- production time calculation - selection of cost optimal processes.

# **UNIT- II: COMPUTER AIDED PROCESS PLANNING**

EDUCAT

Variant process planning - Generative approach -Forward and Backward planning, Input format, Logical Design of a Process Planning - Implementation considerations. Application of computer software's in process planning.

# **UNIT-III: ELEMENTS OF COST**

Introduction - Importance and aims of Cost estimation - Estimation procedure. Material Cost - Determination of Material Cost Labour Cost - Determination of Direct Labour Cost - Expenses - Cost of Product (Ladder of cost) -Illustrative examples. Analysis of overhead expenses - Factory expenses - Depreciation - Causes of depreciation - Methods of depreciation - Administrative expenses - Selling and Distributing expenses - Allocation of overhead expenses.

# **UNIT- IV: PRODUCT COST ESTIMATION**

Estimation in forging shop - Losses in forging - Forging cost - Illustrative examples. Estimation in welding shop - Gas cutting - Electric welding - illustrative examples. Estimation in foundry shop - Estimation of pattern cost and casting cost - Illustrative examples.

# **UNIT- V: ESTIMATION OF MACHINING TIME AND COST**

Estimation of machining time and cost for Lathe operations - Estimation of machining time and cost for drilling, boring, shaping, planning, milling and grinding operations - Illustrative examples. Value engineering - cost reduction

# Total No. of Periods : 45

# **TEXT BOOKS**

- 1) M.Adithan and B.S. Pabla, (1989) "Estimating and Costing", Konark Publishers Pvt. Ltd.
- 2) V.Jayakumar (2012) "Process Planning and Cost Estimation", Lakshmi Publication.

# REFERENCES

- 1) Nanua Singh, (1996) "System approach to Computer Integrated Design and Manufacturing", John Wiley & Sons, Inc.
- 2) Joseph G. Monks, (1982) "Operations Management, Theory & Problems", McGraw Hill Book Company.
- 3) T.R. Banga and S.C. Sharma, (2011) "Estimating and Costing", Khanna Publishers, 16thEdition
- 4) Sadhu singh, (2002) "Computer aided Design and manufacturing", Khanna publisher, new delhi, second edition.



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Subject Code:	S	ubject N	ame: AD	DITIV	E MAN	UFACT	URING	r	Ty/Lb/	L	T/	P/R	С
									ETL		SLr		
<b>EBME22E19</b>	Prer	equisite	: Manufa	cturing	Techno	logy I 8	k II		Ту	3	0/0	0/0	3
I · Lecture T ·	Tutoria	l SIr	· Supervis	ed Lear	ning D.	Project	R · Res	earch C	Credits				
T/L/ETL The	orv/Lab	/Embeda	led Theor	v and La	inig I ih	Tiojeet	<b>K</b> . Kes		Cicuits				
	$\frac{1}{5}$			y und Et									
$\bullet  \text{To un}$	erstand	the fund	amental d	concepts	of Add	itive Ma	mufactu	ring (i e	Ranid Pro	ototyping	σ) and 3-Γ	nrinti	no its
advant	ages and	d limitati	ions	concepts	01 / 100		inuractu		. Rupiu I R	notyping	s) and 5 E	printi	ng, no
• To cla	ssify va	rious ty	pes of Ad	lditive N	Aanufact	turing P	rocesses	s and kr	now their v	working	principle,	advar	itages.
limitat	ions etc	•				Ū.				C C			Ū.
• To have	ve a holi	istic viev	w of vario	us appli	cations	of these	technol	ogies in	relevant f	ields suc	h as meel	nanical	, Bio-
medica	al, Aeros	space, el	ectronics of	etc									
COURSE OU		<u>ES (CO:</u>	$\frac{s}{2}$										<u> </u>
CO1	Describ	e variou	s CAD iss	ues for .	3D print	ing and	rapid pr	ototypin	g and relat	ed opera	tions for S	STL m	odel
CO2	manipu. Formula	ate and s	olve tunic	al probl	ame on r	ovorso	ngingar	ing for s	urface reco	netructi	on from n	veicel	
02	prototy	ne model	ls through	digitizi	ng and si	oline-ba	sed surf	ace fitti	ng	JISUUCIN	on nom p	lysical	
CO3	Formula	ate and s	olve tvpic	al probl	ems on r	everse e	engineer	ing for s	urface reco	onstructio	on from d	gitized	1
	mesh m	nesh models through topological modelling and subdivision surface fitting.											
CO4	Explain	xplain and summarize the principles and key characteristics of additive manufacturing technologies and									and		
	commo	ommonly used 3D printing and additive manufacturing systems.											
CO5	Describ	e and su	mmarize t	ypical r	apid tool	ing pro	cesses fo	or quick	batch prod	uction of	f plastic a	nd met	al
	parts.		·41 D				<u>`````````````````````````````````````</u>						
Mapping of C	ourse O		s with Pro	ogram (	Jutcome	s (POs	)	<b>D</b> 00					
Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO</b> 7	PO8	PO9	PO10	PO11	P	J12
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	PS	501	PSO	02	PS	603	P	<b>SO4</b>					
CO1	2		3		3		-						
CO2	2		3		3		3						
CO3	1		2		2		3						
CO4	3		3		3		2						
CO5	3 3 2												
3/2/1 indicates	Strengt	h of Cor	relation	3- Hig	h, 2- Me	edium, 1	1-Low						
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Subject Code:	Subject Name: ADDITIVE MANUFACTURING	Ty/Lb/ ETL	L	T/ SLr	P/R	С
EBME22E19	Prerequisite: Manufacturing Technology I & II	Ту	3	0/0	0/0	3

#### **UNIT – I Introduction**:

Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes.

# UNIT – II Liquid-based Rapid Prototyping Systems:

Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, Photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

### UNIT - III Powder Based Rapid Prototyping Systems:

Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification; Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling : Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP

#### **UNIT – IV Rapid Prototyping Data Formats:**

STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software's: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL view 3 Data Expert and 3 D doctor.

# **UNIT – V RP Applications:**

Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.

#### **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.  $\operatorname{Dimov}/\operatorname{Springer}$ 

# **Reference Books**

1. Terry Wohlers, Wholers Report 2000, Wohlers Associates

2. Rapid Prototyping and Manufacturing /PaulF.Jacobs/ASME

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		F	Periyar E.V.F	t. High Ro	ad, Madu	ravoyal, (	Chennai-9	5. Tamiln	adu, India.	<u>г г</u>			
Subject Code:	,	Subject	Name: F	LEXIBI SYST	LE MAI EMS	NUFAC	TURIN	G	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E20	Prer Indu	equisite strial A	: Manufa utomatio	cturing n; CAD/	Techno /CAM	logy I &	λII;		Ту	3	0/0	0/0	3
L : Lecture T :	Tutoria	l S Lr	: Supervis	ed Lear	ning P:	Project	R : Res	earch C:	Credits	11			1
T/L/ETL : The	ory/Lab	/Embedo	led Theor	y and La	ıb	-							
OBJECTIVES	S: The s	student v	vill learn										
•	To une	lerstand	the Mode	rn manu	facturing	g systen	ns						
•	To uno	lerstand	the conce	pts and a	pplicati	ons of f	lexible n	nanufact	uring syste	ems			
COURSE OU	TCOM	ES (CO	s):										
CO1	Ur	derstand	the conc	epts of f	lexible r	nanufac	turing sy	stems (l	FMS) (Lev	el 2)			
CO2	Ap	ply the	use of con	nputers i	n FMS (	Level 3	)						
CO3	Ap	ply the s	simulation	and dat	a base n	nanagen	nent in F	MS (Le	evel 3)				
CO4	Jus	stify the	implemen	tation of	f FMS (I	Level 4)							
CO5	Ur	derstand	l the futur	e factory	with th	e applic	ation of	FMS co	ncepts (Le	vel 2)			
Mapping of C	ourse O	utcome	s with Pro	ogram (	Outcome	es (POs)	)						
Cos/Pos	<b>PO1</b>	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	12
CO1	3	3	2	2	3	3	2	2	3	3	3		2
CO2	3	3	2	2	3	3	2	2	3	3	3		2
CO3	3	3	3	3	3	3	2	2	3	3	3		2
CO4	3	3	3	3	3	3	2	2	3	3	3		2
CO5	3	3	2	2	3	3	2	2	3	3	3		2
Cos / PSOs	PS	01	PSO	02	PS	03	P	<b>SO4</b>					
CO1		3	3			2		3					
CO2		3	3		:	2		3					
CO3		3	3		:	2		3					
CO4		3	3			2		3					
CO5		3	3			2		3					
/2/1 indicates S	trength	of Corr	elation	3- High	, 2- Mea	lium, 1-	Low		•		•		
Catego ry	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project				

#### (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamil adu, India. Subject Code: Subject Name : FLEXIBLE MANUFACTURING Ty/Lb/ L **T**/ P/R С SYSTEMS ETL SLr **EBME22E20** Prerequisite: Manufacturing Technology I & II;

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# UNIT- I PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS

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**

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

EDUCATI

**Industrial Automation; CAD/CAM** 

Application of simulation - model of FMS - simulation software - limitation - manufacturing data systems - data flow - FMS database systems - planning for FMS database.

# **UNIT- IV GROUP TECHNOLOGY AND JUSTIFICATION OF FMS**

Introduction - matrix formulation - mathematical programming formulation - graph formulation - knowledge based system for group technology - economic justification of FMS - application of possibility distributions in FMS systems justification.

# **UNIT- V APPLICATIONS OF FMS AND FACTORY OF THE FUTURE**

1. Jha.N.K., "Handbook of flexible manufacturing systems", Academic Press Inc., 1991.

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.

# **REFERENCES:**

**TEXT BOOK:** 

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.

**Total No. of Periods: 45** 

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Subject Code:	,	Subject	Name: P	OWDE	R META	ALLUR	GY		Ty/Lb/ ETL	L	T/ SLr	P/R	С
EBME22E21	Prer	equisite	: Materia	ls Scien	ce; Engi	neering	g Metall	urgy	Ту	3	0/0	0/0	3
L : Lecture T : ' T/L/ETL : Theo	Tutoria Dry/Lab	l S Lr /Embedd	: Supervis led Theor	ed Learr	ning P : b	Project	R : Rese	earch C:	Credits				
ORIECTIVES	· The s	student v	vill learn										
• To und	erstand	basics of	f powder i	metallur	gy								
• To exp	ose vari	ous pow	der metal	lurgy tec	hniques								
To kno	w the a	pplicatio	n of powd	er metal	lurgy in	various	fields						
COURSE OUT	ГСОМ	ES (CO	s) : The st	udent w	vill be al	ble to							
CO1	Underst	and the	fundamer	tals of	powder	metallur	gy (Leve	el 2)					
CO2	Interpre	t the cha	racterizati	ion para	meters o	f metal j	powders	(Level	3)				
CO3 0	Compar	ing the c	lifferent n	nanufact	uring me	ethods o	f compo	nents by	v powder n	netallurgy	(Level 3)		
CO4	Analyzi	ng the di	ifferent sin	ntering t	heories (	Level 4	)						
CO5	Differer	ntiating a	ind compa	ring diff	ferent ap	plicatio	ns of po	wder me	etallurgy (I	Level 3)			
Mapping of Co	ourse O	utcome	s with Pro	ogram C	Outcome	es (POs)		1	1	T		-	
Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	12
CO1	2	2	2	1	3	1	2	2	2	2	1		2
CO2	3	2	2	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$					2	2	-		2
CO3	3	2	2	2 1 3 3 2					2	2	-		2
CO4	3	2	2	2 1 3 3 3 2					2	2	-		2
CO5	3	2	2	1	3	3	3	2	2	2	3		2
Cos / PSOs	PS	501	PSC	02	PS	03	PS	504					
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 S	Strengt	h of Cor	relation	3- Hig	h, 2- Me	dium, 1	l-Low						
			0										
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/	L	Τ/	P/R	С
		ETL		SLr		
<b>EBME22E21</b>	Prerequisite: Engineering Metallurgy	Ту	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**

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 flowabilitymeasurement.

### **UNIT- III POWDER COMPACTION**

Powder compaction: Mechanical, thermal and thermomechanical compacting processes. Presses used for transmission. Die design and tooling for consolidation of powders. New methods of consolidation. E.g. Powder rolling, Powder forging, Isostatic pressing. Advantages and limitations of these methods.

### **UNIT- IV SINTERING PROCESS**

Theories of sintering: Sintering mechanism, Roll of diffusion, Recrystallization, Por emigration, Pore-growth and coalescence. Liquid phase sintering and related processes. Effect of compacting pressure, sintering temperature and time on sintered properties. Type of sintering furnaces. Sintering atmospheres.

# UNIT- V APPLICATIONS OF POWDER METALLURGY

Manufacturing and application of important P/M components: Porous bearing, Electrical contact materials, Metallic filters, Cemented carbides, magnets, Friction materials and Composites.

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

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#### **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 Cod EBME22E22	e: 2	Sub	ject Nam	e: ENT PLA	ERPRIS	SE RES	OURCI	E	Ty/L /ET]	.b L	L	T/ SLr	P/ R	С
		Pre requ Applicat	isite: Mai ion of Co	nufactu mputer	ring Teo Science	chnolog Engine	y I & II ering	;	Ту		3	0/0	0/0	3
L : Lecture T	: Tuto	rial S L	r : Supervi	ised Lea	rning P	: Practic	cal R : F	Research	C: Cre	dits				
I/L/EIL : In	neory/L	ab/Embe		bry and I	Lab									
• Buildin	ES: In ng of h	le student	will learn	l: esource i	nlannino	. Imnaci	t of IT ir	n FRP						
- Dunum	15 01 0			source	pramme	,, impac	. 01 11 11							
COURSE O	UTCO	MES (CO	Os): The	student	will be	able to								
CO1		Underst	and the co	ncepts o	of ERP (l	Level 2)								
CO2		Build th	e business	Model	and imp	lement H	ERP (Le	vel 4)						
CO3		Underst	and the pr	inciples	of organ	izationa	l transfo	ormation	(Level	2)	1 (7	1.0		
CO4 CO5		Examine	e the globa	al Indust	rial Con	petition	and use	e Inform	$\frac{\text{ation Te}}{\sqrt{2}}$	echr	nology (L	evel 4)		
COS Manning of	Course	Outcom	es with P	rogram	Outcon	nes (PO	s)	III (Leve	51 2)					
Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PO10	PO11	PO1	2
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	2
CO3	3	2	2	2	3	2	2	3	3		3	3	2	2
CO4	3	3	3	3	3	2	2	3	3		3	3	2	2
CO5	3	2	2	2	3	2	2	3	3		3	3	2	2
Cos / PSOs	Р	SO1	PSC	)2	PS	03	PS	504						
CO1		3	3			3		3						
CO2		3	3			3		3						
CO3		3	3			3		3						
CO4		3	3			3		3						
CO5		3	3			3		3						
3/2/1 indicates	s Stren	gth of Co	rrelation	3- Hi	gh, 2- M	ledium,	1-Low					•		
Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project					

#### (An ISO 21001 : 2018 Certified Institution) Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India. **Subject Code:** Subject Name : ENTERPRISE RESOURCE P/R Ty/Lb L **T**/ С **PLANNING** /ETL SLr **EBME22E22 Prerequisite: Nil** Ty 3 0/0 0/0 3

# UNIT- I: INTRODUCTION TO ERP

Integrated Management Information, Seamless Integration - Supply Chain Management- Integrated Data Model-Benefits Of ERP - Business Engineering And ERP- Definition Of Business Engineering - Principle of business engineering - Business engineering with information technology.

# UNIT- II: BUSINESS MODELING FOR ERP

EDUCATIO

Building The Business model - ERP implementation – An Overview – Role Of Consultant, Vendors and Users, Customization – Precautions - ERP Post implementation options ERP Implementation Technology – Guidelines for ERP Implementation.

# UNIT- III: INTRODUCTION TO ORGANIZATIONAL TRANSFORMATION

Fundamental elements of organizational transformation - Principles-Methodology -Models (LMI CIP, DSMCQ & PMP) - Process improvements in models ( Moen & Nolan strategy, NPRDC, LMI CIP) - Tools and Techniques.

# UNIT- IV:GLOBAL INDUSTRIAL COMPETITION AND INFORMATION TECHNOLOGY 9

Coping with competition – the impact and value of IT Systems – impact and value of IT – Value chain of a firm and strategic use of IT – development trends of IT. Introduction to SAP and its applications in ERP.

# UNIT- V: SUPPLY CHAIN MANAGEMENT

The concept of supply chain, logistics, customer and supply chain relation, role of IT in supply chain management – strategy and structure of supply chain – factors of supply chain – stages in supply chain progress.

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

# TEXT BOOKS

- 1) Leon, (2014) "Enterprise Resource Planning", McGraw Hill, New Delhi
- 2) P. N. Rastogi, "Re-Engineering And Re-inventing the Enterprise", Wheeler Publishing
- 3) Dr. J. A. Edosomwan, (1995) "Organizational transformation and Process Re-Engineering" 1 edition.

# REFERENCES

1. Jose Antonio Fernandz, (2005) "The SAP R/3 Handbook", TMH, 3 edition 2.Vinod Kumar Garg and N.K.Venkita Krishnan, (2004) "Enterprise Resource Planning Concepts and Practice", PHI. Publishing Co.

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Subject Code:	Subject SIMULA	Name: ATION	SYST	EM	MODE	LING	AND	Ty/Lb/ ETL	L	T/ SLr	P/R	C
EBME22E23	Pre requ	isite:						Ту	3	0/0	0/0	3
L : Lecture T : T	utorial S	Lr : Supervi	sed Lear	ning P :	Project	R : Rese	earch C:	Credits				
T/L/ETL : Theor	ry/Lab/Eml	bedded Theo	ry and La	ab								
<b>OBJECTIVES</b> :	The stude	ent will learn:	:									
The basic system	concept a	nd definitions	s of syste	em;	toma							
Analyze a system	ues to mod	ke use of the	informa	tion to it	uenis;	he perfo	rmance					
	i una to ma				inprove	ne perio	inanee	•				
OURSE OUTC	OMES (C	Os) : The stu	udents w	vill be ab	ole to							
CO1 E	xplain the	system conce	ept and a	pply fund	ctional r	nodeling	method	l to model	the activi	ties of a st	atic s	ystem
<b>CO2</b> D	escribe the	behavior of	a dynam	ic systen	n and cr	eate an a	nalogou	is model fo	or a dynan	nic system	ı;	
<b>CO3</b> St	imulate the	e operation of	f a dynan	nic syste	m and n	ake imp	roveme	nt accordir	ng to the s	imulation	result	ts.
CO4 Id	lentify the	distribution of	of data fr	om the c	ollected	data						
CO5	Create a m	odel building	and vali	date the	perform	nance of	the mod	del				
Mapping of Co	urse Outco	omes with Pi	rogram (	Outcome	es (POs)							
Cos/Pos	PO1 PO	2 PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	12
CO1 2	2	1	1	1	1	1		2	2	2	2	
CO2 2	2	1	1	1	1	1		2	2	2	2	
CO3 2	2	2	1	2	1	1		2	2	2	2	
CO4 2	2	1	1	1	1	1		2	2	2	2	
CO5 2	2	1	1	1	1	1		2	2	2	2	
Cos / PSOs	PSO1	PS	<b>SO2</b>	PS	503	PS	<b>504</b>					
CO1				2		2						
CO2				2		2						
CO3				2		2						
CO4				2		2						
CO5				2		2						
Category	Basic Science Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project				

B. Tech Mechanical Engineering - 2022 Regulation

examples: Simulation of queuing systems. General Principles.

# **UNIT II Statistical Models in Simulation**

# **Statistical Models in Simulation:**

Review of terminology and concepts, Useful statistical models, Discrete distributions. Continuous distributions, Poisson process, Empirical distributions. General Principles.

# **Queuing Models:**

Characteristics of queuing systems, Queuing notation, Long-run measures of performance of queuing systems, Long-run measures of performance of queuing systems cont..., Steady-state behavior of M/G/1 queue, Networks of queues,

# **UNIT III Random-Number Generation**

# **Random-Number Generation:**

Properties of random numbers; Generation of pseudo-random numbers, Techniques for generating random numbers. Tests

for Random Numbers,

#### **Random Variate Generation:**

Inverse transform technique Acceptance-Rejection technique.

# **UNIT IV Input Modeling**

#### **Input Modeling:**

Data Collection; Identifying the distribution with data, Parameter estimation, Goodness of Fit Tests, Fitting a non-stationary Poisson process, Selecting input models without data, Multivariate and Time-Series input models.

Estimation of Absolute Performance:

Types of simulations with respect to output analysis, Stochastic nature of output data, Measures of performance and their estimation, Contd..

# **UNIT V** Measures of performance and their estimation

Measures of performance and their estimation, Output analysis for terminating simulations Continued.., Output analysis for steady-state simulations. Verification, Calibration And Validation: Optimization: Model building, verification and validation, Verification of simulation models, Verification of simulation 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 B.Tech Mechanical Engineering - 2022 Regulation

<b>UNIT I</b>	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

EDUCATI ISO 21001 : 2018 Certified Institution

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

Subject Code:	Subject N SIMULATIO	Name: ON	SYSTEM	MODELING	AND	Ty/Lb/ ETL	L	T/ SLr	P/R	С
EBME22E23	Pre requisite	:				Ту	3	0/0	0/0	3



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**Total No. of Periods: 45** 



Subject Code:	Su	bject Na	me: TO	TAL QU	JALITY	( MAN	AGEME	ENT	Ty/Lb/	L	Τ/	P/R	С
EBME22E24	-								ETL		SLr		
	Pre	requisite	: Manufa	cturing	Techno	ology I &	& II		Ту	3	0/0	0/0	3
L : Lecture T :	Tutoria	l S Lr	: Supervis	ed Leari	ning P:	Project	R : Rese	earch C:	Credits	11			
T/L/ETL : The	ory/Lab	/Embedd	led Theor	y and La	ıb								
OBJECTIVE	S: The s	student v	vill learn										
Various Princip	ples and	Tools of	f TQM; IS	SO Stand	lards								
OURSE OUT	COME	S (COs)	:										
CO1	Underst	and the	various qu	ality too	ols and te	echnique	es (Level	12)					
CO2	Demons	strate the	customer	satisfac	tion tech	nniques	(Level 3	5)					
CO3	Expose	d to qual	ity auditir	ig system	ns and p	procedu	res (Leve	el 2)					
CO4	Implem	ent TQM	I and TP	M (Leve	14)								
CO5	Implem	ent Kaiz	en and co	nduct FN	MEA. (L	evel 3)							
Mapping of C	ourse O	utcome	s with Pro	ogram (	Jutcome	es (POs)	)						
Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	<b>PO8</b>	PO9	PO10	PO11	P	012
CO1	3	1	2	2	2	2	2	3	3	3	2		2
CO2	3	1	2	2	2	2	2	3	3	3	3		3
CO3	3	1	2	2	2	2	3	3	3	3	2		3
CO4	3	1	2	2	2	2	3	3	3	3	3		2
CO5	3	2	2	2	2	2	3	3	3	3	3		3
Cos / PSOs	PS	501	PS	02	PS	03	PS	504					
CO1		3	3		2	2		3					
CO2		3	3			2		3					
CO3		3	3			2		3					
CO4		3	3			2		3				-	
CO5		3	3			2		3				-	
3/2/1 indicates	Strengt	h of Cor	relation	3- Hig	h, 2- Me	edium, 1	l-Low	1		1		_I	
			It										
			ocia		ve		2	Ţ	t.				
	e		s pr		ecti		inaı	nen	ojec				
	enc	ಟ	s ai	lore	n el	tive	cipl	odu	Pr				
ory	Sci	erii	litie e	u C	grar	Elec	Dise	Cor	cal				
teg	asic	gine	mar enc	gra	Prog	en F	ter	cill (	acti				
Ca	B;	Eng Sci	Hu Sci	Pro		Ope	In	Š	Ч Ч				
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												<u> </u>	



Subject Code:	Subject Name :	TOTAL QUALITY	MANAGEMENT	Ty/L	L	Τ/	P/R	С
				b/ET		SLr		
EBME22E24				L				
	Prerequisite: Ma	anufacturing Technol	ogy I & II	Ty	3	0/0	0/0	3

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

Definition of Quality, Dimensions, Planning of quality, conformance to specification, Quality costs-. Basic concepts and evolution of Total Quality Management, Principles of TQM, Deming Philosophy Deming prize MBNQA. Barriers to TQM Implementation.

### **UNIT- II: TQM PRINCIPLES**

Customer satisfaction-Customer Perception of Quality, Customer Complaints. Service Quality, Customer Retention. Employee Involvement- Motivation, Empowerment, Teams. Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement-Juran Triology, PDSA Cycle,58,Kaizen.Supplier Partnership- Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures-Basic Concepts. Strategy, Performance Measure.

# UNIT- III: STATISTICAL QUALITY CONTROL

The Seven Tools Of Quality, Statistical Fundamentals, Control Charts For Variables And Attributes, Process Capability, Concept Of Six Sigma, Phases And Defective UNIT-s Of Six Sigma .Overview Of GB,BB,MBB Leadership Characteristics ,Leadership Concept , Role Of Senior Management, Lean Management Principle, Strategic Planning New Seven Management Tools.

# **UNIT- IV: TQM TOOLS**

Benchmarking-Reasons to Benchmark, Benchmarking Process. Quality Function Deployment (QFD), pareto, process flow diagram, check sheets and histogram Taguchi Quality Loss Function. Total Productive Maintenance (TPM)-Concept, Improvement Needs, FMEA-Stages of FMEA.

#### **UNIT- V: QUALITY SYSTEMS**

Need For ISO 09000 and Other Quality Systems, ISO 09000 – 2000 Quality System -Elements. Implementation Of Quality System, Documentation , Quality Auditing, Quality Council, Quality statements ,Quality Management System TS 1609409, ISO 14000 Concept, Requirements And Benefits. Introduction To Capability Material Management (CMM), People Capability Management (PCM).

#### Total No. of Periods : 45

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# **TEXT BOOK**

1) Dale H Besterfied, "Total Quality Management", Prentice Hall Publishing House

#### REFERENCES

- 1) S.Ramachandran, Dn.S.Jose, "Total Quality Management", Airwalk Publications, First Edition, December.
- 2) Kulneet Suri, (2004 05) "Total Quality Management: Priciples & Practce, Tools & Techniques", S.K. Kateria & sons, First Edition,
- *3)* James R.Evans & William M.Lidsay, "The Management and Control of Quality", (<sup>5th</sup> Edition), South Western(Thomson Learning),2002(ISBN 0-324-06680-5).
- 4) Feigenbaum.A.V. "Total Quality Management", Tata Mcgraw-Hill, 109091.
- 5) Oakland.J.S. "Total Quality Management", Butterworth-Heinemann Ltd., Oxford, 109809
- 6) R.S.Nagarajan, A.A.Arivalagar, "Total Quality Management", New Age International (p) Ltd., Publishers, First Edition.



Subject	Codor	Subjec	Pei t Nomo	riyar E.V.R.	High Road	d, Madura	avoyal, Ch	nennai-95	. Tamilna	du, India. T-//Lb	T	<b>T</b> /	D/D	C
Subject	Coue:	Subjec	t manne	: FACI		) PLAN	INIING F	AND		ТУ/LD /ГТТ	L	1/ SI n	P/K	C
				DESI	GN							SLI		
EBME2	2E25	Prere	quisite:	Manufac	cturing '	Fechnol	logy-I&	II		Ту	3	0/0	0/0	3
L : Lectu	ure T : T	utorial	SLr : S	upervised	Learnir	ng P:Pi	roject R	: Resear	ch C: Ci	redits				
T/L/ETL	: Theor	y/Lab./I	Embedde	ed Theory	and Lal	D.	U							
OBJEC	TIVES:	The stu	ident wi	ll learn										
	• ′	To expla	in proje	ct manage	ement fo	or entrep	reneurs							
COURSE	E OUTC	OMES	(COs) :	The stuc	lent will	be able	e to							
CO1	Underst handling	and the n	eed for F (Level 2)	acilities re	quiremer	nt plannii	ng, select	tion of op	otimum lo	ocation for t	he plant	plant layo	ıt/mate	rial
CO2	Illustrate	e plant la	yout & n	naterial hai	ndling sys	stem (Le	vel 3)							
CO3	Compar	e the pro	s and con	s of altern	ate locati	ons for tl	he plant,	plant lay	outs & m	aterial hand	lling sys	tems (Leve	14)	
CO4	Criticall	y examir	ne/explor	e the optio	ns for pla	nt locati	on, layou	ıt & mate	rial hand	ling system	(Level :	5)		
CO5	Judge w	hich opti	on is bet	ter compar	ed to the	rest for:	Plant loc	cation, Pla	ant layout	t & materia	l handlin	ig system (	Level 4	)
Мар	oping of	Course	Outcon	nes (COs	) with P	rogram	Outcor	nes (PO	s) & Pr	ogram Spo	ecific O	utcomes	PSOs	)
COs/P	Os	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	P	012
CO1		2	2	2	2	3	2	2	2	1	2	2		1
CO2		1	2	2	1	3	1	1	-	-	3	1		1
CO3		3	1	3	2	2	1	1	1	1	3	1		1
CO4		3	3	2	1	2	1	1	-	1	2	1		1
CO5		3	2	1	2	3	1	1	1	1	2	2		1
COs / I	PSOs	PS	01	PSC	02	PS	03	PS	04					
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 indi	icates St	rength	of Corr	elation	3- High	, 2- Mec	lium, 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 P/R Ty/Lb/ **T**/ С $\mathbf{L}$ ETL SLr DESIGN Prerequisite: Manufacturing Technology-I& II **EBME22E25** Ty 0/0 3 0/0 3

#### **UNIT I: INTRODUCTION**

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

#### **UNIT II:** PLANT LOCATION

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

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**

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

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



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Subject Code EBME22E26	: Su	ıbject Na	ame : QU	ALITY	ENGIN	EERIN	NG	Ty/Lb	/ETL	L	T/ SLr	P/R	С
	Pr	rerequisi	te: Nil					T	y	3	0/0	0/0	3
L : Lecture T : T	Futorial	SLr : Sup	pervised Le	earning F	P: Project	t R : Re	search C	: Credits					
T/L/ETL : Theo	ry/Lab./	Embeddeo	d Theory a	nd Lab.									
OBJECTIVE:	• Ba	dent will l asic conce e theory a	earn: ptual idea nd applicat	of Supply ions of S	y Chain N CM Netv	/lanagem vorks wi	nent syste th simple	ems and i e case stu	ts intern dy	al structural	systems; a	lso focı	ısed
				COL	JRSE O	UTCOM	IES (CO	<b>)</b> s):					
CO1	Re	ecall/Expl	ain basic Q	uality co	ncepts, fo	oundatio	n for this	s course (	Level 2)	)			
CO2	I11	ustrate Co	ontrol Char	ts for Va	riables/A	ttributes	for real	life scena	rios (Le	vel 3)			
CO3	Ех	amine Pr	ocess Capa	bility (Le	evel 4)								
CO2	Co	ompare Sa	mple Insp	ection sys	stems (Le	evel 4)							
CO3	Re	ecall/Expl	ain TQM c	oncepts,	TQM too	ols (Leve	el 2)						
Mapping of Co	ourse Ou	itcomes (	COs) with	Program	n Outcor	nes (PO	s) & Pro	ogram Sp	ecific O	outcomes (PS	SOs)		
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	12
CO1	1	-	-	-	1	-	-	-	1	1	-		1
CO2	1	1	-	1	1	1	-	-	1	1	-		1
CO3	1	1	-	1	1	1	-	-	1	1	-		1
CO2	1	1	-	1	1	1	-	2	2	2	3		1
CO3	1	-	2	1	2	2	2	2	3	2	2		2
COs / PSOs	P	SO1	PSO	52	PS	03	P	SO4					
C01		3	2	r.	2	2		-					
CO2		3	2	r	2	2		1					
CO3		3	2		2	2		1					
CO2		3	2	r	2	2		1					
CO3		3	2	,	2	2		2					
3/2/1 indicates	Streng	th of Co	rrelation	3- Hig	h, 2- M	edium,	1-Low		I				
Categor y	Basic Science	Engineering Science	Humanities and social Science	Program Core	<ul> <li>Program</li> <li>elective</li> </ul>	Open Elective	Inter Disciplinary	Skill Component	Practical /Project				

B. Tech Mechanical Engineering - 2022 Regulation

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

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

#### UNIT I: **QUALITY CONCEPTS**

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

#### **CONTROL CHARTS FOR VARIABLES & PROCESS CAPABILITY** UNIT II: 10

Statistical Process Control (SPC), Control Charts for Variables, Action & Warning Limits in Control Charts, Process Capability, Process Capability Indices, Process Capability Studies, Problems in Control Charts for Variables

#### UNIT III: **OTHER CONTROL CHARTS**

Control Charts for Attributes, Special Control Charts – Group Control Chart, Moving Averages/Moving Range Control Charts, Difference Control Charts, Mid-Range and Median Control Charts & Cumulative Sum Control Charts

#### UNIT IV: SAMPLING ISPECTION

Economics of Sampling, Sampling Methods, Sampling Plans, OC Curves, Quality Indices, Standard tables used in Sampling Inspection - Dodge-Romig & ABC Standard

#### **UNIT V:** TOTAL QUALITY MANAGEMENT (TQM)

Main Concepts of 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



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

Subject Code:	Su	bject Na	ame: IND	DUSTRY	č <b>4.0</b>				Ty/Lb/	L	T/	P/R	C
	Dream		Manufa		Tashra	lo av T (	- <b>TT</b>		EIL		SLr		
EBME22E27	Prei	requisite	e: Manula	icturing	Techno	nogy I c	x II		Ту	3	0/0	0/0	3
L : Lecture T :	Tutoria	S Lr	: Supervis	ed Learı	ning P:	Project	R : Rese	earch C:	Credits				
T/L/ETL : The	eory/Lab	/Embedd	led Theor	y and La	ıb								
OBJECTIVE	S: The	student	will learn	concept	ualizes	rapid ch	ange to	technol	ogy, indus	tries, and	societal p	atterr	ns and
processes in th	e 21st ce	entury du	ue to incre	asing in	terconne	ectivity a	and smar	t autom	ation.				
OURSE OUT	COME	S (COs)	:										
CO1	Descri	be Indus	stry 4.0 and	d scope	for India								
CO2	Demoi	nstrate co	onceptual	framewo	ork and i	road ma	p of Indu	ustry 4.0	)				
CO3	Descri	be Robo	tic techno	logy and	l Augme	ented rea	lity for l	Industry	4.0				
CO4	Demo	istrate o	bstacle and	d framev	work cor	stry 4.0							
CO5	Understand the role of augmented reality in the age of Industry 4.0												
Mapping of C	Course O	utcome	s with Pro	ogram (	Outcome	es (POs)							
Cos/Pos	PO1	PO2	PO3	PO4	PO5	<b>PO6</b>	<b>PO7</b>	PO8	PO9	PO10	PO11	PO	012
CO1	1		1			2	2	2	2	2	2	2	
CO2	1		1			2	2	2	2	2	2	2	
CO3	2	2	2	2	2	2	2	2	2	2	2	2	
CO4	1	2	2	1	2	1	1	1		1	2	2	
CO5	1	1	1	1	1	1	1	1	1	1	1	1	
Cos / PSOs	PS	01	PSC	02	PSO3		PS	PSO4					
CO1					2	2 1							
CO2					2		1						
CO3					2		1						
CO4					2		1						
CO5					2		1						
3/2/1 indicates	Strengt	h of Cor	relation	3- Hig	h, 2- Me	edium, 1	-Low						
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			ence										
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		ce	ial		0								
		ienc	soc		tive		ary	ent	ect				
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Subject Code:	Subject Name: INDUSTRY 4.0	Ty/Lb/	L	<b>T</b> /	P/R	С
		ETL		SLr		
EBME22E27	Pre requisite: Manufacturing Technology I & II	Ту	3	0/0	0/0	3

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

Introduction, core idea of Industry 4.0, origin concept of industry 4.0, Industry 4.0 production system, current state of industry 4.0, Technologies, How is India preparing for Industry 4.0

# **Unit-2: A Conceptual Framework for Industry 4.0**

Introduction, Main Concepts and Components of Industry 4.0, State of Art, Supportive Technologies, Proposed Framework for Industry 4.0.

# **Unit-3: Technology Roadmap for Industry 4.0**

Introduction, Proposed Framework for Technology Roadmap, Strategy Phase, Strategy Phase, New Product and Process Development Phase.

# Unit-4: Advances in Robotics in the Era of Industry 4.0

Introduction, Recent Technological Components of Robots- Advanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly.

# Unit-5: The Role of Augmented Reality in the Age of Industry 4.0

Introduction, AR Hardware and Software Technology, Industrial Applications of AR: Obstacles and Framework Conditions for Industry 4.0-Lack of A Digital Strategy alongside Resource Scarcity, Lack of standards and poor data security, Financing conditions, availability of skilled workers, comprehensive broadband infra- structure, state support, legal framework, protection of corporate data, liability, handling personal data.

# Total No. of Periods: 45

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# 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:	S	ubject N	ame: SU	PPLY C	CHAIN	MANA	GEMEN	T	Ty/Lb/	L	T/	P/R	C
EBME22E28	Dro n	aquicito	to. Monufo studing Tashnalagu I & H						EIL		SLr		
	Pre r	equisite		Wanuacturing Technology I & II						3	0/0	0/0	3
L : Lecture T : Tu	utorial	S Lr :	Supervis	ed Learr	ning P :	Project	R : Rese	earch C:	Credits				
T/L/ETL : Theor	y/Lab/	Embedd	led Theory	y and La	b								
<b>OBJECTIVES</b> :	The s	tudent w	ill learn:			·		1 1			1 .1		
Basic Conceptua	l idea	of supp	bly chain	manage	ment sy	stem; 1	heory a	nd appli	ication SC	M netwo	orks with	simpl	e case
study													
OURSE OUTCOMES (COs) :													
CO1	Un	derstand	the vario	us conce	agemen	t. (Level 2)	)						
CO2	Analyze and decide the proper logistics. (Level 4)												
CO3	De	velop pr	oper netw	ork to lo	ocate sou	irce and	distribut	tion cen	ters at a op	timal pri	cing. (Lev	vel 4)	
CO4	Co	ordinate	the supply	y chain 1	manager	nent net	work. (L	evel 3)					
CO5	Use	Use information technology in supply chain management							evel 3)				
Mapping of Course Outcomes with Program Outcomes (POs)													
Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	<b>PO8</b>	PO9	PO10	PO11	P	012
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	PS	01	PSC	)2	PS	03	PS	<b>SO4</b>					
CO1	3	3	3		1	1 2		2					
CO2	3	3	3			3		3					
CO3	3	3	3			3		3					
CO4	3	3	3			3		3					
CO5	3	3	3			3		3					
3/2/1 indicates St	rengtł	ı of Cor	relation	3- Higl	h, 2- Me	dium, 1	-Low						
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	enc	g	s ar ence		g	tive	cipl	odu	Pn				
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Subject Code:	Subject Name : SUPPLY CHAIN MANAGEMENT	Ty/Lb/	L	Τ/	P/R	С
EDMEATEA		ETL		SLr		
EDNIE22E28	Prerequisite: Manufacturing Technology I & II	Ту	3	0/0	0/0	3

#### UNIT- I: INTRODUCTION

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

### UNIT- II: LOGISTICS MANAGEMENT

Factors – Modes of Transportation - Design options for Transportation Networks-Routing and Scheduling – Inbound and outbound logistics- Reverse Logistics – 3PL- Integrated Logistics Concepts- Integrated Logistics Model – Activities - Measuring logistics cost and performance – Warehouse Management - Case Analysis

### UNIT- III: SUPPLY CHAIN NETWORK DESIGN

Distribution in Supply Chain – Factors in Distribution network design –Design options-Network Design in Supply Chain – Framework for network Decisions - Managing cycle inventory and safety.

### UNIT- IV: SOURCING AND PRICING IN SUPPLY CHAIN

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

### UNIT- V: COORDINATION AND TECHNOLOGY IN SUPPLY CHAIN

Supply chain coordination - Bullwhip effect – Effect of lack of co-ordination and obstacles – IT and SCM - supply chain IT frame work. E Business & SCM. Metrics for SC performance – Case Analysis

# Total No. of Periods: 45

# REFERENCES

- 1. Sunil Chopra and Peter Meindl,(2007) "Supply Chain Management, Strategy, Planning, and operation", (2<sup>nd</sup> ed.), PHI
- 2. David J.Bloomberg, Stephen Lemay and Joe B.Hanna, (2002), "Logistics", PHI
- 3. Martin Christopher, "Logistics and Supply Chain Management –Strategies for Reducing Cost and Improving Service", (2<sup>nd</sup> ed.), Pearson Education Asia
- 4. Jeremy F.Shapiro, Thomson Duxbury, (2002) "Modeling the supply chain"
- 5. James B.Ayers, (2000) "Handbook of Supply chain management", St.Lucle Press

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Subject Code EBME22E29	: Su TI	lbject ECHNO	Name LOGY	e: I	BLOCK	(	CHAIN	Ty/Lb	/ETL	L	T/ SLr	P/R	C		
	Pr	Prerequisite: Nil						T	y	3	0/0	0/0	3		
L : Lecture T : T	Futorial	SLr : Su	pervised La	earning F	P: Projec	t R : Re	search C	: Credits				l	1		
T/L/ETL : Theo	ory/Lab./I	Embedde	d Theory a	nd Lab.											
OBJECTIVE:	The stud Un Wi De In	lent will l nderstand ith them, esign, bu tegrate id	earn: d how blo ild, and d deas from	ockchain eploy sn blockch	systems nart cont ain tech	s (mainl racts an nology i	ly Bitco d distrib into thei	in and H buted app r own pr	Ethereun plication ojects	n) work, 18,	To secure	ly inter	act		
COURSE OUT	COMES	(COs):	1 .	1		· 13/1		1 3 7 1							
CO1 CO2	Unders Evalua	stand the	design pi	rinciples v, and ef	of Bitco	on, Ethe	ereum ar ven bloc	id Nakai k chain	moto coi system.	nsensus					
CO3	Explai	n the Sin	nplified P	avment V	Verificat	ion prot	tocol.		J						
CO2	Interac	t with a	block cha	in syster	n by sen	ding an	d readin	ding transactions							
CO3	Design	esign, build, and deploy a distributed application.													
Mapping of Co	ourse Ou	tcomes (	COs) with	Program	n Outcor	nes (POs	s) & Pro	gram Sp	ecific Oı	itcomes (P	SOs)				
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	POI	2		
C01		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	PSO3 PSO4									
C01						2									
CO2						2									
CO3						2									
CO2						2									
CO3						2									
3/2/1 indicates	Strengt	th of Co	rrelation	3- Hig	gh, 2- M	edium,	1-Low								
Categor y	Basic Science	Engineering Science	Humanities and social Science	Program Core	<ul> <li>Program elective</li> </ul>	Open Elective	Inter Disciplinary	Skill Component	Practical /Project						

B. Tech Mechanical Engineering - 2022 Regulation

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and Public	block	rhain			

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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

# **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

Subject Code: FBME22E29	bject Code: Subject Name: BLOCK CHAIN ME22E29 TECHNOLOGY					L	T/ SLr	P/R	С
	Prerequisite	e: Nil		Ту	3	0/0	0/0	3	

# **Unit I: Basics**

Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. • Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

# **Unit II: Blockchain**

Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public block chain.

# **Unit III: Distributed Consensus**

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

# **Unit IV: Crypto currency**

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

# **Unit V: Crypto currency Regulation**

Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Block chain.

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