ADHIYAMAAN COLLEGE OF ENGINEERING

[An Autonomous Institution Affiliated to Anna University, Chennai]
[Accredited by NAAC]
Dr.M.G.R NAGAR, HOSUR, KRISHNAGIRI (DT) – 635 130, TAMILNADU, INDIA
REGULATIONS 2018
CHOICE BASED CREDIT SYSTEM

B.E- MECHANICAL ENGINEERING

VISION

To develop competent and creative world class Mechanical Engineers who use their talents to achieve the excellence.

MISSION

- To provide the students qualitative technical knowledge
- To provide nurture creativity and critical thinking by applying global competency factors in Mechanical Engineering through effective teaching-learning processes
- To keep the students abreast of the latest technology to cope up with ever changing requirements of industries.

The Programme defines Programme Educational Objectives, Programme Outcomes and Programme Specific Outcomes as follows:

I. PROGRAMME EDUCATIONAL OBJECTIVES [PEOs]

PEO 1 Graduates of B.E. Mechanical Engineering should have a comprehensive background of mathematics, science, and basics of mechanical engineering to solve applications related mechanical engineering and multidisciplinary areas.

PEO 2 Graduates of B.E. Mechanical Engineering need to develop expertise and acumen in core areas like design, thermal and manufacturing engineering to the satisfaction of employers and blossom into entrepreneurs, scientists and technocrats with ethical values.

PEO 3 Mechanical Engineering program orients its graduates towards professional growth either through employment or higher studies or research and contemporary areas of socio-technological issues like energy crisis, pollution and industrial relations.

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II. PROGRAM OUTCOMES [POs]

PO1: An ability to apply knowledge of mathematics, science and engineering to real world applications.

PO2: An ability to identify, formulate, analyse and solve complex mechanical engineering problems.

PO3: An ability to design mechanical engineering components, processes and create products or systems within economic, environmental, ethical and manufacturability constraints.

PO4: An ability to visualize and work in the laboratory so as to interpret and analyze data to facilitate report.

PO5: An ability to demonstrate skills to use modern engineering tools, various mechanical software and equipments to analyze problems.

PO6: An ability to understand the professional responsibility to access societal, health, safety and legal issues in this technological world.

PO7: An ability to perceive the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge needed for sustainable development.

PO8: An ability to apprehend code of conduct and ethical responsibilities.

PO9: An ability to work as an individual, as a member or a leader in diverse teams and in multi-disciplinary task.

PO10: An ability to communicate effectively through verbal, written and graphical forms.

PO11: An ability to understand engineering economics and management principles to handle projects effectively.

PO12: An ability to develop confidence for self education and lifelong learning.

III. PROGRAM SPECIFIC OUTCOMES [PSOs]

PSO1: An ability to solicit the knowledge of mathematics, science and mechanical fundamental in the realm of Design, Production and Thermal fluid sciences to solve engineering problems utilizing sophisticated technology.

PSO2: An ability to clutch societal realization to promulgate the organization through entrepreneurship for the advanced technophile world.

PSO3: An ability to develop and implement new ideas on product design with the help of modern computer aided tools for ensuring best manufacturing practices.

Mapping of PEO with PO and PSO

PEOs	POs												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
I	3	3	2		1						1	2		3	
II		1	3	2	3	1	2	1			1	1	2		1
III			1		2	3	3	2	2		3	1			2

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Mapping of CO with PO and PSO

		COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
YEAR 1	SEM 1	Technical English				√	√			√	√	√	√		√	√	
		Engineering Mathematics-I	√	√											√		
		Engineering Physics	√	√	√	√									√		√
		Engineering Chemistry	√	√	√	√	√					√			√	√	
		Engineering Graphics	√	√	√	√						√		√	√	√	√
		Basic Civil, Electrical and Electronics Engineering	√	√	√	√		√							√		√
		Engineering Chemistry Laboratory	√	√		√	√		√			√			√		√
		Engineering Practice Laboratory	√		√	√	√			√	√		√	√	√		√
		COURSE TITLE	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
	SEM 2	Communicative English				√					√	√	√		√		√
		Engineering Mathematics-II	√	√											√		
		Environmental Science and Engineering	√	√	√	√	√		√			√			√	√	
		Engineering Mechanics	√	√	√	√	√							√	√		√
		Problem Solving and Python Programming	√	√	√	√				√		√	√		√		
		Material Science	√	√	√	√									√		√
		Engineering Physics Laboratory	√	√	√	√	√								√		√
		Problem Solving and Python Programming Laboratory	√	√	√	√			√		√		√		√		
		COURSE TITLE	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
YEAR 2	SEM 3	Engineering Mathematics – III	√	√											√		
		Engineering Thermodynamics	√	√	√	√						√	√		√		
		Fluid Mechanics and Machinery	√	√	√	√	√					√			√		
		Composite Materials	√	√	√		√		√		√				√		√
		Manufacturing Technology-I	√	√	√	√	√								√	√	√
		Fluid Mechanics and Machinery Laboratory	√	√		√						√			√		
		Manufacturing Technology Laboratory -I	√	√	√	√	√		√						√		√
		COURSE TITLE	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
	SEM 4	Statistics and Numerical Methods	√	√		√								√	√		
		Kinematics of Machinery	√	√	√		√		√			√			√		√
		Thermal Engineering	√	√	√						√	√	√	√	√		√
		Strength of Materials	√	√	√	√						√			√	√	
		Manufacturing Technology-II	√	√	√	√	√								√	√	√

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		Process Planning and Cost Estimation	√	√		√	√			√		√	√	√	√		√
		Thermal Engineering Laboratory	√	√		√								√	√	√	√
		Material Testing and Metallurgy Laboratory	√	√	√	√	√								√		√
		Manufacturing Technology Laboratory-II	√	√	√	√	√		√						√		√
		COURSE TITLE	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
YEAR 3	**SEM 5**	Metrology and Instrumentation	√	√	√		√				√	√	√	√	√	√	√
		Heat and Mass Transfer	√	√		√	√					√			√		√
		Dynamics of Machinery	√	√	√	√	√	√	√					√	√		√
		Design of Machine Elements	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
		Applied Hydraulics and Pneumatics	√	√	√	√	√	√		√	√	√		√	√	√	√
		Metrology and Instrumentation Laboratory		√		√	√				√	√		√	√	√	√
		Heat Transfer Laboratory	√	√		√								√	√	√	√
		Dynamics Laboratory	√	√		√			√					√	√	√	√
		COURSE TITLE	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
	SEM 6	Principles of Management and Business Concepts		√	√		√	√	√	√	√	√	√	√	√	√	√
		Gas Dynamics and Jet Propulsion	√	√		√	√				√	√	√		√	√	√
		Design of Transmission Systems	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
		CAD/CAM/CIM	√	√	√	√	√		√	√		√	√	√	√	√	√
		Computer Aided Machine Drawing	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
		CAM Laboratory	√	√	√	√	√		√		√	√	√	√	√	√	√
		COURSE TITLE	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
YEAR 4	**SEM 7**	Automobile Engineering	√	√								√			√		
		Mechatronics and Robotics	√	√	√	√	√	√	√	√					√		√
		Finite Element Analysis	√	√	√	√	√					√		√	√		√
		Power Plant and Energy Engineering	√	√				√	√		√	√			√		
		Mechatronics Laboratory	√	√	√	√	√	√			√	√	√	√	√	√	√
		CAE Laboratory	√	√		√								√	√		√
		Design and Fabrication Project	√	√	√		√					√			√		√
		Internship & Technical Seminar	√	√	√	√	√		√	√			√	√	√		√
		COURSE TITLE	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
	SEM 8	Total Quality Management						√			√			√		√	
		Project Work	√	√	√		√		√			√			√		√

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CHOICE BASED CREDIT SYSTEM
B.E-MECHANICAL ENGINEERING
CURRICULA AND SYLLABI FOR SEMESTERS I TO VIII

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	118ENT01	Technical English	HS	2	0	0	4	2
2.	118MAT02	Engineering Mathematics-I	BS	3	0	0	4	3
3.	118PHT03	Engineering Physics	BS	2	0	0	4	2
4.	118CYT04	Engineering Chemistry	BS	3	0	0	4	3
5.	118EGT05	Engineering Graphics	ES	2	0	4	6	4
6.	118ESE02	Basic Civil, Electrical and Electronics Engineering	ES	3	0	0	4	3
PRACTICALS								
7.	118CYP07	Engineering Chemistry Laboratory	BS	0	0	2	2	1
8.	118EPP07	Engineering Practice Laboratory	ES	0	0	3	3	1
			Total	15	0	9	31	19

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	218ENT01	Communicative English	HS	2	0	2	4	3
2.	218MAT02	Engineering Mathematics-II	BS	3	1	0	5	4
3.	218GET03	Environmental Science and Engineering	HS	2	0	0	4	2
4.	218EMT04	Engineering Mechanics	ES	3	0	0	4	3
5.	218PPT05	Problem Solving and Python Programming	ES	3	0	0	4	3
6.	218BSE01	Material Science	BS	2	0	0	4	2
PRACTICALS								
7.	218PHP07	Engineering Physics Laboratory	ES	0	0	2	3	1
8.	218EPP08	Problem Solving and Python Programming Laboratory	ES	0	0	2	3	1
			Total	15	1	6	31	19

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SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	318MAT01	Engineering Mathematics – III	BS	3	1	0	5	4
2.	318MET02	Engineering Thermodynamics	PC	3	0	0	4	3
3.	318MET03	Fluid Mechanics and Machinery	PC	3	0	0	4	3
4.	318MET04	Composite Materials	PC	3	0	0	3	3
5.	318MET05	Manufacturing Technology-I	PC	3	0	0	3	3
6.	OE1	OPEN ELECTIVE 1	OE	3	0	0	3	3
PRACTICALS								
7.	318MEP07	Fluid Mechanics and Machinery Laboratory	PC	0	0	2	3	1
8.	318MEP08	Manufacturing Technology Laboratory-I	PC	0	0	2	3	1
9.	OE2*	*Related to Open Elective 1.	OE	0	0	2	3	1
			Total	18	1	6	31	22

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	418MAT01	Statistics and Numerical Methods	BS	3	0	0	4	3
2.	418MET02	Kinematics of Machinery	PC	3	0	0	4	3
3.	418MET03	Thermal Engineering	PC	3	0	0	4	3
4.	418MET04	Strength of Materials	PC	3	0	0	4	3
5.	418MET05	Manufacturing Technology-II	PC	3	0	0	3	3
6.	418MET06	Process Planning and Cost Estimation	PC	3	0	0	3	3
PRACTICALS								
7.	418MEP07	Thermal Engineering Laboratory	PC	0	0	2	3	1
8.	418MEP08	Material Testing and Metallurgy Laboratory	PC	0	0	2	3	1
9.	418MEP09	Manufacturing Technology Laboratory-II	PC	0	0	2	3	1
			Total	18	0	6	31	21

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SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	518MET01	Metrology and Instrumentation	PC	3	0	0	4	3
2.	518MET02	Heat and Mass Transfer	PC	3	0	0	4	3
3.	518MET03	Dynamics of Machinery	PC	3	0	0	4	3
4.	518MET04	Design of Machine Elements	PC	3	0	0	4	3
5.	518MET05	Applied Hydraulics and Pneumatics	PC	3	0	0	3	3
6.	PE1	PROFESSIONAL ELECTIVE 1	PE	3	0	0	3	3
PRACTICALS								
7.	518MEP07	Metrology and Instrumentation Laboratory	PC	0	0	2	3	1
8.	518MEP08	Heat Transfer Laboratory	PC	0	0	2	3	1
9.	518MEP09	Dynamics Laboratory	PC	0	0	2	3	1
			Total	18	0	6	31	21

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	618MET01	Principles of Management and Business Concepts	PC	3	0	0	5	3
2.	618MET02	Gas Dynamics and Jet Propulsion	PC	3	0	0	5	3
3.	618MET03	Design of Transmission Systems	PC	3	0	0	5	3
4.	618MET04	CAD/CAM/CIM	PC	3	0	0	4	3
5.	PE2	PROFESSIONAL ELECTIVE 2	PE	3	0	0	3	3
6.	PE3	PROFESSIONAL ELECTIVE 3	PE	3	0	0	3	3
PRACTICALS								
7.	618MEP07	Computer Aided Machine Drawing	PC	0	0	2	3	1
8.	618MEP08	CAM Laboratory	PC	0	0	2	3	1
			Total	18	0	4	31	20

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SEMESTER VII

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	718MET01	Automobile Engineering	PC	3	0	0	3	3
2.	718MET02	Mechatronics and Robotics	PC	3	0	0	3	3
3.	718MET03	Finite Element Analysis	PC	3	0	0	3	3
4.	718MET04	Power Plant and Energy Engineering	PC	3	0	0	3	3
5.	PE4	PROFESSIONAL ELECTIVE 4	PE	3	0	0	3	3
6.	OE3	OPEN ELECTIVE 3	OE	3	0	0	3	3
PRACTICALS								
7.	718MEP07	Mechatronics Laboratory	PC	0	0	2	3	1
8.	718MEP08	CAE Laboratory	PC	0	0	2	3	1
9.	718MEP09	Design and Fabrication Project	EEC	0	0	4	4	2
10.	718MEP10	Internship & Technical Seminar	EEC	0	0	3	3	1
			Total	18	0	11	31	23

SEMESTER VIII

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	818MET01	Total Quality Management	PC	3	0	0	4	3
2.	PE5	PROFESSIONAL ELECTIVE 5	PE	3	0	0	3	3
3.	PE6	PROFESSIONAL ELECTIVE 6	PE	3	0	0	3	3
PRACTICALS								
4.	818MEP04	Project Work	EEC	0	0	20	20	10
			Total	9	0	20	30	19

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	818MEP05	Employability Skills Laboratory*	EEC	0	0	2	3	1

***Student those who are interested they can register Employability Skills Laboratory. The credit earned through this course shall be over and above the total credit requirement prescribed in the curriculum for the award of the degree.**

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LIST OF ELECTIVES

SEMESTER III, OPEN ELECTIVE 1

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	318MOE01	Electrical Drives and Controls	OE	3	0	0	3	3
2.	318MOE02	Data Structures	OE	3	0	0	3	3
3.	318MOE03	OOPS and Java Programming	OE	3	0	0	3	3
4.	318MOE04	Digital Electronics and System Design	OE	3	0	0	3	3
5.	318MOE05	Internet Programming	OE	3	0	0	3	3
6.	318MOE06	C# and .NET	OE	3	0	0	3	3

SEMESTER III, OPEN ELECTIVE 2

(*Related to OPEN ELECTIVE 1)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	318MOP01	Electrical Drives and Controls Laboratory	OE	0	0	2	3	1
2.	318MOP02	Data Structures Laboratory	OE	0	0	2	3	1
3.	318MOP03	OOPS and Java Programming Laboratory	OE	0	0	2	3	1
4.	318MOP04	Digital Electronics Laboratory	OE	0	0	2	3	1
5.	318MOP05	Internet Programming Laboratory	OE	0	0	2	3	1
6.	318MOP06	C# and .NET Laboratory	OE	0	0	2	3	1

SEMESTER V, PROFESSIONAL ELECTIVE 1

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	518MEE01	Advanced Manufacturing Processes	PE	3	0	0	3	3
2.	518MEE02	Renewable Energy Sources	PE	3	0	0	3	3
3.	518MEE03	Introduction to Nanotechnology	PE	3	0	0	3	3
4.	518MEE04	Non Destructive Testing and Materials	PE	3	0	0	3	3
5.	518MEE05	Design Concepts in Engineering	PE	3	0	0	3	3

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SEMESTER VI, PROFESSIONAL ELECTIVE 2

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	618MEE01	Design of Experiments	PE	3	0	0	3	3
2.	618MEE02	Professional Ethics and Human Values	PE	3	0	0	3	3
3.	618MEE03	Internal Combustion Engines	PE	3	0	0	3	3
4.	618MEE04	Refrigeration and Air Conditioning	PE	3	0	0	3	3
5.	618MEE05	Industrial Relation and Organizational Development	PE	3	0	0	3	3

SEMESTER VI, PROFESSIONAL ELECTIVE 3

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	618MEE06	Design of Jigs and Fixtures	PE	3	0	0	3	3
2.	618MEE07	Design of Heat Exchanger	PE	3	0	0	3	3
3.	618MEE08	Metal Forming Techniques	PE	3	0	0	3	3
4.	618MEE09	Turbomachinery	PE	3	0	0	3	3
5.	618MEE10	Operations Research	PE	3	0	0	3	3

SEMESTER VII, PROFESSIONAL ELECTIVE 4

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	718MEE01	Maintenance Engineering	PE	3	0	0	3	3
2.	718MEE02	Mechanical Vibration	PE	3	0	0	3	3
3.	718MEE03	Engineering Economics and Cost Analysis	PE	3	0	0	3	3
4.	718MEE04	Rapid Prototyping	PE	3	0	0	3	3
5.	718MEE05	Cryogenics Engineering	PE	3	0	0	3	3
6.	718MEE06	Design of Thermal Equipments	PE	3	0	0	3	3

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SEMESTER VII, OPEN ELECTIVE 3

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	718MOE01	Big Data Analytics	OE	3	0	0	3	3
2.	718MOE02	Cloud Computing	OE	3	0	0	3	3
3.	718MOE03	Software Engineering and Quality Assurance	OE	3	0	0	3	3
4.	718MOE04	Microprocessors and Microcontrollers	OE	3	0	0	3	3
5.	718MOE05	Facility Location	OE	3	0	0	3	3
6.	718MOE06	Logistic Management	OE	3	0	0	3	3
7.	718MOE07	Service Operation Management	OE	3	0	0	3	3
8.	718MOE08	Software Testing	OE	3	0	0	3	3
9.	718MOE09	Automotive Instrumentation and Control	OE	3	0	0	3	3
10.	718MOE10	Power Plant Instrumentation	OE	3	0	0	3	3
11.	718MOE11	Industrial Safety and Hazard Managements	OE	3	0	0	3	3
12.	718MOE12	Disaster Management	OE	3	0	0	3	3
13.	718MOE13	Intellectual Property Rights	OE	3	0	0	3	3
14.	718MOE14	Engineering Acoustics	OE	3	0	0	3	3
15.	718MOE15	Human Resource Management	OE	3	0	0	3	3

SEMESTER VIII, PROFESSIONAL ELECTIVE 5

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	818MEE01	Computational Fluid Dynamics	PE	3	0	0	3	3
2.	818MEE02	Theory of Elasticity	PE	3	0	0	3	3
3.	818MEE03	Six Sigma and Lean Manufacturing	PE	3	0	0	3	3
4.	818MEE04	Introduction to Micro Electro Mechanical Systems	PE	3	0	0	3	3
5.	818MEE05	Energy Conservation in Industries	PE	3	0	0	3	3
6.	818MEE06	Fracture Mechanics	PE	3	0	0	3	3

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SEMESTER VIII, PROFESSIONAL ELECTIVE 6

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	818MEE07	Entrepreneurship and E-Business	PE	3	0	0	3	3
2.	818MEE08	Optimization Techniques	PE	3	0	0	3	3
3.	818MEE09	Tribology	PE	3	0	0	3	3
4.	818MEE10	Advanced IC Engines	PE	3	0	0	3	3
5.	818MEE11	Biomass Energy System	PE	3	0	0	3	3
6.	818MEE12	Design of Materials Handling Equipment	PE	3	0	0	3	3

Minimum number of Credits to be earned

Semester	I	II	III	IV	V	VI	VII	VIII	TOTAL
Credits	19	19	22	21	21	20	23	19	164

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GROUPING OF SUBJECTS

HUMANITIES AND SOCIAL SCIENCES (HS)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	118ENT01	Technical English	HS	2	0	0	4	2
2.	218ENT01	Communicative English	HS	2	0	2	4	3
3.	218GET03	Environmental Science and Engineering	HS	2	0	0	4	2

BASIC SCIENCE (BS)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	118MAT02	Engineering Mathematics-I	BS	3	0	0	4	3
2.	118PHT03	Engineering Physics	BS	2	0	0	4	2
3.	118CYT04	Engineering Chemistry	BS	3	0	0	4	3
4.	118CYP07	Engineering Chemistry Laboratory	BS	0	0	2	2	1
5.	218MAT02	Engineering Mathematics-II	BS	3	1	0	5	4
6.	218BSE01	Material Science	BS	2	0	0	4	2
7.	318MAT01	Engineering Mathematics – III	BS	3	1	0	5	4
8.	418MAT01	Statistics and Numerical Methods	BS	3	0	0	4	3

ENGINEERING SCIENCES (ES)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	118EGT05	Engineering Graphics	ES	2	0	4	6	4
2.	118ESE02	Basic Civil, Electrical and Electronics Engineering	ES	3	0	0	4	3
3.	118EPP07	Engineering Practice Laboratory	ES	0	0	3	3	1
4.	218EMT04	Engineering Mechanics	ES	3	0	0	4	3
5.	218PPT05	Problem Solving and Python Programming	ES	3	0	0	4	3
6.	218PHP07	Engineering Physics Laboratory	ES	0	0	2	3	1
7.	218EPP08	Problem Solving and Python Programming Laboratory	ES	0	0	2	3	1

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PROFESSIONAL CORE (PC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	318MET02	Engineering Thermodynamics	PC	3	0	0	4	3
2.	318MET03	Fluid Mechanics and Machinery	PC	3	0	0	4	3
3.	318MET04	Composite Materials	PC	3	0	0	3	3
4.	318MET05	Manufacturing Technology-I	PC	3	0	0	3	3
5.	318MEP07	Fluid Mechanics and Machinery Laboratory	PC	0	0	2	3	1
6.	318MEP08	Manufacturing Technology Laboratory -I	PC	0	0	2	3	1
7.	418MET02	Kinematics of Machinery	PC	3	0	0	4	3
8.	418MET03	Thermal Engineering	PC	3	0	0	4	3
9.	418MET04	Strength of Materials	PC	3	0	0	4	3
10.	418MET05	Manufacturing Technology-II	PC	3	0	0	3	3
11.	418MET06	Process Planning and Cost Estimation	PC	3	0	0	3	3
12.	418MEP07	Thermal Engineering Laboratory	PC	0	0	2	3	1
13.	418MEP08	Material Testing and Metallurgy Laboratory	PC	0	0	2	3	1
14.	418MEP09	Manufacturing Technology Laboratory-II	PC	0	0	2	3	1
15.	518MET01	Metrology and Instrumentation	PC	3	0	0	4	3
16.	518MET02	Heat and Mass Transfer	PC	3	0	0	4	3
17.	518MET03	Dynamics of Machinery	PC	3	0	0	4	3
18.	518MET04	Design of Machine Elements	PC	3	0	0	4	3
19.	518MET05	Applied Hydraulics and Pneumatics	PC	3	0	0	3	3
20.	518MEP07	Metrology and Instrumentation Laboratory	PC	0	0	2	3	1
21.	518MEP08	Heat Transfer Laboratory	PC	0	0	2	3	1
22.	518MEP09	Dynamics Laboratory	PC	0	0	2	3	1
23.	618MET01	Principles of Management and Business Concepts	PC	3	0	0	5	3
24.	618MET02	Gas Dynamics and Jet Propulsion	PC	3	0	0	5	3
25.	618MET03	Design of Transmission Systems	PC	3	0	0	5	3
26.	618MET04	CAD/CAM/CIM	PC	3	0	0	4	3
27.	618MEP07	Computer Aided Machine Drawing	PC	0	0	2	3	1
28.	618MEP08	CAM Laboratory	PC	0	0	2	3	1
29.	718MET01	Automobile Engineering	PC	3	0	0	3	3
30.	718MET02	Mechatronics and Robotics	PC	3	0	0	3	3
31.	718MET03	Finite Element Analysis	PC	3	0	0	3	3
32.	718MET04	Power Plant and Energy Engineering	PC	3	0	0	3	3
33.	718MEP07	Mechatronics Laboratory	PC	0	0	2	3	1
34.	718MEP08	CAE Laboratory	PC	0	0	2	3	1
35.	818MET01	Total Quality Management	PC	3	0	0	4	3

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PROFESSIONAL ELECTIVES (PE)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	518MEE01	Advanced Manufacturing Processes	PE	3	0	0	3	3
2.	518MEE02	Renewable Energy Sources	PE	3	0	0	3	3
3.	518MEE03	Introduction to Nanotechnology	PE	3	0	0	3	3
4.	518MEE04	Non Destructive Testing and Materials	PE	3	0	0	3	3
5.	518MEE05	Design Concepts in Engineering	PE	3	0	0	3	3
6.	618MEE01	Design of Experiments	PE	3	0	0	3	3
7.	618MEE02	Professional Ethics and Human Values	PE	3	0	0	3	3
8.	618MEE03	Internal Combustion Engines	PE	3	0	0	3	3
9.	618MEE04	Refrigeration and Air Conditioning	PE	3	0	0	3	3
10.	618MEE05	Industrial Relation and Organizational Development	PE	3	0	0	3	3
11.	618MEE06	Design of Jigs and Fixtures	PE	3	0	0	3	3
12.	618MEE07	Design of Heat Exchanger	PE	3	0	0	3	3
13.	618MEE08	Metal Forming Techniques	PE	3	0	0	3	3
14.	618MEE09	Turbomachinery	PE	3	0	0	3	3
15.	618MEE10	Operations Research	PE	3	0	0	3	3
16.	718MEE01	Maintenance Engineering	PE	3	0	0	3	3
17.	718MEE02	Mechanical Vibration	PE	3	0	0	3	3
18.	718MEE03	Engineering Economics and Cost Analysis	PE	3	0	0	3	3
19.	718MEE04	Rapid Prototyping	PE	3	0	0	3	3
20.	718MEE05	Cryogenics Engineering	PE	3	0	0	3	3
21.	718MEE06	Design of Thermal Equipments	PE	3	0	0	3	3
22.	818MEE01	Computational Fluid Dynamics	PE	3	0	0	3	3
23.	818MEE02	Theory of Elasticity	PE	3	0	0	3	3
24.	818MEE03	Six Sigma and Lean Manufacturing	PE	3	0	0	3	3
25.	818MEE04	Introduction to Micro Electro Mechanical Systems	PE	3	0	0	3	3
26.	818MEE05	Energy Conservation in Industries	PE	3	0	0	3	3
27.	818MEE06	Fracture Mechanics	PE	3	0	0	3	3
28.	818MEE07	Entrepreneurship and E-Business	PE	3	0	0	3	3
29.	818MEE08	Optimization Techniques	PE	3	0	0	3	3
30.	818MEE09	Tribology	PE	3	0	0	3	3
31.	818MEE10	Advanced IC Engines	PE	3	0	0	3	3
32.	818MEE11	Biomass Energy System	PE	3	0	0	3	3
33.	818MEE12	Design of Materials Handling Equipment	PE	3	0	0	3	3

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OPEN ELECTIVES (OE)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	318MOE01	Electrical Drives and Controls	OE	3	0	0	3	3
2.	318MOE02	Data Structures	OE	3	0	0	3	3
3.	318MOE03	OOPS and Java Programming	OE	3	0	0	3	3
4.	318MOE04	Digital Electronics and System Design	OE	3	0	0	3	3
5.	318MOE05	Internet Programming	OE	3	0	0	3	3
6.	318MOE06	C# and .NET	OE	3	0	0	3	3
7.	318MOP01	Electrical Drives and Controls Laboratory	OE	0	0	2	3	1
8.	318MOP02	Data Structures Laboratory	OE	0	0	2	3	1
9.	318MOP03	OOPS and Java Programming Laboratory	OE	0	0	2	3	1
10.	318MOP04	Digital Electronics Laboratory	OE	0	0	2	3	1
11.	318MOP05	Internet Programming Laboratory	OE	0	0	2	3	1
12.	318MOP06	C# and .NET Laboratory	OE	0	0	2	3	1
13.	718MOE01	Big Data Analytics	OE	3	0	0	3	3
14.	718MOE02	Cloud Computing	OE	3	0	0	3	3
15.	718MOE03	Software Engineering and Quality Assurance	OE	3	0	0	3	3
16.	718MOE04	Microprocessors and Microcontrollers	OE	3	0	0	3	3
17.	718MOE05	Facility Location	OE	3	0	0	3	3
18.	718MOE06	Logistic Management	OE	3	0	0	3	3
19.	718MOE07	Service Operation Management	OE	3	0	0	3	3
20.	718MOE08	Software Testing	OE	3	0	0	3	3
21.	718MOE09	Automotive Instrumentation and Control	OE	3	0	0	3	3
22.	718MOE10	Power Plant Instrumentation	OE	3	0	0	3	3
23.	718MOE11	Industrial Safety and Hazard Managements	OE	3	0	0	3	3
24.	718MOE12	Disaster Management	OE	3	0	0	3	3
25.	718MOE13	Intellectual Property Rights	OE	3	0	0	3	3
26.	718MOE14	Engineering Acoustics	OE	3	0	0	3	3
27.	718MOE15	Human Resource Management	OE	3	0	0	3	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	718MEP09	Design and Fabrication Project	EEC	0	0	4	4	2
2.	718MEP10	Internship & Technical Seminar	EEC	0	0	3	3	1
3.	818MEP04	Project Work	EEC	0	0	20	20	10
4.	818MEP05	Employability Skills Laboratory	EEC	0	0	2	3	1

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SUMMARY

S.No.	SUBJECT AREA	CREDITS PER SEMESTER								CREDITS TOTAL	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1.	HS	2	5							7	4.26%
2.	BS	9	6	4	3					22	13.41%
3.	ES	8	8							16	9.76%
4.	PC			14	18	18	14	14	3	81	49.39%
5.	PE					3	6	3	6	18	10.96%
6.	OE			4				3		7	4.26%
7.	EEC							3	10	13	7.93%
	Total	19	19	22	21	21	20	23	19	164	

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118ENT01	TECHNICAL ENGLISH	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

The Course prepares first semester Engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT I **9**

Listening - Ink talks and gap exercises - Speaking – Asking for and giving directions - Reading – short technical texts from journals and newspapers - Writing - definitions – instructions – checklists – recommendations - Vocabulary Development - technical vocabulary - Language Development – parts of speech – articles – word formation.

UNIT II **9**

Listening - longer technical talks - Speaking – process description - Reading – longer technical texts – Writing – graphical representation - Vocabulary Development - vocabulary used in formal letters/emails and reports - Language Development – tenses - voices - numerical adjectives – question tags.

UNIT III **9**

Listening - listening to classroom lectures - Speaking – introduction to technical presentations - Reading – longer texts both general and technical and practice in speed reading – Writing – process description using sequence words and sentences - Vocabulary Development - Misspelled words – one-word substitution - Language Development - embedded sentences – singular and plural nouns - compound nouns - editing

UNIT IV **9**

Listening - Listening to documentaries and making notes - Speaking – mechanics of presentations - Reading – reading comprehension – Writing - email etiquettes - job application – cover letter –Résumé preparation - essay writing - Vocabulary Development – synonyms and antonyms –paraphrasing - Language Development – modals – conditionals.

UNIT V **9**

Listening - TED talks - Speaking – brainstorming and debate – Reading – reading and understanding technical articles – Writing – reports - minutes of a meeting - Vocabulary Development- verbal analogies - phrasal verbs - Language Development - concord - reported speech.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

At the end of the course learners will be able to:

CO1: Read technical texts and write area- specific texts effortlessly.
CO2: Listen and comprehend lectures and talks in their area of specialization successfully.
CO3: Speak appropriately and effectively in varied formal and informal contexts.
CO4: Understand the basic grammatical structures and its applications.
CO5: Write reports and winning job applications.

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TEXT BOOKS

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016.
2. Sudharshana. N. P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.
3. Uttham Kumar. N. Technical English I (with work book). Sahana Publications, Coimbatore, 2016.

REFERENCE BOOKS

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015.
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007.

Students can be asked to read Tagore and Chetan Bhagat

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Read technical texts and write area- specific texts effortlessly.				2				1	1	3	1		1	1	
Co2	Listen and comprehend lectures and talks in their area of specialization successfully.				1	1				2	3	1		1		
Co3	Speak appropriately and effectively in varied formal and informal contexts.									2	3					
Co4	Understand the basic grammatical structures and its applications.										2					
Co5	Write reports and winning job applications.				2					1	2	1		1	1	1

118MAT02 ENGINEERING MATHEMATICS - I L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the eigenvalue problems.
- To understand the concepts of curvatures, evolutes and envelopes.
- To learn the total derivatives and apply the same to find maxima and minima.
- To solve differential equations of certain types, including systems of differential equations that they might encounter in engineering subjects.
- To solve certain linear differential equations using the Laplace transform technique which has applications in control theory and circuit theory.

UNIT I MATRICES 9

Eigenvalues and eigenvectors of a real symmetric matrix –Properties – Cayley - Hamilton theorem (Statement and applications only) – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form –Reduction of quadratic form to canonical form by orthogonal transformation.

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UNIT II DIFFERENTIAL CALCULUS 9

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes – Evolutes as envelope of normals.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9

Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Jacobians – Taylor's expansion– Maxima and Minima – Method of Lagrangian multipliers.

UNIT IV ORDINARY DIFFERENTIAL EQUATIONS 9

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients-Applications to Engineering problems-Electric Circuits, Simple Harmonic Motions and bending of beams.

UNIT V LAPLACE TRANSFORM 9

Laplace transforms – Conditions for existence –Basic properties (Statement and applications only) – Laplace Transform of elementary functions, derivatives and integrals, unit step function and impulse functions, periodic functions. Definition of Inverse Laplace transform – Convolution theorem (Statement and applications only) – Initial and final value theorems (Statement and applications only) – Solution of linear ordinary differential equations of second order with constant coefficients using Laplace transform techniques.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

After completing this course, the student will be able to

CO1: Develop the knowledge of linear algebraic concepts.

CO2: Use the differential calculus tools application to seek solutions for many problems in engineering subjects.

CO3: Acquire the knowledge of partial differential concepts and apply to find maxima and minima of a function.

CO4: Determine the solutions of ordinary differential equations by various methods which have an application in their core subjects.

CO5: Apply Laplace transform techniques to solve ordinary differential equations which have an application in many engineering fields.

TEXT BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 10th edition New Delhi 2016.
2. Grewal. B.S, "Higher Engineering Mathematics", 44th Edition, Khanna Publications, Delhi, 2017.

REFERENCE BOOKS

1. T.Veerarajan, "Engineering Mathematics " Tata McGraw-Hill Publishing company, New Delhi, 2014.
2. Kandasamy.P, Thilagavathy,K., & Gunavathi.K., "Engineering Mathematics for first year "., S.Chand & Company Ltd., New Delhi,2014.
3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
5. V.Prameelakaladharan and G.Balaji, "Engineering Mathematics - I", 3rd Edition, Amrutha marketing, Chennai, 2017.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Develop the knowledge of linear algebraic concepts.	3	2											3		
Co2	Use the differential calculus tools application to seek solutions for many problems in engineering subjects.	3	3											3		
Co3	Acquire the knowledge of partial differential concepts and apply to find maxima and minima of a function.	3	3											3		
Co4	Determine the solutions of ordinary differential equations by various methods which have an application in their core subjects.	3	3											3		
Co5	Apply Laplace transform techniques to solve ordinary differential equations which have an application in many engineering fields.	3	3											3		

118PHT03 **ENGINEERING PHYSICS** **L T P C**
2 0 0 2

COURSE OBJECTIVES:

- To understand the concept of properties of matter.
- To understand the properties of sound and principles of quantization of energy.
- To understand the properties of coherent light and its importance.

UNIT I PROPERTIES OF MATTER **9**

Elasticity – Stress – Strain diagram – Factors affecting elasticity – Twisting couple on a wire – Torsion pendulum – Young's modulus - cantilever – Uniform and Non uniform bending (theory and experiment)–Viscosity-Poiseuille's method for Coefficient of Viscosity (Qualitative).

UNIT II ACOUSTICS AND ULTRASONICS **9**

Classification of sound, loudness, intensity – Decibel – Weber Fechner Law – Reverberation and Reverberation time – derivation of Sabine's formula for Reverberation time (Growth and Decay)– Absorption coefficient and its determination.

Introduction of Ultrasonics – Production – magnetostriction effect – magnetostriction generator – piezoelectric effect – piezoelectric generator – Detection of ultrasonic waves, properties – Cavitation – Applications – Depth of sea – Non Destructive Testing.

UNIT III QUANTUM PHYSICS **9**

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh–jeans' Law from Planck's theory – Compton Effect–derivation– Matter waves – Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box – Degeneracy and Non-degeneracy.

UNIT IV LASER **9**

Introduction – Principle of Spontaneous emission and stimulated emission – Population inversion – pumping – Einstein's A and B coefficients – derivation – Types of lasers – He-Ne, CO_2, Nd-YAG, Semiconductor lasers – homojunction – Applications of Laser.

UNIT V WAVE OPTICS & FIBRE OPTICS **9**

Interference – Air wedge (theory & experiment) – Polarization– Methods of polarizing light-Theory of plane circularly and elliptically polarized light.

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Principle and propagation of light in optical fibers – Numerical aperture and Acceptance angle – Types of optical fibers (material, refractive index, and mode) – Fiber optical communication system (Block diagram) – Fiber optic sensors – Temperature & Displacement sensors (Qualitative).

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: To understand properties of solids with different types of moduli and to gain knowledge about absorption coefficients of solids and different surfaces.

CO2: To understand basic concepts of high frequency sound waves and its applications.

CO3: To understand basic concepts of quantum mechanical behavior of wave and particle along with applications.

CO4: To understand the concepts of production of laser and its behavior with diffraction principle of interference.

CO5: To apply the concept of polarization phenomenon and thereby its applications in fiber optic communication.

TEXT BOOKS

1. R.K. Gaur and S.C. Gupta, 'Engineering Physics' Dhanpat Rai Publications, New Delhi, 2003.
2. Jayaprakash R.N, 'Engineering Physics - I', Dhanam Publications, Chennai, 2007.

REFERENCE BOOKS

1. R. Murugeshan , Kiruthiga Sivaprasath , "Modern Physics", S. Chand Publications, New Delhi, 2016.
2. A. Ghatak, "Optics", The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020.
3. Dr.M.N.Avadhanulu, "Introduction to Lasers: theory and applications", S.Chand publications 2012, New Delhi.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	To understand properties of solids with different types of moduli and to gain knowledge about absorption coefficients of solids and different surfaces.	3	2	1	3									3		1
Co2	To understand basic concepts of high frequency sound waves and its applications.	3	2	1	3									3		1
Co3	To understand basic concepts of quantum mechanical behavior of wave and particle along with applications.	3	2		1									3		3
Co4	To understand the concepts of production of laser and its behavior with diffraction principle of interference.	3	2	2	2									3		2
Co5	To apply the concept of polarization phenomenon and thereby its applications in fiber optic communication.	3	2	1	1									3		2

118CYT04 **ENGINEERING CHEMISTRY** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To recall the terminologies of electrochemistry and explain the function of batteries and fuel

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cells with its electrochemical reactions.

- To understand the fundamentals of corrosion, its types and polymers with its applications.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.

UNIT I WATER AND ITS TREATMENT **9**

Hardness of water - types - expression of hardness - units - estimation of hardness of water by EDTA - numerical problems -Alkalinity-types of alkalinity-determination of alkaninity-boiler troubles (scale and sludge) - treatment of boiler feed water - Internal treatment (carbonate, colloidal, phosphate and calgon conditioning) external treatment Ion exchange process, zeolite process - desalination of brackish water - Reverse Osmosis.

UNIT II ELECTROCHEMISTRY AND ENERGY STORAGE DEVICES **9**

Electrochemical cell-single electrode potential-standard electrode potential-electrochemical series and its significance-EMF of a cell- Nernst equation -Electrodes-Reference electrodes-hydrogen, calomel, quinhydrone and glass electrodes. Determination of pH of a solution using a glass electrode. Batteries - primary and secondary cells, dry cell, alkaline, lead acid storage cell, Ni-Cd battery and lithium nano battery. Clean energy fuel cells - H_2-O_2 fuel cell.

UNIT III CORROSION SCIENCE **9**

Corrosion: definition - types of corrosion: chemical and electrochemical corrosion – Pilling Bedworth ratio - types of oxide layer (stable, unstable, volatile, porous) - hydrogen evolution and oxygen absorption mechanism for electrochemical corrosion - mechanism for rusting of iron. Types of electrochemical corrosion: Galvanic corrosion - differential aeration corrosion (pitting, waterline and pipeline). Galvanic series - applications. Factors influencing corrosion: nature of metal and environment. Corrosion control methods: sacrificial anode method - impressed current Cathodic protection method - electroplating - electroless plating.

UNIT IV POLYMERS AND ITS PROCESSING **9**

Monomers - polymers - polymerization - functionality – degree of polymerization - classification of polymers based on source and applications - Molecular weight determination. Types of polymerization: addition, condensation and copolymerization - mechanism of free radical polymerization. Preparation, properties and applications of PE, PVC, Teflon, terylene, Nylon and Bakelite. Rubber-drawbacks of natural rubber-Vulcanization-Compounding of plastics - injection and blow moulding methods.

UNIT V FUELS AND COMBUSTION **9**

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. **Combustion of fuels:** Introduction - calorific value - higher and lower calorific values-theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

CO1: Attribute the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.

CO2: Construct an electrochemical cell and Identify the components and processes in batteries and infer the selection criteria for commercial battery systems with respect to different applications.

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CO3: Utilize electrochemical data to formulate an electrochemical half-cell and cell reactions for corrosion control processes.
CO4: Differentiate the polymers used in day to day life based on its source, properties and applications.
CO5: Analyse the three types of fuels based on calorific value for selected application.

TEXT BOOKS

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

REFERENCE BOOKS

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Attribute the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.	3			2	2					1			3	2	3
Co2	Construct an electrochemical cell and Identify the components and processes in batteries and infer the selection criteria for commercial battery systems with respect to different applications.	3				2								3	2	3
Co3	Utilize electrochemical data to formulate an electrochemical half-cell and cell reactions for corrosion control processes.	3	1											3	2	3
Co4	Differentiate the polymers used in day to day life based on its source, properties and applications.	3		1	1									3	2	3
Co5	Analyse the three types of fuels based on calorific value for selected application.	3				2					2			3	2	3

118EGT05 **ENGINEERING GRAPHICS** **L T P C**
2 0 4 4

COURSE OBJECTIVES:

- To understand the graphical skills for drawing the object and the principle of free-hand sketching techniques.
- To understand the principle of orthographic projection of points, lines and plane surfaces.
- To study the principle of simple solids.
- To understand the principle of section and development of solids.
- To understand the principle of Isometric and Perspective projections.

Concepts and conventions (Not for Examination) **3**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

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UNIT I PLANE CURVES AND FREE HAND SKETCHING 15

Curves used in engineering practices:

Conics – Construction of ellipse, Parabola and hyperbola by Eccentricity method – Construction of cycloid – Construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

Free hand sketching:

Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 15

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT III PROJECTION OF SOLIDS 15

Projection of simple solids like prisms, pyramids, cylinders and cones when the axis is inclined to one reference plane by change of position method.

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 15

Sectioning of simple solids like prisms, pyramids, cylinders and cones in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section.

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 12

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.

Perspective projection of prisms, pyramids and cylinders by visual ray method.

TOTAL HOURS: 75 PERIODS

COURSE OUTCOMES

The student will be able to

CO1: Recognize the conventions and apply dimensioning concepts while drafting simple objects.
CO2: Draw the orthographic projection of points, line, and plane surfaces.
CO3: Draw the orthographic projection of simple solids.
CO4: Draw the section of solid drawings and development of surfaces of the given objects.
CO5: Apply the concepts of isometric and perspective projection in engineering practice.

TEXT BOOKS

1. Ranganath G, Channankaiah and Halesh Koti, “Engineering Graphics”, Second Edition, Sahana Publishers, 2015.
2. Bhatt. N.D., “Engineering Drawing” Charotar Publishing House, 53th Edition, 2014.

REFERENCE BOOKS

1. Dhananjay A.Jolhe, “Engineering Drawing with an introduction to AutoCAD” Tata McGraw Hill Publishing Company Limited, 2017.
2. Gopalakrishnana. K. R, “Engineering Drawing” (Vol. I & II), Subhas Publications, 2014.
3. Basant Agarwal and C.M.Agarwal, “Engineering Drawing”, Tata McGraw Hill, 2013.

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4. Natrajan K. V, “A Text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2012.
5. M.B.Shaw and B.C.Rana, “Engineering Drawing”, Pearson Education India, 2011.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Recognize the conventions and apply dimensioning concepts while drafting simple objects.		2		1								1	1		1
Co2	Draw the orthographic projection of points, line, and plane surfaces.	2	1		1								1		2	
Co3	Draw the orthographic projection of simple solids.	2	2		2								1		3	
Co4	Draw the section of solid drawings and development of surfaces of the given objects.		1		2								2			2
Co5	Apply the concepts of isometric and perspective projection in engineering practice.	1	1	1							2					1

118ESE02 BASIC CIVIL, ELECTRICAL, AND ELECTRONICS ENGINEERING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To gain knowledge about Civil Engineering Materials.
- To learn about Structural Components of Building.
- To learn the basics of electrical elements.
- To introduce the fundamental concepts of DC and AC circuits.
- To interpret the principle and characteristics of semiconductor devices.

PART-A (CIVIL)

UNIT I CIVIL ENGINEERING MATERIALS **9**

Civil Engineering Materials: Bricks, Stones, Sand, Cement, Concrete & Steel sections.
M-Sand and their types, Admixtures-Fibers and Fabrics, Superplasticizers - Selection of Materials.

UNIT II COMPONENTS OF BUILDING **9**

Component parts of the Building -Substructure (Foundation) Types, Bearing capacity, Requirement of Good Foundations.
Superstructure: Brick Masonry, Stone Masonry, Lintels, Roofing, Flooring, Plastering
Typical cross-section showing the Buildings in a Structure, Standard Legends and Insignia

PART-B (ELECTRICAL & ELECTRONICS)

UNIT III INTRODUCTION TO BASIC ELECTRICAL ELEMENTS **9**

Electrical circuit : passive elements - Resistor, Inductor and Capacitor; active elements- Current, Voltage, Power and Energy – Ohm's Law and limitations - Kirchhoff’s Laws – relationship between current, voltage and power – Resistors in series, parallel and series -parallel circuits

UNIT IV FUNDAMENTALS OF DC AND AC CIRCUITS **9**

DC Circuits: Sources of Electrical Energy - Independent and Dependent Source, Source Conversion - Star –Delta conversion- Mesh and Nodal Analysis.

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AC Circuits: Generation of sinusoidal - voltage, average - RMS value, form factor and peak factor- Phasor diagrams of R, L, C, combination of R-L, R-C and R-L-C circuits

UNIT V SEMICONDUCTOR DEVICES AND SWITCHING THEORY 9

Semiconductor Devices - Overview of Semiconductors - basic principle, operation and characteristics of PN diode, zener diode, BJT, JFET -Number systems – binary codes - logic gates - Boolean algebra, laws & theorems - simplification of Boolean expression - implementation of Boolean expressions using logic gates.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Know the usage of surveying and properties of construction materials.

CO2: Understand the stress strain of various building and material such as substructure, road transport and bridge.

CO3: Recognize the different combinations of circuit elements and solving the circuit by applying basic circuital laws.

CO4: Acquire a good understanding of DC and AC circuits.

CO5: Demonstrate the characteristics of semiconductor devices.

TEXT BOOKS

1. Ranganath G and Channankaiah, “Basic Engineering Civil & Mechanical”, S.S.Publishers, 2014.
2. Ramamrutham. S, “Basic Civil Engineering”, Dhanpat Rai Publishing Co. (P) Ltd, 3rd Edition reprint, 2013.
3. Muthusubramanian R, Salivahanan S, “Basic Electrical and Electronics Engineering”, Tata McGraw Hill Education Private Limited, 2010.
4. M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.

REFERENCE BOOKS

1. Shanmugasundaram. S and Mylsamy. K, “Basics of Civil and Mechanical Engineering”, Cenage Learning India Pvt.Ltd, New Delhi, 2012.
2. Shanmugam G and Palanichamy M S, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., New Delhi, 3rd Edition, 2012.
3. B.L.Theraja, A.K.Theraja, “A Text Book of Electrical Technology, Volume I ”, S.Chand and company Ltd., 2006.
4. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 9th Edition, Pearson Education / PHI, 2007.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Know the usage of surveying and properties of construction materials.	3	1	2	2									3		1
Co2	Understand the stress strain of various building and material such as substructure, road transport and bridge.	1		1			2							3		1
Co3	Recognize the different combinations of circuit elements and solving the circuit by applying basic circuital laws.	3	1		2									3		1
Co4	Acquire a good understanding of DC and AC circuits.	2	1	2										3		

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Co5	Demonstrate the characteristics of semiconductor devices.	2	1	2									3		1

118CYP07 ENGINEERING CHEMISTRY LABORATORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVE:

- Students will be conversant with the estimation of various compounds using volumetric and instrumental analysis.

LIST OF EXPERIMENTS

1. Estimation of Total hardness by EDTA
2. Determination of percentage of calcium in Lime Stone by EDTA
3. Estimation of chloride in water sample
4. Estimation of alkalinity of Water sample
5. Determination of DO in Water (Winkler's Method)
6. Determination of Rate of Corrosion of the given steel specimen by weight loss method (Without inhibitor)
7. Determination of Rate of Corrosion of the given steel specimen by weight loss method (With inhibitor)
8. Conduct metric titration (Simple acid base)
9. Conduct metric titration (Mixture of weak and strong acids)
10. Conduct metric titration using $BaCl_2$vs Na_2 SO_4
11. Potentiometric Titration (Fe^{2+} / $KMnO_4$ or $K_2Cr_2O_7$)
12. PH titration (acid & base)
13. Determination of water of crystallization of a crystalline salt -Copper sulphate
14. Preparation of Bio-Diesel by Trans etherification method.

A minimum of TEN experiments shall be offered.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

CO1: Carry out the volumetric experiments and improve the analytical skills.
CO2: Understand the maintenance and usage of analytical instruments and thereby develop their skills in the field of engineering.
CO3: Understand the principle and handling of electrochemical instruments and Spectrophotometer
CO4: Apply their knowledge for protection of different metals from corrosion by using different inhibitors
CO5: Demonstrate the characteristics of PH Titration.

REFERENCE BOOKS:

1. Arthur I. Vogel's, "Quantitative Inorganic Analysis including Elementary Instrumental Analysis", ELBS, Group, 7th Edition, 2000.
2. Dr. K .Sivakumar, "Engineering Chemistry lab manual", S.S publishers, 2016.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Carry out the volumetric experiments and improve the analytical skills.	3	3								2			3		1
Co2	Understand the maintenance and usage of analytical instruments and thereby	3	3		2									3		1

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	develop their skills in the field of engineering.															
Co3	Understand the principle and handling of electrochemical instruments and Spectrophotometer	3	3		2	3		2			3			3		1
Co4	Apply their knowledge for protection of different metals from corrosion by using different inhibitors	3	3		3	2								3		1
Co5	Demonstrate the characteristics of PH Titration.	3	3								1			3		1

118EPP07 ENGINEERING PRACTICE LABORATORY

L	**T**	**P**	**C**
0	**0**	**2**	**1**

COURSE OBJECTIVES:

- To get the knowledge on welding techniques and its types.
- To do the fitting operation on a given material. (Specimen)
- To carry out sheet metal operation.
- To know the principle involved in plumbing work.
- To do the carpentry work on a given work piece.

LIST OF EXPERIMENTS

WELDING:

Study of Electric Arc welding and Gas welding tools and equipment's.

Preparation of Arc welding and Gas welding models:

i) Butt joint ii) Lap joint iii) T - joint.

FITTING:

Study of fitting tools and operations.

Preparation of fitting models: i) V-fitting ii) Square fitting

SHEET METAL WORK:

Study of sheet metal tools and operations

Preparation of sheet metal models: i) Rectangular Tray ii) Funnel

PLUMBING WORKS:

Study of pipeline joints and house hold fittings.

Preparation of plumbing models: Basic pipe connections with PVC and GI pipe fittings.

CARPENTRY:

Study of wooden joints and tools used in roofs, doors, windows, furniture.

Preparation of carpentry models:

i) Lap joint ii) Dovetail joint iii) T-Joint

DEMONSTRATION ON:

ELECTRICAL ENGINEERING PRACTICE

Study of Electrical components and equipments

Residential house wiring using switches, fuse, indicator, lamp and energy meter.

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ELECTRONICS ENGINEERING PRACTICE

Study of Electronic components –Resistor, color coding, capacitors etc

Soldering practice –components soldering in simple electric circuit & testing continuity

COMPUTER HARDWARE AND SOFTWARE PRACTICE

Study of PC Hardware, Internet & World Wide Web and Productivity tools including Word, Excel, Power Point and Publisher.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Prepare simple Lap, Butt and T- joints using arc welding equipments.

CO2: Prepare the rectangular trays and funnels by conducting sheet metal operation.

CO3: Prepare the pipe connections and identify the various components used in plumbing.

CO4: Prepare simple wooden joints using wood working tools.

CO5: Demonstrate basic electrical, electronic and computer components based on their physical parameters and dimensions.

TEXT BOOKS

1. Ranganath. G & Channankaiah, "Engineering Practices Laboratory Manual", S.S. Publishers, 2014.
2. Jeyapoovan.T & Gowri S "Engineering Practice Lab Manual", Vikas publishing house pvt.ltd, 2016.

REFERENCE BOOKS

1. Kannaiah.P & Narayana.K.L, "Manual on Workshop Practice", Scitech Publications, 2015.
2. Ramesh BabuV, "Engineering Practices Laboratory Manual", VRB Publishers Private Limited, Chennai, Revised Edition, 2014.
3. Peter Norton, "Introduction to Computers", 7th Edition, Mc Graw Hill, 2010.
4. Bawa. H.S, "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, 2009.
5. David Anfinson and Ken Quamme, "IT Essentials PC Hardware and Software Companion Guide", CISCO Press, Pearson Education, Third Edition, 2008.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Prepare simple Lap, Butt and T- joints using arc welding equipments.	1		2	2	1			1	1		1	1	1		2
Co2	Prepare the rectangular trays and funnels by conducting sheet metal operation.	2		2	2	1				1		1	1	1		2
Co3	Prepare the pipe connections and identify the various components used in plumbing.	1		1	2	1				1		1	1	1		2
Co4	Prepare simple wooden joints using wood working tools.	1		1	2	1				1		1	1	1		2
Co5	Demonstrate basic electrical, electronic and computer components based on their physical parameters and dimensions.	1		1	1	2				1		1	1	1		2

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218ENT01 **COMMUNICATIVE ENGLISH** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

The Course prepares first semester Engineering and Technology students:

- To help learners develop their listening skills which will enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop grammar and vocabulary of a general kind by developing their reading skills

UNIT I **9**

Listening - conversation - Speaking – introducing oneself - exchanging personal information - Reading – comprehension - Writing - paragraph - Vocabulary Development - synonyms and antonyms - Language Development – consonants & vowels - phonetic transcription.

UNIT II **9**

Listening - telephonic conversation - Speaking – sharing information of a personal kind – greeting - taking leave - Reading – short stories – The Gift of the Magi, A Service of Love and The Last Leaf by O. Henry – Writing – developing hints - Vocabulary Development – everyday vocabulary - Language Development – British and American English - infinitive and gerund.

UNIT III **9**

Listening – class memory quiz - Speaking – impromptu - Reading – magazines – Writing – agenda - proposals - Vocabulary Development - important words used in speaking and writing - Language Development – types of sentences - information and emphasis.

UNIT IV **9**

Listening – interviews of famous persons - Speaking – story narration - Reading – case study – Writing – invitation letter - quotation letter - Vocabulary Development – listening and reading vocabulary - Language Development – cause and effect – purpose and function.

UNIT V **9**

Listening - a scene from a film - Speaking - role play - Reading – jigsaw – Writing – essay writing - Vocabulary Development- business vocabulary - Language Development - degrees of comparison – real English phrases.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

At the end of the course learners will be able to:

CO1: Comprehend conversations and talks delivered in English.
CO2: Participate effectively in formal and informal conversations; introduce themselves and their friends and express opinions in English.
CO3: Read short stories, magazines, novels and other printed texts of a general kind.
CO4: Write short paragraphs, essays, letters and develop hints in English.
CO5: Write reports and winning job applications.

TEXT BOOKS

1. Board of Editors. Using English A Coursebook for Undergarduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015.
2. Richards, C. Jack. Interchange Students' Book-2, New Delhi: CUP, 2015.

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3. Uttham Kumar, N. Communicative English (with work book). Sahana Publications, Coimbatore, 2019.

REFERENCE BOOKS

1. Bailey, Stephen. Academic Writing: A Practical Guide for Students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011.
3. Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013.
4. Means, L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning, USA: 2007.
5. Redston, Chris & Gillies Cunningham. Face2Face (Pre-intermediate Student's Book & Workbook). Cambridge University Press, New Delhi: 2005.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Comprehend conversations and talks delivered in English.				1					2	3	1		1		
Co2	Participate effectively in formal and informal conversations; introduce themselves and their friends and express opinions in English.									1	3	1				
Co3	Read short stories, magazines, novels and other printed texts of a general kind.									1	1	1				
Co4	Write short paragraphs, essays, letters and develop hints in English.									1	3					1
Co5	Write reports and winning job applications.			3					2				1			

218MAT02 ENGINEERING MATHEMATICS-II L T P C
3 1 0 4

COURSE OBJECTIVES:

- To revise the concept of integral calculus and introduce Beta and Gamma functions.
- To understand double and triple integration concepts.
- To study vector calculus comprising of surface and volume integrals along with the classical theorems involving them.
- To learn analytic functions and their properties and also conformal mappings with few standard examples those have direct applications.
- To grasp the basics of complex integration and application to contour integration which is important for evaluation of certain integrals encountered in engineering problems.

UNIT I INTEGRAL CALCULUS 12

Definite and indefinite integrals - Substitution rule – Techniques of integration –Integration by parts – Trignometric integrals - Trigonometric substitutions - Integration of rational functions by partial fractions – Integration irrational functions - Beta and Gamma functions.

UNIT II MULTIPLE INTEGRALS 12

Double integration – Cartesian and polar co-ordinates – Change of order of integration – Change of variables between Cartesian and polar coordinates –Triple integration in Cartesian co-ordinates – Area as double integral – Volume as triple integral.

UNIT III VECTOR CALCULUS 12

Gradient, Divergence and Curl – Directional derivative – Irrotational and solenoidal, vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (Statement and applications only) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT IV ANALYTIC FUNCTIONS 12

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy– Riemann equation and Sufficient conditions (Statement and applications only) – Harmonic and orthogonal properties of analytic function (Statement and applications only) – Harmonic conjugate – Construction of analytic functions – Conformal mapping: w= z+c, cz, 1/z, and bilinear transformation.

UNIT V COMPLEX INTEGRATION 12

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor and Laurent expansions – Singular points –Residues – Residue theorem – Application of residue theorem to evaluate real integrals – Unit circle and semi-circular contour (excluding poles on boundaries).

TOTAL HOURS: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to

CO1: Apply the basic integration concepts and solve problems.

CO2: Determine the area and volume in 2-dimension and 3-dimension respectively using multiple integrals.

CO3: Expertise the concept of vector calculus and apply in core subjects.

CO4: Construct the analytic functions and conformal transformations of complex functions.

CO5: Evaluate the integrals using complex integration.

TEXT BOOK

1. Grewal. B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publications, Delhi, 2017.

REFERENCE BOOKS

1. James Stewart, "Stewart Calculus", 8th edition, 2015, ISBN: 9781285741550 /1285741552.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", tenth edition, Wiley India, 2011.
3. P.Kandasamy, K.Thilagavathy, K.Gunavathy, "Engineering Mathematics for first year", S.Chand & Company Ltd., 9th Edition, New Delhi, 2014.
4. V.Prameelakaladharan and G.Balaji, "Engineering Mathematics - II", Amrutha marketing, Chennai, 2017.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Apply the basic integration concepts and solve problems.	3	2											3	3	2
Co2	Determine the area and volume in 2-dimension and 3-dimension respectively using multiple integrals.	3	3											3	3	3
Co3	Expertise the concept of vector calculus and apply in core subjects.	3	3											3	3	3
Co4	Construct the analytic functions and conformal transformations of complex functions.	3	2											3	3	2
Co5	Evaluate the integrals using complex integration.	3	3											3	3	3

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218GET03 **ENVIRONMENTAL SCIENCE AND ENGINEERING** **L T P C**
2 0 0 2

COURSE OBJECTIVES:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT I NATURAL RESOURCES 14

Definition, scope and importance of environment – need for public awareness - Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT II ECOSYSTEMSAND BIODIVERSITY 8

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers –energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes.

UNIT III ENVIRONMENTAL POLLUTION 10

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization

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environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

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

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

CO1: Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
CO2: Public awareness of environmental is at infant stage.
CO3: Ignorance and incomplete knowledge has led to misconceptions
CO4: Development and improvement in std. of living has led to serious environmental disasters

TEXTBOOKS

1. Benny Joseph, Environmental Science and Engineering ', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M. Masters, Introduction to Environmental Engineering and Science ', 2nd edition, Pearson Education, 2004.
3. Dr. G. Ranganath, Environmental Science and Engineering, Sahana Publishers, 2018 edition.

REFERENCE BOOK

1. Dharmendra S. Sengar, Environmental law ', Prentice hall of India PVT LTD, New Delhi, 2007.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.	3			2	2		3			1			3	2	
Co2	Public awareness of environmental is at infant stage.	3				2		3						3	2	
Co3	Ignorance and incomplete knowledge has led to misconceptions	3	1					3						3	2	
Co4	Development and improvement in std. of living has led to serious environmental disasters	3		1	1			3						3	2	
Co5	Evaluate the integrals using complex integration.	3				2		3			2			3	2	

218EMT04 ENGINEERING MECHANICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the vectorial and scalar representation of forces and moments.
- To understand the static equilibrium of particles and rigid bodies both in two dimensions.
- To understand the concepts of centroids and moment of inertia of composite sections.

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- To understand the principle of work and energy.
- To enable the students to comprehend the effect of friction on equilibrium.

UNIT I BASICS & STATICS OF PARTICLES 12

Introduction-Units and Dimensions-Laws of mechanics - Lame's theorem, Parallelogram and Triangular law of forces, Polygon force, Resolution and Composition of forces, Equilibrium of a particle-Forces in space - Equilibrium of a particle in space-Equivalent systems of forces-Principle of transmissibility-Single equivalent force.

UNIT II EQUILIBRIUM OF RIGID BODIES 12

Free body diagram-Types of supports and their reactions-Requirements of stable equilibrium-Moments and Couples, Moment of a force about a point and about an axis-Vectorial representation of couples-Varignon's theorem-Equilibrium of Rigid bodies in two dimensions- Equilibrium of Rigid bodies in three dimensions – Examples.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 12

Determination of Areas and Volumes-First moment of area and the centroid of sections - rectangle, circle, triangle from integration - T section, I section, Angle section, Hollow section by using standard formula, Second and product moments of plane area - Rectangle, triangle, circle from integration-T section, I section, Angle section, Hollow section by using standard formula, Parallel axis theorem and perpendicular axis theorem.

UNIT IV DYNAMICS OF PARTICLES 12

Displacement, Velocity and Acceleration, their relationship, Relative motion- Rectilinear motion-Curvilinear motion, Newton's law-Work Energy Equation of particles-Impulse and Momentum-Impact of elastic bodies.

UNIT V FRICTION 12

Frictional force - Laws of Coloumb friction - Simple contact friction - Rolling resistance - Belt friction - Ladder friction - wedge friction.

TOTAL HOURS: 60 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Explain the differential principle applies to solve engineering problems dealing with force, displacement, velocity and acceleration.
CO2: Find solution for problems related to equilibrium of particles.
CO3: Solve the Moment of inertia for different 2-D plane figures.
CO4: Analyze the forces in any structures.
CO5: Solve rigid body subjected to frictional forces.

TEXT BOOKS

1. Ramamrutham S, “Engineering Mechanics (S.I Units)”, Dhanpat Rai Publications, 10th Edition, Reprint 2015.
2. Dr. Gujral I S, “Engineering Mechanics”, Lakmi Publications, Second Edition, 2011.

REFERENCE BOOKS

1. Bhavikatti S, “Engineering Mechanics”, New Age International Publisher, 4th Edition, 2014.
2. Khurmi R S, “Engineering Mechanics”, S Chand Publisher, 20th Edition, 2012.
3. Dr. Bansal R K and Sanjay Bansal, “Engineering Mechanics”, Lakshmi Publication, 7th Edition, 2011.
4. Rajput R K, “Engineering Mechanics”, Dhanpat Rai Publications, 3rd Edition, 2005.

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Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Explain the differential principle applies to solve engineering problems dealing with force, displacement, velocity and acceleration.		2											1		1
Co2	Find solution for problems related to equilibrium of particles.	1	1											2		
Co3	Solve the Moment of inertia for different 2-D plane figures.	1	2			1							1	1		1
Co4	Analyze the forces in any structures.	1	2	1	1	1							2	1		1
Co5	Solve rigid body subjected to frictional forces.	1	2	1										1		1

218PPT05 PROBLEM SOLVING AND PYTHON PROGRAMMING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures –- lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I ALGORITHMIC PROBLEM SOLVING **9**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS **9**

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

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

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

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UNIT V FILES, MODULES, PACKAGES 9

Files and exception: text files, reading and writing files, format operator; command line arguments, date and time, errors and exceptions, handling exceptions, debugging, modules, packages; Illustrative programs: word count, copy file.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1: Develop algorithmic solutions to simple computational problems
CO2: Read, write, execute by hand simple Python programs.
CO3: Structure simple Python programs for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, dictionaries.

TEXT BOOKS

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, —An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCE BOOKS

1. John V Guttag, —Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press, 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-Disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, —Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Develop algorithmic solutions to simple computational problems	3	3	3												
Co2	Read, write, execute by hand simple Python programs.	3	3	3							1			1		
Co3	Structure simple Python programs for solving problems.	3	3	3	1				1			1				
Co4	Decompose a Python program into functions.	3	3	3												
Co5	Represent compound data using Python lists, tuples, dictionaries.	3	3	3												

218BSE01 MATERIAL SCIENCE L T P C
2 0 0 2

COURSE OBJECTIVES:

- To study the basic theory of structure of crystalline materials.

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- To understand the essential principles of electrical properties of materials.
- To get the better knowledge of Physics of semiconductor materials.
- Become proficient in dielectric and nano materials.
- To understand the essential concepts of modern engineering materials.

UNIT I CRYSTAL PHYSICS 9

Introduction and structure of atoms – Crystal structure: The space lattice and Unit Cell - Crystal Systems and Bravais lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC, HCP and Diamond cubic structure – NaCl, ZnS structures (qualitative).

UNIT II CONDUCTING MATERIALS 9

Conductors - Classical free electron theory of metals - Expression for electrical conductivity - Expression for Thermal conductivity - Wiedemann-Franz law - Lorentz number - Draw backs of classical theory - Quantum theory - Fermi distribution function - Effect of temperature on Fermi distribution function - Density of energy states - carrier concentration in metals.

UNIT III SEMICONDUCTING MATERIALS 9

Intrinsic Semiconductors - direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors - Fermi level - Variation of Fermi level with temperature – Electrical conductivity of intrinsic semiconductors – band gap determination - Extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors (qualitative) - Variation of carrier concentration with temperature – variation of Fermi level with temperature and impurity concentration - Electrical conductivity of extrinsic semiconductors.

UNIT IV DIELECTRIC MATERIALS AND NANOMATERIALS 9

Dielectric materials: Dielectric constant – Dielectric loss - Electrical susceptibility- Electronic, ionic – orientational and space charge polarization – Frequency and temperature dependence of polarization – internal field – Claussius – Mosotti relation (derivation)

Nano materials: Synthesis-Plasma arcing- – Chemical vapour deposition – Electro deposition – Ball Milling – Properties of nanoparticles and their applications.

UNIT V NUCLEAR PHYSICS AND HEAT TRANSMISSION 9

Nuclear fission-Nuclear fusion-nuclear reactors-classification-general features-efficiency-coolants moderators thermal reactors.

Heat conduction-Expression for thermal conductivity-Amount of heat flow through a plane wall in one direction-Determine the thermal conductivity –Lee's disc method for bad conductors.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the students will able to

CO1: Have the necessary understanding on the functioning of crystalline in solids of materials
CO2: Gain knowledge on classical and quantum electron theories, and energy band structures.
CO3: Acquire knowledge on basics of semiconductor physics and its applications in various devices.
CO4: Get knowledge on dielectric and nano materials and their applications.
CO5: Understand the basics of modern engineering materials.

TEXT BOOKS

1. Jasprit Singh, - Semiconductor Devices: Basic Principles, Wiley 2012.
2. Kasap, S.O. - Principles of Electronic Materials and Devices, McGraw-Hill Education, 2007.
3. Jayaprakash R.N,-Physics for engineers, Dhanam publications, 2018.

4. Kittel, C. - Introduction to Solid State Physics. Wiley, 2005.
5. Theraja B.L - Basic Electronics Solid State, S. Chand & Company Ltd, 2004.

REFERENCE BOOK

1. Garcia, N. & Damask, A. —Physics for Computer Science Students. Springer-Verlag, 2012.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Have the necessary understanding on the functioning of crystalline in solids of materials	3	3	2	1									2		1
Co2	Gain knowledge on classical and quantum electron theories, and energy band structures.	3	3	1	1									3		1
Co3	Acquire knowledge on basics of semiconductor physics and its applications in various devices.	3	3	1	1									3		1
Co4	Get knowledge on dielectric and nano materials and their applications.	3	3	1	1									3		1
Co5	Understand the basics of modern engineering materials.	3	2	1	1									3		1

218PHP07 ENGINEERING PHYSICS LABORATORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To understand the practical concepts of Interference and diffraction.
- To understand the concept of velocities of sound in different liquids.
- To get better knowledge of modulus of elasticity.
- To understand the concepts of thermal conductivity.
- To understand the concepts of viscosities of liquid

LIST OF EXPERIMENTS

1. (a) Determination of laser parameters – Wavelength.
   (b) Particle size determination using Diode Laser.
2. Determination of thickness of a thin wire-Air wedge method.
3. Determination of velocity of sound and compressibility of liquid- Ultrasonic interferometer.
4. Determination of wavelength of mercury spectrum-Spectrometer grating.
5. Determination of thermal conductivity of a bad conductor-Lee's disc method.
6. Determination of Young's modulus of the material –Non uniform bending.
7. Determination of viscosity of liquid – Poiseuille's method.
8. Spectrometer- Dispersive power of prism.
9. Determination of Young's modulus of the material - Uniform bending.
10. Tensional pendulum- Determination of Rigidity modulus.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1: Understanding the moduli of elasticity by determining Young's modulus and Rigidity modulus of a beam and cylinder respectively.

CO2: Understanding the phenomenon of diffraction, dispersion and interference of light using optical component

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CO3: Acquiring knowledge of viscosity by determining coefficient of viscosity of a liquid and measuring the parameters of ultrasound propagating through a liquid

CO4: Understanding the phenomenon of heat transfer through conductors and bad conductors by determining thermal conductivity.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Understanding the moduli of elasticity by determining Young's modulus and Rigidity modulus of a beam and cylinder respectively.	3	3	3	3	3								3		3
Co2	Understanding the phenomenon of diffraction, dispersion and interference of light using optical component	3	3	3	3	3								3		3
Co3	Acquiring knowledge of viscosity by determining coefficient of viscosity of a liquid and measuring the parameters of ultrasound propagating through a liquid	3	3	3	3	3								3		3
Co4	Understanding the phenomenon of heat transfer through conductors and bad conductors by determining thermal conductivity.	3	3	3	3	3								3		3

218PPP08 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

LIST OF PROGRAMS

1. To Implement python scripts using Variables and operators
2. To Demonstrate Operator precedence to evaluate an expression
3. Display grade of a student using elif statement
4. Implement Floyd triangle using for loop
5. Checks the given number is prime or not using while loop
6. Compute the GCD of Numbers using functions
7. Finding factorial of a given number using recursive function.
8. Takes a list of words and returns the length of longest one using strings
9. To perform linear and binary search using strings
10. To implement list as arrays (multiply 2 matrices)
11. To demonstrate use of list & related functions
12. To demonstrate use of tuple, set& related functions
13. To demonstrate use of Dictionary& related functions
14. Finding most frequent words in a text read from a file
15. Programs that take command line arguments (word count)

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

TOTAL HOURS: 45 PERIODS

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COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1: Write, test, and debug simple Python programs.

CO2: Implement Python programs with conditionals and loops.

CO3: Develop Python programs step-wise by defining functions and calling them.

CO4: Use Python lists, tuples, dictionaries for representing compound data.

CO5: Read and write data from/to files in Python.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Write, test, and debug simple Python programs.	3	3	3												
Co2	Implement Python programs with conditionals and loops.	3	3	3				1				1				
Co3	Develop Python programs step-wise by defining functions and calling them.	3	3	3						1				1		
Co4	Use Python lists, tuples, dictionaries for representing compound data.	3	3	3	1											
Co5	Read and write data from/to files in Python.	3	3	3												

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318MAT01 **ENGINEERING MATHEMATICS III** **L T P C**
3 1 0 4

COURSE OBJECTIVES:

- To learn various methods to solve the partial differential equations.
- To introduce Fourier series analysis which plays a vital role in many applications in engineering.
- To understand the boundary value problems and to obtain the solution using partial differential equations.
- To acquaint the Fourier transform techniques used in wide variety of situations.
- To develop z-transform techniques which analyze the discrete time signals.

PRE-REQUISITES: Knowledge of Engineering Mathematics I and II are required.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Solutions of first order partial differential equations-Standard types-Singular solutions-Lagrange's Linear equation- Method of grouping and Method of multipliers-Solution of homogeneous and non-homogenous linear equations of second and higher order with constant coefficients.

UNIT II FOURIER SERIES 12

Dirichlet's conditions – General Fourier series –Change of scale - Odd and even functions – Half -range Sine and Cosine series – Parseval's identify applications – Harmonic Analysis

UNIT III BOUNDARY VALUE PROBLEMS 12

Classification of Partial Differential Equations – Method of separation of Variables – Solutions of one dimensional wave equations and One-dimensional heat equations –Applications using Fourier series solutions in Cartesian coordinates - Steady state solution of two-dimensional heat equation.

UNIT IV FOURIER TRANSFORMS 12

Fourier integral theorem – Fourier transform pair - Sine and Cosine transforms – Properties – Fourier Transform of simple functions – Convolution theorem (statement and applications only) – Parseval's identity (statement and applications only).

UNIT V Z – TRANSFORMS 12

Z-Transform - Elementary properties and applications – Initial and final value theorems (statement and applications only) - Inverse Z-Transform – Partial fractions method, Residue theorem method and Convolution theorem (statement and applications only) - Solution of difference equations by applying Z-transforms.

TOTAL HOURS: 60 PERIODS

COURSE OUTCOMES

After completing this course, the student will be able to

CO1: Know the methods to solve partial differential equations occurring in various physical and engineering problems.

CO2: Describe an oscillating function which appears in a variety of physical problems by Fourier series which helps them to understand its basic nature deeply.

CO3: Acquire the knowledge to construct partial differential equations with initial and boundary conditions for various physical and engineering real time problems and obtaining solution using Fourier series methods.

CO4: Apply the Fourier transform techniques in engineering field.

CO5: Gain the concept of analysis of linear discrete system using Z-transform approach.

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TEXT BOOKS

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 44th edition, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition Wiley India, 2016.

REFERENCES BOOKS

1. Andrews L.C and Shivamoggi. B.K., "Integral Transforms for Engineers", SPIE Press Book, 1999
2. Wylie C R and Barrett L C, "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill Co., New Delhi, 1995.
3. T.Veerarajan,"Engineering Mathematics-III", Tata McGraw-Hill Publishing company, New Delhi,2015.
4. P.Kandasamy, K.Thilagavathy, K.Gunavathy, " Engineering Mathematics-III", S.Chand Publishers,2015.
5. V.Prameelakaladharan and G.Balaji ,"Engineering Mathematics-III", Amrutha marketing, Chennai,2016.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Know the methods to solve partial differential equations occurring in various physical and engineering problems.	3	3											3		
Co2	Describe an oscillating function which appears in a variety of physical problems by Fourier series which helps them to understand its basic nature deeply.	3	3											3		
Co3	Acquire the knowledge to construct partial differential equations with initial and boundary conditions for various physical and engineering real time problems and obtaining solution using Fourier series methods.	3	3											3		
Co4	Apply the Fourier transform techniques in engineering field.	3	3											3		
Co5	Gain the concept of analysis of linear discrete system using Z-transform approach.	3	3											3		

318MET02 ENGINEERING THERMODYNAMICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study about the basic laws of thermodynamics.
- To know the concept of second law, entropy and availability.
- To analyze the performance of various thermodynamic cycles.
- To know the properties of ideal and real gases.
- To perform the calculations of air vapour mixtures using psychometric charts.

UNIT I BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS 12

Basic concepts - Concept of continuum, macroscopic approach, Thermodynamic systems - closed, open and isolated. Property, State, Path and process, Quasi-static process, work, modes of work, Zeroth law of thermodynamics – Concept of temperature and heat. Concept of ideal and real gases.

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First law of thermodynamics – applied to closed and open systems, Internal energy, Specific heat capacities, Enthalpy, Steady Flow Energy Equation applied to various thermal equipments.

UNIT II SECOND LAW OF THERMODYNAMICS 12

Second law of thermodynamics – Kelvin's – Planck and Clausius statement. Reversibility and Irreversibility. Carnot theorem, Carnot cycle, Reversed carnot cycle, Efficiency, Coefficient of Performance (COP). Thermodynamic temperature scale, Entropy, Clausius Inequality, Principles of Entropy Increase, Entropy change in different processes, Availability & Irreversibility: Availability of a flow and non-flow process, Effectiveness & Irreversibility, Second law of Efficiencies of processes and cycles.

UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 12

Properties of pure substances – Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, p-v, p-T, T-v, T-s, h-s diagrams, p-v-T surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non-flow and flow processes. Standard Rankine cycle - Reheat and Regenerative cycle.

UNIT IV IDEAL AND REAL GASES AND THERMODYNAMIC RELATIONS 12

Gas mixtures – properties ideal and real gases, Equation of state, Avagadro's Law, Vander Waal's equation of state, Compressability factor, Compressability chart – Dalton's law of partial pressure, Exact differentials, Tds relations, Maxwell's relations, Clausius Clapeyron equations, Joule –Thomson coefficient.

UNIT V PSYCHROMETRY 12

Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling.

TOTAL HOURS: 60 PERIODS

(Use of standard steam tables, Mollier diagram, Psychometric chart and compressibility chart are permitted)

COURSE OUTCOMES

The students will be able to

CO1: Describe the thermodynamic systems and apply first law of thermodynamics to analyze the systems.
CO2: Comprehend the second law of thermodynamics and determine the efficiencies of engines.
CO3: Acquire the knowledge to calculate specified parameters of various thermodynamic cycles.
CO4: Estimate thermodynamic properties of substances in gas or liquid state of ideal and real mixture.
CO5: Analyze the performance of various gas power cycles and to study the psychometric process.

TEXT BOOKS

1. Nag.P.K., "Engineering Thermodynamics", Fifth Edition, Tata McGraw-Hill Education, New Delhi, 6th Edition, 2017.
2. Yunus A Cengel and Michael A Boles, "Thermodynamics – An Engineering Approach", 8th Edition, Tata McGraw Hill Education, 2017.
3. Er.R.K.Rajput, "Engineering Thermodynamics", Fifth Edition, Lakshmi Publications, 2016.

REFERENCE BOOKS

1. Moran, Shapiro, Boether, Bailey, "Principles of Engineering Thermodynamics", Si version, Wiley Student, 8th Edition, 2015.

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2. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.
3. Rogers and Mayhew, "Engineering Thermodynamics", Longman Scientific, 4th Edition, 1996.
4. Holman.J.P., "Thermodynamics", 4th Edition, McGraw-Hill, 1988.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Describe the thermodynamic systems and apply first law of thermodynamics to analyze the systems.	3	2	1							1	1		2		
Co2	Comprehend the second law of thermodynamics and determine the efficiencies of engines.	2	1	2	1						1	1		2		
Co3	Acquire the knowledge to calculate specified parameters of various thermodynamic cycles.	2	1	1							1	1		2		
Co4	Estimate thermodynamic properties of substances in gas or liquid state of ideal and real mixture.	2	2	1							1	1		2		
Co5	Analyze the performance of various gas power cycles and to study the psychometric process.	3	2	1							1	1		3		

318MET03 FLUID MECHANICS AND MACHINERY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To familiarize with the properties of fluids and the applications of fluid mechanics.
- To derive and analyze the problems related to laminar and turbulent flow.
- To analyze the dimensional parameters and importance of dimensional analysis in various flow problems.
- To interpret the importance of various types of turbines and draw the velocity vector triangle.
- To learn the concepts of reciprocating and rotary pump.

UNIT I INTRODUCTION **9**

Units & Dimensions. Properties of fluids – Specific gravity, Specific weight, Viscosity, Compressibility, Vapour pressure and gas laws – Capillarity and Surface tension. Flow characteristics: Concepts of system and control volume. Application of control volume to continuity equation, energy equation, momentum equation and moment of momentum equation.

UNIT II FLOW THROUGH CIRCULAR CONDUITS **9**

Laminar flow though circular conduits and circular annuli. Boundary layer concepts - Boundary layer thickness. Hydraulic and energy gradient. Darcy – Weisbach equation. Friction factor and Moody diagram. Commercial pipes - Minor losses. Flow though pipes in series and in parallel.

UNIT III DIMENSIONAL ANALYSIS **9**

Dimensions and units: Buckingham's Π theorem. Discussion on dimensionless parameters. Models and similitude. Applications of dimensionless parameters to the various flow problems.

UNIT IV ROTODYNAMIC MACHINES **10**

Elementary cascade theory, theory of turbomachines, Euler's equation, Classification of turbines –

Heads and efficiencies – velocity triangles, Axial, Radial and Mixed flow turbines. Pelton wheel turbine, Francis turbine and Kaplan turbine – working principles, Centrifugal pump, Specific speed – unit quantities – performance curves for pumps and turbines.

UNIT V POSITIVE DISPLACEMENT MACHINES 8

Classification of positive displacement machines - Reciprocating pumps - Indicator diagrams, Work saved by air vessels. Rotory pumps - Working Principle and performance curves.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Acquire the knowledge regarding basic concepts in fluid mechanics.

CO2: Determine flow rates, pressure changes, minor and major head losses for laminar and turbulent flows through pipes.

CO3: Determine the significance of dimensional parameters that influence the flow in fluid mechanics.

CO4: Acquire knowledge and concepts of various turbine and centrifugal pump with drawing velocity vector triangle.

CO5: Apply principles of fluid mechanics to the operation, design and selection of pumps.

TEXT BOOKS

1. Streeter. V. L., and Wylie, E.B., "Fluid Mechanics", McGraw Hill, 9th Edition, 2017.
2. Modi.P.N and Seth.S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2017.
3. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", 21st Edition, Laxmi Publications (P) Ltd., New Delhi, 2017.
4. Rathakrishnan. E, "Fluid Mechanics", Prentice Hall of India, 3rd Edition, 2012.

REFERENCE BOOKS

1. Robert W Fox, Alan T. Mc Donald, Philip J Pritchard, "Introduction to Fluid Mechanics", Wiley, 6th Edition, 2013.
2. Munson B.R., Young D.F. and Okiisi.T.H., "Fundamentals of Fluid Mechanics", John Wiley and Sons Inc., New York, 6th Edition, 2009.
3. Kumar. K.L., "Engineering Fluid Mechanics", (7th Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 2002.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Acquire the knowledge regarding basic concepts in fluid mechanics.	2	2	1	3	1					1			3		
Co2	Determine flow rates, pressure changes, minor and major head losses for laminar and turbulent flows through pipes.	2	2	1	3	1					1			3		
Co3	Determine the significance of dimensional parameters that influence the flow in fluid mechanics.	3	2	1	3	1					1			3		
Co4	Acquire knowledge and concepts of various turbine and centrifugal pump with drawing velocity vector triangle.	2	2	1	3	1					1			3		
Co5	Apply principles of fluid mechanics to the operation, design and selection of pumps.	2	2	1	3	1					1			3		

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318MET04 **COMPOSITE MATERIALS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To interpret the basic concepts of modern composite materials and their applications.
- To gain the knowledge on processing and applications of PMC.
- To identify the properties, advantages and disadvantages of the metal matrix composites.
- To analyze the different processing/ fabrication techniques of composite materials.
- To analyze the mechanics of laminated composites.

UNIT I INTRODUCTION TO COMPOSITES **9**

Fundamentals of composites - need for composites – enhancement of properties - classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – particle reinforced composites, Fibre reinforced composites, Hybrid composites. Applications of various types of composites.

UNIT II POLYMER MATRIX COMPOSITES **9**

Polymer resin – thermosetting resin, thermoplastic resin – reinforcement fibres – rovings – woven fabrics – nonwoven random mats – various types of fibres. PMC processes - Hand layup- Pre Pregs Process- Vacuum bag molding processes, Auto Clave Method – spray-up processes – compression molding –injection molding–Blow molding– Pultrusion – Filament winding. Fibre reinforced plastics (FRP), Glass Fibre Reinforced Plastics (GFRP), Recycling of PMCs.

UNIT III METAL MATRIX COMPOSITES **9**

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, Advantages of MMC, limitations of MMC, Reinforcements – particles – fibres. Effect of reinforcement - Processing of MMC – stir casting - powder metallurgy process–squeeze casting, a spray process, Liquid infiltration In-situ reactions- applications of MMC in automotive industries

UNIT IV CERAMIC MATRIX COMPOSITES **9**

Engineering ceramic materials – properties – advantages – limitations – monolithic ceramics - need for CMC – ceramic matrix - various types of ceramic matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres whiskers, Carbon Carbon Composites (CCC). Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing). Applications of CMC in automotive industries.

UNIT V MECHANICS OF LAMINATED COMPOSITES **9**

Stress-strain relationship for anisotropic and orthotropic materials, Unidirectional laminas – Rule of mixtures, Volume fraction and weight fraction, Fibre length and fibre orientation distribution, voids, Strength of orthotropic lamina, Failure criteria of the orthotropic lamina, Macro mechanical behaviour of laminates – Interfacing Bonding Mechanics.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

CO1: The students become aware of different composite materials, reinforcement materials, matrix materials and their usages.

CO2: The students will have knowledge about different fabrication techniques for polymer matrix composites.

CO3: The students will have skills to evaluate properties and applications of metal matrix composite materials.

CO4: The students are able to develop their skills about fabrication techniques for ceramic matrix composites.

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CO5: The students will have a thorough knowledge of micro & macro-structural analysis of orthotropic materials, derivation of equations and application to problem-solving.

TEXT BOOKS

1. Chawla K.K., "Composite Materials Science and Engineering", Springer, Third Edition, 2013.
2. Mallick P.K., "Fibre Reinforced Composites", CRC Press, Third Edition, 2008.

REFERENCE BOOKS

1. Mallick, P.K. and Newman. S., "Composite Materials Technology", Hanser Publishers, 2003.
2. Harold Belofsky, "Plastics, Product Design and Process Engineering", Hanser Publishers, 2002.
3. Matthews F.L. and Rawlings R.D, "Composite Materials: Engineering and Science", CRC Press and wood head Publish Limited, 2002.
4. Derek Hull, "An Introduction to Composite Materials", Second Edition, Cambridge University Press, 1996.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students become aware of different composite materials, reinforcement materials, matrix materials and their usages.	3	1	1		1		1		1				1		1
Co2	The students will have knowledge about different fabrication techniques for polymer matrix composites.	1		1		1				1				2		1
Co3	The students will have skills to evaluate properties and applications of metal matrix composite materials.	1		1		1				1				2		1
Co4	The students are able to develop their skills about fabrication techniques for ceramic matrix composites.	1		1		1				1				2		1
Co5	The students will have a thorough knowledge of micro & macro-structural analysis of orthotropic materials, derivation of equations and application to problem-solving.	1		1		1				1				2		1

318MET05 MANUFACTURING TECHNOLOGY – I

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To comprehend the basic concepts of sand casting technique and special casting techniques.
- To know about the working principles, equipment's of different welding techniques.
- To know the various operations and equipments required for hot and cold metal forming processes.
- To understand the working principle and applications of different types of sheet metal processes.
- To understand the working principles of different types of thermo plastic manufacturing methods.

UNIT I METAL CASTING PROCESSES **9**

Introduction to casting - Type of patterns – Pattern materials – Pattern allowances – Types of Green sand Moulding –Moulding sand – Properties – Core making - Melting furnaces –Electric Arc Furnace – Induction furnace - Special casting processes – Investment casting – Pressure die casting – Centrifugal casting – CO_2 process – Sand Casting defects – Inspection methods.

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UNIT II JOINING PROCESSES 9

Welding processes and its classifications –Gas welding – Flame characteristics –Arc welding types - Electrodes – Coating and specifications – Principles of Resistance welding – Spot/butt, Seam welding - Gas metal arc welding –Submerged arc welding – TIG welding – Principle and application of special welding processes - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding – Friction Stir Welding – Weld defects – Brazing and soldering process.

UNIT III BULK DEFORMATION PROCESSES 9

Hot working and cold working of metals – Forging processes – Open and closed die forging –Types of Forging Machines – Typical forging operations – Rolling of metals – Types of Rolling mills - Flat strip rolling – Shape rolling operations – Defects in rolled parts - Principle of rod and wire drawing - Tube drawing – Principles of Extrusion – Types of Extrusion – Hot and Cold extrusion.

UNIT IV SHEET METAL PROCESSES 9

Sheet metal characteristics - Typical shearing operations, bending and drawing operations – Stretch forming operations – Principle and application of special forming processes - Hydro forming – Rubber pad forming – Metal spinning – Introduction to Explosive forming, Magnetic pulse forming, Peen forming, Super plastic forming.

UNIT V MANUFACTURING OF PLASTIC COMPONENTS 9

Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of Injection moulding and its types – Plunger and screw machines – Compression moulding, Transfer moulding - Typical industrial applications – Introduction to Blow moulding – Rotational moulding– Extrusion - Thermoforming - Bonding of Thermoplastics – Types of Adhesive bonding.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will have ability to

CO1: Explain the requirements, process, applications and defects of sand casting and special casting processes.

CO2: Explain the working principles and applications of different arc welding processes, special welding processes and defects associated with it.

CO3: Select the suitable process for manufacturing of components among forging, rolling, drawing, extrusion and its types.

CO4: Explain the principles and working of shearing, bending, drawing and forming in sheet metal.

CO5: Judge the suitability of a plastic manufacturing process based on application requirements.

TEXT BOOKS

1. Rao P.N, “Manufacturing Technology”, Tata McGraw-Hill Publishing Limited, 5th Edition, 2018.
2. Hajra Choudhury, “Elements of Workshop Technology Vol. I”, Media Promotors Pvt Ltd., Mumbai, 15th Edition, 2013.
3. Gowri S, P.Hariharan, and A.Suresh Babu, “Manufacturing Technology I”, Pearson Education, 2008.

REFERENCE BOOKS

1. Serope Kalpakjian, Steven R.Schmid, “Manufacturing Engineering and Technology”, Pearson Education, 7th Edition, 2018.
2. Jain R.K, “Production Technology”, Khanna Publishers, 17th Edition, 2012.
3. Khanna O.P, “Foundry technology”, Dhanpat Rai Publications, 2011.
4. Sharma P.C, “A Text Book of Production Technology”, S. Chand and Company, IV Edition, 2009.

5. Rajput R.K, “A Text Book of Manufacturing Technology”, Lakshmi Publications, 2007.
6. Beddoes.J and Bibby M.J, “Principles of Metal Manufacturing Processes”, Elsevier, 2006.
7. Begeman, “Manufacturing Process”, John Wiley & Sons, VIII Edition, 2005.
8. Nagendra Parashar B.S & R.K. Mittal, “Elements of Manufacturing Processes”, Prentice Hall of India, 2005.
9. Parmer R. S, “Welding processes and Technology”, Khanna Publishers, 3rd Edition, 2003.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Explain the requirements, process, applications and defects of sand casting and special casting processes.	3												2		
Co2	Explain the working principles and applications of different arc welding processes, special welding processes and defects associated with it.	3	2	1	3	3								3		
Co3	Select the suitable process for manufacturing of components among forging, rolling, drawing, extrusion and its types.	3	3	2	3	3								3		1
Co4	Explain the principles and working of shearing, bending, drawing and forming in sheet metal.	3	1	2	3	3								3		2
Co5	Judge the suitability of a plastic manufacturing process based on application requirements.	3	2	1	2									2	2	

318MEP07 FLUID MECHANICS AND MACHINERY LABORATORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To gain the knowledge in flow measuring devices such as venturimeter, orificemeter and rotameter.
- To gain knowledge about flow through different pipes.
- To provide practice in estimating friction losses.
- To study the performance characteristics for centrifugal, reciprocating, gear oil and submersible pump.
- To study the performance characteristics for Pelton wheel, Francis and Kaplan turbine.

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump / submergible pump.
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Measure flow through the venturimeter, orifice meter and rotometer.

CO2: Acquire knowledge in flow through different pipes.

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CO3: Determine the friction factor for a given set of pipes.
CO4: Draw the characteristics curve for centrifugal, reciprocating, gear oil and submersible pump.
CO5: Draw the characteristics curve for Pelton wheel, Francis and Kaplan turbine.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Measure flow through the venturimeter, orifice meter and rotometer.	2	1		2						1			2		
Co2	Acquire knowledge in flow through different pipes.	2	1		2						1			2		
Co3	Determine the friction factor for a given set of pipes.	2	1		2						1			2		
Co4	Draw the characteristics curve for centrifugal, reciprocating, gear oil and submersible pump.	2	1		2						1			2		
Co5	Draw the characteristics curve for Pelton wheel, Francis and Kaplan turbine.	2	1		2						1			2		

318MEP08 MANUFACTURING TECHNOLOGY LABORATORY – I

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To know about basic machining processes.
- To get practical knowledge on Lathe machine operations.
- To gain the knowledge on foundry concepts.
- To perform production of contour shapes on the given component.
- To learn about injection moulding.

LIST OF EXPERIMENTS

1. Facing, plain turning and step turning.
2. Taper turning using compound rest, Tailstock set over, etc.
3. Single and Multi-start V- thread cutting and knurling.
4. Drilling, Boring and internal thread cutting.
5. Mould with solid, split patterns.
6. Mould with loose-piece pattern.
7. Mould with Core.
8. Cold Forging.
9. Injection Moulding- for demonstration purpose.
10. Spot Welding.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

CO1: The students are capable to perform plain turning, taper turning, thread cutting, knurling, drilling, reaming and tapping etc.
CO2: Ability to know about the basic concepts of cold forging operations.
CO3: Ability to know the concepts of foundry technology and to develop skills on sand casting.
CO4: Students can get the knowledge on applications on welding operation.
CO5: Students can demonstrate and fabricate different types of components using the machine tools.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students are capable to perform plain turning, taper turning, thread cutting, knurling, drilling, reaming and tapping etc.	1	1	2	3									2		
Co2	Ability to know about the basic concepts of cold forging operations.	1	2	3	2	1								2		1
Co3	Ability to know the concepts of foundry technology and to develop skills on sand casting.	1	1	3	2	1								2		2
Co4	Students can get the knowledge on applications on welding operation.	1	1	2	3	1								1		1
Co5	Students can demonstrate and fabricate different types of components using the machine tools.	1	1	2	3	1		2						2		1

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418SNT01 **STATISTICS AND NUMERICAL METHODS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To solve equations using direct and iterative methods.
- To introduce interpolation techniques and to study the principle of numerical differentiation and integration.
- To learn some of the methods of numerical solutions of ordinary differential equations with initial conditions.
- To introduce the notion of sampling distributions and acquire the knowledge of statistical techniques useful in decision making.
- To expose the statistical methods for analysis of variance and control limits.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Newton-Raphson method- Direct Methods-Gauss Elimination method-Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel – Eigenvalues of a matrix by Power method.

UNIT II INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 12

Newton's forward and backward difference interpolation - Lagrange's and Newton's divided difference interpolation - Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal and Simpson's $1/3^{rd}$ and $3/8^{th}$ rules.

UNIT III NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order equations - Predictor-Corrector methods for solving first order equations: Milne's Method and Adam-Bashforth Method.

UNIT IV TESTING OF HYPOTHESIS 12

Sampling distributions - Tests for single Mean, Proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes.

UNIT V DESIGN OF EXPERIMENTS 12

Analysis of variance – Completely Randomized Design (CRD) -one way classification – Randomised Block Design (RBD) -two way classification - Latin Square Design (LSD) – Factorial Designs- 2^2 Factorial designs- Control charts for measurements - $\overline{x}$ chart, R-chart, *p* - chart and *np* – chart.

Note: Use of approved statistical table is permitted in the examination.

TOTAL HOURS: 60 PERIODS

COURSE OUTCOMES

At the end of the course the student will be able to

CO1: Apply numerical methods such as direct, iterative and interpolation to solve algebraic or transcendental equations and system of equations.
CO2: Appreciate numerical solutions for differential and integral calculus as a handy tool to solve problems.
CO3: Implement numerical algorithms to find solutions for intial value problems for ordinary differential equations
CO4: Draw inference and decision making through hypothesis testing.
CO5: Acquaint the knowledge of analysis of variance and control limits.

TEXT BOOKS

1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, 2004.

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2. Miller and Freund., “Probability and Statistics for Engineers”, Pearson Education, Asia, 7th edition, 2012.

REFERENCE BOOKS

1. Richard L.Burden and J.Dougles Faires, “Numerical Analysis”, Ninth Edition, BROOKS/COLE, Cengage.com.,2012. Visit www.cengage.com/international.
2. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, “Probability and Statistics for Engineers and Scientists”, Pearson Education, Asia , 8th edition, 2007.
3. Veerarajan.T., “Probability, Statistics and Random Processes”, Tata McGraw-Hill publishing company Limited, New Delhi, 2014.
4. S.S.Sastry, “Introductory Methods of Numerical Analysis”, 5th Edition, Prentice Hall of India Private Ltd., New Delhi, 2012.
5. Gupta.S.C., & Kapoor,V.K., “Fundamentals of mathematical statistics”, 11th edition, Sultan Chand & Sons publishers, New Delhi, 2013.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Apply numerical methods such as direct, iterative and interpolation to solve algebraic or transcendental equations and system of equations.	3	3		1									3		
Co2	Appreciate numerical solutions for differential and integral calculus as a handy tool to solve problems.	3	3		1									3		
Co3	Implement numerical algorithms to find solutions for intial value problems for ordinary differential equations	3	3		1									3		
Co4	Draw inference and decision making through hypothesis testing.	3	3		1								1	3		
Co5	Acquaint the knowledge of analysis of variance and control limits.	3	3		1								1	3		

418MET02 **KINEMATICS OF MACHINERY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To differentiate between machine, mechanism and structure.
- To draw velocity and acceleration diagrams for different linkages.
- To design cam profile for the desired follower motion.
- To determine gear parameters and check for interference.
- To synthesis linkages for different mechanisms.

PRE-REQUISITES: Knowledge of Engineering Mechanics is required

UNIT I BASICS OF MECHANISMS **9**

Definitions – Link, Kinematic pair, Kinematic chain, Mechanism and Machine. Degree of Freedom – Mobility, Kutzbach criterion (Gruebler’s equation), Grashoff's law, Kinematic Inversions of four bar chain and slider crank chain, Mechanical Advantage, Transmission angle.

Description of common Mechanisms - Offset slider mechanism, Quick return mechanisms, Pantograph, Exact and Approximate straight line generators, Steering gear for automobile, Hooke’s joint, Toggle mechanism, Ratchets and escapements, Indexing Mechanisms.

UNIT II KINEMATIC ANALYSIS 9

Displacement, velocity and acceleration analysis of simple mechanisms using graphical method, graphical velocity analysis using instantaneous centers, Coincident points, Coriolis acceleration, Analytical method of analysis - slider crank mechanism, and four bar mechanism.

UNIT III KINEMATICS OF CAMS 9

Classifications of Cams and followers -Displacement diagrams – Uniform Velocity, Parabolic, Simple harmonic and Cycloidal motions, derivatives of follower motions, Graphical construction of displacement diagrams and layout of plate cam profiles - circular arc and tangent cams, Pressure angle and undercutting, sizing of cam.

UNIT IV GEARS & GEAR TRAINS 9

Classification of gears, Spur gear - terminology, involute and cycloidal gear profiles - Fundamental Law of toothed gearing, Length of path of contact and contact ratio, Interference and undercutting. Gear trains – Simple, compound, Epicyclic gear trains and Differentials.

UNIT V SYNTHESIS OF LINKAGES 9

Numbers and Dimensional synthesis- Functional generation, path generation and motion generation-Graphical methods-Two and three position synthesis of slider crank and four bar mechanism using function generation method– Frudenstein Equation.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Demonstrate the simple mechanisms with suitable examples.
CO2: Determine displacement, velocity and acceleration of any point on a link in simple mechanism.
CO3: Construct cam profile for various follower motions
CO4: Describe law of gearing, types of gears, terminologies of spur gears and gear trains.
CO5: Analyze and synthesis position, velocity and acceleration for various mechanisms

TEXT BOOKS

1. Rattan S.S, “Theory of Machines”, Tata McGraw Hill Education Pvt. Ltd., 5th Edition, 2020.
2. Robert L. Norton, “Design of Machinery”, Tata Mc Graw Hill, 2012.

REFERENCE BOOKS

1. Ambekar A. G., “Mechanism and Machine Theory”, Prentice Hall of India, New Delhi, 2015.
2. UickerJ.J., Pennock G.R., Shigley J.E., “Theory of Machines and Mechanisms” (Indian Edition), Oxford University Press, 2017.
3. Rao J.S and Dukkipati R.V, “Mechanism and Machine Theory”, Wiley-Eastern Ltd., New Delhi, 2007.
4. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 2005.
5. Khurmi R.S, “Theory of Machines”, S. Chand & Co. Ltd., New Delhi, 14th Edition, 2005.
6. Ramamurti,V., “Mechanism and Machine Theory”, Second Edition, Narosa Publishing House, 2005.
7. John Hannah and Stephens R.C, “Mechanics of Machines”, Viva Low-Price Student Edition, 1999.
8. Ghosh A and A.K.Mallick, “Theory of Mechanisms and Machines”, Affiliated East-West Pvt. Ltd., New Delhi, 2020.

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Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Demonstrate the simple mechanisms with suitable examples.	1	2	1										1		
Co2	Determine displacement, velocity and acceleration of any point on a link in simple mechanism.	1	2	1							1			1		1
Co3	Construct cam profile for various follower motions	1	2	2							1			1		1
Co4	Describe law of gearing, types of gears, terminologies of spur gears and gear trains.	1	2	1							1					
Co5	Analyze and synthesis position, velocity and acceleration for various mechanisms	1	2	2		1		1						2		2

418MET03 **THERMAL ENGINEERING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand various process in air standard cycles.
- To understand the basic concepts in air compressors
- To familiarize with the principles, working of internal combustion engines and combustion.
- To learn the performance of Internal combustion engines
- To study the basic principles of refrigeration systems.

PRE-REQUISITES: Knowledge of Engineering Thermodynamics is required.

UNIT I AIR STANDARD CYCLES 10

Air standard cycles – Assumptions - Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure and air standard efficiency – Comparison of cycles -Actual and Theoretical P-V diagram of two stroke and four stroke engines.

UNIT II AIR COMPRESSOR 9

Classification and working principle of reciprocating air compressor, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency - Isentropic efficiency of reciprocating air compressors, Multi stage air compressor and Inter cooling -Work of multi stage air compressor.

UNIT III INTERNAL COMBUSTION ENGINES AND COMBUSTION 9

IC engine – Classification, working, components and their functions. Ideal and actual: Valve and port timing diagrams, SI and CI engines – comparison. Chemical reactions, fuel properties, flue gas analysis, Heating values –HCF and LCF analysis. Minimum air flow requirement for combustion. Fuel ratings: Octane and Cetane numbers, knocking / detonation, adiabatic flame temperature.

UNIT IV INTERNAL COMBUSTION ENGINE PERFORMANCE AND SYSTEMS 9

Performance parameters and calculations, Morse and Heat Balance tests, Multipoint fuel injection system and Common Rail Direct injection systems, Ignition systems – Magneto, battery and electronic, Lubrication and Cooling systems, Concepts of supercharging and turbo charging – Emission measurement, emission reduction techniques.

UNIT V REFRIGERATION SYSTEMS 8

Refrigerants –Working principle of vapour compression systems - use of T-s and p-h diagrams, Effect

of sub cooling and super heating – Performance calculations – working principle of vapour absorption system - Comparison between vapour compression and absorption systems, Construction and working of Ammonia – Water, Lithium bromide – water systems (Description only)

(Use of standard Refrigerant property data book are permitted.)

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

Students will able to

CO1: Calculate the mean effective pressure and air standard efficiency of different gas power cycles.

CO2: Calculate the efficiency of reciprocating air compressor

CO3: Acquire the basic concepts of Internal combustion engines and combustion

CO4: Evaluate the performance test on IC engine.

CO5: Evaluate COP of vapour compression refrigeration systems.

TEXT BOOKS

1. Rajput. R. K., "Thermal Engineering", Laxmi Publications (P) Ltd., 10th Edition, 2017.
2. Kothandaraman.C.P., Domkundwar.S, Domkundwar. A.V., "A Course in Thermal Engineering", Dhanpat Rai & sons, 9th Edition, 2016.

REFERENCE BOOKS

1. Ganesan V., "Internal Combustion Engines", Fourth Edition, Tata McGraw-Hill Publishers, 2017.
2. Sarkar, B.K, "Thermal Engineering" Tata McGraw-Hill Publishers, 2017.
3. Rudramoorthy, R, "Thermal Engineering ", Tata McGraw-Hill Publishers, New Delhi, 2017.
4. Arora.C.P, "Refrigeration and Air Conditioning", Tata McGraw-Hill Publishers, 3rd Edition, 2013.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Calculate the mean effective pressure and air standard efficiency of different gas power cycles.	3	2	1						1	1	1		2		1
Co2	Calculate the efficiency of reciprocating air compressor	3	2	1						1	1	1		2		1
Co3	Acquire the basic concepts of Internal combustion engines and combustion	3	2	1						1	1	1	1	2		1
Co4	Evaluate the performance test on IC engine.	3	2	1						1	1	1		2		1
Co5	Evaluate COP of vapour compression refrigeration systems.	3	2	1						1	1	1		2		1

418MET04 **STRENGTH OF MATERIALS** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams and columns by various methods.
- To study the stresses and deformations induced in thin and thick shells.

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PRE-REQUISITES: Knowledge of Engineering Mechanics is required.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Simple stresses and strains in tension, compression and shear– Stress strain diagrams- Factor of safety-Poisson's ratio-Deformation of simple, compound and composite bars– Hooke's law– Elastic constants and their relation – Volumetric strains, Thermal stresses, State of stress in two dimensions - Stresses on inclined planes – Principal stresses - Principal planes – Maximum shear stress- Mohr's circle of stresses.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

Beam - Types of beams– Types of transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams - Over hanging beams. Theory of simple bending– Bending stress distribution for beam sections – Section modulus for beam sections – Flitched beams – Shear stress distribution for beam sections.

UNIT III TORSION 9

Torsion formulation stresses and deformation in solid and hollow circular shafts – Power transmitted to shaft – Shaft in series and parallel, Stresses in helical springs – Deflection of helical springs – Springs in series and parallel-Various spring applications.

UNIT IV DEFLECTION OF BEAMS AND COLUMNS 9

Computation of slopes and deflections in beams using Double Integration method, Macaulay's method and Area moment method.

Columns – End conditions, equivalent length of a column, Euler's equation, Slenderness ratio, Rankine's formula for columns.

UNIT V SPHERES, THIN AND THICK CYLINDERS 9

Stresses in thin and thick cylindrical shell due to internal pressure in circumferential and longitudinal - Deformation in thin and thick cylinders – Lame's theorem for thick cylinders- Spherical shells subjected to internal pressure –Deformation in spherical shells.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

Students will be able to

CO1: Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.

CO2: Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.

CO3: Apply basic equation of simple torsion in designing of shafts and helical spring

CO4: Calculate the slope and deflection in beams and columns using different methods.

CO5: Analyze and design thin and thick shells for the applied internal and external pressures.

TEXT BOOKS

1. Dr R. K. Bansal, "Strength of Materials" 4th Edition, Laxmi Publications (P) Ltd., 2018
2. R. K. Rajput, "Strength of Materials", Laxmi Publications (P) Ltd., 2018

REFERENCE BOOKS

1. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2016
2. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2015
3. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole, "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.
4. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013

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5. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.	2	2	3	1									2		
Co2	Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.	2	1	2	1						2			2	1	
Co3	Apply basic equation of simple torsion in designing of shafts and helical spring	2	2	3	2									2		
Co4	Calculate the slope and deflection in beams and columns using different methods.	2	2	3	2									2		
Co5	Analyze and design thin and thick shells for the applied internal and external pressures.	2	2	3										2		

418MET05 MANUFACTURING TECHNOLOGY – II

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know the fundamentals of metal cutting like cutting forces, tool materials, tool life, surface finish (machinability).
- To learn the parts and working principle of centre lathe and special purpose lathes.
- To gain the knowledge about special purpose machines used in industrial application.
- To study the abrasive processes and gear cutting.
- Able to know about basic usage of CNC machines, its construction and learning about program.

PRE-REQUISITES: Knowledge of Manufacturing Technology I and Engineering Materials and Metallurgy is required.

UNIT I THEORY OF METAL CUTTING 9

Introduction: Material removal processes, types of machine tools – theory of metal cutting: chip formation, orthogonal cutting, cutting tool materials, tool wear, tool life, surface finish, cutting fluids.

UNIT II CENTRE LATHE AND SPECIAL PURPOSE LATHES 9

Centre lathe, constructional features, cutting tool geometry, various operations, special attachments, machining time and power estimation. Capstan and turret lathes – Automats – single spindle, Swiss type, Automatic screw type, Multi spindle - Turret Indexing mechanism, Bar feed mechanism.

UNIT III SPECIAL PURPOSE MACHINES 9

Reciprocating machine tools: Shaper, Planer, Slotter - Milling: types, milling cutters, operations - Hole making: drilling - Quill mechanism, Reaming, Boring, Tapping - Sawing machine: Hack saw, band saw, circular saw; broaching machines: broach construction – push, pull, surface and continuous broaching machines.

UNIT IV ABRASIVE PROCESSES AND GEAR CUTTING 9

Abrasive processes: grinding wheel – specification and selection, types of grinding process – cylindrical grinding, surface grinding, Centreless grinding – Honing, Lapping, Super finishing, Polishing and Buffing, Gear cutting, Forming, Generation, Shaping, Hobbing.

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UNIT V CNC MACHINE TOOLS AND PART PROGRAMMING 9

Numerical control (NC) machine tools – CNC: types, constructional details, special features – Structural members – Slide ways –Linear bearings – Ball screws – Spindle drives and feed drives, Part Programming fundamentals – Manual programming – Computer Assisted Part Programming**.**

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Gain the knowledge on the fundamentals of metal cutting, merchant circle diagram, to solve tool life problems, types of wear, tool-tip temperature.

CO2: Learn various types of centre lathe and special purpose lathes.

CO3: Learn various types and operations of drilling machine, boring and reaming, broaching, shaping and planning, grinding, honing, lapping and super finishing operations.

CO4: Learn the manufacturing processes of abrasive processes and gear cutting.

CO5: Know the concepts of Part programming and about CNC machine tools.

TEXT BOOKS

1. Narang J.S., "CNC Machines and Automation", Dhanpat Rai & Co., 2016.
2. P.N. Rao, "Manufacturing Technology - Metal Cutting and Machine Tools (Vol-2)", Tata McGraw–Hill, New Delhi, 3rd Edition, 2013.
3. Hajra Choudry, "Elements of Work Shop Technology – Vol. II", Media Promoters, 2010.

REFERENCE BOOKS

1. Chapman. W. A. J, "Workshop Technology", Volume 3, CBS Publishers, 2018.
2. Serope KalpakJian, Steven R Schmid, "Manufacturing Engineering and Technology", Pearson, 7th Edition, 2013.
3. Milton C.Shaw, "Metal Cutting Principles", Oxford University Press, Second Edition, 2011.
4. P.N. Rao, "CAD/CAM Principles and Applications", Tata McGraw Hill, 3rd Edition 2011.
5. P.C. Sharma, "A Text Book of Production Engineering", S. Chand and Co. Ltd, 2010.
6. Rajput R.K, "A Text Book of Manufacturing Technology", Lakshmi Publications, 2010.
7. M.P.Groover and Zimers Jr., "CAD/CAM", Prentice Hall of India Ltd., 1st Edition, 2006.
8. HMT – "Production Technology", Tata McGraw-Hill, 23rd Edition, 2005.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Gain the knowledge on the fundamentals of metal cutting, merchant circle diagram, to solve tool life problems, types of wear, tool-tip temperature.	3												2		
Co2	Learn various types of centre lathe and special purpose lathes.	3	2	1	3	3								3		
Co3	Learn various types and operations of drilling machine, boring and reaming, broaching, shaping and planning, grinding, honing, lapping and super finishing operations.	3	3	2	3	3								3		1
Co4	Learn the manufacturing processes of abrasive processes and gear cutting.	3	1	2	3	3								3		2
Co5	Know the concepts of Part programming and about CNC machine tools.	3	2	1	2									2	2	

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418MET06 **PROCESS PLANNING AND COST ESTIMATION** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To know the use of work study leads to high productivity in a manufacturing unit.
- To study the steps involved in conducting a method study and apply the principles of motion economics.
- To know the importance of process planning in manufacturing environment.
- To get knowledge on step by step procedures in the cost estimation of any product.
- To learn the concept of pricing of material.

UNIT I WORK STUDY AND ERGONOMICS 10

Method study - Definition - Objectives-Motion economy- Principles - Tools and Techniques- Applications - Work measurements- Purpose - Use - Procedure - Tools and techniques- Standard time - Ergonomics - principles - Applications.

UNIT II PROCESS PLANNING 10

Definition - Objective - 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 III INTRODUCTION TO COST ESTIMATION AND BREAK EVEN ANALYSIS 7

Objective of cost estimation- costing - Cost accounting- classification of cost- Elements of cost – Break Even Analysis – Basic assumptions – Problems on Break Even Analysis – Break Even chart – Managerial use of Break Even Analysis.

UNIT IV COST ESTIMATION AND PRICING 8

Types of estimates - Methods of estimates - Data requirements and sources- Collection of cost- Allowances in estimation. Pricing practice – Full cost pricing – Marginal cost pricing – Going rate pricing – Bid pricing – Pricing for a rate of return.

UNIT V PRODUCTION COST ESTIMATION 10

Estimation of material cost, Labour cost and over heads, Allocation of overheads - Estimation for different types of jobs. Internal rate of return – Payback period – Net present value – Calculations on Cost benefit analysis.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

CO1: The students can make analyze on the techniques of work study and principles of ergonomics.
CO2: The students will know the concept of process planning and cost estimation for various product and process of industry.
CO3: The students will be familiar with types of estimation, pricing methods and production cost estimation.
CO4: The student will have an ability to know about the calculations of finding internal rate of return, net present value and payback period.
CO5: The students will have knowledge about estimation of production costs.

TEXT BOOKS

1. T.R. Banga and S.C.Sharma, "Mechanical Estimating and Costing", Khanna Publishers, 16th Edition, 2011.
2. Sinha.B.P., "Mechanical Estimating and Costing", Tata McGraw-Hill, Publishing Co., 2000.

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REFERENCE BOOKS

1. Varshney R.L and Maheshwari K.L., "Managerial Economics", S.Chand & Co., 2014.
2. Russell.R.S and Tailor, B.W, "Operations Management", Prentice Hall of India, 7th Edition, 2011.
3. Khan M.Y. and Jain P.K., "Financial Management", McGraw-Hill Publishing Co. Ltd, 6th Edition, 2011.
4. Kesavan R K, "Process Planning and Cost Estimation", New Age International (P) Ltd, 2009.
5. Dewett K.K and Jain J.D., "Elementary Economic Theory", S.Chand & Co., 2006.
6. Adithan M and Pabla B S, "Production Engineering Estimating and Costing", Konark Publishers, 1990

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students can make analyze on the techniques of work study and principles of ergonomics.		2		1								1	1		1
Co2	The students will know the concept of process planning and cost estimation for various product and process of industry.	3	2								1			3		2
Co3	The students will be familiar with types of estimation, pricing methods and production cost estimation.	3	2		2	2					1			3		
Co4	The student will have an ability to know about the calculations of finding internal rate of return, net present value and payback period.		1		2								2			2
Co5	The students will have knowledge about estimation of production costs.								2		3	2		2		

418MEP07 THERMAL ENGINEERING LABORATORY – I

L	T	P	C
0	0	3	1

COURSE OBJECTIVES:

- To expertise in the various thermodynamic concepts and principles.
- To conduct performance tests on a petrol engine and diesel engine, heat balance test, energy balance test on 4 stroke diesel engine.
- To expertise in the computerized VCR and emission measurement in S.I engine.
- To expertise in the computerized VCR and emission measurement in C.I engine.
- To compare justification on conventional fuel with alternative fuel.

PRE-REQUISITES: Knowledge of Engineering Thermodynamics and Thermal Engineering are required.

LIST OF EXPERIMENTS

CYCLE – 1

1. Valve Timing Diagram and Port Timing Diagram.
2. Performance Test on 4-stroke S.I Engine.
3. Performance Test on 4-stroke C.I Engine.
4. Heat Balance Test on 4-stroke Diesel Engine.
5. Morse Test on Multi - cylinder Petrol Engine.
6. Retardation Test to find Frictional Power of a Diesel Engine.

CYCLE – 2

7. Performance Test on Computerised VCR Engine.
8. Emission measurement in VCR Engine.
9. Determination of Viscosity of fuel oils.

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10. Determination of Flash Point and Fire Point of fuel.
11. Boiler efficiency and energy balance sheet.
12. Performance Test on two stage Reciprocating Air Compressor.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

Students will able to

CO1: Draw the valve and port timing diagram.
CO2: Perform experiments on the engine and draw the characteristics curve.
CO3: Perform experiments on computerised VCR S.I and C.I Engine.
CO4: Perform experiments on two stage Reciprocating Air Compressor and draw the characteristics curve.
CO5: Perform experiments to determine the properties of fuels and oils.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Draw the valve and port timing diagram.		2		1								1	1		1
Co2	Perform experiments on the engine and draw the characteristics curve.	2	1		1								1		2	1
Co3	Perform experiments on computerised VCR S.I and C.I Engine.	2	2		2								2	1	3	2
Co4	Perform experiments on two stage Reciprocating Air Compressor and draw the characteristics curve.	1	1		2								1			
Co5	Perform experiments to determine the properties of fuels and oils.		1		1								1			

418MEP08 MATERIAL TESTING AND METALLURGY LABORATORY

L	T	P	C
0	0	3	1

COURSE OBJECTIVES:

- To understand the basic principles of strength of materials to the undergraduate students through a series of experiments.
- To evaluate the mechanical properties of materials.
- To learn the concept of testing of materials under untreated and heat treated conditions.
- To understand the various microstructure of engineering materials by metallographic examination.
- To study about various non – destructive testing methods.

PRE-REQUISITES: Knowledge of Strength of Materials is required.

LIST OF EXPERIMENTS

PART – A

1. Tension test on a different specimen.
2. Shear test on metal specimen.
3. Torsion test on metal specimen.
4. Impact test on metal specimen.
5. Hardness test on metals - Brinell and Rockwell Hardness Number.
6. Deflection test on beams.
7. Compression test on springs.

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PART – B

8. Preparation of specimen for Metallographic examination of different engineering materials. Identification of microstructures of plain carbon steel, tool steel, gray CI, SG iron, Brass, Bronze & composites.
9. Heat treatment: Annealing, normalizing, hardening and tempering of steel. Hardness studies of heat – treated samples.
10. Non – destructive test experiments like,
    (a) Ultrasonic flaw detection
    (b) Magnetic crack detection
    (c) Dye penetration testing, to study the defects of Casted and Welded specimens.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

CO1: The student will have the knowledge to perform various mechanical testing.
CO2: The student will have the knowledge to prepare the specimens as per standard for mechanical testing.
CO3: The student will be able to analyze the microstructure of various engineering materials.
CO4: The students will have an ability to conduct experiment of materials under untreated and heat treated conditions.
CO5: The student will have the knowledge of performing various non – destructive tests.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The student will have the knowledge to perform various mechanical testing.	1	2		3	2								2		
Co2	The student will have the knowledge to prepare the specimens as per standard for mechanical testing.	1	2	1	3	2								2		1
Co3	The student will be able to analyze the microstructure of various engineering materials.	1	2		3	2								2		1
Co4	The students will have an ability to conduct experiment of materials under untreated and heat treated conditions.	1	2		3	2								2		1
Co5	The student will have the knowledge of performing various non – destructive tests.	1	2		3	2								2		1

418MEP09 MANUFACTURING TECHNOLOGY LABORATORY II

L	T	P	C
0	0	3	1

COURSE OBJECTIVES:

- To know the machining operations on Shaper, Lathe, Milling, Drilling and Slotting.
- To know about Milling Machine: Indexing methods, Cutting of gear tooth (Spur gear, Helical gear), face milling, grooving and cylindrical grinding operation.
- To understand the Surface Grinding operations and cylindrical grinding machine.
- To understand the working principles of Capstan and Turret lathes.
- To understand the working principles of gear hobbing operation.

PRE-REQUISITES: Knowledge of Manufacturing Technology I and II are required.

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LIST OF EXPERIMENTS

1. Two or more measurements in metal cutting experiment (Example: Shear Angle, Cutting Force, Tool Wear etc.)
2. One or More Exercises in Shaper, Slotter, Planner, Drilling, Milling Machines (Example: Round to Square, Dovetail in shaper, Internal keyway cutting in Slotter, Round to square in Planner, Drilling, Reaming and Tapping in Drilling machine, Gear Milling and Keyway milling in Milling machine.)
3. Two or More Exercises in Grinding / Abrasive machining (Example: Surface Grinding, Cylindrical Grinding.)
4. Two or More Exercises in Assembly of Machined Components for different fits. (Example: Parts machined using Lathes, Shapers, Drilling, Milling, and Grinding Machines etc.)
5. One or More Exercises in Capstan or Turret Lathes.
6. One or More Exercises in Gear Machining (Example: Gear Milling, Gear Hobbing etc.)

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Calculate machining time, metal removal rate for all machining operation.

CO2: Prepare the models with dimensional accuracy and tolerance using the special purpose machineries.

CO3: Find suitable machining process for various applications.

CO4: Perform Lathe, Milling and Drilling operations

CO5: Perform Grinding, Milling and Drilling operations.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Calculate machining time, metal removal rate for all machining operation.	1	1	2	3	1		1						2		1
Co2	Prepare the models with dimensional accuracy and tolerance using the special purpose machineries.	1	2	2	3	1								2		2
Co3	Find suitable machining process for various applications.	2	2	2	3	1								2		1
Co4	Perform Lathe, Milling and Drilling operations	1	2	3	3	1								2		1
Co5	Perform Grinding, Milling and Drilling operations.	1	1	2	3	1								2		2

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518MET01 **METROLOGY AND INSTRUMENTATION** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To comprehend the concept of measurement system and understanding the geometric dimensioning and tolerancing.
- To know about linear and angular measurement.
- To impart knowledge about screw thread measurement, gear measurement and surface finish.
- To know about the laser and advances in metrology.
- To know about measurement of mechanical parameter by using different instrument and devices in practical applications.

PRE-REQUISITES: Knowledge of Engineering Physics is required.

UNIT I **CONCEPT OF MEASUREMENT** **9**

General concept - Generalised measurement system-Units and standards-measuring instruments: Definitions of sensitivity, stability, range, accuracy and precision-static and dynamic response-repeatability-systematic and random errors-correction, calibration - Introduction to Dimensional and Geometric Toleranceing – interchangeability, Transducers-Types-L.V.D.T.

UNIT II **LINEAR AND ANGULAR MEASUREMENT** **9**

Definition of metrology-Linear measuring instruments: Vernier, Micrometer, Slip gauges and classification, Tool Makers Microscope - interferometery, optical flats, Comparators: limit gauges Mechanical, Pneumatic and Electrical comparators, applications. Angular measurements: -Sine bar, Sine center, Bevel Protractor and Angle Decker.

UNIT III **FORM MEASUREMENT** **9**

Measurement of screw threads: Thread gauges, floating carriage micrometer- measurement of gear tooth thickness: constant chord and base tangent method- Parkinson gear testing machine - radius measurements-surface finish: equipment and parameters, straightness, flatness and roundness measurements.

UNIT IV **LASER AND ADVANCES IN METROLOGY** **9**

Precision instruments based on laser-Principles- Laser interferometer-application in measurements and machine tool metrology- Coordinate Measuring Machine (CMM): need, construction, types, applications- computer aided inspection.

UNIT V **MEASUREMENT OF MECHANICAL PARAMETERS** **9**

Force, torque, power: mechanical, pneumatic, hydraulic and electrical type-Pressure measurement - Flow: Venturi, Orifice meter, Rotameter, Pitot tube-Temperature: bimetallic strip, thermocouples, pyrometer, electrical resistance thermistor.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Know about the working principle of generalized measurement system, the knowledge on calibration and definitions of various measurement terms.
CO2: Know about the concepts of linear and angular measuring instruments.
CO3: Know the concepts of screw thread, gear measurement and surface finish.
CO4: Gain knowledge on working principle of Laser devices and Coordinate measuring machine.
CO5: Gain knowledge on how to measure the instrumentation parameters like force, power, torque, flow and temperature.

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TEXT BOOKS

1. Jain R.K., "Engineering Metrology", Khanna Publishers, 21st Edition, 2012.
2. Alan S. Morris, "The Essence of Measurement", Prentice Hall of India, 1997.
3. D.S.Kumar, "Mechanical Measurements and Control", Metropolian Publisher, New Delhi, Revised and Enlarged, 2002.

REFERENCE BOOKS

1. Gupta S.C, "Engineering Metrology", Dhanpat rai Publications, 2018.
2. Thomas G.Beckwith, Roy D.Marangoni, John H.Lienhard V, "Mechanical Measurements", Pearson Education, 6th Edition, 2006.
3. Donald P Eckman, "Industrial Instrumentation", CBS, 2004.
4. Tayal A.K, "Instrumentation and Mechanical Measurements", Galgotia Publications 2000.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Know about the working principle of generalized measurement system, the knowledge on calibration and definitions of various measurement terms.	2		2							2				1	
Co2	Know about the concepts of linear and angular measuring instruments.	2		1							2					
Co3	Know the concepts of screw thread, gear measurement and surface finish.	2	1			2					2					1
Co4	Gain knowledge on working principle of Laser devices and Coordinate measuring machine.	2	2							2	2	2	2	1	1	
Co5	Gain knowledge on how to measure the instrumentation parameters like force, power, torque, flow and temperature.	2	2			2					2	2	3			1

518MET02 **HEAT AND MASS TRANSFER** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To study about the basic concepts of heat transfer modes.
- To analyze the relationship between fluid flow and convection heat transfer.
- To study about the fundamental concepts of radiation heat transfer to include both black body radiation and gray body radiation.
- To learn the thermal analysis and sizing of heat exchangers.
- To study about the basic concepts of mass transfer and its applications.

PRE-REQUISITES: Knowledge of Engineering Thermodynamics and Fluid mechanics is required.

UNIT I CONDUCTION **9**

Introduction and basics of heat transfer– Modes of Heat Transfer – Conduction, Convection and Radiation – Effect of temperature on thermal conductivity of different solids, liquids and gases – Fourier's law of Conduction – Newton's Law of cooling– Derivation of generalized heat conduction equation in Cartesian and Polar coordinates and its reduction to specific cases – OneDimensionalSteady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical Systems – Composite Systems – Conduction with Internal Heat Generation– Critical radius of insulation – Extended Surfaces – Unsteady state Heat Conduction – Lumped system Analysis –Semi-Infinite and Infinite solids –Use of Heisler's Charts.

UNIT II CONVECTION 9

Introduction to Convection Fundamentals – Velocity and Thermal boundary layer – Types of Convection –Dimensional analysis applied to forced and free convection– Dimensionless numbers and their physical significance–Forced Convection – External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar and Turbulent Flow – Combined Laminar and Turbulent – Flow over Bank of tubes – Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9

Boiling heat transfer – Pool boiling–Pool boiling curve–Flow boiling – Nusselt's theory of condensation– Condensation heat transfer, film condensation – Heat transfer correlations in boiling and condensation. Types of Heat Exchangers – Overall Heat Transfer Coefficient – Fouling Factors – Analysis of heat exchangers – LMTD Method and ε-NTU method.

UNIT IV RADIATION 9

Introduction to Radiation – Absorptivity, Reflectivity and Transmissivity– black, white and grey body, emissive power and emissivity– Laws of radiation – Planck, Stefan-Boltzmann, Wein's displacement, Kirchhoff's law, Lambert's cosine law – Radiation heat exchange between black bodies – Shape factor– Heat exchange between non-black bodies– Infinite parallel planes and infinite long concentric cylinders– Radiation shield– Heat exchange between two grey surfaces– electrical analogy – Introduction to Gas Radiation.

UNIT V MASS TRANSFER 9

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady State Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The student will be able to

CO1: Intrepret conduction, convection and radiation heat transfer.
CO2: Solve problems involving steady-state and transient heat conduction in simple geometries.
CO3: Determine values of the convection heat transfer co-efficient by applying empirical correlations.
CO4: Analyze heat transfer performance by using the method of log mean temperature difference and heat exchanger effectiveness.
CO5: Evaluate radiation heat transfer between black body and gray body surfaces.

TEXT BOOKS

1. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International Publishers, 5th Edition, 2017.
2. Yunus A Cengel and Afshin J Ghajar, "Heat and Mass transfer" Tata McGraw-Hill, New Delhi, 5th Edition, 2015.

REFERENCE BOOKS

1. Frank P. Incropera, David P. Dewitt, Theodore L. Bergman and Adrienne S Lavine, "Fundamentals of Heat and Mass Transfer", Wiley, 7th Edition, 2013.
2. Kothandaraman C.P "Fundamentals of Heat and Mass Transfer" New Age International Publishers, New Delhi, 4th Edition, 2012.
3. Nag P.K, "Heat and Mass Transfer", Tata McGraw-Hill Education, New Delhi, 3rd Edition, 2011.
4. Holman J.P and Souvik Bhattacharyya, "Heat Transfer", McGraw-Hill Education, 10th Edition, 2010.

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5. Rudramoorthy R and Mayilsamy K, “Heat and Mass Transfer”, Pearson Education, 2nd Edition, 2010.
6. Yadav R, “Heat and Mass Transfer”, Central Publishing House, 4th Edition, 2004.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Intrepret conduction, convection and radiation heat transfer.	2	2		2	2					1			3		3
Co2	Solve problems involving steady-state and transient heat conduction in simple geometries.	2	2		2	2					1			3		1
Co3	Determine values of the convection heat transfer co-efficient by applying empirical correlations.	2	2		2	2					1			3		2
Co4	Analyze heat transfer performance by using the method of log mean temperature difference and heat exchanger effectiveness.	2	2		2	2					1			3		2
Co5	Evaluate radiation heat transfer between black body and gray body surfaces.	1												1		1

518MET03 **DYNAMICS OF MACHINERY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the method of static force analysis and dynamic force analysis of mechanism and machines.
- To study the undesirable effects of unbalance in rotors and engines.
- To study the free vibration and degree of freedom.
- To understand the functions of forced vibration.
- To understand the principles of governors and gyroscopes.

PRE-REQUISITES: Knowledge of Kinematics of Machinery is required.

UNIT I FORCE ANALYSIS AND FLYWHEELS **9**

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, Crankshaft Torque-Engine shaking Forces, Turning moment diagrams, Flywheels of engines and punch press.

UNIT II BALANCING **9**

Static and dynamic balancing, Balancing of rotating masses, Balancing of a single-cylinder Engine - Primary and secondary unbalanced forces, Balancing of Multi-cylinder Engines - Firing order.

UNIT III FREE VIBRATION **9**

Basic features of vibratory systems, Basic elements and lumping of parameters, Degrees of freedom - Single degree of freedom - 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.

UNIT IV FORCED VIBRATION **9**

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

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UNIT V MECHANISMS FOR CONTROL 9

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 Automobiles, ships & Aeroplanes.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The student will be able to

CO1: Predict the force analysis in the mechanical system.
CO2: Balance the static and dynamic balancing of rotating and reciprocating masses.
CO3: Analyse the free vibration in a single degree of freedom.
CO4: Analyse force vibration caused by unbalancing, vibration transmissibility and isolation.
CO5: Find the role of governors and gyroscopes used for speed control and stability control.

TEXT BOOKS

1. Rattan.S.S, "Theory of Machines", Tata McGraw Hill Inc, 5th Edition, 2019.
2. Shigley J.E., Uicker J.J., & Pennock G.R., "Theory of Machines and Mechanisms", Oxford University Press, 5th Edition, 2017.

REFERENCES BOOKS

1. Dr.R.K.Bansal and Dr.J.S. Brar, "Theory of Machines", Lakshmi Publications, New Delhi, 2011.
2. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 3rd Edition2011.
3. Gupta B.V.R, "Theory of Machines: Kinematics and Dynamics", I K International PublishingHouse (P) Ltd, New Delhi,2010.
4. Ambekar A. G., "Mechanism and Machine Theory", Prentice-Hall of India Private Limited, New Delhi, 2007.
5. Rao J.S. and Dukkipati R.V., "Mechanism and Machine Theory", Wiley-Eastern Limited, New Delhi, 2007.
6. P.L.Ballaney, "Theory of Machines and Mechanisms", 23rd Edition, Khanna Publications, New Delhi, 2003.
7. Sadhu Singh,"Theory of Machines", 2nd Edition, Pearson Education India, South Asia, 2006.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Predict the force analysis in the mechanical system.	2	2	1	1		1	1						2		1
Co2	Balance the static and dynamic balancing of rotating and reciprocating masses.	2	2	1	2									1		1
Co3	Analyse the free vibration in a single degree of freedom.	2	2	1	2								1	1		
Co4	Analyse force vibration caused by unbalancing, vibration transmissibility and isolation.	2	3	1	2								1	1		2
Co5	Find the role of governors and gyroscopes used for speed control and stability control.	2	2	1	3	1	1	1						1		2

518MET04 DESIGN OF MACHINE ELEMENTS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To familiarize the various steps involved in the Design Process.

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- To acquire knowledge on standards and procedure for designing shaft and coupling.
- To interpret the design of bolt, welded and riveted joint so as to meet desired needs within the realistic constraints.
- To analyse the design of energy storing elements in order to perform safely with their intended functions
- To impart the design principles to evaluate the bearings in order to satisfy the strength and functional requirements.

PRE-REQUISITES: Knowledge of Strength of Materials is required.

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9

Introduction to the design process - factor influencing machine design, Selection of materials based on mechanical properties, Direct, Bending and torsional stress equations, Impact and shock loading, Calculation of principal stresses for various load combinations, Eccentric loading, Factor of safety, Theories of failure, Stress concentration, Design for variable loading - Soderberg, Goodman and Gerber relations.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 9

Design of solid and hollow shafts based on strength, rigidity and critical speed, Design of keys, key ways and splines, Design of rigid couplings – Muff, Split muff and flange coupling, Design of flexible couplings - Bushed pin and Oldham coupling.

UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 9

Threaded fasteners, Design of bolted joints including eccentric loading, Knuckle joint, Cotter joints, Design of welded joints including eccentric loading, Riveted joints for structures including eccentric loading.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS 9

Various types of springs, Design of helical springs under compression and tension, Design of leaf springs, Design of flywheels considering stresses in rims and arms for engines and punching machines.

UNIT V DESIGN OF BEARINGS 9

Theory of lubrications, Sliding contact and rolling contact bearings, Design of hydrodynamic journal bearings, McKee's equations, Sommerfield number, Raimondi & Boyd graphs, Selection of rolling contact bearings.

TOTAL HOURS: 45 PERIODS

Note: (Use of P S G Design Data Book is permitted in the end semester examination)

COURSE OUTCOMES

The students will be able to

CO1: Apply the concept of steady stresses in design of machine elements.
CO2: Design shafts and couplings for various applications.
CO3: Design temporary and permanent joints.
CO4: Design various energy storing elements.
CO5: Select bearings for specific applications.

TEXT BOOKS

1. Shigley J.E and Mischke C. R., "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill, 2015.
2. Bhandari V.B, "Design of Machine Elements", Third Edition, Tata McGraw-Hill Book Co, 2010.

REFERENCE BOOKS

1. Orthwein W, "Machine Component Design", Jaico Publishing Co, digitized 2010.
2. Ugural A.C, "Mechanical Design - An Integrated Approach", McGraw-Hill Book Co, 2004.
3. Spotts M.F., Shoup T.E., "Design and Machine Elements", Pearson Education, 2004.
4. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Apply the concept of steady stresses in design of machine elements.	3	3	3	3	2	1	1	1	2	1	1	2	3	2	2
Co2	Design shafts and couplings for various applications.	3	3	3	3	2	1	1	1	2	1	1	2	3	2	2
Co3	Design temporary and permanent joints.	3	3	3	3	2	1	1	1	2	1	1	2	3	2	2
Co4	Design various energy storing elements.	3	3	3	3	2	1	1	1	2	1	1	2	3	2	2
Co5	Select bearings for specific applications.	2	2	3	2	2	1	1	1	2	1	1	2	3	2	2

518MET05 APPLIED HYDRAULICS AND PNEUMATICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To familiar with applications, advantages of the fluid power engineering and transmission systems.
- To learn the function of fluid power system in hydraulic system and components.
- To know the function of fluid power system with control components, accessories of hydraulic systems.
- To learn the function of fluid power system for pneumatic system and components.
- To draw the invention of circuits for hydraulic and pneumatic power systems in the industrial applications.

PRE-REQUISITES: Knowledge of Engineering Physics I, Basics of Civil and Mechanical Engineering and Fluid Mechanics and Machinery are required.

UNIT I FLUID POWER PRINCIPLES AND FUNDAMENTALS 6

Introduction to Fluid power- Advantages and Applications- Types of fluid power systems – Fluid power symbols-Types of fluids- Properties of hydraulics fluids – Applications of Pascal's Law- Principles of flow –Work, Power and Torque-Darcy–Weisbach equation, Losses in pipe, valves and fittings.

UNIT II HYDRAULIC SYSTEMS AND COMPONENTS 9

Sources of Hydraulic power: Pumping theory – Pump classification- Variable displacement pumps for Gear pump, Vane pump and Piston pump Construction, working principle, advantages, disadvantages and Performance-Types of hydraulic cylinders- Linear cylinders, Rotary cylinders, construction, working principle, advantages, disadvantages and applications- Cushioning Mechanism in cylinder.

UNIT III CONTROL COMPONENTS, ACCESSORIES OF HYDRAULIC SYSTEMS 9

Control Components: Direction control, Flow control and Pressure control valves- Types, Construction and Operation, Applications – Types of actuation- Accessories: Reservoirs, Accumulators, Intensifiers and Pressure Switches- Applications.

UNIT IV PNEUMATIC SYSTEMS AND COMPONENTS 9

Properties of air-Compressors- (FRL)Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Servo systems and Proportional valves -Introduction the fluidics devices -Pneumatic logic circuits.

UNIT V HYDRAULIC AND PNEUMATIC CIRCUITS AND TROUBLESHOOTING 12

Hydraulic circuits: Regenerative (with accumulator devices), Fail-safe, Speed control, Sequence, Electro hydraulic circuits-Case studies of to draw the circuits of hydraulic system for the Shaping and Punching operation (with intensifier device).

Pneumatic circuits: Sequential circuit design for simple application (of two or three cylinders) using cascade method-Electro pneumatic circuits- Fluid power circuits failures and troubleshooting.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

CO1: The students are able to comprehend the concept of fluid power systems and applications in industries.

CO2: The students are able to select appropriate fluid power driving system and actuators for any given applications.

CO3: The students are able to know about the use of control components, accessories of hydraulic systems.

CO4: The students are able to gain knowledge on pneumatic system and components.

CO5: An ability to design the hydraulic and pneumatic circuits and exposure of diagnose or troubleshoot the power systems.

TEXT BOOKS

1. Majumdar, S.R., “Oil Hydraulics Systems- Principles and Maintenance”, McGraw Hill, 2017.
2. Anthony Esposito,” Fluid Power with Applications”, Pearson Education, 2013.

REFERENCES BOOKS

1. Shanmugasundaram.K, “Hydraulic and Pneumatic controls”, S. Chand & Co, 2013.
2. Srinivasan .R, “Hydraulic and Pneumatic controls”, McGraw Hill, 2008.
3. Micheal J, Pinches and Ashby, J.G., “Power Hydraulics”, Longman Higher Education, 1988.
4. Dudley, A Pease and John J Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.
5. Anthony Lal, “Oil hydraulic in the service of industry”, Allied publishers, 1982.

WEB REFERENCE:

www.nptel.ac.in

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students are able to comprehend the concept of fluid power systems and applications in industries.	3	1			1			1	1			2			
Co2	The students are able to select appropriate fluid power driving system and actuators for any given applications.	2	1								2			1		
Co3	The students are able to know about the use of control components, accessories of hydraulic systems.	2	1	2					1	1			1		1	1
Co4	The students are able to gain knowledge on pneumatic system and components.	2	3	1	1	1					1		2	1		

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Co5	An ability to design the hydraulic and pneumatic circuits and exposure of diagnose or troubleshoot the power systems.	2	1	2	1	1	1				2		2	1		1

518MEP07 METROLOGY AND INSTRUMENTATION LABORATORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To gain knowledge on the basic principles of measurements.
- To learn the various linear and angular measuring equipments, their principle of operation and applications.
- To learn about various methods of measuring Mechanical parameters.
- To calculate least count of measuring equipments.
- To know about the procedure of calibration for various measuring devices.

PRE-REQUISITES: Knowledge of Metrology and Instrumentation is required.

LIST OF EXERCISES

1. Calibration of Vernier / Micrometer / Dial Gauge.
2. Checking Dimensions of part using slip gauges.
3. Measurements of Gear Tooth Dimensions.
4. Measurement of Angle using Sine bar / Sine center / Tool makers microscope.
5. Measurement of Straightness and Flatness using Autocollimator.
6. Measurement of Thread parameters.
7. Setting up of Comparators for inspection (Mechanical / Pneumatic / Electrical).
8. Measurement of Temperature using Thermocouple / Pyrometer.
9. Measurement of Displacement.
10. Measurement of Force.
11. Measurement of Torque.
12. Measurement of Vibration / Shock.
13. Measurement of Dimensional attributes like Cylindricity, Circularity, Flatness, Straightness by using Coordinate Measuring Machine.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Perform calibration process for micrometer, dial gauge, vernier caliper.
CO2: Perform experiments by using sine bar, gear tooth vernier caliper and tool makers microscope.
CO3: Use autocollimator for straightness and flatness measurement and thermocouple for temperature measurement.
CO4: Learn about coordinate measuring machine for linear and angular measurements.
CO5: Identify sources of variability, error and uncertainties.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Perform calibration process for micrometer, dial gauge, vernier caliper.					3				2				1		
Co2	Perform experiments by using sine bar, gear tooth vernier caliper and tool makers microscope.		2			2				2	1				1	
Co3	Use autocollimator for straightness and flatness measurement and thermocouple for temperature measurement.				2								3			1

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Co4	Learn about coordinate measuring machine for linear and angular measurements.												3		1	
Co5	Identify sources of variability, error and uncertainties.				2						2					1

518MEP08 **HEAT TRANSFER LABORATORY** **L T P C**
0 0 2 1

COURSE OBJECTIVES:

- To demonstrate the concepts discussed in the heat transfer course.
- To experimentally determine thermal conductivity and heat transfer coefficient through various materials.
- To experimentally measure effectiveness of heat exchangers.
- To conduct performance tests on refrigeration systems.
- To determine emissivity of radiation surface with different surfaces namely polished, gray and metal black.

PRE-REQUISITES: Knowledge of Thermal Engineering is required.

LIST OF EXPERIMENTS

Conduction Mode Experiments

1. Heat transfer through composite wall.
2. Thermal Conductivity of insulating powder.
3. Thermal Conductivity measurement by guarded plate method.
4. Thermal Conductivity of pipe insulation using lagged pipe apparatus.
5. Thermal Conductivity of metal rod.

Convection Mode Experiments

6. Heat transfer from a pin-fin apparatus (Natural Convection).
7. Heat transfer from a pin-fin apparatus (Forced Convection).
8. Heat transfer in natural convection (Vertical cylinder).
9. Heat transfer in forced convection (Inside tube).

Radiation Mode Experiments

10. Emissivity measurement apparatus.
11. Stefan Boltzmann apparatus.

Experiments on applications of heat transfer

12. Effectiveness of parallel flow heat exchanger.
13. Effectiveness of counter flow heat exchanger.
14. Determination of heat transfer coefficient in shell and tube heat exchanger.
15. Determination of COP of a refrigeration system.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Practically relate to concepts discussed in the heat transfer course.
CO2: Conduct various experiments to determine thermal conductivity of various materials.
CO3: Conduct performance tests and thereby improve effectiveness of heat exchangers.
CO4: Conduct performance tests and improve COP of refrigeration systems.
CO5: To determine the overall heat transfer coefficient for a composite wall.

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Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Practically relate to concepts discussed in the heat transfer course.		2		1								1	1		1
Co2	Conduct various experiments to determine thermal conductivity of various materials.	2	1		1								1		2	
Co3	Conduct performance tests and thereby improve effectiveness of heat exchangers.	2	2		2								1		3	2
Co4	Conduct performance tests and improve COP of refrigeration systems.		1		2								2		2	2
Co5	To determine the overall heat transfer coefficient for a composite wall.	1	1		1								1			1

518MEP09 **DYNAMICS LABORATORY** **L T P C**
0 0 2 1

COURSE OBJECTIVES:

- To study the kinematics of different mechanisms.
- To study the mass moment of inertia of body by experimentally.
- To study the cam and its applications.
- To study the natural frequency of vibratory systems.
- To study the principles of governors and gyroscopic.

PRE-REQUISITES: Knowledge of Kinematics and Dynamics of Machinery is required.

LIST OF EXPERIMENTS

1. a) Study of gear parameters.
   b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
2. a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.
   b) Kinematics of single and double universal joints.
3. a) Determination of Mass moment of inertia of Flywheel and Axle system.
   b) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
   c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
4. Motorized gyroscope - Study of gyroscopic effect and couple.
5. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
6. Cams - Cam profile drawing, Motion curves and study of jump phenomenon.
7. a) Single degree of freedom of Spring Mass System - Determination of Natural Frequency and verification of Laws of springs - Damping coefficient determination.
   b) Multi degree of freedom of suspension system - Determination of influence coefficient.
8. a) Determination of torsional natural frequency of single and Double Rotor systems-Undamped and Damped Natural frequencies.
   b) Vibration Absorber - Tuned vibration absorber.
9. The Vibration of the Equivalent Spring mass system - undamped and damped vibration.
10. Whirling of shafts - Determination of critical speeds of shafts with concentrated loads.
11. a) Balancing of rotating masses.
    b) Balancing of reciprocating masses.
12. a) Transverse vibration of Free-Free beam - with and without concentrated masses.
    b) Forced Vibration of Cantilever beam - Mode shapes and natural frequencies.
    c) Determination of transmissibility ratio using a vibrating table.

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TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will have the ability to

CO1: Demonstrate the principles of kinematics and dynamics of machinery.
CO2: Determine mass-moment of inertia for simple bodies experimentally.
CO3: Design the cam and follower for different applications.
CO4: Analyze natural frequency of vibratory systems.
CO5: Analyze governors and gyroscopes.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Demonstrate the principles of kinematics and dynamics of machinery.		2		1								1	1		1
Co2	Determine mass-moment of inertia for simple bodies experimentally.	2	1		1								1		2	
Co3	Design the cam and follower for different applications.	2	2		2								1		3	
Co4	Analyze natural frequency of vibratory systems.		1		3								2			2
Co5	Analyze governors and gyroscopes.				2			1					1			2

518MEE01 ADVANCED MANUFACTURING PROCESSES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To gain knowledge on advanced manufacturing processes and their applications.
- To learn about mechanical energy based processes and its process parameters.
- To know the electrical energy based processes and its process parameters.
- To be familiar with chemical and electro-chemical energy based processes and its process parameters.
- To identify the thermal energy based processes and its process parameters.

PRE-REQUISITES: Knowledge of Manufacturing Technology II is required.

UNIT I INTRODUCTION **5**

Introduction of Unconventional machining Processes - Need for Unconventional machining Processes - Classification – Design Considerations, Process economics – Introduction to Abrasives and Bond abrasives.

UNIT II MECHANICAL ENERGY BASED PROCESSES **10**

Abrasive Jet Machining (AJM) - Water Jet Machining (WJM) - Abrasive Water Jet Machining (AWJM) - Ultrasonic Machining. (USM). Working Principles - Equipments - Process parameters – Material Removal Rate - Applications.

UNIT III ELECTRICAL ENERGY BASED PROCESSES **8**

Electro Discharge Machining (EDM) - Working Principle-Equipments-Process Parameters-Surface Finish and MRR- Electrode / Tool - Power and control Circuits-Tool Wear - Dielectric - Flushing - Wire cut EDM Process - Applications.

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UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 12

Chemical machining (CHM) and Electro-Chemical machining (ECM)-Etchants- Maskants-Techniques of applying maskants-Process Parameters - Surface finish and MRR-Applications. Principles of ECM-Equipments-Surface Roughness and MRR- Electrical circuits-Process Parameters-ECG and ECH - Applications.

UNIT V THERMAL ENERGY BASED PROCESSES 10

Laser Beam Machining and Drilling (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining (EBM) - Principles - Equipment -Types - Beam control techniques – Applications, Introduction to 3D printing.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Demonstrate the basic operation of various unconventional manufacturing processes.

CO2: Apply the knowledge of mechanical energy based processes in their projects and interpret the importance of different processes for various applications.

CO3: Apply the knowledge of electrical energy based processes in their projects and to identify the various parameters and their influence on the performance of the processes.

CO4: Explain the various chemical machining processes and its effects on environment.

CO5: Explain thermal energy based processes like laser beam machining, electron beam machining and plasma arc machining, cutting and spraying.

TEXT BOOKS

1. Vijay.K. Jain, "Advanced Machining Processes", Allied Publishers Pvt. Ltd., New Delhi, 2009.
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi, 1980.

REFERENCE BOOKS

1. M Adithan, “Unconventional Machining Processes”, Atlantic Publishers, 2009.
2. Serope KalpakJian, Steven R Schmid, “Manufacturing Processes for Engineering Materials”, Pearson Education, 5th Edition, 2007.
3. Mc Geough, "Advanced Methods of Machining", Chapman and Hall, Springer, 1988.
4. Benedict. G.F., "Non traditional Manufacturing Processes", Marcel Dekker Inc., New York, 1987.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Demonstrate the basic operation of various unconventional manufacturing processes.	2		2				2			2					1
Co2	Apply the knowledge of mechanical energy based processes in their projects and interpret the importance of different processes for various applications.	2			2						2				1	
Co3	Apply the knowledge of electrical energy based processes in their projects and to identify the various parameters and their influence on the performance of the processes.	2				2			1		2	1		1		
Co4	Explain the various chemical machining processes and its effects on environment.	2						2			2					1
Co5	Explain thermal energy based processes like laser beam machining, electron beam machining and plasma arc machining, cutting and spraying.	3	2		1	2			1		2					2

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518MEE02 **RENEWABLE ENERGY SOURCES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To explain the concept of various forms of solar energy.
- To outline the utilization of wind energy for both domestic and industrial applications.
- To know about the cost economics and eco-friendly nature of bio energy as compared to fossil fuels.
- To provide an overview of global renewable energy resources.
- To impart knowledge in new energy resources and estimation.

PRE-REQUISITES: Basic Knowledge in Fluid Mechanics and Thermodynamics are required.

UNIT I SOLAR ENERGY **9**

Solar Radiation - Measurements of solar Radiation and sunshine - Solar Thermal Collectors - Flat Plate and Concentrating Collectors - Solar Applications - Fundamentals of Photo Voltaic Conversion - Solar Cells - PV Systems - PV Applications.

UNIT II WIND ENERGY **9**

Wind Data and Energy Estimation - Wind Energy Conversion Systems - Wind Energy generators and its performance - Wind Energy Storage - Applications - Hybrid systems.

UNIT III BIO – ENERGY **9**

Biomass, Biogas, Source, Composition, Technology for utilization - Biomass direct combustion - Biomass gasifier - Biogas plant - Digesters - Ethanol production - Bio diesel production and economics.

UNIT IV OTEC, TIDAL, GEOTHERMAL AND HYDEL ENERGY **9**

Tidal energy - Wave energy - Data, Technology options - Open and Closed OTEC Cycles - Small hydro, turbines - Geothermal energy sources, Power plant and environmental issues.

UNIT V NEW ENERGY SOURCES **9**

Hydrogen generation, storage, transport and utilization- Applications: power generation, transport - Fuel cells - technologies, types - Economics and the power generation.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Identify the techniques used to utilize the solar energy effectively.
CO2: Appreciate the need of wind energy and the various components used in energy generation and know the classifications.
CO3: Acquire the knowledge of biomass energy resources and their classification, types of biogas plant applications.
CO4: Acquire the knowledge of modern energy conversion technologies.
CO5: Get awareness of new energy and economics of power generation.

TEXT BOOKS

1. Sukhatme S.P., "Solar Energy", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018.
2. Rai G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 5th Edition 2014.

REFERENCE BOOKS

1. Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 3rd Revised Edition, 2015.
2. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press,

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U.K., 2012.
3. Tiwari G.N., "Solar Energy - Fundamentals Design, Modelling and Applications", Narosa Publishing House, New Delhi, 2012.
4. Freris L.L., "Wind Energy Conversion Systems", Prentice Hall, UK, 1990.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Identify the techniques used to utilize the solar energy effectively.	2	2	2		1							1	1	1	2
Co2	Appreciate the need of wind energy and the various components used in energy generation and know the classifications.	2	1	2		1		1					1	1		1
Co3	Acquire the knowledge of biomass energy resources and their classification, types of biogas plant applications.	3	1	2		1	2	1					1	1	1	1
Co4	Acquire the knowledge of modern energy conversion technologies.	1	1	2		1	1						2	1		2
Co5	Get awareness of new energy and economics of power generation.	2	1	2		1	2						2		1	1

518MEE03 INTRODUCTION TO NANOTECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know about the fundamentals of Nanotechnology
- To give a general introduction to different classes of nanomaterials
- To impart basic knowledge on various synthesis and characterization techniques involved in nanotechnology.
- To make the learner familiarize with nanotechnology potentialities.
- To study about the applications of nanotechnology.

UNIT I BASICS AND SCALE OF NANOTECHNOLOGY 9

Introduction – Scientific revolutions –Time and length scale in structures – Definition of a nanosystem –Dimensionality and size dependent phenomena – Surface to volume ratio -Fraction of surface atoms – Surface energy and surface stress- surface defects-Properties at nanoscale (optical, mechanical, electronic and magnetic).

UNIT II DIFFERENT CLASSES OF NANOMATERIALS 9

Classification based on dimensionality-Quantum Dots,Wells and Wires- Carbon- based nano materials (buckyballs, nanotubes, graphene)– Metal based nano materials (nanogold, nanosilver and metal oxides) -Nanocomposites- Nanopolymers – Nanoglasses –Nano ceramics -Biological nanomaterials.

UNIT III SYNTHESIS OF NANOMATERIALS 9

Chemical Methods: Metal Nanocrystals by Reduction - Solvothermal Synthesis- Photochemical Synthesis - Sonochemical Routes- Chemical Vapor Deposition (CVD) – Metal Oxide - Chemical Vapor Deposition (MOCVD).Physical Methods:Ball Milling – Electro deposition - Spray Pyrolysis - Flame Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE).

UNIT IV FABRICATION AND CHARACTERIZATION OF NANOSTRUCTURES 9

Nanofabrication: Photolithography and its limitation-Electron-beam lithography (EBL)- Nanoimprint – Soft lithography patterning. Characterization: Field Emission Scanning Electron Microscopy (FESEM) – Environmental Scanning Electron Microscopy (ESEM) - High Resolution Transmission Electron

Microscope (HRTEM) –Scanning Tunneling Microscope (STM)-Surface Enhanced Raman Spectroscopy (SERS)- X-ray Photoelectron Spectroscopy (XPS) - Auger Electron Spectroscopy (AES) – Rutherford Backscattering Spectroscopy (RBS).

UNIT V APPLICATIONS 9

Solar energy conversion and catalysis - Molecular electronics and printed electronics -Nanoelectronics -Polymers with a special architecture - Liquid crystalline systems - Linear and nonlinear optical and electro-optical properties, Applications in displays and other devices -Nanomaterials for data storage - Photonics, Plasmonics- Chemical and biosensors -Nanomedicine and Nanobiotechnology – Nanotoxicology challenges.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will able to

CO1: Have a working knowledge of Nano science and nanotechnology, including theory and experiments.

CO2: Get ideas about various microscopic techniques used for studying nanomaterials was understood.

CO3: Get knowledge on synthesis of Nano materials and their applications.

CO4: Learn different lithographic techniques used for nanofabrication.

CO5: Get knowledge on plasmonics and photonics for developing various applications such as optoelectronics gained.

TEXT BOOKS

1. Pradeep T., “A Textbook of Nanoscience and Nanotechnology”, Tata McGraw Hill Education Pvt. Ltd., 2017.
2. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, 2002.

REFERENCE BOOKS

1. Lindy Bouman, “Organic and Inorganic Nanostructures”, Willford Press, 1st Edition, 2016.
2. Dupas C, Houdy P, Lahmani M., “Nanoscience: Nanotechnologies and Nanophysics”, Springer-Verlag Berlin Heidelberg, 2007.
3. Nabok A, “Organic and Inorganic Nanostructures”, Artech House Publishers, 2005.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Have a working knowledge of Nano science and nanotechnology, including theory and experiments.	2	3	2			3	3		1		2		1		
Co2	Get ideas about various microscopic techniques used for studying nanomaterials was understood.	3		3	2					1						
Co3	Get knowledge on synthesis of Nano materials and their applications.	3		2	3		1	1				1				1
Co4	Learn different lithographic techniques used for nanofabrication.	1	2	1	2	1					2					
Co5	Get knowledge on plasmonics and photonics for developing various applications such as optoelectronics gained.	1	1	1	1	2	1	1							1	

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518MEE04 **NON DESTRUCTIVE TESTING AND MATERIALS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand principle behind various NDT techniques.
- To study about NDT equipments and accessories.
- To learn working procedures of various NDT techniques.
- To know the applications and recent trends in NDT.
- To know about the NDT techniques for flaw detection.

PRE-REQUISITES: Knowledge of Manufacturing technology and Material science are required.

UNIT I INTRODUCTION AND VISUAL INSPECTION TECHNIQUE 6

Introduction to various Non-destructive methods – Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for Visual inspection - Applications.

UNIT II LIQUID PENETRANT TESTING AND MAGNETIC PARTICLE TESTING 10

Physical principles, procedure for liquid penetrant testing, Characteristics of penetrants – Developers, Penetrant testing methods – Applications, Principle of MPT, Magnetising procedure used for testing a component, Equipment used for MPT, Applications

UNIT III EDDY CURRENT TESTING AND ACOUSTIC EMISSION TESTING 10

Principles, Instrumentation for ECT, Various Techniques – High sensitivity Techniques, Single, Multi and high frequency ECT, Applications - Principle of AET, AE signal parameters, Applications.

UNIT IV ULTRASONIC TESTING 10

Introduction, Principle of operation, Types of Ultrasonic propagation – Ultrasonic probes. Types of Ultrasonic Transducers – Testing Techniques and Inspection methods – Pulse Echo, ABC scans, Transmission angle beam, Testing procedures and its applications.

UNIT V RADIOGRAPHY, COMPARISON AND SELECTION OF NDT METHODS 9

Basic principle, Effect of radiation of Film, Radiographic Imaging – Inspection Techniques – Single wall single image, Double wall Penetration & Multiwall Penetration technique – Comparison and selection of various NDT techniques.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Apply scientific and technical knowledge to the field of non-destructive testing.
CO2: Use the relevant non-destructive testing methods for various engineering practice.
CO3: Analyse and interpret the defects to improve the overall quality of products.
CO4: Develop their skills in inspection of the components.
CO5: Increase overall reliability of the products by selection of suitable inspection techniques.

TEXT BOOKS

1. J Prasad, and CGK Nair, “Non Destructive Test and Evaluation of Materials”, Tata McGraw Hill, 2017.
2. Ravi Prakash, “Non Destructive Testing Techniques”, New Age International, 1st Edition revised, 2010.

REFERENCE BOOKS

1. Baldev Raj and B.Venkataraman, “Practical Radiography”, Narosa Publishing House, 2004.

2. Baldev raj, T Jeyakumar, M. Thavasimuthu "Practical Non-Destructive Tesitng" Narosa Publishing house, New Delhi, 2002.
3. Krautkramer.J, "Ultra Sonic Testing of Materials", 1st Edition, Springer – Verlag Publication, New York, 1996.
4. Birchan.B, "Non-Destructive Testing", Oxford University Press, London, 1975.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Apply scientific and technical knowledge to the field of non-destructive testing.	3		2	1	2					1		1		2	1
Co2	Use the relevant non-destructive testing methods for various engineering practice.	3	2	2	1	2		1			1		1	1		
Co3	Analyse and interpret the defects to improve the overall quality of products.	3		1	1	2					1		1		2	
Co4	Develop their skills in inspection of the components.	2	1	2	1	2		1			1		1			1
Co5	Increase overall reliability of the products by selection of suitable inspection techniques.	1		1			2					2	2	1		

518MEE05 DESIGN CONCEPTS IN ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce basic concepts in design process.
- To provide knowledge on tools in engineering design.
- To learn material selection and materials in designing to machine members.
- To impart basic knowledge in material processing for designing machine members.
- To identify legal, ethical environmental and safety issue in design and quality Engineering.

UNIT I THE DESIGN PROCESS **8**

The Design Process - Need identification – Design requirements – Product Life Cycle – Morphology of Design steps of Product Design – Conceptual Design, Embodiment Design, Detailed Design – Concurrent Engineering – CAD & CAM, Human factors in Design.

UNIT II TOOLS IN ENGINEERING DESIGN **9**

Creativity and Problem solving, Decision Theory, Modeling – Role of models in Engineering Design, Mathematical Modeling, Geometric modeling, Finite Element Modeling, Rapid Prototyping – Simulation Finite Difference method, Monte Carlo method – Optimization – Search Methods, Geometric programming, Structural and Shape optimization.

UNIT III MATERIAL SELECTION AND MATERIALS IN DESIGN **9**

Classification and Properties of Engineering materials, Material Standards and specifications – Methods of material selection – Ashby Chart and method of weight factors, Derivation of material indices, Use of material selection Chart, Pugh selection method, Selection with computed aided databases – Design for brittle fracture, Design for fatigue failure, Design for corrosion resistance, Designing with plastics.

UNIT IV MATERIAL PROCESSING AND DESIGN **9**

Classification of manufacturing processes and their role in design, Factors determining the process selection, Use of process selection chart and computerized database – Design for manufacturing,

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Design for forging and sheet metal forming, Design for casting, Design for machining, welding and assembly, Design for residual stresses and heat treatment

UNIT V LEGAL, ETHICAL ENVIRONMENTAL AND SAFETY ISSUES IN DESIGN AND QUALITY ENGINEERING 10

Origin of laws, Contracts, Liability, Tort Law, Product Liability , Design aspects of product liability, Codes of ethics, Solving ethical conflicts, Design for environment – Life Cycle assessment, Material recycling and remanufacture, Design for safety – Potential Dangers and Guidelines for design for safety, Design for reliability failure mode effect analysis, Robust Design.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

Student will be able to

CO1: Perform design process for developing new machine members.
CO2: Notice tools in engineering design
CO3: Find the solution in materials selection and materials in designing a new machine member.
CO4: Conduct designing machine members using materials processing.
CO5: Apply knowledge to select material basing on legal, ethical environmental and safety issues in design and quality engineering.

TEXT BOOKS

1. Dieter George E, "Engineering Design – A Materials and Processing Approach", McGraw Hill, International 4th Edition, Singapore 2017.
2. Karl T. Ulrich and Steven D. Eppinger, "Product Design and Development", McGraw Hill, International Edition, 2017.

REFERENCE BOOKS

1. Gerhard Pahl and Beitz W, "Engineering Design: A Systematic Approach", Springer, Verlag, London, 3rd Edition, 2007.
2. Suh. N. P., "The Principles of Design", Oxford University Press, New York, 1990.
3. Ray M.S., "Elements of Engineering Design: An Integrated Approach", Prentice Hall Inc. 1985.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Perform design process for developing new machine members.	2	3	3	2	2	1	1	1	1	2	1	2	2	2	2
Co2	Notice tools in engineering design	2	2	2	2	2	1	1	1	1	2	1	2	2	2	2
Co3	Find the solution in materials selection and materials in designing a new machine member.	3	3	3	3	2	1	1	1	1	2	1	2	3	2	2
Co4	Conduct designing machine members using materials processing.	3	3	3	2	2	1	1	1	1	2	1	2	2	2	2
Co5	Apply knowledge to select material basing on legal, ethical environmental and safety issues in design and quality engineering.	2	2	2	2	2	1	1	1	1	2	1	2	2	2	2

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618MET01 PRINCIPLES OF MANAGEMENT AND BUSINESS CONCEPTS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To gain knowledge on organization structure.
- To understand the various types of business organizations.
- To know the modern techniques in controlling.
- To gain knowledge on various types of business activities.
- To know about the marketing concepts.

UNIT I OVERVIEW OF MANAGEMENT AND PLANNING **10**

Definition of Management – Role of managers – Evolution of Management thoughts. Contribution of Taylor and Fayol, Functions of management – Types of business organizations.

Nature and purpose of planning – Planning process – Types of plans – Objectives – Management By Objective (MBO) Strategies – Types of strategies – Policies – Decision Making – Decision Making Process – Forecasting techniques.

UNIT II ORGANIZING AND DIRECTING **10**

Nature and purpose of organizing – Organization structure – Organisation Chart – Formal and informal groups of organization – Line and Staff authority – Departmentation – Span of control – Centralization and Decentralization – Delegation of authority – Selection and Recruitment – Orientation – Career Development – Career stages – Training – Performance Appraisal.

Creativity and Innovation – Management and Human facts – Motivation – Motivation Theories – Leadership Styles – Leadership theories – Communication – Barriers to effective communication – Electronic Media in Communication.

UNIT III CONTROLLING **7**

Process of controlling – Types of control – Budgetary and non-budgetary control techniques – Managing Productivity – Cost Control – Purchase Control – Maintenance Control – Quality Control – Planning operations, Modern Techniques in Controlling.

UNIT IV BUSINESS ENVIRONMENT **10**

Nature and purpose of business, Classification of business activities: Industry, Commerce and Trade – Objectives of business and essentials of successful business – Economic environment – Basic problems of scarcity and choice – Allocation of resources – Opportunity cost – Business growth and measurement of size – International Environment – Balance of trade, the trade gap and balance of payments – Role and methods of trade protectionism – Business Ethics.

UNIT V ELEMENTS OF BUSINESS ACTIVITY **8**

Purchasing – Choosing of suppliers – Overview of stock control – Production – Scale of production, Main features of job – Mass and Batch production systems – Marketing – Concept and Role of marketing – Marketing mix – Channels of distribution – Finance – Sources of Finance – Assessing business performance.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Understand the elements of effective management.
CO2: Know about motivation theories.
CO3: Gain the knowledge on managerial skills and business activities.
CO4: Understand business concepts and its applications.
CO5: Organize, plan and control the process of business activity.

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TEXT BOOKS

1. P C Tripathi and P N Reddy, "Principles of Management", Tata Mc Graw Hill Pvt Ltd, 6th Edition, 2017.
2. Stephen P. Robbins and Mary Coulter, "Management", Pearson Education, 13rd Edition, 2016.

REFERENCE BOOKS

1. Philip Kotler, "Marketing Management", Pearson Education, 15th Edition, 2015.
2. Charles W L Hill, Steven L McShane, "Principles of Management", McGraw Hill Education, Special Indian Edition, 2012.
3. Harold Koontz, Heinz Weihrich and Mark V Cannice, "Essentials of Management", Tata McGraw Hill, 9th Edition, 2012.
4. Andrew J.Dubrin, "Essentials of Management", Thomson Southwestern, 7th Edition, 2007.
5. Hellriegel, Slocum & Jackson, "Management - A Competency Based Approach", Thomson South Western, 10th Edition, 2002.
6. Gary Dessler, "Human Resource Management", 7th Edition, Prentice-Hall of India P.Ltd., Pearson, 1999.
7. Joel Dean, "Managerial Economics", Prentice Hall Pearson Education, 1992.
8. Rangarajan, "Principles of Macro Economics", Tata McGraw Hill, 1979.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Understand the elements of effective management.		3			1	2				2	2	3			2
Co2	Know about motivation theories.		3	2									3		1	
Co3	Gain the knowledge on managerial skills and business activities.			1		1	1		1		1	2				1
Co4	Understand business concepts and its applications.			1			2	2		1						
Co5	Organize, plan and control the process of business activity.		3	2		1	2	2	2	1	1	2	2	1		

618MET02 GAS DYNAMICS AND JET PROPULSION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts of isentropic flows.
- To understand the phenomenon of heat transfer and friction for flow through ducts.
- To study the phenomenon of shock waves and its effects on flow.
- Analyse the performance of aircraft propulsion.
- Analyse the performance of rocket propulsion.

PRE-REQUISITES: Knowledge of Engineering Thermodynamics, Fluid Mechanics and Machinery, Thermal Engineering are required.

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS **9**

Energy and momentum equations of compressible fluid flows – concepts of compressible flow Mach waves and Mach cone - Effect of Mach number on compressibility - Isentropic flow through variable ducts - Nozzle and Diffusers - Use of Gas tables.

UNIT II FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - variation of flow properties – Variation of mach number with duct length-Use of tables and charts.

UNIT III NORMAL AND OBLIQUE SHOCKS 9

Governing equations - Variation of flow parameters across the normal and oblique shocks - Prandtl - Meyer relations - Use of table and charts - Applications.

UNIT IV JET PROPULSION 9

Theory of jet propulsion - Thrust equation - Thrust power and propulsive efficiency – Operation Principle, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop engines and pulse jet engines.

UNIT V SPACE PROPULSION 9

Types of rocket engines - Propellants- Liquid fuel feeding systems - Theory of single stage and multistage rocket propulsion – Rocket performance calculations - Terminal and characteristic velocity - Applications - space flights.

TOTAL HOURS: 45 PERIODS

Note: (Use of standard gas table book is permitted in the examination)

COURSE OUTCOMES

CO1: The students will become familiar with basic fundamental equations of one dimensional flow of compressible fluid and isentropic flow of an ideal gas.

CO2: The students will be able to acquire knowledge on the effects of heat transfer and friction flow through ducts.

CO3: An ability to acquire the knowledge on flow parameters with normal and oblique shocks.

CO4: An ability to understand the working concepts of the gas dynamics principles in the jet propulsions.

CO5: An ability to study the working concepts of rocket propulsion and various propellants.

TEXT BOOKS

1. S.M. Yahya, “Fundamentals of Compressible Flow”, New Age International (P) Limited, New Delhi, 5th Edition, 2016.
2. Anderson, J.D., “Modern Compressible flow”, Third Edition, McGraw Hill, 2003.

REFERENCE BOOKS

1. G.P. Sutton, “Rocket Propulsion Elements”, John Wiley & sons, New York, 9th Edition, 2016.
2. V. Babu, “Fundamentals of Gas Dynamics”, ANE Books India, 2015.
3. V.Ganesan, “Gas Turbines”, Tata McGraw Hill Publishing Co., NewDelhi,2010.
4. P. Hill and C. Peterson, “Mechanics and Thermodynamics of Propulsion”, Addison - Wesley Publishing Company, 2009.
5. Anderson J.D., “Modern Compressible flow”, McGraw Hill, 3rd Edition, 2003.
6. S.L. Somasundaram, “Gas Dynamics and Jet Propulsions”, New Age International Publishers, New Delhi, 1996.
7. A.H. Shapiro, “The Dynamics and Thermodynamics of Compressible Fluid Flow”, John Wiley &sons, New York, 1983.
8. M.J.Zucrow, “Aircraft and Missile Propulsion”,Vol.1&II, John Wiley & sons,1975.
9. M.J. Zucrow, “Principles of Jet Propulsion and Gas Turbines”, John Wiley & sons, New York, 1970.

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Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students will become familiar with basic fundamental equations of one dimensional flow of compressible fluid and isentropic flow of an ideal gas.	3	2								1			3	2	1
Co2	The students will be able to acquire knowledge on the effects of heat transfer and friction flow through ducts.	3	1								3	2		2	3	1
Co3	An ability to acquire the knowledge on flow parameters with normal and oblique shocks.	3	3		1					2	1	1		2	3	1
Co4	An ability to understand the working concepts of the gas dynamics principles in the jet propulsions.	3	3		1	2				1	2	1		2	3	3
Co5	An ability to study the working concepts of rocket propulsion and various propellants.	3	3		1					1	3	1		3	1	3

618MET03 **DESIGN OF TRANSMISSION SYSTEMS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the standards and procedure for designing flexible elements.
- To understand the design of spur gears and parallel axis helical gears.
- To understand the design of bevel, worm and cross helical gears.
- To analyse the design of gear boxes in order to perform safely with their intended functions.
- To study the design principles to evaluate the clutches and brakes in order to satisfy the strength and functional requirements.

PRE-REQUISITES: Knowledge of Kinematics of Machinery and Design of Machine Elements are required.
NOTE: Usage of Design Data Book is permitted in the end examination.

UNIT I DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS 9

Selection of V- belts and pulleys - Selection of Flat belts and pulleys- Wire ropes and pulleys, Selection of Transmission chains and Sprockets. Design of pulleys and sprockets.

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9

Gear Terminology, Speed ratios and number of teeth. Force analysis -Tooth stresses, Dynamic effects, Fatigue strength. Factor of safety, Gear materials, Module and Face width, power rating calculations based on strength and wear considerations, Parallel axis Helical Gears - Pressure angle in the normal and transverse plane, Equivalent number of teeth, forces and stresses. Estimating the size of the helical gears.

UNIT III BEVEL, WORM AND CROSS HELICAL GEARS 9

Straight bevel gear - Tooth terminology, tooth forces and stresses, equivalent number of teeth, Estimating the dimensions of pair of straight bevel gears.
Worm Gear - Merits and demerits, Terminology, Thermal capacity, materials, forces and stresses, efficiency, estimating the size of the worm gear pair.
Cross helical Gear – Terminology, helix angles, Estimating the size of the pair of cross helical gears.

UNIT IV DESIGN OF GEAR BOXES 9

Geometric progression - Standard step ratio, Ray diagram, kinematics layout. Design of sliding mesh gear box, Constant mesh gear box, Design of multi speed gear box.

UNIT V DESIGN OF CLUTCHES AND BRAKES 9

Design of plate clutches –Friction materials, Centrifugal clutch, axial clutches, Single plate clutch, multiple plate clutch, cone clutch and internal expanding rim clutch, Internal and external shoe brakes, Band brake, Disk brakes**.**

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Design and select pulleys, chain drives, rope drives and belt drives.
CO2: Design and select spur gears and parallel axis helical gears.
CO3: Design and select bevel, worm and cross helical gears.
CO4: Design gear boxes.
CO5: Design brakes and clutches.

TEXT BOOKS

1. Bhandari, V.B., "Design of Machine Elements", 4th Edition Tata McGraw-Hill Publishing Company Ltd., 2017.
2. Shigley J.E., "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill, 2014.

REFERENCE BOOKS

1. Hamrock B.J., Jacobson B., Schmid S.R., "Fundamentals of Machine Elements", Third Edition, CRC Press, 2013.
2. Sundararajamoorthy T. V and Shanmugam. N, "Machine Design", Anuradha Publications, Chennai, 2007.
3. R. S. Khurmi & J. K. Gupta, “A Text book of Machine Design”, Eurasia Publishing House, 2005.
4. Ugural A.C, "Mechanical Design, An Integrated Approach", McGraw-Hill, 2003
5. Prabhu. T.J., "Design of Transmission Elements", Fifth Edition, Mani Offset, Chennai, 2002.
6. Maitra G.M., and Prasad L.V., "Hand book of Mechanical Design", II Edition, Tata McGraw-Hill, 1985.

STANDARDS:

1. IS 4460: Parts 1 to 3: 1995, Gears - Spur and Helical Gears - Calculation of Load Capacity.
2. IS 7443: 2002, Methods of Load Rating of Worm Gears.
3. IS 15151: 2002, Belt Drives - Pulleys and V-Ribbed belts for Industrial applications - PH, PJ, PK, Pl and PM Profiles: Dimensions.
4. IS 2122: Part 1: 1973, Code of practice for selection, storage, installation and maintenance of belting for power transmission: Part 1 Flat Belt Drives.
5. IS 2122: Part 2: 1991, Code of practice for selection, storage, installation and maintenance of belting for power transmission: Part 2 V-Belt Drives.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Design and select pulleys, chain drives, rope drives and belt drives.	3	3	3	3	2	1	1	1	2	1	1	2	3	2	2
Co2	Design and select spur gears and parallel axis helical gears.	3	3	3	3	2	1	1	1	2	1	1	2	3	2	2

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Co3	Design and select bevel, worm and cross helical gears.	3	3	3	3	2	1	1	1	2	1	1	2	3	2	2
Co4	Design gear boxes.	3	3	3	3	2	1	1	1	2	1	1	2	3	2	2
Co5	Design brakes and clutches.	3	3	3	3	2	1	1	1	2	1	1	2	3	2	2

618MET04 **CAD/CAM/CIM** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To study the computer aided design and drawing using popular software package.
- To study the basics of manufacturing, DNC and CNC servo system.
- To understand the components of computer integrated manufacturing.
- To study the group technology and computer aided process planning in industry.
- To understand the system of shop floor control and flexible manufacturing system in industry

PRE-REQUISITES: Knowledge of Manufacturing Technology II is required.

UNIT I INTRODUCTION OF COMPUTER AIDED DESIGN 9

Concept of Graphic Primitives- 2Dimensional Transformations and 3Dimensional Transformations (Concept) -Geometric Modeling, Concept and Types (Any Popular CAD Software) - Typical features of drafting package - Salient features of solid modeling- Understanding curve and Surface design.

UNIT II DNC AND CNC SERVO SYSTEM 9

Principle and operation of a CNC servo system- Direct Numerical Control (DNC), Objectives of DNC- Types of standard controllers (Only Industrial Purpose), Programming codes- Manual part programming of turning operation and milling operation(examples of turning, facing, taper, thread and rectangular and circular packet, drilling holes)

UNIT III COMPONENTS OF COMPUTER INTEGRATED MANUFACTURING 9

Computer Integrated Manufacturing: Concept and Technology, Role of the elements of CIM system, CASA/SME model of CIM, CIM II, Benefits – Communication matrix in CIM, Fundamentals of computer communication in CIM - CIM data transmission methods - Types of communication in CIM - Computer networking in CIM (LAN and MAP model) - OSI model seven layer -Network topologies: Types and advantages

UNIT IV GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 9

Group Technology (GT) – Part Families – Parts Classification and Coding systems (DCLASS , MICLASS and OPTIZ) -Facility design using GT - Benefits of GT- Concept of Cellular Manufacturing Process planning: Role of process planning in CAD/CAM Integration -Approaches to computer aided process planning, Structure of a process planning software, Variant approach and Generative approaches, CMPP systems

UNIT V SHOP FLOOR CONTROL AND INTRODUCTION TO FLEXIBLE MANUFACTURING SYSTEM 9

Components of shop floor data collection systems, shop floor control phases-Types of data collection systems- Automatic data collection system, Flexible Manufacturing System: Scopes, Components, Types, Workstation, Benefits, Material handling and Storage system, Layouts, Computer control systems

TOTAL HOURS: 45 PERIODS

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COURSE OUTCOMES

The students will be able to

CO1: Use computer and popular CAD software's for modelling.
CO2: Know the construction features of NC and CNC machines and the components.
CO3: Gain the knowledge of computer integrated manufacturing.
CO4: Develop knowledge on group technology and computer aided process planning.
CO5: Utilize knowledge of flexible manufacturing system on shop floor in industries.

TEXT BOOKS

1. Mikell. P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education, 4th Edition, 2016.
2. Radhakrishnan.P., Subramanyan.S. and Raju.V., "CAD/CAM/CIM", New Age International, 2012.

REFERENCE BOOKS

1. P N Rao, "CAD/CAM Principles and Applications", TMH Publications, 3rd Edition, 2010.
2. Chris McMahon and Jimmie Browne, "CAD CAM Principles, Practice and Manufacturing Management", Pearson Education, Second Edition, 2005.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall of India Pvt. Ltd., 2005.
4. Mikell. P. Groover and Emory Zimmers Jr.,"CAD/CAM", Prentice Hall of India Pvt. Ltd., 2003.
5. Krar.S, and Gill.A, "CNC Technology and Programming" , McGraw Hill Publishers, 1989.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Use computer and popular CAD software's for modelling.	2			1						2	2			1	
Co2	Know the construction features of NC and CNC machines and the components.		1			2			1		1					
Co3	Gain the knowledge of computer integrated manufacturing.	2	1	1		2		2			2	1		1		
Co4	Develop knowledge on group technology and computer aided process planning.	2				2					1		1			1
Co5	Utilize knowledge of flexible manufacturing system on shop floor in industries.	2	1								2	1			1	

618MEP07 COMPUTER AIDED MACHINE DRAWING

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To provide knowledge on reading of machine drawing with drawing standards
- To make the students understand and interpret drawings of machine components
- To familiarize the representation of various machine element drawings
- To impart the significance of sectional views and its representation in drawings
- To develop skill to handle 2D drafting, 3D modeling and assembly using standard CAD packages

PRE-REQUISITES: Knowledge of Engineering Graphics and Design of Machine Elements are required.

DRAWING STANDARDS, FITS AND TOLERANCES **5**

Code of practice for Engineering Drawing, BIS specifications – Geometric constraint and symbols – Fundamentals of Limits, Tolerances, Fits, surface roughness and its indication in drawings – Elementary weld symbol – Preparation of production drawings and reading of part and assembly drawings.

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2D DRAFTING, 3D MODELLING AND ASSEMBLY **40**

Introduction to 2D drafting - Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing – Conversion of pictorial views into orthographic projections of simple machine parts.

Introduction to 3D modelling, assembly concept, sectional views and sectional views of assembled drawings, Bill of materials – Assembly drawing of Sleeve and Cotter joint, Knuckle Joint, Flanged coupling, Plummer block, Stuffing box, Safety valve, Screw jack, Machine Vice, Tail stock, Piston and connecting rod.

Use of standard CAD application packages is recommended from the point of view of requirement by industries.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

Student will be able to

CO1: Follow the drawing standards, Fits and Tolerances
CO2: Represent the machine elements in industrial drawings.
CO3: Explain the concept of sectional views in drawings.
CO4: Prepare bill of materials for production drawings.
CO5: Re-create part drawings and assembly drawings of machine components as per standards

REFERENCE BOOKS

1. Sidheswar N, Kannaiah P and Sastry V. V. S, “Machine Drawing”, Tata McGraw Hill, 2017.
2. Narayana K.L., Kannaiah P and Venkata Reddy K, “Machine Drawing “, 5th Edition, New Age International (P) Limited Publishers, 2016.
3. Bhatt N.D. and Panchal V.M., “Machine Drawing”, 49th Edition, Charotar Publishing House Pvt. Ltd., 2014.
4. Gopalakrishna K.R., “Machine Drawing”, 22nd Edition, Subhas Stores Books Corner, Bangalore, 2013.
5. Basudeb Bhattacharyya, “Machine Drawing”, Oxford University Press, 2011.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Follow the drawing standards, Fits and Tolerances	3	3	3	3	2	1	1	1	2	1	1	2	3	2	2
Co2	Represent the machine elements in industrial drawings.	2	3	3	2	2	1	1	1	2	1	1	2	3	2	2
Co3	Explain the concept of sectional views in drawings.	3	2	2	3	2	1	1	1	2	1	1	2	3	3	2
Co4	Prepare bill of materials for production drawings.	3	2	3	3	2	1	1	1	2	1	1	2	3	2	2
Co5	Re-create part drawings and assembly drawings of machine components as per standards	2	2	3	3	2	1	1	1	2	1	1	2	3	2	2

618MEP08 **CAM LABORATORY** **L T P C**
0 0 2 1

COURSE OBJECTIVES:

- The students acquire practical knowledge about fundamentals of numerical control.
- To know the types of CNC machines and the programming technique.
- To understand the concepts of G and M codes.

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- To write the manual part programming to modern control systems. (Fanuc, Siemens etc)
- To know the modern application of various CNC machines.

PRE-REQUISITES: Knowledge of CAD/CAM/CIM and Manufacturing Technology –II are required.

INTRODUCTION

1. Study of CNC lathe, milling
2. Study of international standards G-Codes, M-Codes
3. Program writing – Turning simulator – Milling simulator, IS practice – commands – menus

EXERCISE PRACTICE

CNC Lathe

1. Develop a part program for plain turning and simulate
2. Develop a part program for Facing turning and simulate
3. Develop a part program for Step turning and simulate
4. Develop a part program for taper turning and simulate
5. Develop a part program for Thread cutting and simulate
6. Develop a part program for drilling and simulate

CNC Milling

7. Develop a part program for drilling with dwell and simulate
8. Develop a part program for drilling with dwell and PCD and simulate
9. Develop a part program for rectangular pocket and simulate
10. Develop a part program for circular pocket and simulate

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will able to know about

CO1: PC based CNC machines and windows based CAM software packages has made CNC programming.

CO2: Good aptitude for understand by the modern CNC control system in modern manufacturing system.

CO3: Knowledge to prepare the CNC Part Programming Techniques and to perform the manufacturing operation.

CO4: CAM software packages make it easy to translate CAD files into CNC programs which enable users to handle sophisticated jobs.

CO5: Knowledge of programming codes used in industry.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	PC based CNC machines and windows based CAM software packages has made CNC programming.		2		2			1		2		1		2		
Co2	Good aptitude for understand by the modern CNC control system in modern manufacturing system.			2	1						1				2	
Co3	Knowledge to prepare the CNC Part Programming Techniques and to perform the manufacturing operation.			2				1				1	2			1
Co4	CAM software packages make it easy to translate CAD files into CNC programs which enable users to handle sophisticated jobs.					3				2		2			1	
Co5	Knowledge of programming codes used in industry	3			2											1

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618MEE01 **DESIGN OF EXPERIMENTS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the different philosophical approaches to experimental design get familiar with Design of experiment.
- To build a solid foundation for the statistical concepts for experimental design.
- To gain knowledge of experimental design.
- To gain the knowledge on the signal to noise ratio and parameter design
- To study the analysis and interpretation methods.

UNIT I INTRODUCTION **9**

The strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments, Concepts of random variable, probability, density function cumulative distribution function, Sample and population, Measure of Central tendency, Mean median and mode, Measures of Variability.

UNIT II BASIC STATISTICAL CONCEPTS **9**

Concepts of random variable, probability, density function cumulative distribution function, Sample and population, Measure of Central tendency, Mean median and mode, Measures of Variability, Concept of confidence level, Statistical Distributions, Normal, Log Normal & Weibull distributions, Hypothesis testing, Probability plots, choice of sample size, Illustration through Numerical examples.

UNIT III EXPERIMENTAL DESIGN **9**

Two-level experimental designs for two factors and three factors. Three-level experimental designs for two factors and three factors, Factor effects, Factor interactions, Fractional factorial design, Saturated Designs, Central composite designs, Types of Orthogonal Arrays, selection of standard orthogonal arrays, Linear graphs and Interaction assignment, Dummy level Technique, Illustration through Numerical examples.

UNIT IV SIGNAL TO NOISE RATIO AND PARAMETRIC DESIGN **9**

Evaluation of sensitivity to noise, Signal to Noise ratios for static problems, Smaller the better type, Nominal the better type, Larger the better type, Signal to Noise ratios for Dynamic problems, Parameter and tolerance design concepts, Taguchi's inner and outer arrays, parameter design strategy, tolerance design strategy, Illustration through Numerical examples.

UNIT V ANALYSIS AND INTERPRETATION METHODS **9**

Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments, YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data, Taguchi's quality philosophy, elements of cost, Noise factors causes of variation, Quadratic loss function & variations of quadratic loss function, Robust Design, Steps in Robust Design, Illustration through Numerical examples.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will able to

CO1: Apply the experimental techniques to practical problems.
CO2: Develop basic Statistical Concepts.
CO3: Able to understand the experimental designs such as factorial and fractional factorial designs.
CO4: Gaining knowledge in signal to noise ratio and parameter design.
CO5: Impart the knowledge on analyzing and interpretation of experimental data.

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TEXT BOOKS

1. Mark Allen Durivage, “Practical Design of Experiments (DOE), A Guide for Optimizing Designs and Processes”, ASQ Quality Press, 2016.
2. Jiju Antony, “Design of Experiments for Engineers and Scientists”, Elsevier Science, 2014.
3. Krishnaiah K, and Shahabudeen P, “Applied Design of Experiments and Taguchi Methods”, PHI, India, 2012.

REFERENCE BOOKS

1. Douglas C. Montgomery, “Design and Analysis of Experiments”, John Wiley and sons, 2005.
2. Phillip J. Ross, “Taguchi Techniques for Quality Engineering”, Tata McGraw-Hill, India, 2005.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Apply the experimental techniques to practical problems.	1	1	1		1								1		1
Co2	Develop basic Statistical Concepts.	1	1	1										1		
Co3	Able to understand the experimental designs such as factorial and fractional factorial designs.	1	1											1		
Co4	Gaining knowledge in signal to noise ratio and parameter design.	1		1				1					1	1		
Co5	Impart the knowledge on analyzing and interpretation of experimental data.	1	2	1		1					1			1		1

618MEE02 PROFESSIONAL ETHICS AND HUMAN VALUES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the scope of ethics in engineering.
- To learn about research ethics, codes of ethics and industrial standards.
- To know about the concepts of engineers responsibility on safety and risk.
- To understand about the professional rights and crime.
- To gain the knowledge on multinational corporation ethics like business ethics, environmental ethics, computer ethics, etc.

UNIT I HUMAN VALUES AND ENGINEERING ETHICS **9**

Objectives – Morals – Values – Ethics – Integrity – Work Ethics – Service learning – Virtues – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-confidence – Challenges in the Work place – Sprituality.

Sense of Engineering Ethics - Variety of moral issues - Types of inquiry - Moral dilemmas - Moral Autonomy - Kohlberg's theory - Gilligan's theory - Consensus and Controversy - Professions and Professionalism - Professional Ideals and Virtues - Uses of Ethical Theories.

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as experimentation - Engineers as responsible Experimenters - Research Ethics - Codes of Ethics - Industrial Standards - A Balanced Outlook on Law - The Challenger Case Study.

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY **9**

Safety and Risk - Assessment of Safety and Risk - Risk Benefit Analysis - Reducing Risk - The Government Regulator's Approach to Risk - Chernobyl Case Study and Bhopal gas tragedy.

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UNIT IV RESPONSIBILITIES AND RIGHTS 9

Collegiality and Loyalty - Respect for Authority - Collective Bargaining - Confidentiality - Conflicts of Interest - Occupational Crime - Professional Rights - Employee Rights - Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 9

Multinational Corporations - Business Ethics - Environmental Ethics - Computer Ethics - Role in Technological Development - Weapons Development - Engineers as Managers - Consulting Engineers - Engineers as Expert Witnesses and Advisors - Honesty - Moral Leadership - Sample Code of Conduct.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

CO1: The students will have awareness on engineering ethics and human values to instill moral and social values.
CO2: Students will be able to know about the importance and outcomes of experimentation of ethics with a case study.
CO3: Students will be able to know about assessment of safety and risk.
CO4: The student will have an ability to develop the knowledge in the area of collegiality, loyalty, confidentiality and IPR.
CO5: The students are aware of about the global issues related to engineering.

TEXT BOOKS

1. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics - Concepts and Cases", Wardsworth Publishing, 6th Edition, 2018.
2. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 4th Edition, 2017.

REFERENCE BOOKS

1. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 8th Edition, 2016.
2. M. Govindarajan, S.Natarajan, V.S. Senthil Kumar, "Engineering Ethics", Prentice Hall of India Pvt. Ltd., New Delhi, 2013.
3. Subramaniam R, "Professional Ethics", Oxford University Press, New Delhi, 2013.
4. Laura P Hartman and Joe Desjardins, "Business Ethics: Decision making for personal integrity and social responsibility", McGraw Hill Education India Pvt. Ltd., New Delhi, 2013.
5. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 4th Edition, 2011.
6. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2008.
7. Gail D Baura, "Engineering Ethics: An Industrial Perspective", Elsevier Academic Press, 2006.
8. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics - An Indian Perspective", Dreamtech Press, 2004.
9. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, 2003.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students will have awareness on engineering ethics and human values to instill moral and social values.			2			2		3			2	2		2	1

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Co2	Students will be able to know about the importance and outcomes of experimentation of ethics with a case study.					2			2		1				1	
Co3	Students will be able to know about assessment of safety and risk.			2			3								1	
Co4	The student will have an ability to develop the knowledge in the area of collegiality, loyalty, confidentiality and IPR.			2			2		3			3	1			
Co5	The students are aware of about the global issues related to engineering.			2			3								2	2

618MEE03 **INTERNAL COMBUSTION ENGINES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To enable the students to understand the concepts of IC engines.
- To study about the combustion aspects in Spark Ignition engines.
- To know about the combustion aspects in Compression Ignition engines.
- To study the recent technologies adopted in IC engines for alternative fuels.
- To study the pollutant formation and its control in IC engines.

PRE-REQUISITES: Basic Knowledge in Thermodynamics and Thermal Engineering are required.

UNIT I INTRODUCTION **9**

Basic components and terminology of IC engines, working of four stroke/two stroke - petrol/diesel engine, classification, engine performance and application of IC engines

UNIT II SPARK IGNITION ENGINES **9**

Stages of combustion in SI engines, abnormal combustion and knocking in SI engines, factors affecting knocking, effects of knocking, control of knocking, Knock rating of fuels-octane number, HUCR values. Anti- knock agents-pre ignition-post ignition, Combustion chambers for SI engines.

UNIT III COMPRESSION IGNITION ENGINES **9**

Stages of combustion in CI engines, detonation in C.I. engines, factors affecting detonation, controlling detonation, Diesel knock –methods of controlling diesel knock. knock rating of diesel fuels, Combustion chamber for CI engine. Introduction to Turbo charging.

UNIT IV ALTERNATIVE FUELS **9**

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits as fuels

UNIT V POLLUTANT FORMATION AND CONTROL **9**

Pollutant – Sources – Formation of carbon monoxide, Unburnt hydrocarbon, oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters and Particulate Traps – Methods of measurements.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Acquire the knowledge and concepts of IC engines.
CO2: Interpret the basic concept and combustion parameters in Spark Ignition engines.
CO3: Interpret the basic concept and combustion parameters in Compression Ignition engines.
CO4: Acquire knowledge in usage of alternative fuels in internal combustion engines.
CO5: Identify the source of pollution formation and its control.

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TEXT BOOKS

1. John B. Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill, 2017.
2. Ganesan V, "Internal Combustion Engines", Tata McGraw Hill, 2017.

REFERENCE BOOKS

1. Bosch, "Automotive Hand Book", SAE, 9th Edition, 2014.
2. Mathur R.B and Sharma R.P, "Internal Combustion Engines", Dhanpat Rai & Sons, 2017.
3. Dr. K.K Ramalingam, "Introduction to Internal Combustion Engines", Scitech Publications, 2016.
4. Richard .L. Bechfold, "Alternative Fuels Guide Book", SAE International Warrendale, 1997.
5. Heinz Heisler, "Advanced Engine Technology", SAE Publication, 1995.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Acquire the knowledge and concepts of IC engines.	3	2								1			2		
Co2	Interpret the basic concept and combustion parameters in Spark Ignition engines.	3	2								1			2		
Co3	Interpret the basic concept and combustion parameters in Compression Ignition engines.	3	2								1			2		
Co4	Acquire knowledge in usage of alternative fuels in internal combustion engines.	3	2								1			2		
Co5	Identify the source of pollution formation and its control.	3	2								1			2		

618MEE04 REFRIGERATION AND AIR CONDITIONING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand vapour compression and vapour absorption system operation of different refrigerants.
- To familiarize with the component of refrigeration system and its applications.
- To familiarize its different type of air conditioning system.
- To know about the basic knowledge of different type ventilation and electrical system of air conditioning equipment's.
- To know its application of refrigeration and air conditioning systems

PRE-REQUISITES: Knowledge of Engineering Thermodynamics and Heat transfer are required.

UNIT I REFRIGERATION CYCLES AND REFRIGERANTS 10

Review of thermodynamics, Principle of refrigeration, Reversed Carnot cycle, Air refrigeration cycles - Bell Coleman cycle, Simple vapour compression refrigeration cycle, Vapour absorption system, Refrigerants – properties and classification, Alternate refrigerants, Selection of refrigerants

UNIT II REFRIGERATION EQUIPMENT 8

Refrigeration compressors - Reciprocating, rotary and centrifugal compressors, Evaporators flooded, dry expansion, shell and tube and double pipe evaporators, Condensers – air cooled, water cooled and evaporative condensers, Expansion devices - capillary tube and thermostatic expansion valve, other components such as Accumulators, Receivers, Oil Separators, Strainers, Driers, Check Valves, Solenoid Valves Defrost Controllers, etc

UNIT III AIR CONDITIONING SYSTEM 9

The principle of air conditioning and human comfort, Classification, - Air conditioning system and main components selection, Applications and building occupancies indoor air quality, Air-Conditioning Loads, Central Air-Conditioning System, Unitary Air-Conditioning System, Window Air- Conditioner and Packaged Air-Conditioner, Thermal distribution systems – Single, multi zone systems, terminal reheat systems, variable air volume systems, water systems and Unitary type systems.

UNIT IV AIR CONDITIONING EQUIPMENT 9

Air distribution and ventilation system, Basics of airflow in ducts, Types. Cooling tower -natural and mechanical draught system, Control system - pneumatic and electric system for air conditioning, Fans- Types & selection, Condensate control, and freeze-up protection, Air filters, Electronic air cleaners, humidification and humidifiers, Selection of humidifiers, Air-handling units and Packaged units, Functions of AHU, classifications.

UNIT V APPLICATIONS OF REFRIGERATION AND AIR CONDITIONING SYSTEMS 9

Preservation of different products - Food preservation, Ice factory, Domestic refrigerator. Applications of air conditioning - Commercial applications - Air conditioning of houses and offices, air conditioning of hospitals - Industrial applications -Transport Air-conditioning - Railway Air conditioning , Aircraft air conditioning

TOTAL HOURS: 45 PERIODS

Note: Use of standard refrigeration tables is permitted in the examination.

COURSE OUTCOMES

Students will be able to

CO1: Understanding the various refrigeration cycle and refrigerants.
CO2: Understand the function of each of the major refrigeration system and its components.
CO3: Understanding the various factors involving in human comfort of air condition systems.
CO4: Analyse the various air condition equipment and control systems.
CO5: Analyse the applications of refrigeration and air conditions systems for industrial needs.

TEXT BOOKS

1. S.C.Arora and Domkundwar S., “A Course in Refrigeration and Air conditioning”, Dhanpat Rai & Sons, New Delhi, 13th Edition, 2017.
2. C.P. Arora, "Refrigeration and Air Conditioning", Tata McGraw Hill Education, 3rdEditions, New Delhi, 2017.

REFERENCE BOOKS

1. Manohar Prasad, "Refrigeration and Air Conditioning", 3rd Edition, New Age International, New Delhi, 2021.
2. R. S. Khurmi, J. K. Gupta, “Textbook of Refrigeration and Air Conditioning”, Revised Edition, S. Chand, 2015.
3. Roy J. Dossat, "Principles of Refrigeration", 4th Edition, Pearson India, 2007.
4. S.S. Thipse, “Refrigeration and Air Conditioning”, 1st Edition, Jaico Publishing House, 2007.
5. Jordon and Priester, "Refrigeration and Air Conditioning", Prentice Hall of India Pvt. Ltd., New Delhi, 1985.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Understanding the various refrigeration cycle and refrigerants.	3	2							1	1			2		

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Co2	Understand the function of each of the major refrigeration system and its components.	2	1	1						1	1			2		
Co3	Understanding the various factors involving in human comfort of air condition systems.	2	1	1						1	1			2		
Co4	Analyse the various air condition equipment and control systems.	2		1						1	1			2		
Co5	Analyse the applications of refrigeration and air conditions systems for industrial needs.	2	1							1	1			2		2

618MEE05 INDUSTRIAL RELATION AND ORGANIZATIONAL DEVELOPMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To explore contemporary knowledge and gain a conceptual understanding of industrial relations and human resource management.
- To resolve industrial conflicts successfully.
- To know about the industrial safety system.
- To know the concepts of integration, centralization, decentralization and standardization.
- To gain knowledge of change management concepts.

UNIT I INDUSTRIAL RELATIONS **9**

Concepts – Importance – Industrial Relations problems in the Public Sector – Growth of Trade Unions – Codes of conduct.

UNIT II INDUSTRIAL CONFLICTS **9**

Disputes – Impact – Causes – Strikes – Prevention – Industrial Peace – Government Machinery – Conciliation – Arbitration – Adjudication.

UNIT III INDUSTRIAL SAFETY **9**

Causes of Accidents – Prevention – Safety Provisions – Industrial Health and Hygiene – Importance – Problems – Occupational Hazards – Diseases – Psychological problems – Counseling – Statutory Provisions.

UNIT IV ORGANIZATIONAL DESIGN **9**

Organizational Design – Determinants – Components – Types - Basic Challenges of design – Differentiation, Integration, Centralization, Decentralization, Standardization, Mutual adjustment Mechanistic and Organic Structures- Technological and Environmental Impacts on Design- Importance of Design – Success and Failures in design - Implications for Managers.

UNIT V ORGANISATIONAL CHANGE **9**

Meaning – Forces for Change - Resistance to Change – Types and forms of change – Evolutionary and Revolutionary change – Change process -Organisation Development – HR functions and Strategic Change Management - Implications for practicing Managers.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Know how to manage work place conflict and they understand how to resolve industrial relations and human resource problems.

CO2: Know about the causes for strikes and its prevention.

CO3: Know about industrial safety provisions and industrial health and hygienic conditions.

CO4: Analyze organizations more accurately and deeply by applying organization theory.

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CO5: Know about the applications of evolutionary and revolutionary change management system.

TEXT BOOKS

1. Gareth R.Jones, Mary Mathew, "Organisational Theory, Design & Change", Pearson Education, 7th Edition 2017.
2. Mamoria C.B. and Sathish Mamoria, "Dynamics of Industrial Relations", Himalaya Publishing House, New Delhi, 6th Edition, 2016.

REFERENCE BOOKS

1. Stephen P. Robbins , Timothy A. Judge , Neharika Vohra "Organizational Behaviour", 18th Edition, Pearson India Education service Pvt Ltd, 2018.
2. Richard L. Daft, "Understanding the Theory & Design of Organisations", Cengage Learning Western, 11th Edition, 2014.
3. Thomson G. Cummings and Christopher G. Worley, "Organisational Development and Change", Cengage learning, 10th Edition, 2014.
4. Arun Monappa, Ranjeet Nambudiri and Patturaja Selvaraj, "Industrial Relations & Labour Laws", Tata McGraw Hill, 2nd Edition, 2012.
5. Ratna Sen, "Industrial Relations in India, Shifting Paradigms", Macmillan India Ltd., New Delhi, 2009.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Know how to manage work place conflict and they understand how to resolve industrial relations and human resource problems.								2	3		2	3		1	
Co2	Know about the causes for strikes and its prevention.						2			3			2		1	
Co3	Know about industrial safety provisions and industrial health and hygienic conditions.			1			3									
Co4	Analyze organizations more accurately and deeply by applying organization theory.		3			2		1							1	
Co5	Know about the applications of evolutionary and revolutionary change management system.	2							2		1		3		2	

618MEE06 **DESIGN OF JIGS AND FIXTURES** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To understand the principles of jigs and fixtures design, locating principles, locating elements and clamping devices.
- To gain knowledge about the design and development of jigs and fixtures for various components.
- To study about the principle of press working and elements of cutting dies
- To understand the concepts of bending, forming and drawing dies.
- To study about the different process, assembly & computer aids used for the bulk forming process.

PRE-REQUISITES: Knowledge of Design of Machine Elements is required

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UNIT I LOCATING AND CLAMPING PRINCIPLES 8

Objectives of tool design- Function and advantages of Jigs and fixtures - Basic elements - Principles of location - Locating methods and devices - Redundant Location - Principles of clamping - Mechanical actuation - Pneumatic and hydraulic actuation Standard parts - Drill bushes and Jig buttons - Tolerances and materials used.

UNIT II JIGS AND FIXTURES 10

Design and development of jigs and fixtures for given component- Types of Jigs - Post, Turnover, Channel, latch, box, pot, angular post jigs - Indexing jigs - General principles of milling, Lathe, boring, broaching and grinding fixtures - Assembly, Inspection and Welding fixtures - Modular fixturing systems- Quick change fixtures.

UNIT III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 10

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- Design of various elements of dies - Die Block - Punch holder, Die set, Guide plates - Stops - Strippers - Pilots - Selection of Standard parts - Design and preparation of four standard views of Simple blanking, Piercing, Compound and progressive dies.

UNIT IV BENDING FORMING AND DRAWING DIES 10

Difference between bending, forming and drawing - Blank development for above operations - Types of Bending dies - Press capacity - Spring back - Knockouts - Direct and indirect - Pressure pads - Ejectors - Variables affecting Metal flow in drawing operations - Draw die inserts - Draw beads- Ironing - Design and development of bending, forming, drawing reverse re-drawing and combination dies - Blank development for axisymmetric, rectangular and elliptic parts - Single and double action dies.

UNIT V BULK FORMING PROCESSES 7

Bulging, Swaging, Embossing, Coining, Curling, Hole flanging, Shaving and sizing, Assembly, Fine blanking dies - Recent trends in tool design- Computer Aids for sheet metal forming analysis - Basic introduction - Tooling for numerically controlled machines- Setup reduction for work holding - Single minute exchange of dies – Poka-Yoke mechanism.

(Course should be supplemented with visits to industries.)

TOTAL HOURS: 45 PERIODS

Note: Use of Approved Design Data Book is permitted.

COURSE OUTCOMES

The student will have an ability to

CO1: Locate and clamp the jigs and fixtures
CO2: Design, develop, assembly and inspect the jigs and fixtures for various components
CO3: Design the various elements of dies
CO4: Develop the required views of the final design.
CO5: Use the computer aids for sheet metal forming analysis.

TEXT BOOKS

1. Cyril Donaldson, George H. LeCain, V. C. Goold, Joyjeet Ghose, "Tool Design", 4th Edition, Tata McGraw Hill, 2012.
2. Joshi, P.H. "Jigs and Fixtures", Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.

REFERENCE BOOKS

1. Venkataraman K, "Design of Jigs Fixtures & Press Tools", Wiley, United Kingdom, 2015.

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2. Design Data Hand Book, PSG College of Technology, Coimbatore, Reprint 2013.
3. Hoffman "Jigs and Fixture Design" - Thomson Delmar Learning, Singapore, 2012.
4. Frank W Wilson, “Fundamental of Tool Design”, Literary Licencing, 2012.
5. Joshi, P.H. "Press Tools" - Design and Construction", Wheels publishing, 2000.
6. M H A Kempster, "An Introduction to Jigs and Tool Design", Butterworth Heinemann Ltd, 1974.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Locate and clamp the jigs and fixtures		2		1								1	1		
Co2	Design, develop, assembly and inspect the jigs and fixtures for various components	2	1		1								1			2
Co3	Design the various elements of dies	2	2		2								1			2
Co4	Develop the required views of the final design.		1		2								2			2
Co5	Use the computer aids for sheet metal forming analysis.	1	1	2	1	2					1			1		1

618MEE07 DESIGN OF HEAT EXCHANGER

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concept of heat exchangers and the types, over all heat transfer co-efficient, LMTD and NTU method of analysis for various flow.
- To learn the thermal and hydraulic design of different concentric tube heat exchangers.
- To understand the mechanical design standards of TEMA (tubular engineering manufacturing association) code and methods.
- To learn the various heat transfer enhancement and analysis of compact heat exchangers.
- To develop an awareness of fouling on surfaces and Design of surface and evaporative condensers.

PRE-REQUISITES: Knowledge of Thermodynamics and Design of Machine Elements are required.

UNIT I INTRODUCTION 9

Classification of heat exchanger, selection of heat exchanger, Thermal Hydraulic fundamentals, Overall heat transfer coefficient, LMTD method for heat exchanger analysis for parallel, counter, multi pass and cross flow heat exchanger, e- NTU method for heat exchanger analysis, Fouling, Rating and sizing problems, heat exchanger design methodology.

UNIT II DESIGN OF DOUBLE PIPE HEAT EXCHANGERS 9

Thermal and Hydraulic design of inner tube and annulus, hairpin heat exchanger with bare and finned inner tube, total pressure drop.

UNIT III DESIGN OF SHELL & TUBE HEAT EXCHANGERS 9

Basic components, basic design procedure of heat exchanger, TEMA code, J-factors, conventional designs methods, Bell-Delaware method.

UNIT IV DESIGN OF COMPACT HEAT EXCHANGERS 9

Heat transfer enhancement, plate fin heat exchanger, tube fin heat exchanger, heat transfer and pressure drop.

UNIT V DESIGN OF SURFACE AND EVAPORATIVE CONDENSERS AND FOULING OF HEAT EXCHANGERS 9

Design of surface and evaporative condensers –Design of Shell and Tube, Plate type evaporators- Effect of fouling on heat transfer and pressure drop, cost of fouling.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The student will able to

CO1: Perform the heat transfer analysis using LMTD and NTU method depending on nature of problem and available data.
CO2: Perform the thermal and hydraulic design of concentric tube heat exchanger.
CO3: Become aware of heat transfer co-efficient and friction for shell and tube heat exchanger.
CO4: Perform the heat transfer enhancement and pressure drop on compact heat exchangers.
CO5: Understand the design of condensers and evaporators and the effect of fouling of heat exchangers.

TEXT BOOKS

1. Sadikkakac, Hongtan Liu and Anchasa Pramuanjaroenkij, "Heat Exchangers Selection, Rating and Thermal Design", CRC Press, 3rd Edition, 2012.
2. Shah.R.K and Dusan P. Sekulic, "Fundamentals of Heat Exchangers Design", John Wiley & sons, 2003.

REFERENCE BOOKS

1. Sarit Kumar Das, "Process Heat Transfer", Alpha Science International, 2018.
2. Kuppan T, "Heat Exchanger Design Hand Book", CRC Press, 2nd Edition, 2017.
3. Arthur, P. Frass, "Heat Exchanger Design", John Wiley and Sons, 2nd Edition, 2016.
4. Robert W Serth, "Process Heat Transfer: Principles, Application and Rules of Thumb", Academic Press, Elsevier, 2nd Edition, 2014.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Perform the heat transfer analysis using LMTD and NTU method depending on nature of problem and available data.	2	2								2			2		
Co2	Perform the thermal and hydraulic design of concentric tube heat exchanger.	2								2	2			2		
Co3	Become aware of heat transfer co-efficient and friction for shell and tube heat exchanger.						1				1			1		
Co4	Perform the heat transfer enhancement and pressure drop on compact heat exchangers.		3											3		
Co5	Understand the design of condensers and evaporators and the effect of fouling of heat exchangers.	1		1										1		

618MEE08 METAL FORMING TECHNIQUES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To know about Von-mises stress, Octahedral shear stress and shear strain theory.
- To know about the forging and rolling operations.
- To study about the working principle and applications of extrusion and drawing processes.
- To gain the knowledge on sheet metal forming processes.
- To develop new component by using new techniques and analyse with CAM software.

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PRE-REQUISITES: Knowledge of Manufacturing technology is required.

UNIT I FUNDAMENTALS OF METAL FORMING 9

State of stress – Components of stress, symmetry of stress tensor, principle stresses – Stress deviator – von-mises, Tresca yield criteria – Octahedral shear stress and shear strain theory – Flow stress determination – Temperature in metal forming – Hot, cold and warm working – Strain rate effects – Metallurgical structures – Residual stresses – Spring back.

UNIT II FORGING AND ROLLING 9

Principle – Classification – Equipment – Tooling – Process parameters and calculation of forces during forging and rolling processes – Ring compression test – Post forming heat treatment – defects (causes and remedies) – Applications – Roll forming.

UNIT III EXTRUSION AND DRAWING PROCESSES 9

Classification of extrusion processes – tool, equipment and principle of these processes – influence of friction – extrusion force calculation – defects (causes and remedies) – Rod-Wire drawing – tool, equipment and principle of processes – defects – Tube drawing and sinking processes – Mannessmann process of seamless pipe manufacturing – Tube bending.

UNIT IV SHEET METAL FORMING PROCESSES 9

Classification – conventional and HERF processes – Presses – types and selection of presses – formability studies – FLD, Limiting Draw ratio – processes: Deep drawing, spinning, stretch forming, plate bending, Rubber pad forming, bulging and press brake forming – Explosive forming, Electro hydraulic forming, Magnetic pulse forming and Super plastic forming.

UNIT V POWDER FORGING AND RECENT ADVANCES 9

Powdered metals and fabrication procedures, Applications, Preparation of powders, Compacting and sintering, Yield criteria and flow rules, Hot and cold pressing (HIP, CIP) –P/M forming – Electro forming – fine blanking – Hydro forming – Peen forming – Laser Forming – Micro forming – Isothermal forging – High speed forging and extrusion near net shape forming – Ultra fine grained materials by severe plastic deformation, CAD and CAM in forming.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

CO1: The students can understand load requirements for various bulk metal forming with or without addition of heat.
CO2: The students can understand tooling and press capacity for making sheet metal components.
CO3: Ability to know about extrusion processes and its force calculations.
CO4: The students are able to develop super plastic forming processes technique.
CO5: Student can able to analyse the new develop component by using simulation software.

TEXT BOOKS

1. Dieter G.E., "Mechanical Metallurgy", McGraw Hill, Co., 3rd Edition, 2017.
2. Nagpal G.R. "Metal forming processes", Khanna Publishers, New Delhi, 2005.

REFERENCE BOOKS

1. Rao, P.N. "Manufacturing Technology", TMH Ltd., Vol 2, 2017
2. B.L.Juneja, "Fundamentals of Metal Forming Processes", New Age International Publishers, 2018.
3. Marciniak Z, Duncen J L and Hu S J, "Mechanics of Sheet Metal Forming", Butterworth-Heinemann, An imprint of Elsevier, 2006.

4. Serope Kalpakjian, Steven R Schmid, “Manufacturing Process for Engineering Materials” Pearson Education, 4th Edition, 2003.
5. ASM Hand book, “Forming and Forging”, Ninth Edition, Vol-III, 2003.
6. Edward M.Mielink, “Metal Working Science Engineering”, McGraw Hill, Inc, 2000.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students can understand load requirements for various bulk metal forming with or without addition of heat.		2	2										2		
Co2	The students can understand tooling and press capacity for making sheet metal components.	1				3				1				2		
Co3	Ability to know about extrusion processes and its force calculations.		3	2		3				1				1		
Co4	The students are able to develop super plastic forming processes technique.			2		3				1				3		
Co5	Student can able to analyse the new develop component by using simulation software.		2	1		3							2	1		3

618MEE09 **TURBOMACHINERY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To familiarize students with different types of turbo machinery components including energy transfer.
- To understand the arrangements and function of centrifugal compressors.
- To impart the knowledge on centrifugal Pumps.
- To impart the knowledge on centrifugal fans and blowers.
- To understand the basic concepts for Steam nozzles and turbines.

PRE-REQUISITES: Knowledge of Fluid Mechanics and Machinery is required

UNIT I PRINCIPLES OF TURBOMACHINERY 9

Definition of turbo machines, parts of a turbo machine, comparison with positive displacement machine, classification, dimensionless parameters and their physical significance, Euler's turbine equation, components of energy transfer.

UNIT II AXIAL AND CENTRIFUGAL COMPRESSOR 9

Axial flow compressor - classification, expression for pressure ratio developed per stage - work done factor. Centrifugal compressor - classification, expression for overall pressure ratio, blade angles, slip factor, diffuser, surging.

UNIT III AXIAL AND CENTRIFUGAL PUMPS 9

Axial flow pumps: Expression for degree of reaction; velocity triangles for different values of degree of reaction. Centrifugal pumps: definition - manometric head, suction head, delivery head, pressure rise, efficiency, slip, priming and Net Positive Suction head.

UNIT IV CENTRIFUGAL FANS AND BLOWERS 9

Types- Stage and design parameters- Flow analysis in impeller blades- Volute and Diffusers, Losses, characteristic curves and selection, fan drives and fan noise.

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UNIT V STEAM NOZZLE AND TURBINES 9

Types - convergent - divergent, maximum mass flow rate and velocity of steam at exit, simple problems, critical pressure ratio. Classification - single stage impulse turbine, condition for maximum blade efficiency, stage efficiency - Compounding - need for compounding, method of compounding.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The student will be able to

CO1: Explain the working principle of turbo machines with suitable energy equations.
CO2: Explain the working principle and operation of centrifugal compressor.
CO3: Draw inlet and outlet velocity triangles of centrifugal Pump.
CO4: Became aware of centrifugal fans and blowers.
CO5: Draw inlet and outlet velocity triangles for impulse turbine.

TEXT BOOKS

1. Yahya, S.M., "Turbines, Compressors and Fans", Tata McGraw-Hill Publishing Company, 2010.
2. Gopalakrishnan. G and Prithvi Raj. D, "A Treatise on Turbomachines", Scitech Publications (India) Pvt. Ltd., 2008.

REFERENCE BOOKS

1. Ganesan, V., "Gas Turbines", Tata McGraw Hill Education, 2010.
2. Dixon, S.L. & C. A. Hall, "Fluid Mechanics and Thermodynamics of Turbomachinery", Pergamon Press, 2013.
3. Earl Logan, Jr., "Hand book of Turbomachinery", CRC Press, 2003.
4. Bruneck, "Fans", Pergamom Press, 1973.
5. Shepherd, D.G., "Principles of Turbomachinery", Macmillan, 1971.
6. Stepanoff, A.J., "Pumps and Blowers", John Wiley and Sons Inc., 1966.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Explain the working principle of turbo machines with suitable energy equations.		1			1					1			2		
Co2	Explain the working principle and operation of centrifugal compressor.	3									3			3		
Co3	Draw inlet and outlet velocity triangles of centrifugal Pump.	1	1	2										1		
Co4	Became aware of centrifugal fans and blowers.		1								1			1		
Co5	Draw inlet and outlet velocity triangles for impulse turbine.		1			2								1		

618MEE10 OPERATIONS RESEARCH L T P C

3 0 0 3

COURSE OBJECTIVES:

The student should be made

- To know about linear programming formulation and its graphical solution.
- To know about dual simplex method.
- To get knowledge on branch and bound techniques.

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- To know about classical optimization techniques.
- To understand the applications of CPM and PERT techniques.

PRE-REQUISITES: Knowledge of Engineering Mathematics is required.

UNIT I LINEAR PROGRAMMING 9

Principal components of decision problem – Modeling phases – LP Formulation and graphic solution – Resource allocation problems – Simplex method – Sensitivity analysis.

UNIT II DUALITY AND NETWORKS 9

Definition of dual problem – Primal – Dual relationships – Dual simplex methods – Post optimality analysis – Transportation and assignment model – Shortest route problem.

UNIT III INTEGER PROGRAMMING 9

Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming.

UNIT IV CLASSICAL OPTIMISATION THEORY 9

Unconstrained external problems, Newton – Raphson method – Equality constraints – Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems.

UNIT V OBJECT SCHEDULING 9

Network diagram representation – Critical path method – Time charts and resource leveling – PERT.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Understand the mathematical tools that are needed to solve optimization problems.

CO2: Identify and develop operational research models from the verbal description of the dual systems.

CO3: Study the techniques of integer programming.

CO4: Solve mathematical models like Newton Raphson method, Lagrangian method and Kuhn Tucker conditions.

CO5: Develop a operational event and activities effectively by use of CPM and PERT for project management

TEXT BOOKS

1. S.D.Sharma, “Operations Research”, Kedar Nath Ram Nath Publications, Chennai, 2015.
2. Panneerselvam, “Operations Research”, Prentice Hall of India, 2nd Edition, 2015.

REFERENCE BOOKS

1. J.K.Sharma, “Operations Research Theory and Applications”, Mc Millan India, 5th Edition 2013.
2. Hira and Gupta, “Problems in Operations Research”, S.Chand and Co, 2013.
3. Hamdy A Taha, “Operations Research: An Introduction”, Prentice Hall, 9th Edition, 2010.
4. Frederick.S.Hiller and Gerald.J.Lieberman, “Operations Research Concepts and Cases”, McGraw Hill Publishers, 9th Edition, 2010.
5. G Srinivasan, “Operations Research Principles and Applications”, Prentice Hall of India (EEE), 2010.
6. Wagner, “Operations Research”, Prentice Hall of India, 2000.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Understand the mathematical tools that are needed to solve optimization problems.	3	3	1		3				1	2			3		
Co2	Identify and develop operational research models from the verbal description of the dual systems.					2					3			1		
Co3	Study the techniques of integer programming.	1				2								1		
Co4	Solve mathematical models like Newton Raphson method, Lagrangian method and Kuhn Tucker conditions.	3	3			2								3		
Co5	Develop a operational event and activities effectively by use of CPM and PERT for project management	3	3			2							3	3		

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718MET01 **AUTOMOBILE ENGINEERING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the structure of vehicle chassis and engine components.
- To understand the working of various engine auxiliary and emission system.
- To impart knowledge about the various transmission system and their working.
- To demonstrate the students about working principle of steering, suspension and braking systems.
- To learn about the electrical systems and advances in automotive engineering.

PRE-REQUISITES: Knowledge of Basic of Civil and Mechanical Engineering is required.

UNIT I VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles, and need for a gearbox, components of engine-their forms, functions and materials. Vehicle construction - Chassis and body – Specifications, resistances to vehicle motion. Engine - Types - Construction - Location of engine - Cylinder arrangement - Construction details - Cylinder block - Cylinder head - Cylinder liners - Piston – piston rings - Piston pin - Connecting rod - Crankshaft - Valves. Lubrication system - Types - Oil pumps - Filters - Cooling system - Types - Water pumps - Radiators - Thermostats - Anti-freezing compounds.

UNIT II ENGINE AUXILIARY SYSTEMS AND EMISSION CONTROL SYSTEM 9

Ignition system - Coil and Magneto - Spark plug - Distributor – Electronic ignition system - Fuel system - Carburetor - Fuel pumps - Fuel injection systems - Mono point and Multi point – Unit injector – Nozzle types - Electronic Fuel Injection system (EFI) – GDI, MPFI, DTSI-Automobile Emissions - Source of formation – Effects on human health and environment - Control techniques - Exhaust Gas Recirculation (EGR) - Catalytic converter - Emission tests and standards (Indian and Europe)

UNIT III TRANSMISSION SYSTEMS 9

Clutches - Function - Types - Single plate, Multiple plate and Diaphragm Clutch - Fluid coupling - Gearbox - Manual - Sliding - Constant - Synchromesh - Overdrive - Automatic transmission - Torque converter - Epicylic and Hydromatic transmission - Continuously variable transmission - Universal joint - Propeller shaft - Hotchkiss drive – Final drive - Rear axle assembly - Types -Differential - Need - Construction – Non-slip differential – Differential locks - Four wheel drive.

UNIT IV STEERING, SUSPENSION AND BRAKING SYSTEM 9

Principle of steering - Steering Geometry and wheel alignment - Steering linkages – Steering gearboxes - Power steering - front axle - Suspension system - Independent and Solid axle – coil, leaf spring and air suspensions - torsion bar - shock absorbers - Wheels and Tires - Construction - Type and specification - Tire wear and causes - Brakes - Needs – Classification –Drum and Disc Mechanical - Hydraulic and pneumatic - Vacuum assist – Retarders – Anti-lock Braking System (ABS)

UNIT V AUTOMOBILE ELECTRICAL SYSTEMS AND ADVANCES IN AUTOMOBILE ENGINEERING 9

Electronic Brake Distribution (EBD)-Battery-General electrical circuits-Dash board instrumentation - HVAC - Seat belts - Air bags. Layout of electrical vehicle, performance of electrical vehicle, traction motor characteristics- transmission requirement, layout of hybrid vehicle-working and types, electronic control system in electrical and hybrid vehicles- Basics of fuel cell vehicle.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will able to

CO1: Imparts knowledge on different types of chassis and identify suitable engine for different applications.

CO2: Develop knowledge on troubleshooting of engine auxiliary systems and emission control.

CO3: Equipped with knowledge on automatic transmission system.

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CO4: Analyze the steering geometry, braking principle and suspension systems.
CO5: Identify the usage of Electrical system and advances in automotive Engineering

TEXT BOOKS

1. Dr. Kirpal Singh, "Automobile Engineering Vols 1 & 2 ", Standard Publishers Distributors, 13th Edition, New Delhi, 2014.
2. Srinivasan. S, "Automotive Mechanics", Tata McGraw Hill Publishers, 2nd Edition, New Delhi, 2003.

REFERENCE BOOKS

1. Rajput R K, "A Text book of Automobile Engineering", Laxmi Publication, 2015.
2. Ganesan V, "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012.
3. Richard van Basshuysen, "Modern Engine Technology from A to Z", SAE International Publications, USA, 2007.
4. Martin W. Stockel and Martin T Stockel, "Auto Fundamentals", The Goodheart -Will Cox Company Inc, USA, 10th Edition, 2005.
5. Heinz Heisler, "Advanced Vehicle Technology", SAE International Publications USA, 2nd Edition, 2002.
6. Garret.T.K, Newton.K and Steeds.W, "Motor Vehicles", Butterworth-Heinemaan Publishers, 13th Edition, 2001.
7. Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi , "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles"- CRC Press, 3rd Edition, 2018.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Imparts knowledge on different types of chassis and identify suitable engine for different applications.	3	1								1			2		
Co2	Develop knowledge on troubleshooting of engine auxiliary systems and emission control.	3	1								1			2		
Co3	Equipped with knowledge on automatic transmission system.	3	1								1			2		
Co4	Analyze the steering geometry, braking principle and suspension systems.	3	1								1			2		
Co5	Identify the usage of Electrical system and advances in automotive Engineering	3	1								1			2		

718MET02 **MECHATRONICS AND ROBOTICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To have knowledge on various types of sensors and transducer used in mechatronics systems.
- To learn about the different system models and controllers used in mechatronics system.
- To comprehend the concepts of electrical circuits and signal conditioning.
- To learn the various types of grippers and selection of grippers.
- To know about the basic concepts associated with the design and functioning and applications of Robots.

PRE-REQUISITES: Knowledge of Applied Hydraulic and Pneumatics, Engineering Mechanics are required.

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UNIT I MECHATRONICS SENSORS AND TRANSDUCERS 9

Introduction to Mechatronics Systems, Measurement Systems, Control Systems - Microprocessor based Controllers, Sensors and 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 II SYSTEM MODELS AND CONTROLLERS 8

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational and Translational Systems, Electromechanical Systems, Hydraulic and Mechanical Systems.

Continuous and discrete process Controllers, Control Mode, Two - Step mode, Proportional Mode, Derivative Mode, Integral Mode, PID Controllers, Digital Controllers, Velocity Control, Adaptive Control, Digital Logic Control, Micro Processors Control.

UNIT III PROGRAMMING LOGIC CONTROLLERS AND DESIGN OF MECHATRONICS SYSTEM 10

Programmable Logic Controllers, Basic Structure, Input / Output Processing, Programming – Mnemonics, Timers, Internal relays and counters, Shift Registers, Master and Jump Controls, Data Handling, Analogs Input / Output, Selection of a PLC.

Stages in designing Mechatronics Systems, Traditional and Mechatronic Design, Possible Design Solutions, Autonomous mobile robot-Wireless surveillance balloon- Engine Management system-Automatic car park barrier.

UNIT IV ROBOT AND END EFFECTORS 9

Robot – Definition, Robot Anatomy, Co-ordinate Systems, Work Envelope, types and classification, Specifications - Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load, Robot Parts and Functions, Need for Robots, Different Applications.

End Effectors, Grippers - Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers, Two Fingered and Three Fingered Grippers, Internal Grippers and External Grippers, Selection and Design Considerations.

UNIT V ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Differences, Forward Kinematics and Inverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional).

Teach Pendant Programming, Lead through programming, Robot programming Languages - VAL Programming - Motion Commands, Sensor Commands, End effector commands, and Simple programs.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

CO1: The students will be able to analyze mechatronics systems and different sensors used for displacement, position, velocity, motion, force, fluid pressure, temperature, etc

CO2: The students acquire knowledge in system models of mechanical, electrical, fluid, thermal systems and continuous and discrete process controllers

CO3: The students will be familiar with the basic structure of programmable logic controllers and in designing mechatronics systems

CO4: The students will be able to acquire the knowledge of different types and classification of robots, end effectors and robot kinematics.

CO5: The students will be able to gain the knowledge on robot programming languages.

TEXT BOOKS

1. Bolton W, “Mechatronics- Electronic Control Systems in Mechanical and Electrical Engineering”, Pearson Education, 6th Edition, Indian Reprint, 2015.
2. M.P.Groover, “Industrial Robotics - Technology, Programming and Applications”, Tata McGraw-Hill, 2nd Edition, Special Indian Edition, 2012.

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REFERENCE BOOKS

1. Fu.K.S., Gonzalz.R.C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw-Hill Book Co., 2008.
2. Rajput. R.K, "A Textbook of Mechatronics", S. Chand & Co, 2007.
3. Michael B. Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2007.
4. Lawrence J. Kamm, "Understanding Electro - Mechanical Engineering, An Introduction to Mechatronics", Prentice - Hall of India Pvt., Ltd., 1995.
5. Janakiraman.P.A.,"Robotics and Image Processing", Tata McGraw-Hill, 1995.
6. Yoram Koren, "Robotics for Engineers", McGraw-Hill Book Co., 1985.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students will be able to analyze mechatronics systems and different sensors used for displacement, position, velocity, motion, force, fluid pressure, temperature, etc	2				1		1						2		1
Co2	The students acquire knowledge in system models of mechanical, electrical, fluid, thermal systems and continuous and discrete process controllers	1		3										2		1
Co3	The students will be familiar with the basic structure of programmable logic controllers and in designing mechatronics systems	1	1	2	1	2								2		2
Co4	The students will be able to acquire the knowledge of different types and classification of robots, end effectors and robot kinematics.	2	1	2										2		2
Co5	The students will be able to gain the knowledge on robot programming languages.		1	1		2	1	1	1					2		1

718MET03 **FINITE ELEMENT ANALYSIS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To interpret the mathematical and physical principles underlying the Finite Element Analysis.
- To acquire knowledge about the characteristics of various one dimensional elements for the problems being solved.
- To explain about the finite element equations for simple and complex elements.
- To learn how the finite element method is implemented in vibration analysis.
- To develop finite element formulations of engineering problems from a variety of application areas including heat transfer and fluid flow analysis.

PRE-REQUISITES: Knowledge of Engineering Mathematics, Strength of Materials, Engineering Thermodynamics, Dynamics of Machinery are required.

INTRODUCTION (Not for examination) **4**

Solution to engineering problems - Mathematical modeling - Discrete and Continuum modeling - need for numerical methods of solution - Relevance and scope of finite element methods - engineering applications of FEA.

UNIT I **FINITE ELEMENT FORMULATION OF BOUNDARY VALUE PROBLEMS** **8**

Weighted residual methods -General weighted residual statement - Weak formulation of the weighted residual statement - Piecewise continuous trial functions- Principle of stationary total potential -

Rayleigh Ritz method - Piecewise continuous trial functions – Solution of equilibrium problems – Gaussian elimination method – Rayleigh Ritz method – Galerkin method.

UNIT II ONE DIMENSIONAL FINITE ELEMENT ANALYSIS 8

General form of total potential for 1D applications - Generic form of finite element equations - linear bar element – Quadratic bar element -Nodal approximation - Development of shape functions - Element matrices and vectors - Example problems - Extension to plane truss- Development of Element equations - assembly - Element connectivity - Global equations - Solution methods -Beam element - Nodal approximation - Shape functions - Element matrices and vectors - Assembly - solution - Example problems.

UNIT III TWO DIMENSIONAL FINITE ELEMENT ANALYSIS 9

Introduction - Approximation of geometry and field variable - 3 noded triangular elements - four noded rectangular elements - Higher order elements - Natural coordinates and coordinate transformations - Triangular and quadrilateral elements - Iso-parametric elements - Structural mechanics applications in 2 Dimensions - Elasticity equations - stress strain relations - plane problems of elasticity - Element equations - Assembly - Need for quadrature formule - transformations to natural coordinates - Gaussian quadrature - Example problems in plane stress, Plane strain and Axisymmetric applications.

UNIT IV DYNAMIC ANALYSIS USING FINITE ELEMENT METHOD 8

Introduction - Vibrational Problems - Equations of motion based on weak form - Axial vibration of bars - Transverse vibration of beams - Consistent mass matrices and lumped mass matrices- element equations -Solution of eigen value problems - Vector iteration methods.

UNIT V APPLICATIONS IN HEAT TRANSFER & FLUID FLOW ANALYSIS 8

Basic equation of steady state heat transfer and fluid flow problems – 1D finite element formulation – 1D heat transfer and fluid flow problems - Scalar variable problems in 2Dimensions - Applications to heat transfer in 2 Dimension.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

Student will be able to

CO1: Identify mathematical model for solution of common engineering problems
CO2: Formulate one dimensional finite element equation for simple problems.
CO3: Examine 2-D finite element continuum for structural applications
CO4: Formulate and solve vibration problems using finite element techniques.
CO5: Solve 1-D and 2-D heat transfer and fluid flow problems using finite element approach.

TEXT BOOKS

1. Logan D.L., "A First Course in the Finite Element Method", 6th Edition, Thomson Learning, 2016.
2. P.Seshu, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2012.

REFERENCE BOOKS

1. Rao S.S, "The Finite Element Method in Engineering", Butterworth-Heinemann (An imprint of Elsevier), 6th Edition, 2018.
2. J.N.Reddy, "An Introduction to the Finite Element Method", McGraw-Hill International, 3rd Editions, 2017.
3. David V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition 2017.
4. Chandrupatla T.R. & Belagundu A.D., "Introduction to Finite Elements in Engineering", Pearson Education, New Delhi, 4th Edition, 2014.
5. K.J. Bathe, "Finite Element Procedures", Prentice-Hall India Pvt. Ltd., New Delhi, 2nd Edition, 2014.

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6. Chennakesava R Alavela, “FEM: Basic Concepts and Applications”, Prentice Hall India Pvt. Ltd, New Delhi, 2012.
7. Cook R.D., Malkus D.S., Plesha M.E., and Witt R.J., “Concepts and Applications of Finite Element Analysis”, Wiley India (P) Ltd., New Delhi, 4th Edition, 2007.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Identify mathematical model for solution of common engineering problems		2		1								1	1		1
Co2	Formulate one dimensional finite element equation for simple problems.	2	1		1								1			2
Co3	Examine 2-D finite element continuum for structural applications	2	2		2								1			3
Co4	Formulate and solve vibration problems using finite element techniques.		1		2								2			2
Co5	Solve 1-D and 2-D heat transfer and fluid flow problems using finite element approach	1	1	2	1	1					1			1		1

718MET04 **POWER PLANT AND ENERGY ENGINEERING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To penetrate the various components, operations and applications of different types of power plants.
- To gain the knowledge on steam power plants, steam generators their analyses on fuel and fluidized bed combustion, ash handling systems,
- To findout the requirements for a Nuclear and hydroelectric Power Plant from sources to consumption.
- To describe basic working principles of gas turbine and diesel engine power plants.
- To gain knowledge in renewable energy and to know various methods for the economics of power generation.

PRE-REQUISITES: Knowledge of Basic of Civil and Mechanical Engineering is required.

UNIT I INTRODUCTION TO POWER PLANTS AND BOILERS 9

Layout of Steam, Hydel, Diesel, MHD, Nuclear and Gas turbine Power Plants. Combined Power cycles - Comparison and selection, Load duration Curves, Steam boilers and cycles - High pressure and Super Critical Boilers - Fluidised Bed Boilers.

UNIT II STEAM POWER PLANT 9

Fuel and ash handling, Combustion Equipment for burning coal, Mechanical Stokers. Pulveriser, Electrostatic Precipitator, Draught- Different Types, Surface condenser types, Cooling towers.

UNIT III NUCLEAR AND HYDEL POWER PLANT 9

Basics of Nuclear Engineering- Layout and subsystems of Nuclear power plant- Working of Nuclear power plants: Boiling water reactor (BWR), Pressurised water reactor (PWR), Canada Deuterium Uranium (CANDU) reactor, Gas cooled reactor (GCR), Fast breeder reactor (FBR)- safety measures for Nuclear power plant.

Basics of hydro electric power generation - Classification, Typical layout of associated components including selection of turbines and governing of turbines- Micro hydel development.

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UNIT IV DIESEL AND GAS TURBINE POWER PLANTS 9

Types of diesel plants, components, Selection of Engine type, applications-Gas turbine power plant- Fuels- Gas turbine material - Open and Closed cycles- Reheating - Regeneration and intercooling - Combined cycle.

UNIT V RENEWABLE ENERGY & ECONOMICS OF POWER PLANTS 9

Bio energy, Biomass, Biogas, Sources, Composition, Wind energy, Wind data and energy estimation, Wind energy conversion system- Geothermal- OTEC- Tidal energy. Power tariff types- Load distribution parameters- Cost of electric energy- Fixed and operating cost- Economics of load sharing- Comparison of various power plants.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Realize the importance of power requirement, generation and utilization in the present world energy scenario.

CO2: Apply the knowledge gained by analyzing the steam power plants, steam generators and gas turbine power plants, to improve the efficiency and reduce the thermal losses.

CO3: Analyse the processes and cycles followed in nuclear and hydro electric power plant and components used in the power plants and identify the losses to get better efficiency.

CO4: Describe the working of various components of diesel power plant and Illustrate the working of gas turbine power plant and its components.

CO5: Apply knowledge about economics of power generation and use of renewable energy.

TEXT BOOKS

1. Nag P.K, "Power Plant Engineering", Tata McGraw- Hill, 4th Edition, 2017.
2. Arora S.C and Domkundwar S, "A Course in Power Plant Engineering", Dhanpat Rai, 8th Edition, 2016.

REFERENCE BOOKS

1. R.K.Rajput, "Power Plant Engineering", Laxmi Publications, 5th Edition, 2016.
2. G.D.Rai, "An Introduction to Power Plant Technology", Khanna Publishers, 2015.
3. EI-Wakil M.M, "Power Plant Technology", Tata McGraw-Hill, 2013.
4. G.R,Nagpal , "Power Plant Engineering", Khanna Publishers, 2002.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Realize the importance of power requirement, generation and utilization in the present world energy scenario.	3	1				1	1		1	1			2		
Co2	Apply the knowledge gained by analyzing the steam power plants, steam generators and gas turbine power plants, to improve the efficiency and reduce the thermal losses.	3	1				1	1		1	1			2		
Co3	Analyse the processes and cycles followed in nuclear and hydro electric power plant and components used in the power plants and identify the losses to get better efficiency.	3	1				1	1		1	1			2		
Co4	Describe the working of various components of diesel power plant and Illustrate the working of gas turbine power plant and its components.	3	1				1	1		1	1			2		
Co5	Apply knowledge about economics of power generation and use of renewable energy.	3	1				1	1		1	1			2		

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718MEP07 **MECHATRONICS LABORATORY** **L T P C**
0 0 2 1

COURSE OBJECTIVES:

- To know the basic working principle of hydraulic and pneumatic systems.
- To interpret system drawings and design simple systems for sequential control systems involving valves and cylinders.
- To develop the capability of design and implementation of pneumatic circuits for industrial automation / electro - pneumatic circuits for industrial automation.
- To learn the virtual instrumentation software and its applications for automated measurement / monitoring.
- To familiar with interfacing of electromechanical system to micro controllers.

PRE-REQUISITES: Knowledge of Basic Applied Hydraulic and Pneumatics, Mechatronics and Robotics are required

LIST OF EXPERIMENTS

1. Design and testing of Fluid Power Circuits to Control.
   (i) Velocity (ii) Direction and (iii) Force of single and double acting Actuators.
2. Design of circuits with logic sequence using Electro Pneumatic Trainer Kits.
3. Design and Simulation of basic Hydraulic, Pneumatic and Electric Circuits using Software.
4. Circuits with multiple cylinder sequences in Electro pneumatic using PLC.
5. Speed Control of AC & DC drives.
6. Servo Controller interfacing for DC motor.
7. PID controller interfacing.
8. Stepper motor interfacing with 8051 Micro controller.
   (i) Full step resolution (ii) Half step resolution.
9. Modeling and Analysis of Basic Electrical, Hydraulic and Pneumatic Systems using LAB VIEW.
10. Computerized Data Logging System with control for process variables like Pressure Flow and Temperature.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Identify the hydraulic and pneumatic systems employed in manufacturing industry.
CO2: Apply the principles of Mechatronics and automation for the development of productive and efficient manufacturing systems.
CO3: Use the engineering technique skills and modern engineering tools necessary for practical applications.
CO4: Use design principles and develop conceptual, engineering design and fabrication of various components.
CO5: Simulate the basic electrical, hydraulic and pneumatic system using simulation software.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Identify the hydraulic and pneumatic systems employed in manufacturing industry.	2	2	3	2	3	1			2	1	2	3	1		3
Co2	Apply the principles of Mechatronics and automation for the development of productive and efficient manufacturing systems.	3	2	2	1	2				1	1	2	1	1	2	1
Co3	Use the engineering technique skills and modern engineering tools necessary for practical applications.	2	2	2	2	1				1		2	1	1	3	1

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Co4	Use design principles and develop conceptual, engineering design and fabrication of various components.	3	1	2	2	2				2	1	2	2	1		2
Co5	Simulate the basic electrical, hydraulic and pneumatic system using simulation software.	3	2	2	1	2				1	2	2	1			

718MEP08 **CAE LABORATORY** **L T P C**
0 0 2 1

COURSE OBJECTIVES:

- To interpret design concepts to use the Finite Element Method software correctly and efficiently
- To comprehend the types of element used, type of analysis done, interpretation of results, method of solving and analyzing a given problem.
- To acquire the basic skills in using professional level finite element software, applied to structural and heat transfer components at various loading conditions.
- To analyze a physical problem, develop experimental procedures for accurately investigating the problem, and effectively perform and document findings.
- To simulate simple mechanisms using simulation software.

PRE-REQUISITES: Knowledge of Finite Element Analysis is required.

LIST OF EXPERIMENTS

A.ANALYSIS (SIMPLE TREATMENT ONLY) **37**

1. Stress Analysis of bars (Constant cross sectional area, Tapered area &Stepped bar).
2. Two Dimensional Truss analysis.
3. Stress Analysis of Beams (Cantilever, Simply supported, Fixed ends).
4. Stress Analysis of a Plate with a Circular Hole.
5. Stress Analysis of Rectangular L Bracket.
6. Stress Analysis of an Axi-symmetric Component.
7. Mode Frequency Analysis of Beams (Cantilever, Simply supported, Fixed ends).
8. Mode Frequency Analysis of a 2-D Component.
9. Harmonic Analysis of Beams.
10. Thermal Stress Analysis of a 2D Component.
11. Conductive Heat Transfer Analysis of a 2D Component.
12. Convective Heat Transfer Analysis of a 2D Component.

B. SIMULATION **8**

1. Simulation of Cam and Follower Mechanism using C / MAT Lab.
2. Simulation of Four Bar Mechanism using C / MAT Lab.
3. Simulation of Slider Crank Mechanism using C / MAT Lab.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Select the method, meshing, analysis and optimize the given problem for structural and thermal applications.

CO2: Conduct structural analyses and selected other analysis like normal modes/natural frequency analysis, harmonic analysis, steady-state heat conduction analysis.

CO3: Use professional level finite element software to solve engineering problems in solid mechanics and heat transfer.

CO4: Simulate simple kinematic mechanisms and air conditioning system using simulation software.

CO5: Recognize sources of errors in FEA.

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Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Select the method, meshing, analysis and optimize the given problem for structural and thermal applications.		2		1								1	1		1
Co2	Conduct structural analyses and selected other analysis like normal modes/natural frequency analysis, harmonic analysis, steady-state heat conduction analysis.	2	1		1								1			2
Co3	Use professional level finite element software to solve engineering problems in solid mechanics and heat transfer.	2	2		2								1			3
Co4	Simulate simple kinematic mechanisms and air conditioning system using simulation software.		1		2								2			2
Co5	Recognize sources of errors in FEA.		1											1		1

718MEP09 **DESIGN AND FABRICATION PROJECT** **L T P C**
0 0 4 2

COURSE OBJECTIVES:

- To provide opportunity for the student to recollect the fundamental knowledge acquired during the earlier semesters and apply the same to real life problems and provide solution to the problems
- To learn concepts, models, frameworks, and tools that engineering graduate need in a world where creativity and innovation is fast becoming a pre-condition for competitive advantage.
- Each student will choose a nagging workplace problem or socially relevant problems and prove their understanding of fundamental concepts.
- To give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them
- To understand the basic steps of project planning, project management, Quality assurance, process management and their relationships

GUIDE LINES

1. The students in convenient groups of not more than 4 members have to take one small system for design and fabrication.
2. Every project workgroup shall have a guide who is the member of the faculty of the institution and if possible with an industrial guide also.
3. The system chosen may be a machine element (Example-screw jack, coupling, machine vice, cam and follower, governor etc), attachment to machine tools, tooling (jigs, fixtures etc), small gear box, automotive appliances, agricultural implements, simple heat exchangers, small pumps, hydraulic /pneumatic devices etc.
4. The students are required to design and fabricate the chosen system in the college and demonstrate its working apart from submitting the project report. The report should contain assembly drawing, parts drawings, process charts relating to fabrication.

CONTINUOUS ASSESSMENT

1. The progress of the project is evaluated by a review committee consisting of a minimum of three members.
2. The review committee may be constituted by the Head of the Department.
3. The continuous assessment shall be made by conducting three reviews.

TOTAL HOURS: 45 PERIODS

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COURSE OUTCOMES

The students are able to

CO1: Use design principles and develop conceptual design of various components
CO2: Fabricate various components using different manufacturing tools
CO3: Develop skills to be the effective members of team
CO4: Have the knowledge of contemporary issues and modern practices
CO5: Familiarize presentation, communication and team-work skills

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Use design principles and develop conceptual design of various components	1	1	1		1								1		1
Co2	Fabricate various components using different manufacturing tools	1	1	3										1		2
Co3	Develop skills to be the effective members of team	1	2	1		1								1		1
Co4	Have the knowledge of contemporary issues and modern practices					1					1			1		
Co5	Familiarize presentation, communication and team-work skills					1					2					1

718MEP10 INTERNSHIP & TECHNICAL SEMINAR

L	T	P	C
0	0	3	1

COURSE OBJECTIVES:

- To make the students to get practical exposure and learn about various activities happening in the industries.
- To make the students to learn about effective communication, presentation skills and report preparation.
- To build the strength, team work spirit and self confidence in students life.
- To develop skills in the application of theory to practical work situations.
- To increase the student's strength of responsibility and good working habits.

GUIDELINES

- It is mandatory that each student should undergo internship / in-plant training in reputed industries for the duration of 2-3 weeks after second semester end examination. Then the student has to submit a hard copy of the training report not less than 10 pages. Also he / she has to give presentation on the training report for about 30 minutes.
- Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models.

EVALUATION

- The training report will be evaluated by the faculty in-charge.
- There is internal assessment and end examination.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

CO1: The students will have practical knowledge about various activities like process design, quality control that are takes place in industries.
CO2: The students will have the skills of effective communication, presentation and report preparation.

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CO3: The students are able to improve their problem solving and critical thinking skills.
CO4: The students are able to identify the professional standards.
CO5: The students are able to create or modify the new technology policies.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students will have practical knowledge about various activities like process design, quality control that are takes place in industries.	1	2		1	1								1		1
Co2	The students will have the skills of effective communication, presentation and report preparation.	2	1		1	1						1				
Co3	The students are able to improve their problem solving and critical thinking skills.	2	2		2											1
Co4	The students are able to identify the professional standards.		1					1	1							
Co5	The students are able to create or modify the new technology policies.	1	1	1									1	1		3

718MEE01 MAINTENANCE ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To study about the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To gain the knowledge about different maintenance categories like Preventive maintenance and about the methods of lubrication.
- To know about condition monitoring systems.
- To know about the repair methods of basic machine elements.
- To gain knowledge on repair methods for material handling equipments.

PRE-REQUISITES: Knowledge of Process Planning and Cost Estimation, Production Planning and Cost Estimation are required.

UNIT I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 10

Basic Principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound Maintenance systems - Reliability and machine availability - MTBF, MTTR and MWT - Factors of availability - Maintenance organization - Maintenance economics.

UNIT II MAINTENANCE POLICIES - PREVENTIVE MAINTENANCE 9

Maintenance categories - Comparative merits of each category - Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – Total Productive Maintenance.

UNIT III CONDITION MONITORING 9

Condition Monitoring - Cost comparison with and without CM - On-load testing and off- load testing - Methods and instruments for CM - Temperature sensitive tapes - Pistol thermometers - wear-debris analysis.

UNIT IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS 10

Repair methods for beds, slideways, spindles, gears, lead screws and bearings - Failure analysis - Failures and their development - Logical fault location methods - Sequential fault location.

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UNIT V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 7

Repair methods for Material handling equipment - Equipment records -Job order systems -Use of computers in maintenance.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The Students will be able to

CO1: Analyze the basic concepts of different types of maintenance and selection maintenance methods for various types of organizations like product oriented and service oriented sectors based on the understanding.

CO2: Gain the knowledge of preventive maintenance concept and implementation of PM budget cost control techniques.

CO3: Know about the working principle of pistol thermometers.

CO4: Know the Concept's of repair, replacement and overhaul.

CO5: Apply the knowledge on use of computers in maintenance.

TEXT BOOKS

1. Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., First Edition Reprint 2013.
2. Alakesh Manna, “A Textbook of Reliability and Maintanence Engineering”, I K International Publishing ware Pvt Ltd, 2011.
3. Srivastava S.K., "Industrial Maintenance Management", S. Chand and Co., 2002.

REFERENCE BOOKS

1. RC Mishra and K Pathak, “Maintenance Engineering and Management”, Eastern Economy Edition, 2012.
2. Garg H.P, "Industrial Maintenance", S. Chand & Co., 2010.
3. A. Davies, "Handbook of Condition Monitoring", Chapman & Hall, Springer link, 1998.
4. "Advances in Plant Engineering and Management", Seminar Proceedings - IIPE, 1996.
5. Higgins L.R., "Maintenance Engineering Hand book", McGraw Hill, 5th Edition, 1995.
6. White E.N., "Maintenance Planning", I Documentation, Gower Press, 1979.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Analyze the basic concepts of different types of maintenance and selection maintenance methods for various types of organizations like product oriented and service oriented sectors based on the understanding.	1	2	1	2	1		2		2			1	2		1
Co2	Gain the knowledge of preventive maintenance concept and implementation of PM budget cost control techniques.	1	2	1	2	1		2		2			1	2		1
Co3	Know about the working principle of pistol thermometers.	2	1	1	2	1						1	2	2		1
Co4	Know the Concept's of repair, replacement and overhaul.	2	1	2	1	1				1		1	2	2		1
Co5	Apply the knowledge on use of computers in maintenance.	2	1	1	3							1	2	2		1

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718MEE02 **MECHANICAL VIBRATION** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To fully understand and appreciate the importance of vibrations in mechanical design of machine parts that operates in vibratory conditions.
- To obtain linear vibratory models of dynamic systems with changing complexities (SDOF, MDOF).
- To write the differential equation of motion of vibratory systems.
- To make free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multi degree of freedom linear systems.
- To understand working principles of vibration measurement devices.

PRE-REQUISITES: Knowledge of Kinematics and Dynamics of Machinery is required.

UNIT I FUNDAMENTALS OF VIBRATION 9

Introduction, Single degree freedom - Free vibration systems, Damped vibrations, Single degree freedom - Forced vibration with elastically coupled viscous dampers, System Identification from frequency response, Support motion, Duhamel's Integral, Impulse Response function, Virtual work, Lagrange's equation, Transient Vibration.

UNIT II TWO DEGREE FREEDOM SYSTEM 9

Free vibration of spring-coupled system, mass coupled system, Vibration of two degree freedom system, Forced vibration, Vibration Absorber, Vibration isolation.

UNIT III MULTI-DEGREE FREEDOM SYSTEM 9

Normal mode of vibration, Flexibility Matrix and Stiffness matrix, Eigen values and eigen vectors, Orthogonal properties, Modal matrix-Modal Analysis, Forced Vibration by matrix inversion, Modal damping in forced vibration, Numerical methods for fundamental frequencies.

UNIT IV VIBRATION OF CONTINUOUS SYSTEMS 9

Systems governed by wave equations, Vibration of strings, Vibration of rods, Euler Equation for Beams, Effect of Rotary inertia and shear deformation, Vibration of plates.

UNIT V EXPERIMENTAL METHODS IN VIBRATION ANALYSIS 9

Vibration instruments, Vibration exciters Measuring Devices, Analysis, Vibration Tests – Free and Forced Vibration tests, Examples of Vibration tests – Industrial, case studies.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The student will have an ability to

CO1: Analyze the mathematical model of a linear vibratory system to determine its response.
CO2: Obtain linear mathematical models of real life engineering systems.
CO3: Use Lagrange's equations for linear and nonlinear vibratory systems.
CO4: Determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation.
CO5: Conduct test by using different vibration measuring device.

TEXT BOOKS

1. Rao, J.S. and Gupta, K., "Introductory Course on Theory and Practice Mechanical Vibration", New Age International (P) Ltd., New Delhi, 6th Edition, 2017.
2. William T. Thomson, Marie Dillon Dahleh., "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, Fifth Edition, 1997.

REFERENCE BOOKS

1. Ahmed A. Shabana, "Theory of Vibration", Springer- Verlag, New York, 3rd Edition, 2019.
2. Rao S.S., "Mechanical Vibrations", Addison Wesley Longman, New York, 6th Edition, 2017.
3. Shrikant Bhave, "Mechanical Vibrations Theory and Practice", Pearson Education, Inc, New Delhi 2010.
4. G.K. Grover and S.P.Nigam, "Mechanical Vibrations", Nem Chand and Bros, Roorkee, 8th Edition, 2009.
5. Srinivasan P., "Nonlinear Mechanical Vibrations", New Age International, 1995.
6. Rao J. S., "Advanced Theory of Vibration: Nonlinear Vibration and One-dimensional Structures", New Age International, 1992.
7. Den Hartog J.P, "Mechanical Vibrations", Dover Publications, New York, 1985.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Analyze the mathematical model of a linear vibratory system to determine its response.	1	2	1										2	1	1
Co2	Obtain linear mathematical models of real life engineering systems.	2	1	2										1	2	1
Co3	Use Lagrange's equations for linear and nonlinear vibratory systems.	2	2	1										2	1	1
Co4	Determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation.	1	2	1										1	1	1
Co5	Conduct test by using different vibration measuring device.	2	1	2										2	1	1

718MEE03 ENGINEERING ECONOMICS AND COST ANALYSIS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To know the different engineering economic principles and strategies.
- To know about the concept of value engineering and the various methods to calculate interest.
- To gain the knowledge on cost calculations.
- To study various replacement policies.
- To know about the types of depreciation methods.

UNIT I INTRODUCTION TO ECONOMICS 8

Introduction to Economics- Circular in an economy, Law of supply and demand, Concept of engineering economics - Engineering efficiency, Economic efficiency, Scope of engineering economics- Element of costs, Marginal cost, Marginal revenue, Sunk cost, Opportunity cost, Break-even analysis- P/V ratio, Elementary economic Analysis - Material selection for product Design selection for a product, Process planning.

UNIT II ECONOMICS IN ENGINEERING 10

Make or buy decision, Value engineering - Function, aims, value engineering procedure. Interest formulae and their applications -Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- Equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

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UNIT III CASH FLOW **9**

Methods of comparison of alternatives - Present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Rate of return method, Examples in all the methods.

UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS **9**

Replacement and Maintenance analysis - Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset - capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT V DEPRECIATION **9**

Depreciation- Introduction, Straight line method of depreciation, Declining balance method of depreciation-Sum of the years digits method of depreciation, Sinking fund method of depreciation/ Annuity method of depreciation, Service output method of depreciation-Evaluation of public alternatives- introduction, examples, Inflation adjusted decisions - Procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

Student are able to

CO1: Get knowledge about basics of economics.
CO2: Know about make or buy decisions.
CO3: Become familiar with cost calculations.
CO4: Know the concept of challenger and defender.
CO5: Know about how to find the depreciation of an asset.

TEXT BOOKS

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2nd Edition, 2014.
2. Suma Damodaran, "Managerial Economics", Oxford University Press, 2nd Edition, 2010.

REFERENCE BOOKS

1. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and Analysis", Engg. Press, Texas, 2013.
2. Luke M Froeb & Brian T McCann, "Managerial Economics - A Problem solving approach", Thomson learning, 2013.
3. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2010.
4. Ted G Eschenbach, "Engineering Economy: Applying Theory to Practice", 3rd Edition, 2010.
5. L.J.Truett & T.B.Truett, "Managerial Economics- Analysis, problems & cases", Wiley India, 8th Edition, 1999.
6. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Mcmillan, New York, 1996.
7. Smith G.W., "Engineering Economy", Lowa State University Press, 3rd Edition, 1987.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Get knowledge about basics of economics.			3										1		

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Co2	Know about make or buy decisions.									2			2			
Co3	Become familiar with cost calculations.	3	2			1					2			3		
Co4	Know the concept of challenger and defender.								1	3		2	3		2	
Co5	Know about how to find the depreciation of an asset.	2	2		2	1								3		

718MEE04 **RAPID PROTOTYPING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the rapid prototyping techniques in manufacturing.
- To study the stereo lithography process and selective laser sintering.
- To study the fused deposition modeling and solid ground curing.
- To understand the laminated object manufacturing, concept modeler and laser engineered net shaping.
- To applying rapid-prototyping techniques to the production of tooling (rapid tooling) that can be used in other manufacturing processes.

PRE-REQUISITES: Knowledge of CAD/CAM/CIM, Advanced Manufacturing Process are required.

UNIT I INTRODUCTION OF ADDITIVE MANUFACTURING 8

Need for the compression in product development- history of rapid prototyping systems, classification, benefits, limitations and applications- Basic information subtractive (conventional) manufacturing process vs. additive manufacturing process, working principle of basic process of 3Dimensional printing technology.

UNIT II STEREO LITHOGRAPHY PROCESS AND SELECTIVE LASER SINTERING 9

Stereo Lithography Process: Principle, Data Preparation, Process Parameters, Process Details, Data Files Machine Details and Applications-Selective Laser Sintering: Types, Principle of Operation, Process Parameters, Data Preparations and Applications.

UNIT III FUSED-DEPOSITION MODELING AND SOLID-GROUND CURING 9

Fused-Deposition Modeling: Principle, Process Parameters, Path Generation and Applications-Solid-Ground Curing: Principle, Process Parameters, Machine Details, and Applications.

UNIT IV LAMINATED-OBJECT MANUFACTURING, CONCEPT MODELER AND LASER-ENGINEERED NET SHAPING 9

Laminated-Object Manufacturing: Principle of Operation, Laminated object manufacturing Materials, Process Details and Applications-Concept Modeler: Principle, Thermo Jet Printer, Sanders Model Maker, 3-Dimensional Printing, Genesis Xs Printer, JP 5 System, Objects Quadra System-Laser engineered Net Shaping: Principle and Applications.

UNIT V DIRECT OR RAPID MANUFACTURING AND RAPID TOOLING AND CASE STUDIES 10

Basic concept of direct manufacturing- Rapid Tooling: Indirect Rapid Tooling, silicone rubber tooling, aluminium filled epoxy tooling, spray metal tooling, Direct Rapid Tooling: quick cast process, copper polyamide, sand cast tooling, laminated tooling -Case studies of additive manufacturing: automotive, industry, aerospace and medical.

TOTAL HOURS: 45 PERIODS

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COURSE OUTCOMES

CO1: The students will able to gain knowledge on rapid prototyping technique.

CO2: The students will be able to gain knowledge about stereo lithography process and selective laser sintering.

CO3: The students get sound knowledge on the processes like fused-deposition modeling and solid ground curing.

CO4: The students get sound knowledge on the processes like laminated object manufacturing, concept modeler and laser engineered net shaping.

CO5: The students can enhance their knowledge in rapid tooling and different software used for rapid prototyping like solid view.

TEXT BOOKS

1. Pham. D. T. & Dimov. S. S., "Rapid Manufacturing", Verlag, London, 2011.
2. Paul. F. Jacobs, "Stereo lithography and other RP & M Technologies", SME, NY, 2010.

REFERENCE BOOKS

1. Hari Prasad & K.S.Badrinarayanan, “Rapid Prototyping and Tooling”, SIP Pageturners, 2013.
2. Chee Kai Chua, Kah Fai Leong, Chu Sing Lim, “Rapid Prototyping Principles and Applications”, World Scientific Publishing Company, 2010.
3. Serope Kalpakjian, Steven R. Schmid, “Manufacturing Engineering and Technology”, Sixth Edition, Prentice Hall, 2009
4. Frank W. Lioli, “Rapid Prototyping and Engineering Applications”, CRC Press, 2008.
5. Terry Wohlers, "Wohlers Report 2006", Wohlers Associates, 2006.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students will able to gain knowledge on rapid prototyping technique.	2		3		2							1	3		2
Co2	The students will be able to gain knowledge about stereo lithography process and selective laser sintering.	2		3	2	2							1	3		2
Co3	The students get sound knowledge on the processes like fused-deposition modeling and solid ground curing.	2		3	1	2							1	3		2
Co4	The students get sound knowledge on the processes like laminated object manufacturing, concept modeler and laser engineered net shaping.	2		3		2							1	3		2
Co5	The students can enhance their knowledge in rapid tooling and different software used for rapid prototyping like solid view.	2		1		3				1			1	1		1

718MEE05 **CRYOGENIC ENGINEERING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To learn about fundamental material properties of cryogenic fluids.
- To study on various types of liquefaction cycles.
- To make the students understand the various methods of cryogenic measuring systems.
- To study the importance of cryogenic insulations.
- To have a knowledge in storage, transportation and insulation for cryogenics.

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PRE-REQUISITES: Knowledge of Fluid Mechanics and Machinery, Engineering Thermodynamics are required.

UNIT I INTRODUCTION 10

Meaning & definition of cryogenics, Importance of cryogenics studies, properties of engineeri ng materials at cryogenic temperatures, mechanical properties, thermal properties, electric & magnetic properties, super conducting materials, thermo electric materials, composite materials, properties of cryogenic fluids.

UNIT II LIQUEFACTION CYCLES 10

Carnot Liquefaction Cycle and Yield of Liquefaction Cycles. Inversion Curve - Joule Thomson Effect. Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claude's Cycle Dual Cycle, Helium Refrigerated Hydrogen Liquefaction Systems. Critical Components in Liquefaction Systems.

UNIT III CRYOGENIC MEASUREMENT SYSTEMS 9

Temperature measurements, pressure measurements, flow measurements, liquid level measurements, fluid quality measurements.

UNIT IV IMPORTANCE OF CRYOGENIC INSULATIONS 8

Various factors for selection of insulations, various types such as expanded foams, gas filled & fibrous insulation, vacuum insulation, evacuated powder& fibrous insulation, opacified powder insulation, multi-layer insulation, comparison of performance of various insulations.

UNIT V HANDLING OF CRYOGENS 8

Cryogenic Dewar Design, Cryogenic Transfer Lines. Insulations in Cryogenic Systems, Operating principle of different Types of Vacuum Pumps, Instruments to measure Flow, Level and Temperature operating principles.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Be familiar with the properties and applications of cryogenic substances in various field of science.

CO2: Analyze the structure of different cryogenic systems and the analytical method for cryogenic thermodynamic cycle for gases and liquid mixture.

CO3: Familiar with the measurement of cryogenic instruments.

CO4: Interpret the applications of the cryogenic insulation.

CO5: Design a low-temperature systems and machinery to meet the requirements to ensure their maximum performance of durability and safety of cryogenics life.

TEXT BOOKS

1. Klaus D. Timmerhaus and Thomas M. Flynn, "Cryogenic Process Engineering", Plenum Press, New York, 1989.
2. Randall F. Barron, "Cryogenic Systems", Oxford University Press, 1985.

REFERENCE BOOKS

1. Venkatarathnam G, "Cryogenic Mixed Refrigerant Processes", Springer Publication, 2010.
2. Guglielmo Ventura and Lara Risegari, "The Art of Cryogenics: Low – Temperature Experimental Techniques", Elsevier, 2008.
3. Thomas Flynn, "Cryogenic Engineering", CRC Press, New Delhi, 2004.
4. Valery V Kostionk, "A Text Book of Cryogenics", Discovery Publishing House, 2003.

5. Hands B A, “Cryogenic Engineering”, Academic Press, 1986.
6. Martini W, “Sterling cycle design manual, NASA Report, 1978.
7. Herald Weinstock, “Cryogenic Technology”, Boston Technical Publishers Inc., 1969.
8. Robert W Vance, “Cryogenic Technology”, John Wiley and Sons Inc., New York, 1963.
9. Scott R.B., “Cryogenic Engineering”, Van Nostrand and Co., 1962.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Be familiar with the properties and applications of cryogenic substances in various field of science.	1									1			1		
Co2	Analyze the structure of different cryogenic systems and the analytical method for cryogenic thermodynamic cycle for gases and liquid mixture.		2								2			2		
Co3	Familiar with the measurement of cryogenic instruments.										3			3		
Co4	Interpret the applications of the cryogenic insulation.										3			3		
Co5	Design a low-temperature systems and machinery to meet the requirements to ensure their maximum performance of durability and safety of cryogenics life.			2			2				2			2		

718MEE06 DESIGN OF THERMAL EQUIPMENT

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COURSE OBJECTIVES:

- To provide the basic design and analysis of different heat exchangers.
- To gain knowledge on double pipe heat exchanger.
- To gain knowledge on shell and tube heat exchanger.
- To carry out the performance of heat exchanger with the extended surfaces.
- To understand the concepts to design different types of cooling towers and provide basic concept of heat pipe and its applications.

UNIT I CLASSIFICATION OF HEAT EXCHANGERS 9

Introduction, Recuperation & Regeneration – Types of heat exchangers, Basic equations in design, Overall heat transfer coefficient – LMTD method for heat exchanger analysis – parallel flow, counter flow multipass, cross flow heat exchanger design calculations.

UNIT II DOUBLE PIPE HEAT EXCHANGER 9

Film coefficient for fluids in annulus, fouling factors, calorific temperature, average fluid temperature, the calculation of double pipe exchanger, Double pipe exchangers in series-parallel arrangements.

UNIT III SHELL AND TUBE HEAT EXCHANGERS 9

Tube layouts for exchangers, baffle heat exchangers, calculation of shell and tube heat exchangers – shell side film coefficients, Shell side equivalent diameter, tube side pressure drop, Analysis of performance of 1-2 heat exchanger, the calculations of 2-4 exchangers.

UNIT IV EXTENDED SURFACES 9

Longitudinal fins, weighted fin efficiency curve, calculation of a double pipe fin efficiency curve, calculation of a double pipe finned exchanger, calculation of a longitudinal fin shell and tube exchanger.

UNIT V DIRECT CONTACT HEAT EXCHANGER AND HEAT PIPES 9

Cooling towers, relation between wet bulb & dew point temperatures, the Lewis number, and classification of cooling towers, heat balance, heat transfer by simultaneous diffusion and convection, design of cooling towers, calculation of cooling tower performance.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Gain knowledge on the basics of heat transfer processes in heat exchangers.
CO2: Develop the double pipe heat exchanger and analyze various factors.
CO3: Optimize the performance of shell and tube heat exchanger.
CO4: Analyze the performance of heat exchanger with extended surfaces.
CO5: Develop a heat pipe for practical applications.

TEXT BOOKS

1. Yogesh Jaluria, "Design and Optimization of Thermal Systems", 3rd Edition, CRC Press, 2018.
2. Donald Q Kern, "Process Heat Transfer", Tata McGraw-Hill Publication Company ltd., 2017.

REFERENCE BOOKS

1. Kuppan Thulukkanam "Heat Exchanger Design Handbook", CRC Press, 3rd Edition, 2019.
2. R. F. Boehm, "Developments in the Design of Thermal Systems", Cambridge University Press, 2nd Edition, 2019.
3. N.V. Suryanarayana, "Design & Simulation of Thermal Systems", Mc Graw-Hill, 2019.
4. Bejan, G. Tsatsaronis, M.J. Moran, "Thermal Design and Optimization", Wiley Publisher, 2015.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Gain knowledge on the basics of heat transfer processes in heat exchangers.	1	2		1			1		1		2	2	1		1
Co2	Develop the double pipe heat exchanger and analyze various factors.	2	1		1	1				1			1	1	2	
Co3	Optimize the performance of shell and tube heat exchanger.	2	1	2						1			1	1	3	
Co4	Analyze the performance of heat exchanger with extended surfaces.	1	1		2					1			2	1		2
Co5	Develop a heat pipe for practical applications.	1	1		2					1			2	1		2

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818MET01 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the basic concepts of TQM and to know about various philosophies of TQM.
- To know about the concepts of motivation, PDSA cycle and Kaizen.
- To gain knowledge on old and new seven management tools and concepts like six sigma and bench marking.
- To gain knowledge on implementation of QFD.
- To know about quality certificates like ISO 9000 and ISO 14000.

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM - TQM Framework - Philosophies of Deming, Juran and Crosby - Barriers to implement TQM.

UNIT II TQM PRINCIPLES **9**

Leadership - Strategic quality planning, Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDSA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I **9**

The seven traditional tools of quality - New management tools - Six-sigma: Concepts, methodology, Applications to manufacturing and Service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II **9**

Quality circles - Quality Function Deployment (QFD) – House of Quality - Taguchi quality loss function – Total Productive Maintenance - Concepts, improvement needs - Cost of Quality - Performance measures.

UNIT V QUALITY SYSTEMS **9**

Need for ISO 9000- ISO 9000-2000 Quality System - Elements, Documentation, Quality auditing- QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - Case studies of TQM Implementation in manufacturing and Service sectors including IT.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

CO1: The student will get the knowledge on philosophies of management and basic concepts.
CO2: The students will have an ability to gain the knowledge on leadership qualities and management tools of quality and statistical concepts.
CO3: The students will be able to have exposure on concepts like Benchmarking and Failure Mode Effective Anaysis.
CO4: The students will be able to gain knowledge on Quality Function Deployment, and Total Productive Maintenance.
CO5: The students will be able to gain knowledge on the Quality certification procedure on ISO 9000, QS14000 and information on Auditing can be obtained.

TEXT BOOKS

1. Dale H.Besterfield, at., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint, 2018.

2. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2008.

REFERENCE BOOKS

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2007.
2. Janakiraman.B and Gopal. R.K, "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd, 2007.
3. Oakland, J.S. "TQM - Text with Cases", Butterworth - Heinemann Ltd., Oxford, 3rd Edition, 2003.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The student will get the knowledge on philosophies of management and basic concepts.						1						3		1	
Co2	The students will have an ability to gain the knowledge on leadership qualities and management tools of quality and statistical concepts.						1						2		1	
Co3	The students will be able to have exposure on concepts like Benchmarking and Failure Mode Effective Anaysis.						1			2			2		1	
Co4	The students will be able to gain knowledge on Quality Function Deployment, and Total Productive Maintenance.														1	
Co5	The students will be able to gain knowledge on the Quality certification procedure on ISO 9000, QS14000 and information on Auditing can be obtained.						2								1	

818MEP04 **PROJECT WORK** **L T P C**
0 0 20 10

COURSE OBJECTIVES:

The objectives of the project are

- To get an opportunity to synthesize knowledge from various areas of learning, and critically and creatively apply it to real life situations.
- To acquire skills like collaboration, communication and independent learning, prepares them for lifelong learning and the challenges ahead.
- To deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation or an analysis.
- To use the engineering technical skills and modern engineering tools necessary for practical applications.
- To document and present one's own work, for a given target group, with strict requirements on structure, format, and language usage.

GUIDELINES

1. The project work is to enable the students in convenient groups of not more than 4 members on a project involving theoretical and experimental studies related to the branch of study.
2. Every project work shall have a guide who is the member of the faculty of the institution.
3. Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.

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4. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. The final report shall be typewritten form as specified in the guidelines.

EVALUATION

1. The progress of the project is evaluated by a review committee consisting of a minimum of three members.
2. The review committee may be constituted by the Head of the Department.
3. The continuous assessment shall be made by conducting three reviews.
4. The external assessment shall be done by one internal examiner and one external examiner (from other institution) by conducting oral examination.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Use the engineering technical skills and modern engineering tools necessary for practical applications.

CO2: Use design principles and develop conceptual, engineering design and fabrication of various components.

CO3: Take up any challenging practical problems and find solution by formulating proper methodology.

CO4: Create the document of the project with correct format and structure.

CO5: Gain Practical knowledge about various activities like processes, design, quality control that are taking place in industries.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Use the engineering technical skills and modern engineering tools necessary for practical applications.	1				1		1						1		
Co2	Use design principles and develop conceptual, engineering design and fabrication of various components.	2	1	2										1		2
Co3	Take up any challenging practical problems and find solution by formulating proper methodology.	1	1	1										1		1
Co4	Create the document of the project with correct format and structure.					2					2			1		
Co5	Gain Practical knowledge about various activities like processes, design, quality control that are taking place in industries.					1					2					

818MEE01 COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To apply the fundamentals of CFD, and developing case specific governing equations.
- To perform finite difference and finite volume based analysis for steady and transient diffusion problems.
- To implement various mathematical schemes under finite volume method for convention diffusion.
- To solve complex problems in the field of fluid flow and heat transfer with the support of high speed computers.

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- To apply the various discretization methods, solution procedure and the concept of turbulence modeling.

PRE-REQUISITES: Knowledge of Fluid Mechanics and Machinery, Engineering Thermodynamics, Engineering Mathematics III are required

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9

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

UNIT II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9

Derivation of finite difference equations– General Methods for first and second order accuracy – Finite volume formulation for steady and transient diffusion problems –Example problems– Use of Finite Difference and Finite Volume methods.

UNIT III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9

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

UNIT IV FLOW FIELD ANALYSIS 9

Stream function and vorticity, Representation of the pressure gradient term, Staggered grid – Momentum equations, Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

UNIT V TURBULENCE MODELS AND MESH GENERATION 9

Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models, Mesh Generation and refinement Techniques-software tools.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The student will be able to

CO1: Apply the fundamentals of CFD, and develop case specific governing equations.

CO2: Perform finite difference and finite volume based analysis for steady and transient diffusion problems.

CO3: Implement various mathematical schemes under finite volume method for convention diffusion.

CO4: Solve complex problems in the field of fluid flow and heat transfer with the support of high speed computers.

CO5: Apply the various discretization methods, solution procedure and the concept of turbulence modeling.

TEXT BOOKS

1. Versteeg, H.K., and Malalasekera, W., “An Introduction to Computational Fluid Dynamics: The finite volume Method”, Pearson Education, 2014
2. Ghoshdastidar, P.S., “Computer Simulation of flow and heat transfer”, Tata McGraw Hill, 1998.

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REFERENCE BOOKS

1. John. F. Wendt, "Computational Fluid Dynamics – An Introduction", Springer, 2013.
2. K.Muralidhar&T.Sundararajan, Computational Fluid Flow and Heat Transfer, Narora Publishing House, 1994.
3. Suhas V, Patankar, "Numerical Heat transfer and Fluid flow", Taylor & Francis, 2009.
4. Uriel Frisch, Turbulence, Cambridge University Press, 1999.
5. YogeshJaluria& Kenneth E. Torrance, "Computational Heat Transfer", CRC press, 2002.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Apply the fundamentals of CFD, and develop case specific governing equations.	1	1	1							1			1		
Co2	Perform finite difference and finite volume based analysis for steady and transient diffusion problems.	2	2							3				3		
Co3	Implement various mathematical schemes under finite volume method for convention diffusion.		3								2			2		
Co4	Solve complex problems in the field of fluid flow and heat transfer with the support of high speed computers.					2				2				2		
Co5	Apply the various discretization methods, solution procedure and the concept of turbulence modeling.	1										2		2		

818MEE02 **THEORY OF ELASTICITY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To analyse the different types of stress and its applications to simple problems.
- To understand the compatibility equation, stress transformation and its applications to simple problems.
- To understand the concept of Two-Dimensional classical elasticity.
- To analyse the stress acting on disc and thick walled cylinder.
- To study the thermal stress and elastic stability of circular disc.

UNIT I ANALYSIS OF STRESS **9**

Definition and notation of stress, equations of equilibrium in differential form, stress components on an arbitrary plane, equality of cross shear, stress invariants, principal stresses, octahedral stress, planes of maximum shear, stress transformation, plane state of stress, Numerical problems.

UNIT II ANALYSIS OF STRAIN **9**

Displacement field, strains in term of displacement field, infinitesimal strain at a point, engineering shear strains, strain invariants, principal strains, octahedral strains, plane state of strain, compatibility equations, strain transformation, Numerical Problems.

UNIT III TWO-DIMENSIONAL CLASSICAL ELASTICITY PROBLEMS **9**

Relation between plane stress and plane strain, stress functions for plane stress and plane strain state, Airy's stress functions, Investigation of Airy's stress function for simple beams, bending of a narrow cantilever beam of rectangular cross section under edge load. Bending of simply supported beam under UDL. General equations in polar coordinates, stress distribution symmetrical about an axis, thick walled cylinder subjected to internal and external pressures, Numerical Problems.

UNIT IV AXISYMMETRIC AND TORSION PROBLEMS 9

Stresses in rotating discs of uniform thickness and cylinders, Torsion of circular, elliptical and triangular bars, Prandtl's membrane analogy, torsion of thin walled thin tubes, torsion of thin walled multiple cell closed sections, Numerical Problems.

UNIT V THERMAL STRESS AND ELASTIC STABILITY 9

Thermo elastic stress strain relations, equations of equilibrium, thermal stresses in thin circular discs and in long circular cylinders. Euler's column buckling load- clamped-free, clamped-hinged, clamped-clamped and pin-ended, Numerical Problems.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Analyse the stress components in different planes and form differential equations of equilibrium.
CO2: Solve problems related to principal strains, octahedral strains and plane state of strain.
CO3: Understand the Airy's function for different beam of varing load conditions.
CO4: Analyse and interpret the stress in Axisymmetric and torsional elements.
CO5: Develop the equation of equilibrium under thermal stress and elastic stability condition.

TEXT BOOKS

1. Timoshenko, S., and Goodier, T.N., "Theory of Elasticity", McGraw – Hill Ltd., Tokyo, 3rd Edition, 2017.
2. Ansel C Ugural and Saul K Fenster, "Advanced Strength and Applied Elasticity", 4th Edition, Prentice Hall, New Jersey, 2003.

REFERENCE BOOKS

1. Jane Helena H, "Theory of Elasticity and Plasticity", PHI Learning Pvt. Ltd., 2017.
2. Bhaskar, K., and Varadan, T. K., "Theory of Isotropic/Orthotropic Elasticity", CRC Press USA, 2009.
3. Chakrabarty.J, "Theory of Plasticity", Third Edition, Elsevier Butterworth - Heinmann – UK, 2007.
4. Barber, J. R., "Elasticity", Kluwer Academic Publishers, 2004.
5. Wang, C. T., "Applied Elasticity", McGraw – Hill Co., New York, 1993.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Analyse the stress components in different planes and form differential equations of equilibrium.	1	1	1										1	1	
Co2	Solve problems related to principal strains, octahedral strains and plane state of strain.	2	2	2										2	2	2
Co3	Understand the Airy's function for different beam of varing load conditions.	1	2	2										1	1	
Co4	Analyse and interpret the stress in Axisymmetric and torsional elements.	2	1	1										2	2	2
Co5	Develop the equation of equilibrium under thermal stress and elastic stability condition.	2	2	2										1	2	

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818MEE03 **SIX SIGMA AND LEAN MANUFACTURING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To analyze process models and maps, product flows, value streams, and activity based costing data.
- To use techniques in applying the integrated Lean and Six Sigma DMAIC methodology for process improvement.
- To apply advanced statistical analysis tools to problem solving.
- To study about cell layout.
- To study about the kaizen development industry.

PRE-REQUISITES: Knowledge of Manufacturing Technology II, Total Quality Management are required.

UNIT I **LEAN MANUFACTURING AND SIX SIGMA - OVERVIEW** **8**

Evolution of Lean - Traditional versus Lean Manufacturing - Business of Survival and Growth - Business Model Transformation - Ford Production System - Job Shop Concepts Concept of Lean - Toyota's foray in Lean.

UNIT II **DESIGN - VALUE STREAM MANAGEMENT** **10**

Definition - VSM Types - Product Family Selection - Value Stream Manager - Current State Map; Process Box - Value Stream Icons - 3 Ms - Muda, Mura, Muri - 7 Types of Muda - Future State Map - Value Stream Plan - Process Stability - Loss Reduction 7 Major Losses Reduction. Demand Stage - Market Dynamics - Customer Demand - PQ Analysis - PR Analysis - TAKT Time - Pitch - Finished Goods Stock - Cycle Stock - Buffer Stock - Safety Stock.

UNIT III **SYSTEM IMPLEMENTATION** **10**

Flow Stage: Continuous Flow - Cell Layout - Line Balancing - Macro and Micro Motion Analysis - Standardised Work - Concept of Kaizen - Steps involved in Kaizen Deployment - Industrial Engineering - Concepts and Fundamentals - Kanban Concepts - Types of Kanbans - and Practical Application - Concept of Pull and push system and its applications.

UNIT IV **LEAN METRICS AND LEAN SUSTENANCE** **7**

Identify Lean Metrics - Steps involved in Goal Setting - Corporate Goals - Kaizen Cloud identification in VSM - Lean Assessment. Cultural Change; Reviews - Recognition - Improving Targets and Benchmarks.

UNIT V **SIX SIGMA AND DMAIC TOOLS** **10**

Project charter, stakeholder analysis, SIPOC, Voice of the customer, Rolled throughput yield, KANO Models, CTQ Tree, Process Mapping Data collection, measurement system analysis, sampling plans, process capability, cost of poor quality (COPQ), FMEA, Regression Analysis, Cause & Effect diagram.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Identify key requirements and concepts in lean manufacturing.
CO2: Initiate a continuous improvement change program in a manufacturing organization.
CO3: Apply the tools in lean manufacturing to analyze a manufacturing system and plan for its importance.
CO4: Manage the manufacturing system to achieve six sigma and sustainability.
CO5: Develop a board understanding of lean/ six sigma principles and practices.

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TEXT BOOKS

1. Tom Luyster and Don Tapping, "Creating Your Lean Future State: How to Move from Seeing to Doing", Productivity Press, 2006.
2. Rick Harris, Chris Harris & Earl Wilson, "Making Materials Flow", Publisher: Lean Enterprise Institute, Inc., 2003.

REFERENCE BOOKS

1. Rath and Strong's "Six sigma pocket guide", 2006.
2. Keki R. Bhote, "The ultimate six sigma", Prentice hall India, 2003.
3. Don Tapping, Tom Luyster and Tom Shuker,"Value Stream Management", Productivity Press, 2002.
4. Mike Rother and Rick Harris, "Creating Continuous Flow", Publisher: Lean Enterprise Institute, Inc., 2001.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Identify key requirements and concepts in lean manufacturing.			1												2
Co2	Initiate a continuous improvement change program in a manufacturing organization.					1										
Co3	Apply the tools in lean manufacturing to analyze a manufacturing system and plan for its importance.		1		1	1										
Co4	Manage the manufacturing system to achieve six sigma and sustainability.				1		2	1	2						1	
Co5	Develop a board understanding of lean/ six sigma principles and practices.						2	2					1	1		1

818MEE04 INTRODUCTION TO MICRO ELECTRO MECHANICAL SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To get an exposure in the microsystem and application of MEMS in various domains.
- To impart knowledge of manufacturing, design and packaging technologies of MEMS.
- To understand the working of micro sensors and actuators.
- To gain knowledge about nano fluids and their application.
- To know about micro systems design and packaging.

PRE-REQUISITES: Knowledge of Applied Hydraulics and Pneumatics and Mechatronics are required.

UNIT I INTRODUCTION TO MICROSYSTEMS 7

Review of microelectronics manufacture and introduction to MEMS Overview of Microsystems technology. Differences between micro electronics and micro systems, Laws of scaling. The multi disciplinary nature of MEMS. Survey of materials central to micro engineering. Applications of MEMS in various industries.

UNIT II MICRO MANUFACTURING TECHNIQUES 10

Photolithography, Film deposition, Etching processes, Bulk micro machining, silicon surface Micro machining, LIGA process, Rapid micro product development.

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UNIT III MICRO SENSORS AND MICRO ACTUATORS 10

Energy conversion and force generation, Electromagnetic Actuators, Reluctance motors, piezoelectric actuators, bi-metal-actuator Friction and wear. Transducer principles, Signal detection and signal processing, Mechanical and physical sensors, Acceleration sensor, pressure sensor, Sensor arrays.

UNIT IV INTRODUCTION TO MICRO / NANO FLUIDS 10

Fundamentals of micro fluidics, Micro pump - introduction - Types - Mechanical Micro pump - Non Mechanical micro pumps, Actuating Principles, Design rules for micro pump - modeling and simulation, Verification and testing - Applications.

UNIT V MICROSYSTEMS DESIGN AND PACKAGING 8

Design considerations, Mechanical Design, Process design, Realization of MEMS components using intellisuite. Micro system packaging, Packing Technologies, Assembly of Microsystems, Reliability in MEMS.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Understand the difference between microsystem and microelectronics and their applications.
CO2: Explain the manufacturing, design and packing technologies of MEMS.
CO3: Understand the working principle of actuators and sensors.
CO4: Design, model, simulate and perform testing on the nano fluids and micro pump.
CO5: Design a microsystem and knowledge on packing technologies.

TEXT BOOKS

1. Chang Liu, "Foundations of MEMS", Pearson Education, 2nd Edition, 2012.
2. Tai-Ran Hsu, "MEMS & Micro Systems Design and Manufacture and Nanoscale Engineering", John Wiley & Sons, 2nd Edition, 2008.

REFERENCE BOOKS

1. Nitaigour Premchand Mahalik, "MEMS", Tata Mc Graw Hill Education, 2007.
2. Marc F Madou, "Fundamentals of Micro Fabrication", CRC Press, 2nd Edition, 2002.
3. Nadim Maluf, "An introduction to Micro electro mechanical Systems Engineering", AR Tech house, Boston, 2000.
4. Stephen D Senturia, "Micro System Design", Springer Publication, 2000.
5. Sabrie Solomon, "Sensors Handbook", Mc Graw Hill, 1998.
6. Francis E.H. Tay and W.O.Choong, "Micro fluidics and Bio MEMS application", IEEE Press New York, 1997.
7. Trimmer William S., Ed., "Micromechanics and MEMS", IEEE Press New York, 1997.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Understand the difference between microsystem and microelectronics and their applications.					2								1		
Co2	Explain the manufacturing, design and packing technologies of MEMS.	2	2											1		
Co3	Understand the working principle of actuators and sensors.	2	1	1										1		
Co4	Design, model, simulate and perform testing on the nano fluids and micro pump.			3											1	2

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Co5	Design a microsystem and knowledge on packing technologies.	1		2									1		1

818MEE05 **ENERGY CONSERVATION IN INDUSTRIES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To quantifying the energy demand and energy supply scenario of nation and need for energy auditing for becoming environmentally benign.
- To analyzing factors behind energy billing and applying the concept of demand side.
- To computing the stoichiometric air requirement for any given fuel and quantifying the explaining the management for lowering energy costs energy losses associated with thermal utilities of industries.
- To diagnosing the causes for under performance of various electrical utilities and suggesting remedies for improving their efficiency
- To applying CUSUM and other financial evaluation techniques energy savings/monetary benefits for any energy efficiency project.

UNIT I ELEMENTS OF ENERGY CONSERVATION 9

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization –Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II ENERGY CONSERVATION APPROACHES IN INDUSTRIES 9

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting.

UNIT III ENERGY CONSERVATION IN POWER GENERATION AND TRANSMISSION 9

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories- Waste Heat Recovery Devices.

UNIT IV ENERGY CONSERVATION IN MAJOR UTILITIES 9

Energy conservation in Motors - Pumps - Fans - Blowers - Compressed Air Systems - Refrigeration and Air Conditioning Systems - Illumination systems

UNIT V ENERGY AUDIT AND MANAGEMENT 9

Definition, energy audit, need, types of energy audit. energy management (audit) approach - understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies- cumulative sum of differences (CUSUM) – Cost / Energy Share Diagram – Break Even Analysis – Depreciation – Financial Analysis Techniques – CUSUM Technique – Energy Management Information Systems (EMIS) ESCO Concept.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Quantify the energy demand and energy supply scenario of nation and appreciate the need for energy auditing for becoming environmentally benign

CO2: Analyze factors behind energy billing and apply the concept of demand side management for lowering energy costs

CO3: Compute the stoichiometric air requirement for any given fuel and quantify the energy losses associated with thermal utilities of industries

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CO4: Diagnose the causes for under performance of various electrical utilities and suggest remedies for improving their efficiency

CO5: Apply CUSUM and other financial evaluation techniques to estimate the accruable energy savings/monetary benefits for any energy efficiency project

TEXT BOOKS

1. Guide book for National Certification Examination for "Energy Managers and Energy Auditors" (4 Volumes). Available at http://www.em-ea.org/gbook1.asp. This website is administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.
2. K. NagabhushanRaju, Industrial Energy Conservation Techniques: (concepts, Applications and Case Studies), Atlantic Publishers & Dist, 2007.

REFERENCE BOOKS

1. Abbi Y P, Shashank Jain., Handbook on Energy Audit and Environment Management, TERI Press, 2006.
2. Albert Thumann and Paul Mehta D, "Handbook of Energy Engineering", 7thEdition, The Fairmont Press, 2013.
3. Murphy.W.R. and McKay.G, "Energy Management", Butterworth, London 1982.
4. Paul W.O'Callaghan, Design and management for energy conservation: A handbook for energy managers, plant engineers, and designers, Pergamon Press, 1981.
5. Steve Doty, Wayne Turner C, Energy Management Handbook 7th Edition, The Fairmont Press, 2009.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Quantify the energy demand and energy supply scenario of nation and appreciate the need for energy auditing for becoming environmentally benign	2	3		1		3					2		2	1	
Co2	Analyze factors behind energy billing and apply the concept of demand side management for lowering energy costs	2	2		2							3		2	1	
Co3	Compute the stoichiometric air requirement for any given fuel and quantify the energy losses associated with thermal utilities of industries	2	1		3							2		2	1	
Co4	Diagnose the causes for under performance of various electrical utilities and suggest remedies for improving their efficiency	2	3		2			2			3	2	2	2	1	1
Co5	Apply CUSUM and other financial evaluation techniques to estimate the accruable energy savings/monetary benefits for any energy efficiency project	2	3		2	2		2	3	2		2	2	2	1	1

818MEE06 **FRACTURE MECHANICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To obtain the knowledge about mechanical behavior of a material under various loading conditions.
- To get knowledge on stationary crack, crack growth and fatigue crack growth.
- To understand the concept of stress concentration and able to plot S-N curve for various component fractures.
- To understand the concepts of fatigue crack growth curve.

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- To understand the behavior of material failures and their quality.

PREREQUISITE: Knowledge of Engineering Materials and Metallurgy is required.

UNIT I INTRODUCTION TO FRACTURE MECHANICS 9

Introduction, Mechanisms of Fracture, a crack in structure, the Griffith's criterion, modern design – Strengths, stiffness and toughness. Stress intensity approach.

UNIT II STRESS ANALYSIS FOR MEMBERS WITH CRACKS 9

Linear elastic fracture mechanics, Crack tip stress and deformations, Relation between stress intensity factor and fracture toughness, Stress intensity based solutions. Crack tip plastic zone estimation, Plane stress and plane strain concepts. The Dugdale approach, the thickness effect.

UNIT III ELASTIC- PLASTIC FRACTURE MECHANICS 9

Introduction, Elasto–plastic factor criteria, crack resistance curve, J-integral, Crack opening displacement, crack tip opening displacement. Importance of R-curve in fracture mechanics, experimental determination of J-integral, COD and CTOD.

UNIT IV FATIGUE CRACK GROWTH RATE 9

Introduction to fatigue, factors affecting fatigue, parameters influencing in the fatigue, fatigue loading - low cycle fatigue, high cycle fatigue, S-N Curve, various stages of crack propagation, crack growth integration, fatigue crack growth laws.

UNIT V FRACTURE TOUGHNESS TESTING OF METALS 9

Specimen size requirements, various test procedures, effects of temperature, loading rate and plate thickness on fracture toughness. Fracture testing in shear modes, fatigue testing, NDT methods.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Calculate the stress-strain and load-displacement fields around a crack tip.

CO2: Identify and formulate stress intensity factor, strain energy release rate, and the stress and strain fields around a crack tip for linear and non linear materials.

CO3: Define and predict fracture toughness of materials and be familiar with the experimental methods to determine the fracture toughness and energy balance.

CO4: Calculate the life calculation for load amplitude.

CO5: Design materials and structures using fracture mechanics approaches.

TEXT BOOKS

1. David Broek, "Elementary Engineering Fracture Mechanics", 4th Edition, Kluwer Academic Publishers, 2005.
2. George E.Dieter, "Mechanical Metallurgy", 3rd Edition, Tata McGraw Hill, 1986.

REFERENCE BOOKS

1. Anderson T L, "Fracture Mechanics: Fundamentals and Applications", CRC Press, 4th Edition, 2017.
2. Jayatilake. "Fracture of Engineering Brittle Materials", Applied Science, London, 2015.
3. Preshant Kumar, "Elements of Fracture Mechanics", Tata McGraw Hill, 2009.
4. Kare Hellan, "Introduction of Fracture Mechanics", McGraw-Hill Book Company, 2000.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Calculate the stress-strain and load-displacement fields around a crack tip.	2	2	2										2		
Co2	Identify and formulate stress intensity factor, strain energy release rate, and the stress and strain fields around a crack tip for linear and non linear materials.	1	2	1										1	2	
Co3	Define and predict fracture toughness of materials and be familiar with the experimental methods to determine the fracture toughness and energy balance.	2	1	2										2	1	1
Co4	Calculate the life calculation for load amplitude.	2	2	1										2	2	2
Co5	Design materials and structures using fracture mechanics approaches.	1	2	2										1	1	1

818MEE07 **ENTREPRENEURSHIP AND E-BUSINESS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- The aim of the course is to provide the students, with an opportunity to gain the knowledge in the field of entrepreneur, entrepreneurship and management of resources.
- The student learns the function, types, role of entrepreneur in economic growth of a country. And also studies the different stages of entrepreneurial process.
- To gain the knowledge to start up small scale industries with the support (consultancy & finance) from government, institutes & others.
- To impart motivation studies and training.
- To study its need and source of finance related to entrepreneurships.

PRE-REQUISITES: Knowledge of Principle of Management and Business Concepts is required

UNIT I ENTREPRENEURSHIP **9**

Entrepreneur - Types of Entrepreneurs - Difference between Entrepreneur and Intrapreneur - Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurical Growth.

UNIT II MOTIVATION **9**

Major Motives Influencing an Entrepreneur - Achievement Motivation Training, self Rating, Business Game, Thematic Apperception Test - Stress management, Entrepreneurship Development Programs - Need, Objectives.

UNIT III BUSINESS **9**

Small Enterprises - Definition, Classification - Characteristics, Ownership Structures - Project Formulation - Steps involved in setting up a Business - identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment - Preparation of Preliminary Project Reports - Project Appraisal - Sources of Information - Classification of Needs and Agencies.

UNIT IV FINANCE AND ACCOUNTING **9**

Need - Sources of Finance, Term Loans, Capital Structure, Financial Institution, management of working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT/CPM - Taxation -

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Income Tax, Excise Duty - Sales Tax.

UNIT V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business - Concept, Magnitude, causes and consequences, Corrective Measures - Government Policy for Small Scale Enterprises - Growth Strategies in small industry - Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

CO1: The students will understand the necessity of management in the field of engineering and it realizes the importance of entrepreneurship in the modern world.

CO2: The students will have an ability to define, characteristics and role of SSI in economic Development. Impact of privatization and globalization on SSIs and understand the meaning of project and project identification.

CO3: The students are well trained to analyze the parameters of project like project appraisal, identification of business Opportunities, market feasibility study, technical feasibility study etc.

CO4: The students will be able to understand the motivation techniques and the financial analysis in entrepreneurships.

CO5: Students will understand the concept of management as a science, art and profession and appreciate the role of planning in management.

TEXT BOOKS

1. S.S.Khanka, "Entrepreneurial Development", S.Chand & Co. Ltd., Ram Nagar, New Delhi, Reprint, 2012.
2. Kuratko & Hodgetts, "Enterprenuership - Theory, Process and Practices", Cenagage learning, 8th Edition, 2012.

REFERENCE BOOKS

1. Hisrich R D and Peters M P, "Entrepreneurship", 6th Edition, Tata McGraw-Hill, 2012.
2. Mathew J Mandimala, "Enterprenuership theory at cross roads: paradigms and praxis", Dream tech, 2nd Edition, 2006.
3. Rabindra N. Kanungo "Entrepreneurship and Innovation", Sage Publications, New Delhi, 1998.
4. EDII, "Faulty and External Experts - A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students will understand the necessity of management in the field of engineering and it realizes the importance of entrepreneurship in the modern world.			1			2	2					3		2	
Co2	The students will have an ability to define, characteristics and role of SSI in economic Development. Impact of privatization and globalization on SSIs and understand the meaning of project and project identification.						3	1							1	
Co3	The students are well trained to analyze the parameters of project like project appraisal, identification of business Opportunities, market feasibility study, technical feasibility study etc.												3	1		1
Co4	The students will be able to understand the motivation techniques and the financial analysis in entrepreneurships.								2			2			3	

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Co5	Students will understand the concept of management as a science, art and profession and appreciate the role of planning in management.	2		1			1					1	1		2	

818MEE08 **OPTIMIZATION TECHNIQUES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the basic knowledge of optimization techniques.
- To understand the concept of linear programming and their applications.
- To understand the various methods and applications of non linear programming.
- To understand the concept of sub optimization and principle of optimability.
- To learn the various nontraditional optimization techniques.

UNIT I INTRODUCTION TO CLASSICAL OPTIMIZATION TECHNIQUES 9

Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems. Single variable Optimization, Multi variable Optimization with and without constraints, Multivariable Optimization with equality constraints - solution by method of Lagrange multipliers, Multivariable Optimization with inequality constraints - Kuhn – Tucker conditions.

UNIT II LINEAR PROGRAMMING 9

Various definitions, statements of basic theorems and properties, Advantages, Limitations and Application areas of Linear Programming, Graphical method of Linear Programming problem. **Simplex Method** – Phase I and Phase II of the Simplex Method, The Revised Simplex method, Primal and Dual Simplex Method, Big – M method.

UNIT III NON LINEAR PROGRAMMING 9

One dimensional minimization – Unimodal and Multimodal Function - Unrestricted search –Interval halving method – Fibonacci method. Multi dimensional minimization – Uni-variate method – Pattern search method – Hooke and Jeeves method – Gradient of a function – Steepest descent method – Conjugate gradient method.

UNIT IV DYNAMIC AND INTEGER PROGRAMMING 9

Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution. **Integer Programming**-Pure and mixed integer programming problems, Solution of Integer programming problems – Gomory's all integer cutting plane method and mixed integer method, branch and bound method, Zero-one programming.

UNIT V NONTRADITIONAL OPTIMIZATION TECHNIQUES 9

Genetic Algorithm – Working Principle – Comparison between GA and traditional method – GA operators – GA for constrained Optimization – Real coded GA. Swarm intelligence, Particle Swarm optimization, Ant Colony optimization, Comparison with GA.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Use the basic concept of classical optimization techniques for different applications.
CO2: Formulate the linear programming using simplex method.
CO3: Define the various non linear programming methods for 1D minimization.
CO4: Illustrate the example for dynamic and integer programming problems.
CO5: Define the working principle of various nontraditional optimization techniques.

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TEXT BOOKS

1. Kalyanmoy Deb, "Optimization for Engineering Design Algorithms and Examples", PHI Learning, 2012.
2. Singiresu S Rao, "Engineering Optimization Theory and Practice", New Age International, 2011.

REFERENCE BOOKS

1. Hamdy A Taha, "Operations Research – An introduction", Pearson Education, 2012.
2. Kambo N S, "Mathematical Programming Techniques", Affiliated East – West Press, 2012.
3. Maurice Clerc, "Particle Swarm Optimization", Wiley ISTE, 2012.
4. Marco Dorigo and Thomas Stützle, "Ant Colony Optimization", PHI Learning, 2012.
5. Hillier and Lieberman, "Introduction to Operations Research", Tata McGraw-Hill, 2011.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Use the basic concept of classical optimization techniques for different applications.	2	2	1	2	1		1					2	2		1
Co2	Formulate the linear programming using simplex method.	1	1	1		2										1
Co3	Define the various non linear programming methods for 1D minimization.	1	1	1									1			1
Co4	Illustrate the example for dynamic and integer programming problems.		2	2												
Co5	Define the working principle of various nontraditional optimization techniques.	1	1	1									1	1		1

818MEE09 **TRIBOLOGY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce tribology as an important design consideration that affects the performance of engine and automotive elements.
- To provide knowledge on the surface topography, physico-chemical aspects of solid surfaces, and surface interactions.
- To learn the laws of friction, mechanisms of friction, friction space, stiction, stick slip, and surface temperature.
- To impart basic knowledge on various modes of wear: adhesive, delamination, fretting, abrasive, erosive, corrosive, oxidational (mild and severe), melt, and the wear-mechanism maps.
- To identify the appropriate lubrication type based on contact condition.

PRE-REQUISITES: Knowledge of Engineering Mechanics and Composite Materials are required.

UNIT I SURFACES AND FRICTION **9**

Topography of Engineering surfaces, Contact between surfaces, Sources of sliding Friction, Adhesion, Ploughing, Energy dissipation mechanisms, Friction Characteristics of metals, Friction of non metals, Friction of lamellar solids, friction of Ceramic materials and polymers, Rolling Friction, Source of Rolling Friction, Stick slip motion, Measurement of Friction.

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UNIT II WEAR 9

Types of wear, Simple theory of Sliding, Wear Mechanism of sliding wear of metals, Abrasive wear, Materials for Adhesive and Abrasive wear situations, Corrosive wear, Surface Fatigue wear situations, Brittle Fracture, wear, Wear of Ceramics and Polymers, Wear Measurements.

UNIT III LUBRICANTS AND LUBRICATION TYPES 9

Types and properties of Lubricants, Testing methods, Hydrodynamic Lubrication, Elasto-hydrodynamic lubrication, Boundary Lubrication, Solid Lubrication, Hydrostatic Lubrication.

UNIT IV FILM LUBRICATION THEORY 9

Fluid film in simple shear, Viscous flow between very close parallel plates, Shear stress variation, Reynolds Equation for film Lubrication, High speed unloaded journal bearings, Loaded journal bearings, Reaction torque on the bearings, Virtual Co-efficient of friction, The Sommerfeld diagram.

UNIT V SURFACE ENGINEERING AND MATERIALS FOR BEARINGS 9

Surface modifications, Transformation Hardening, surface fusion, Thermo chemical processes, Surface coatings, Plating and anodizing, Fusion Processes, Vapour Phase processes, Materials for rolling Element bearings, Materials for fluid film bearings, Materials for marginally lubricated and dry bearings.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Find the solution for surfaces and friction related problem in automobile component.
CO2: Perform wear analysis on machine components using various measuring devices.
CO3: Notice the various types of lubricants and their effect on machine components.
CO4: Conduct motion analysis of automotive components using theory of film lubrication.
CO5: Apply their knowledge to select the materials for automotive components.

TEXT BOOKS

1. A.Harnoy, "Bearing Design in Machinery "Marcel Dekker Inc, New York, 2003.
2. M.M.Khonsari & E.R.Booser, "Applied Tribology", John Willey &Sons, New York, 2001.

REFERENCE BOOKS

1. Bharat Bhushan, “Principles and Applications of Tribology”, John Wiley and sons Inc., 2nd Edition, 2013.
2. Suresh Kumar R, “Tribology”, Subhas Publications, 2013.
3. Basu S K, Sengupta S N and Ahuja B B “Fundamentals of Tribology”, Prentice Hall Inc, 2010.
4. M.J.Neale (Editor), "Tribology Handbook", Newnes. Butter worth, Heinemann, U.K., 1995.
5. Hutchings I M, “Tribology, Friction and wear of Engineering Materials”, Butterworth Heinemann, 1992.
6. A.Cameron, "Basic Lubrication theory ", Longman, U.K.., 1981.
7. E.P.Bowden and D.Tabor, "Friction and Lubrication", Heinemann Educational Books Ltd., 1974.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Find the solution for surfaces and friction related problem in automobile component.	2	2	2										2	2	1
Co2	Perform wear analysis on machine components using various measuring devices.	1	2											1		

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Co3	Notice the various types of lubricants and their effect on machine components.	2	1	1										1	2	
Co4	Conduct motion analysis of automotive components using theory of film lubrication.	1	2	2									2		2	
Co5	Apply their knowledge to select the materials for automotive components.	2	1	1									1	2	2	

818MEE10 **ADVANCED I.C. ENGINES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the various process and characteristics of IC engines.
- To enable the students to understand the combustion of fuels in IC engines.
- To learn the thermo chemistry properties of fuels and testing of fuels.
- To study the measurement techniques and test procedure of exhaust gas.
- To gain complete knowledge in recent trends in IC engines.

PRE-REQUISITES: Knowledge of Thermal Engineering and Internal Combustion Engines are required

UNIT I INTRODUCTION 9

Basic characteristics of engines: Compression ratio – Clearance Volume- energy supply to an engine – power developed by engine – specific weight and specific volume – cylinder pressures – Indicated Mean Effective Pressure determination – torque characteristics – cylinder arrangement and their relative merits.

UNIT II COMBUSTION OF FUELS 9

Chemical composition and molecular structure of hydrocarbon fuels. Concepts of combustion, Chemical energy and heat of reaction calculations – Chemical equilibrium and adiabatic flame temperature calculation. Theory of SI and CI engine combustion – Flame velocity and area of flame front. Fuel spray characteristics – droplet size, depth of penetration and atomization.

UNIT III PROPERTIES AND TESTING OF FUELS 9

Thermo-chemistry of fuels, Heating values –HCF and LCF analysis, Properties and testing of fuels- relative density, calorific value, flash point, fire point, distillation, vapour pressure, spontaneous ignition temperature, viscosity, pour point, flammability, ignitability, diesel index, API gravity, aniline point, carbon residue, copper strip corrosion Fuel ratings- Octane and Cetane numbers

UNIT IV MEASUREMENT TECHNIQUES AND TEST PROCEDURE 9

Orsat Apparatus, Non Destructive Infra Red analyzer, Flame Ionization Detector, Gas Chromatograph, Chemiluminescence analyzers, smoke meters, Test procedures - Federal test procedure (FTP), Sealed housing evaporative determination (SHED) - chassis dynamometers, dilution tunnels.

UNIT V RECENT TRENDS 9

Homogeneous Charge Compression Ignition Engine, Lean Burn Engine, Stratified Charge Engine, Surface Ignition Engine, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Calculate various characteristics and parameter in IC engines
CO2: Explain the process parameter in combustion of fuels
CO3: Explain thermo chemistry properties of fuels and testing of fuels.

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CO4: Evaluate the measurement techniques and test procedure of exhaust gas
CO5: Acquire knowledge in recent trends in IC engines

TEXT BOOKS

1. Ganesan. V, "Internal Combustion Engines", McGraw Hill, India, 4th Edition, 2017.
2. Mathur M.L., and Sharma, R.P., "A course in Internal Combustion Engines", Dhanpat Rai Publications Pvt., 3rd Edition, 2014.
3. John B.Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill Book, 1998.

REFERENCE BOOKS

1. Ramalingam, K.K., "Internal Combustion Engines", Scitech Publications (India) Pvt. Ltd, 2016.
2. Heinz Heisler, "Advanced Engine Technology", SAE International Publications USA, 1998.
3. Doeblin, "Measurements System application and design", McGraw Hill, 1978.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Calculate various characteristics and parameter in IC engines	3	2								1			2		
Co2	Explain the process parameter in combustion of fuels	3	2								1			2		
Co3	Explain thermo chemistry properties of fuels and testing of fuels.	3	2								1			2		
Co4	Evaluate the measurement techniques and test procedure of exhaust gas	3	2								1			2		
Co5	Acquire knowledge in recent trends in IC engines	3	2								1			2		

818MEE11 BIOMASS ENERGY SYSTEM

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the various forms of conventional energy resources.
- To have an advanced understanding of bio-fuel and biomass production.
- To understand the various sources of alternative energies.
- To perform technical, economic and environmental comparisons of various energy systems.
- To critically appraise logistical issues associated with implementing large scale biofuel.

PRE-REQUISITES: Knowledge of Renewable Source of Energy is required

UNIT I INTRODUCTION **8**

Biomass energy sources- Energy content of various Bio-fuels- Energy plantation- Origin of Biomass photo synthesis process-Biomass Characteristics- sustainability of Biomass.

UNIT II BIOMASS CONVERSION METHOD **9**

Conversion Mechanism- Agrochemical- Thermo- Chemical- Biochemical (flowchart) and Explanation-Briquetting-types of Briquetting-merits and demerits-feed requirements and pre-processing-advantages and limitations.

UNIT III BIOGASIFICATION **10**

Chemical reaction in gasification- Producer gas and the constituents- Types of gasifiers- Fixed bed

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gasifiers- Fluidized bed gasifiers. Liquefaction-Liquefaction through pyrolysis & Methanol synthesis- Application of producer gas in I C Engines.

UNIT IV BIO-METHANIZATION 10

Anaerobic digestion- Basic principles- factors influencing Biogas yield, classification of Biogas digester- floating gasholder and fixed dome type (Working Principle with diagram). Biogas plants- types- design constructional details and comparison.

UNIT V BIODIESEL 8

Bio Diesel from edible and non-edible oils- Production of Bio diesel from Honge and Jatropha seeds, use of bio diesel in I C engines, Blending of Bio diesel- Performance analysis of diesel engines using bio diesel.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

The student will be able to

CO1: Understand the concept of biomass energy resources and their classifications.
CO2: Acquire the knowledge of biomass conversion mechanism and its principles.
CO3: Identify the differences among biomass and biogas.
CO4: Calculate the biomass gasifier size, energy output and source required.
CO5: Describe the current potential contribution of sustainable energy resources to the global energy scenes.

TEXT BOOKS

1. Samir Kumar Khana, "Bioenergy and Biofuel from Biowastes and Biomass", ASCE Publications, 2015.
2. Mital K.M, "Biogas Systems: Principles and Applications", New Age International publishers (P) Ltd., 2010.

REFERENCE BOOKS

1. VVN Kishore, "Renewable Energy Engineering and Technology, Principles and Practices", TERI, 2018.
2. Venkata Ramana P and Srinivas S.N, "Biomass Energy Systems", Tata Energy Research Institute, 2016.
3. Chakraverthy A, "Biotechnology and Alternative Technologies for Utilization of Biomass or Agricultural Wastes", Oxford & IBH publishing Co, 2014.
4. Nijaguna, B.T., "Biogas Technology", New Age International Publishers (P) Ltd., 2012.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Understand the concept of biomass energy resources and their classifications.	1					2	1								1
Co2	Acquire the knowledge of biomass conversion mechanism and its principles.	2	1		1		1						1	2		
Co3	Identify the differences among biomass and biogas.		2				1									
Co4	Calculate the biomass gasifier size, energy output and source required.	3	1		2									2		2
Co5	Describe the current potential contribution of sustainable energy resources to the global energy scenes.				2		1						1		2	1

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818MEE12 **DESIGN OF MATERIALS HANDLING EQUIPMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To learn fundamental principles of material handling systems. To understand the design of hoist in material handling.
- To impart knowledge on various drives used for material handling equipment's.
- To familiarize on transfer mechanism, conveyors, part feeding devices in material handling system.
- To develop knowledge on the construction &working of elevators, escalators and improve presentation and team work skills.
- To know about specific requirements of material handling systems and their design.

UNIT I MATERIALS HANDLING EQUIPMENT 6

Type, selection and applications of material handling equipment's, choice of material handling equipment – hoisting equipment – components and theory of hoisting equipment – chain and ropes – selection of ropes, pulleys, pulley systems, sprockets and drums.

UNIT II DESIGN OF HOISTS 10

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 10

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

UNIT IV CONVEYORS 10

Types-description -design and applications of Belt conveyors - chain conveyors – apron conveyors- Continuous motion vertical conveyors – reciprocating motion vertical conveyors – escalators – flight conveyors – roller conveyors - oscillating conveyors - design of belt conveyors, screw conveyors and pneumatic conveyors.

UNIT V ELEVATORS 9

Bucket elevators: Design - stackers –work levelers and tail gates – industrial lifts passenger lifts – freight elevators -Cage elevators, shaft way, guides, counter weights–– mast type elevators – vertical skip hoist elevators.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES

CO1: The students will be able to gain knowledge on the concepts and benefits of better material handling systems.
CO2: The students will have knowledge on proper selection, use and care through work area hazard assessments and training.
CO3: The course would familiarize the student on the technique to select suitable material handling equipment and design them based on the need.
CO4: The student will be able to design material handling equipments such as drives of hoisting gears, conveyors, elevators.
CO5: The student will have knowledge on safe shifting of materials in a diary processing operation.

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TEXT BOOKS

1. Rudenko, N, “Materials handling equipment”, ELnvee Publishers, 1970.
2. Spivakovsy, A.O. and Dyachkov, V.K, “Conveying Machines”, Volumes I and II, MIR Publishers, 1985.

REFERENCE BOOKS

1. Alan Mulemann, John Oakland, Keith Locker, “Production and Operations Management” Macmillan India Ltd, 2015.
2. Datta A.K, “Materials Management: Procedures, Text and Cases”, Prentice Hall of India, 2008.
3. Everett E. Adam Jr & Ronald J. Ebert, “Production and Operations Management”, Prentice Hall of India, 2003 (Digitized 2008).
4. Alexandrov, M., ‘Materials Handling Equipments’, MIR Publishers, 1981.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students will be able to gain knowledge on the concepts and benefits of better material handling systems.	2	1	1			2			2				2		
Co2	The students will have knowledge on proper selection, use and care through work area hazard assessments and training.	1	2	2						1				1	1	1
Co3	The course would familiarize the student on the technique to select suitable material handling equipment and design them based on the need.	2	2	1						2				2	2	2
Co4	The student will be able to design material handling equipments such as drives of hoisting gears, conveyors, elevators.	1	1	1						1				1	1	1
Co5	The student will have knowledge on safe shifting of materials in a diary processing operation.	2	2	1						2				2	2	2

G RANGANATH

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