GOVERNMENT COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to Anna University)

BARGUR – 635 104

Curriculum for

MECHANICAL ENGINEERING

(Full Time)

I TO VIII SEMESTERS

2020

Regulation

For the students admitted

AY 2020-21 onwards

Dated:09.05.2021

OFFICE OF CONTROLLER OF EXAMINATIONS
GOVERNMENT COLLEGE OF ENGINEERING
BARGUR – 635 104

Website: www.gcebargur.ac.in

PROGRAM SPECIFIC OUTCOMES (PSOs):	
1	Acquire basic knowledge and expertise necessary for professional practice in Mechanical Engineering for higher studies and research.
2	Attain and practice technical skills to identify, analyze, innovate and interact with industry to solve complex problems related to Mechanical Engineering.
3	Possess a professional attitude as an individual or a team member with consideration for society, professional ethics, environmental factors and motivation for lifelong learning.
PROGRAM OUTCOMES (POs)	
1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	**Problem Analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	**Design/development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	**Modern Tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
8	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	**Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

MECHANICAL ENGINEERING (UG) CURRICULUM DESIGN

CREDIT SUMMARY

Name of the UG Programme: **B.E - MECHANICAL ENGINEERING**

S. No	Sub. Area	Credits per Semester								Credits Total	% of Total Credits	Total no. of Courses	Breakup of Credits AICTE (Total 160)*
		I	II	III	IV	V	VI	VII	VIII				
1	HSMC		3		3		1.5			7.5	5	4	12
2	BSC	8.5	11.5	4						24	15	8	25
3	ESC	7.5	7.5	7						22	13.5	8	24
4	PCC			13.5	17	17.5	14	8		70	43.5	25	48
5	PEC					3	3	6	6	18	11	6	18
6	OEC						3	3	3	09	5.5	3	18
7	PROJ					1.5		3	6	10.5	6.5	3	15
8	MC	0	0		0					0	0	3	
	Total	16	22	24.5	20	22	21.5	20	15	161	100	60	160*

STUDENTS ARE ENCOURAGED TO SELECT ELECTIVES FROM SWAYAM / NPTEL / MOOC

Induction Program

Induction program(mandatory)	**3 Weeks Duration**
Induction program for students to be Offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

FIRST SEMESTER

S. No	**Subject Code**	**Course Title**	**CAT**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	20ZBS101	Engineering Mathematics I	BSC	4	3	1	0	4
2	20ZBS102	Engineering Physics	BSC	3	3	0	0	3
3	20ZES103	Engineering Graphics	ESC	5	1	0	4	3
4	20MES104	Basic Electrical Engineering	ESC	3	2	1	0	3
		PRACTICAL						
6	20MES109	Basic Electrical Engineering Laboratory	ESC	3	0	0	3	1.5
7	20ZBS110	Physics Laboratory	BSC	3	0	0	3	1.5
		TOTAL		21	9	2	10	**16**

SECOND SEMESTER

Sl.No	Subject Code	Course Title	CAT	CONTACT PERIODS	L	T	P	C
THEORY								
1	20ZBS201	Engineering Mathematics - II	BSC	4	3	1	0	4
2	20MBS202	Applied Physics	BSC	3	3	0	0	3
3	20MBS203	Applied Chemistry	BSC	3	3	0	0	3
4	20ZHS204	Technical English	HSMC	2	2	0	0	2
5	20ZMC205	Constitution of India	MC	1	1	0	0	0
6	20MES206	Programming in Python	ESC	3	3	0	0	3
PRACTICAL								
7	20MES208	Programming in Python Laboratory	ESC	3	0	0	3	1.5
8	20ZBS209	Chemistry Laboratory	BSC	3	0	0	3	1.5
9	20ZES210	Workshop Practice	ESC	5	1	0	4	3
10	20ZHS211	Communication English Laboratory	HSMC	2	0	0	2	1
		TOTAL		29	16	1	12	**22**

THIRD SEMESTER

SL. NO	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C
THEORY								
1	20ZBS301	Transforms and Partial Differential Equations	BSC	4	3	1	0	4
2	20MES302	Engineering Mechanics	ESC	4	3	1	0	4
3	20MPC303	Manufacturing Technology I	PCC	3	3	0	0	3
4	20MPC304	Engineering Thermodynamics	PCC	4	3	1	0	4
5	20MPC305	Fluid Mechanics and Fluid Machinery	PCC	3	3	0	0	3
6	20MES306	Basic Electronics Engineering	ESC	3	3	0	0	3
PRACTICAL								
7	20MPC308	Fluid Mechanics and Fluid Machinery Laboratory	PCC	3	0	0	3	1.5
8	20MPC309	Machine Drawing	PCC	4	0	0	4	2.0
		TOTAL		28	18	3	7	**24.5**

FOURTH SEMESTER

SL. NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C
THEORY								
1	20MPC401	Thermal Engineering	PCC	3	3	0	0	3
2	20MHS402	Human Values and Professional Ethics	HSMC	3	3	0	0	3
3	20MPC403	Strength of Materials	PCC	4	3	1	0	4
4	20MPC404	Engineering Materials and Metallurgy	PCC	3	3	0	0	3
5	20MPC405	Kinematics of Machines	PCC	4	3	1	0	4
6	20ZMC406	Environmental Science and Engineering	MC	1	1	0	0	0
PRACTICAL								
7	20MPC408	Strength of Materials Laboratory	PCC	3	0	0	3	1.5
8	20MPC409	Thermal Engineering Laboratory	PCC	3	0	0	3	1.5
		TOTAL		24	16	2	6	**20.0**

FIFTH SEMESTER

Sl. No	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C
THEORY								
1	20MPC501	Design of Machine Elements	PCC	4	3	1	0	4
2	20MPC502	Heat and Mass Transfer	PCC	4	3	1	0	4
3	20MPC503	Manufacturing Technology - II	PCC	3	3	0	0	3
4	20MPC504	Metrology and Measurements	PCC	3	3	0	0	3
5		Professional Elective - I	PEC	3	3	0	0	3
PRACTICAL								
6	20MPC508	Manufacturing Processes and Metrology Laboratory	PCC	4	0	0	4	2
7	20MPC509	Heat and Mass Transfer Laboratory	PCC	3	0	0	3	1.5
8	20MPR510	Project - I	PROJ	3	0	0	3	1.5
		TOTAL		27	15	2	10	**22**

SIXTH SEMESTER

Sl. No	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C
THEORY								
1	20MPC601	Dynamics of Machinery	PCC	4	3	1	0	4
2	20MPC602	Finite Element Analysis	PCC	4	3	1	0	4
3	20MPC603	Additive Manufacturing	PCC	3	3	0	0	3
4		Professional Elective - II	PEC	3	3	0	0	3
5		Open Elective I	OEC	3	3	0	0	3
PRACTICAL								
6	20MPC608	Simulation Laboratory	PCC	3	0	0	3	1.5
7	20MPC609	Dynamics of Machinery Laboratory	PCC	3	0	0	3	1.5
8	20MHS610	Soft skills and Personality Development Laboratory	HSMC	3	0	0	3	1.5
		TOTAL		26	15	2	9	**21.5**

SEVENTH SEMESTER

Sl. No	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C
THEORY								
1	20MPC701	Automation in Manufacturing	PCC	3	3	0	0	3
2	20MPC702	Design of Transmission systems	PCC	3	3	0	0	3
3		Professional Elective - III	PEC	3	3	0	0	3
4		Professional Elective - IV	PEC	3	3	0	0	3
5		Open Elective - II	OEC	3	3	0	0	3
PRACTICAL								
6	20MPC708	CAD/CAM and Mechatronics Laboratory	PCC	4	0	0	4	2
7	20MPR709	Project - II	PROJ	6	0	0	6	3
		TOTAL		25	15	0	10	**20**

EIGHTH SEMESTER

Sl. No	Course Code	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C
THEORY								
1		Professional Elective - V	PEC	3	3	0	0	3
2		Professional Elective - VI	PEC	3	3	0	0	3
3		Open Elective - III	OEC	3	3	0	0	3
PRACTICAL								
5	20MPR808	Project III	PROJ	12	0	0	12	6
		TOTAL		21	9		12	**15**

TOTAL NO. OF CREDITS: 161

Value Added Courses

The students can undergo **Internship** in Government / Government Recognized industries / Organizations, for the period of 4 to 6 weeks.
This will be indicated in the **Grade Sheet** under the head, “Value Added Courses”.

PROFESSIONAL ELECTIVES

S.No	Subject Code	Course Title	CAT	L	T	P	C
1	20MPE001	Internal Combustion Engines	PEC	3	0	0	3
2	20MPE002	Mechatronic Systems	PEC	3	0	0	3
3	20MPE003	Microprocessors in Automation	PEC	3	0	0	3
4	20MPE004	Processing of Composite Materials	PEC	3	0	0	3
5	20MPE005	Computer Aided Design	PEC	3	0	0	3
6	20MPE006	Operations Research	PEC	3	0	0	3
7	20MPE007	Theory of Metal cutting	PEC	3	0	0	3
8	20MPE008	Welding Technology	PEC	3	0	0	3
9	20MPE009	Refrigeration and Air Conditioning	PEC	3	0	0	3
10	20MPE010	Power Plant Engineering	PEC	3	0	0	3
11	20MPE011	Gas Dynamics and Jet Propulsion	PEC	3	0	0	3
12	20MPE012	Process Planning and Cost Estimation	PEC	3	0	0	3
13	20MPE013	Lean Manufacturing	PEC	3	0	0	3
14	20MPE014	Design of Jigs, Fixtures and Press Tools	PEC	3	0	0	3
15	20MPE015	Mechanical Vibrations	PEC	3	0	0	3
16	20MPE016	Principles of Management	PEC	3	0	0	3
17	20MPE017	Automobile Engineering	PEC	3	0	0	3
18	20MPE018	Energy Conservation and Management	PEC	3	0	0	3
19	20MPE019	Industrial Robotics	PEC	3	0	0	3
20	20MPE020	Computational Fluid Dynamics	PEC	3	0	0	3
21	20MPE021	Design for Manufacture, Assembly and Environments	PEC	3	0	0	3
22	20MPE022	Nanotechnology	PEC	3	0	0	3
23	20MPE023	Total Quality Management	PEC	3	0	0	3
24	20MPE024	Optimization Techniques	PEC	3	0	0	3

LIST OF OPEN ELECTIVES
(OFFERED TO OTHER DEPARTMENT STUDENTS)
Autonomous Regulation 2020

Sl.No	Subject Code	Course Title	CAT	L	T	P	C
1	20MOE001	Engineering Economics	OEC	3	0	0	3
2	20MOE002	Industrial Engineering	OEC	3	0	0	3
3	20MOE003	Entrepreneurship Development	OEC	3	0	0	3
4	20MOE004	Elements of Project Management	OEC	3	0	0	3
5	20MOE005	Non Destructive Testing	OEC	3	0	0	3
6	20MOE006	Introduction to Automobile Engineering	OEC	3	0	0	3
7	20MOE007	Industrial Automation	OEC	3	0	0	3
8	20MOE008	Introduction to Composite Materials.	OEC	3	0	0	3
9	20MOE009	Industrial Refrigeration and Air Conditioning	OEC	3	0	0	3
10	20MOE010	Renewable Energy Sources	OEC	3	0	0	3
11	20MOE011	Industrial Safety Engineering	OEC	3	0	0	3
12	20MOE012	Rapid Prototyping and Tooling	OEC	3	0	0	3
13	20MOE013	Welding Technology	OEC	3	0	0	3
14	20MOE014	Heating, Ventilation and Air Conditioning	OEC	3	0	0	3

Open Elective courses offered by EEE Department

SI No	Course Code	Course Name	Course Category	L	T	P	C
1	20EOE01	MATLAB Programming	OEC	2	1	0	3
2	20EOE02	Renewable Energy Sources	OEC	3	0	0	3
3	20EOE03	Energy Management and Auditing	OEC	3	0	0	3
4	20EOE04	Reliability Engineering	OEC	2	1	0	3
5	20EOE05	Disaster Management and Mitigation	OEC	3	0	0	3
6	20EOE06	Power Electronics and Drives	OEC	3	0	0	3

Open Elective courses offered by ECE Department

SI No	Course Code	Course Name	Course Category	L	T	P	C
1	20LOE001	Real Time Systems	OEC	2	1	0	3
2	20LOE002	Wireless Sensor Networks	OEC	3	0	0	3
3	20LOE003	Industrial Automation and Robotics	OEC	3	0	0	3
4	20LOE004	Principles of VLSI Design	OEC	2	1	0	3
5	20LOE005	Applied Electronics	OEC	3	0	0	3
6	20LOE006	Fundamentals of Wireless Networks	OEC	3	0	0	3
7	20LOE007	Fundamentals of IoT	OEC	3	0	0	3
8	20LOE008	Soft Computing	OEC	3	0	0	3

Open Elective courses offered by CSE Department

Sl.No	Subject Code	Course Title	CAT	L	T	P	C
1	18SOE001	Programing in C++	OEC	3	0	0	3
2	18SOE002	Java Programing	OEC	3	0	0	3
3	18SOE003	Data base Concepts	OEC	3	0	0	3
4	18SOE004	Web Designing	OEC	3	0	0	3
5	18SOE005	Android Application Development	OEC	3	0	0	3
6	18SOE006	Computer Architecture	OEC	3	0	0	3
7	18SOE007	Fundamentals of Computer Network	OEC	3	0	0	3
8	18SOE008	Linux and RTOS	OEC	3	0	0	3
9	18SOE009	Problem solving and Python Programming	OEC	3	0	0	3
10	18SOE010	Introduction to Data Analytics	OEC	3	0	0	3

LIST OF MANDATORY COURSES (MC)

S. No	Subject	Course Title	CAT	L	T	P	C
1	---	Induction Program	MC	3weeks			
2	20ZMC205	Constitution of India	MC	1	0	0	0
3	20ZMC406	Environmental Science and Engineering	MC	1	0	0	0

LIST OF BASIC SCIENCE (BS) COURSES

S.No	Subject Code	Course Title	CAT	Contact Periods	L	T	P	C
1	20ZBS101	Engineering Mathematics I	BSC	4	3	1	0	4
2	20ZBS102	Engineering Physics	BSC	3	3	0	0	3
3	20ZBS110	Physics Laboratory	BSC	3	0	0	3	1.5
4	20ZBS201	Engineering Mathematics II	BSC	4	3	1	0	4
5	20MBS202	Applied Physics	BSC	3	3	0	0	3
6	20MBS203	Applied Chemistry	BSC	3	3	0	0	3
7	20ZBS209	Chemistry Laboratory	BSC	3	0	0	3	1.5
8	20ZBS301	Transforms and Partial Differential Equations	BSC	4	3	1	0	4

LIST OF ENGINEERING SCIENCE (ES) COURSES

S.No	Subject Code	Course Title	CAT	Contact Periods	L	T	P	C
1	20ZES103	Engineering Graphics	ESC	5	1	0	4	3
2	20MES104	Basic Electrical Engineering	ESC	3	2	1	0	3
3	20MES109	Basic Electrical Engineering Laboratory	ESC	3	0	0	3	1.5
4	20MES206	Programming in Python	ESC	3	3	0	0	3
5	20MES208	Programming in Python Laboratory	ESC	3	0	0	3	1.5
6	20ZES210	Workshop Practice	ESC	5	1	0	4	3
7	20MES302	Engineering Mechanics	ESC	4	3	1	0	4
8	20MES306	Basic Electronics Engineering	ESC	3	3	0	0	3

LIST OF HUMANITIES AND MANAGEMENT SCIENCE COURSES

S.No	Subject Code	Course Title	CAT	Contact Periods	L	T	P	C
1	20ZHS204	Technical English	HSMC	2	2	0	0	2
2	20ZHS211	Communication English Laboratory	HSMC	2	0	0	2	1
3	20MHS402	Human Values and Professional Ethics	HSMC	3	3	0	0	3
4	20MHS610	Soft skills and Personality Development Laboratory	HSMC	3	0	0	3	1.5

LIST OF PROFESSIONAL CORE (PC)COURSES

S.No	Subject Code	Course Title	CAT	Contact Periods	L	T	P	C
1.	20MPC303	Manufacturing Technology - I	PCC	3	3	0	0	3
2.	20MPC304	Engineering Thermodynamics	PCC	4	3	1	0	4
3.	20MPC305	Fluid Mechanics and Fluid Machinery	PCC	3	3	0	0	3
4.	20MPC308	Fluid Mechanics and Fluid Machinery Laboratory	PCC	3	0	0	3	1.5
5.	20MPC309	Machine Drawing	PCC	4	0	0	4	2.0
6.	20MPC401	Thermal Engineering	PCC	3	3	0	0	3
7.	20MPC403	Strength of Materials	PCC	4	3	1	0	4
8.	20MPC404	Engineering Materials and Metallurgy	PCC	3	3	0	0	3
9.	20MPC405	Kinematics of Machines	PCC	4	3	1	0	4
10.	20MPC408	Strength of Materials Laboratory	PCC	3	0	0	3	1.5
11.	20MPC409	Thermal Engineering Laboratory	PCC	3	0	0	3	1.5
12.	20MPC501	Design of Machine Elements	PCC	4	3	1	0	4
13.	20MPC502	Heat and Mass Transfer	PCC	4	3	1	0	4
14.	20MPC503	Manufacturing Technology - II	PCC	3	3	0	0	3
15.	20MPC504	Metrology and Measurements	PCC	3	3	0	0	3
16.	20MPC508	Manufacturing Processes and Metrology Laboratory	PCC	4	0	0	4	2
17.	20MPC509	Heat and Mass Transfer Laboratory	PCC	3	0	0	3	1.5
18.	20MPC601	Dynamics of Machinery	PCC	4	3	1	0	4
19.	20MPC602	Finite Element Analysis	PCC	4	3	1	0	4
20.	20MPC603	Additive Manufacturing	PCC	3	3	0	0	3
21.	20MPC608	Simulation Laboratory	PCC	3	0	0	3	1.5
22.	20MPC609	Dynamics of Machinery Laboratory	PCC	3	0	0	3	1.5
23.	20MPC701	Automation in Manufacturing	PCC	3	3	0	0	3
24.	20MPC702	Design of Transmission systems	PCC	3	3	0	0	3
25.	20MPC708	CAD/CAM and Mechatronics Laboratory	PCC	4	0	0	4	2

EVALUATION SCHEME :: 2020 REGULATIONS

Each course shall be evaluated for a maximum of **100 marks** as shown below:

Sl. No	Category of course	Continuous Assessment	End-Semester Examinations
1.	Theory Courses	50 Marks	50 Marks
2.	Laboratory Courses	50 Marks	50 Marks
3.	Project Work	50 Marks	50 Marks
4.	All other EEC Courses (Non theory)	100 Marks	-
5.	Mandatory Courses	---	100 Marks (Internal Evaluation)

Continuous Assessment Mark the following guidelines are to be followed.

Sl. No.	Category Details	CA Marks	Weightage
1.	Test (3 Nos.) {each test is to be conducted for 50 Marks}	30 Marks	60%
2.	Assignment (3 Nos.)	20 Marks	40%
	TOTAL	50 Marks	100%

Marks for **Mini Project & Project Work and the Viva-Voce Examination** will be distributed as indicated below:

Continuous Assessment: 50 Marks				**End Semester Examination: 50 Marks**		
Review I (25 Marks)		Review II (25 Marks)		Report Evaluation (20 Marks)	Viva-Voce (30 Marks)	
Review Committee (Excluding Guide)	Guide	Review Committee (Excluding Guide)	Guide	External Examiner	External Examiner	Internal Examiner **
15	10	15	10	20	15	15

**Guide will be the internal

ATTENDANCE

A student has to **secure minimum of 75% attendance** for appearing end semester examination. If a student secures **65% to 75% attendance** in the Current Semester due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College / University / State / National / International Level Sports events with prior permission from the Head of the Department concerned, the student shall apply for **condonation**. Condonation can be allowed only two semesters during the entire course of study (i.e O**nly two condonations during the entire course of study**)**.**

Students who secure **less than 65% attendance** will **not be permitted to write the End-Semester Examination.**

SPECIAL NOTE: All the students should **undergo Internship** (4 to 6 weeks duration) as a value added course. This will be indicated in the Grade Sheet under the head, "**Value Added Course**

20ZBS101	ENGINEERING MATHEMATICS- I	L	T	P	C
		3	1	0	4

OBJECTIVES

- Matrix algebra and techniques and using them in engineering applications.
- The concept of infinite series and their convergence so that they will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modelling.
- Differential and integral calculus and their applications in various engineering applications.

UNIT I	MATRICES	9+3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Statement and applications of Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II	SEQUENCES AND SERIES	9+3

Sequences: Definition and examples – Series: Types and Convergence – Series of positive terms – Tests of convergence: Comparison test, Integral test and D,,Alembert,,s ratio test – Alternating series – Leibnitz,,s test – Series of positive and negative terms – Absolute and conditional convergence.

UNIT III	APPLICATIONS OF DIFFERENTIAL CALCULUS	9+3

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

UNIT IV	FUNCTIONS OF SEVERAL VARIABLES	9+3

Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylors series for functions of two variables – Maxima and minima of functions of two variables – Lagranges method of undetermined multipliers.

UNIT V	MULTIPLE INTEGRALS	9+3

Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

LECTURE: 45 TUTORIAL: 15 TOTAL : 60 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	solve problems on matrices and to apply concepts of matrix theory whenever applicable in the field of engineering.
2.	solve problems using convergence tests on sequences and series and to apply them in engineering field appropriately.
3.	solve problems on differential and integral calculus and will be exposed to their applications in engineering

TEXT BOOKS:

1.	Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
2.	Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.

REFERENCES:

1.	Dass, H.K., and Er. Rajnish Verma, "Higher Engineering Mathematics",S. Chand Private Ltd., 2011.
2.	Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.
3.	Peter V.O Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.
4.	Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.
5.	Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, PEARSON Publishing, 2011.

Mapping of COs, POs and PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1		1			1	1	2		2	3	2	
CO2	3	2	1		1			1	1	2		2	3	2	
CO3	3	2	1		1			1	1	2		2	3	2	
Average	3	2	1		1			1	1	2		2	3	2	
Round off	3	2	1		1			1	1	2		2	3	2	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20ZBS102	ENGINEERING PHYSICS	L	T	P	C
	Common to MECH, EEE, ECE & CSE	3	0	0	3

OBJECTIVES:

- To develop knowledge on properties of solids
- To understand the thermal properties of materials and their relevant applications.
- To apply principles of quantum physics in the engineering field
- To know about the fundamentals of LASER
- To know about the fundamental's fibre optics and its applications

UNIT I	PROPERTIES OF MATTER	9

Elasticity – Hooke's law – Stress – Types of Stresses – Strain- Types of Strain - Young's Modulus – Rigidity Modulus – Bulk Modulus –Poisson's ratio – Relationship between three elastic constants and Poisson's ratio – Factors affecting elasticity of materials - Bending moment of a Beam – Depression of cantilever (Theory and Experiment) – Determination of Young's modulus – Uniform and non-uniform bending (Theory and Experiment).

UNIT II	THERMAL PHYSICS	9

Transfer of heat energy - thermal expansion of solids and liquids - expansion joints - bimetallic strips - thermal conduction, convection and radiation - heat conductions in solids - thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) - thermal insulation

UNIT III	QUANTUM PHYSICS	9

Blackbody radiation – Wien's displacement law – Rayleigh-Jean's law - Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh-Jean's law – Matter waves – De-Broglie's Hypothesis – Properties of matter waves - Wave-particle duality – Wavefunction and its physical Significance – Schrodinger wave equation – Time-dependent and time-independent – Application of Schrodinger wave equation: Particle in a 1 D box.

UNIT IV	LASERS	9

LASER – Interaction of light radiation with materials – Einstein's A and B coefficient derivation – Concept of LASER – Population inversion – Pumping action – Methods for pumping action – Characteristics of LASER – Principle, construction and working of Nd-YAG – Industrial and medical applications of lasers.

UNIT V	FIBRE OPTICS	9

Structure of Optical Fibre – Guiding mechanism – Total internal reflection – Critical Angle – Conditions for total internal reflection – Principle and Propagation of light in Optical Fibres – Numerical aperture and acceptance angle – Types of optical fibres (Material, refractive index and mode) – their characteristics and applications.

TOTAL: 45 PERIODS

OUTCOMES:	
At the end of the course, the student will be able	
1	To explain about three types of elastic moduli and able to calculate them for different materials
2	To apply concepts of thermal properties of materials and their applications inexpansion joints and heat exchangers
3	To understand the quantum nature of materials and apply fundamental principles of quantum physics to the engineering field
4	To understand the working principles of lasers and their types
5	To know about fibre optics and mechanism of propagation of light through them
TEXTBOOKS:	
1.	P. Mani, "Engineering Physics I and Engineering Physics II", Shri Dhanam Publishers, 2016
2.	D.K. Bhattacharya & T. Poonam. "Engineering Physics". Oxford University Press, 2015.
3.	R.K. Gaur & S.L. Gupta. "Engineering physics". Dhanpat Rai Publishers, 2012.
4.	A. Marikani, "Engineering Physics", PHI Learning Pvt., India 2009
5.	B.K. Pandey & S. Chaturvedi. "Engineering Physics". Cengage Learning India, 2012
REFERENCES:	
1.	*D. Haliday, R. Resnick and J. Walker. "Principles of Physics". Wiley, 2015*
2.	*M. N. Avadhanulu and P. G. Kshirsagar, "A textbook of engineering physics", S. Chand and Company Ltd, New Delhi, 2005.*
3.	*K. Rajagopal, "Engineering Physics", PHI, New Delhi, 2011.*
4.	*R.A. Serway & J.W. Jewett. "Physics for Scientist and Engineers". Cengage Learning, 2010.*
5.	*M. Arumugam, "Engineering physics", Anuradha publishers*

Mapping of COs, POs and PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1										3	2	
CO2	3	2	1										3	2	
CO3	3	2	1										3	2	
CO4	3	2	1										3	2	
CO5	3	2	1										3	2	
Average	3	2	1										3	2	
Round off	3	2	1										3	2	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20ZES103	ENGINEERING GRAPHICS	L	T	P	C
(Common to MECH, EEE, ECE & CSE)		1	0	4	3

COURSE OBJECTIVES:

•	This course aims to introduce the concept of graphic communication, develop the drawing skills for communicating concepts, ideas and designs of engineering products and to expose them to existing national standards related to technical drawings
•	To draw the projection of simple solids like prisms, pyramids, cylinder etc.
•	To draw the development of surfaces to estimate the sheet metal requirement and to prepare sectional views of solids.
•	To develop skills in three-dimensional visualization of engineering components and to draw isometric views of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications – use of drafting instruments – BIS / ISO conventions and specifications – size, layout and folding of drawing sheets – lettering and dimensioning.

UNIT I	PLANE CURVES AND FREE-HAND SKETCHING	6+9

Basic geometrical constructions, curves used in engineering. Conics – construction of ellipse, parabola and hyperbola by eccentricity method – drawing of tangents and normal to the above curves. Visualization concepts and free hand sketching: visualization principles –representation of three dimensional objects – layout of views- freehand sketching of multiple views from pictorial views of objects.

UNIT II	PROJECTION OF POINTS, LINES AND PLANE SURFACES	6+9

Orthographic projection – Principles-principal planes - First angle projection - Projection of points - Projection of straight lines inclined to both the principal planes - determination of true lengths and true inclinations by rotating line method - traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III	PROJECTION OF SOLIDS	6+9

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids, when the axis is inclined to both the principal planes by rotating object method.

UNIT IV	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	6+9

Sectioning of prisms, pyramids, cylinders and cones in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – prisms, pyramids cylinders and cones.

UNIT V	ISOMETRIC PROJECTION AND OVERVIEW OF COMPUTER GRAPHICS	6+9

Principles of isometric projection – isometric scale –isometric projections of simple solids and truncated solids - prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions – Introduction to CAD - The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD- (CAD – evaluation during CA only)

Lecture: 15 Periods	Tutorial: 0 Periods	Practical: 60 Periods	Total: 75 Periods

OUTCOMES:	On completion of this course, students will be able to
1	Familiarize with the fundamentals, standards of Engineering graphics and Perform freehand sketching of multiple views of basic geometrical constructions.
2	Draw orthographic projections of points, lines and plane surfaces.
3	Draw projections of simple solids.
4	Visualize and draw sectioned solids and development of surfaces.
5	Visualize and draw isometric views of simple solids and appreciate the use of computers in drawing and modelling of simple objects.

TEXT BOOKS:

1	Natrajan K. V., "**A text book of Engineering Graphics**", Dhanalakshmi Publishers, Chennai, 2016.
2	Venugopal K. and Prabhu Raja V., "**Engineering Graphics**", New Age International (P) Limited, 2016.
3	Shah, M. B. and Rana B. C. **"Engineering Drawing and Computer Graphics",** Pearson Education, 2010

REFERENCES:

1	*N S Parthasarathy and Vela Murali, "**Engineering Graphics**", Oxford University, Press, New Delhi, 2015.*
2	*Gopalakrishna K.R., **"Engineering Drawing" (Vol. I&II combined),** Subhas publications, Bangalore, 2014.*
3	*Basant Agrawal and Agrawal C.M., "**Engineering Drawing**", Tata McGraw Hill Publishing Company Limited, New Delhi, 2013.*
4	*Luzzader, Warren J. and Duff John M., "**Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production**", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005*
5	*Bhatt N. D. and Panchal V. M., **"Engineering Drawing**", Charotar Publishing House, 53rd Edition, 2014.*

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2		3		3			3			3	2	2
CO2	3	2	2		3		3			3			3	2	2
CO3	3	2	2		3		3			3			3	2	2
CO4	3	2	2		3		3			3			3	2	2
CO5	3	2	2		3		3			3			3	2	2
Average	3	2	2		3		3			3			3	2	2
Round off	3	2	2		3		3			3			3	2	2
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MES104	BASIC ELECTRICAL ENGINEERING	L	T	P	C
		2	1	0	3

OBJECTIVES:	
•	To introduce electric circuits and theorems.
•	To understand the basics of AC circuits
•	To study the Basics of Transformer
•	To understand the concept of electrical machines
•	To study about the electrical installations

UNIT I	DC CIRCUITS	9

Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff‟s current and voltage laws, analysis of simple circuits with DC excitation, star delta transformation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

UNIT II	AC CIRCUITS	9

Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor. Time domain Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT III	TRANSFORMERS	9

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT IV	ELECTRICAL MACHINES	9

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of dc motor. Construction and working of synchronous generators[Elementary Analysis only]

UNIT V	POWER CONVERTERS AND ELECTRICAL INSTALLATIONS	9

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery Backup.

TOTAL : 45 PERIODS

OUTCOMES:	At the end of this course, students will able to
1.	Understand and analyze basic Electric and magnetic circuits.

2.	Study the working principles of Electrical Machines.
3.	Understand the Power Converters and the components of low-voltage electrical installations.

TEXT BOOKS:

1.	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2.	D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3.	L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011

REFERENCES:

1.	*E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.*
2.	*V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.*

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
CO2	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
CO3	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
Average	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
Round off	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MES109	BASIC ELECTRICAL ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:	
•	To introduce basic electrical measuring Instruments.
•	To obtain transient and steady state characteristics of electrical circuits.
•	To obtain different electrical machines and transformer basic characteristics.
•	To introduce basic power converters.

LIST OF EXPERIMENTS :	
1.	(a) Study of Electrical basic safety precautions. (b) Measurement of voltage, current, Power in resistive loads.
2.	(a) Measurement of waveforms parameters using CRO (b) Identification and calculation of resistors, inductors and Capacitors values.
3.	a) Steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a Step input voltage using a storage oscilloscope. b) Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. c) Observation of phase differences between current and voltage. d) Resonance in R-L-C circuits.
4.	(a) Observation of the no-load current waveform Transformer on an oscilloscope. (b) Load Test on Single phase Transformer.
5.	Measurement of three phase power in a balanced three phase circuits.
6.	Demonstration of cut-out sections of machines (a) DC machine (commutator-brush arrangement) (b)Induction machine (squirrel cage rotor) (c) synchronous machine (field winging – slip ring arrangement) (d) Single-phase induction machine.
7.	Torque Speed Characteristics of DC Shunt motor.

8.	(a)Synchronous speed of two and four-pole, three-phase induction motors. (b)Direction reversal by change of phase-sequence of connections. (c) Torque-Slip Characteristics of an induction motor. (d) Generator operation of an induction machine driven at super-synchronous speed.
9.	Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor
	(d) Components of LT switchgear.
	TOTAL PERIODS **45**

OUTCOMES:	After the course, the student will be able to
1.	Identify common electrical components and their ratings
2.	Make electrical connections by wires of appropriate ratings.
3.	Understand the usage of common electrical measuring instruments.
4.	Understand the basic characteristics of transformers and electrical machines.
5.	Understand the working of power electronic converters.

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
CO2	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
CO3	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
CO4	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
CO5	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
Average	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
Round off	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20ZBS110	PHYSICS LABORATORY	L	T	P	C
	(Common to MECH, EEE, ECE & CSE)	0	0	3	1.5

OBJECTIVES

•	To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids

LIST OF EXPERIMENTS : PHYSICS LABORATORY (ANY 5 EXPERIMENTS)

1.	Determination of rigidity modulus by Torsion Pendulum
2.	Determination of Young's modulus by non-uniform bending method
3.	Determination of Young's modulus by uniform bending method
4.	(a) Determination of wave length and particle size using LASER (b) Determination of acceptance angle in an optical fibre
5.	Determination of thermal conductivity of a bad conductor – Lee's Disc method
6.	Determination of velocity of sound and compressibility of fluid – Ultrasonic interferometer
7.	Determination of wavelength of mercury spectrum – Spectrometer grating
8.	Determination of band gap of a semiconductor
	Total: 45 Periods

OUTCOMES:	On completion of this course, students will be able to
1.	to apply principles of elasticity, optical and thermal properties for engineering applications..

Mapping of COs, POs and PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1		1			1	1	2		2	3	2	
Average	3	2	1		1			1	1	2		2	3	2	
Round off	3	2	1		1			1	1	2		2	3	2	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20ZBS201	ENGINEERING MATHEMATICS- II	L	T	P	C
	(Common to MECH, EEE, ECE & CSE)	3	1	0	4

OBJECTIVES

- Vector calculus and their uses in various field theoretic subjects.
- Higher order and special type of linear differential equations and methods to find solutions.
- Laplace transforms and properties and their applications in engineering.
- Construction of analytic functions and concepts of concepts of conformal mapping, complex integration and series solutions.

UNIT I **VECTOR CALCULUS** **9+3**

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 (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT II **ORDINARY DIFFERENTIAL EQUATIONS** **9+3**

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.

UNIT III **LAPLACE TRANSFORMS** **9+3**

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform -Statement of Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

UNIT IV **ANALYTIC FUNCTIONS** **9+3**

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: $w = z+k$, kz, $1/z$, z^2, e^z and bilinear transformation.

UNIT V **COMPLEX INTEGRATION** **9+3**

Complex integration – Statement and applications of Cauchy,,s integral theorem and Cauchy,,s integral formula – Taylor,,s and Laurent,,s series expansions – Singular points – Residues – Cauchy,,s residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

LECTURE: 45 TUTORIAL: 15 TOTAL : 60 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Solve problems on vector calculus and to apply them in any other field theory related subjects.
2.	Solve differential equations and will be exposed to their applications in various fields of engineering.
3.	Solve problems on Laplace transforms and will be able to use Laplace transform in finding solutions of differential and integral equations and other engineering applications.
4.	Solve complex integration problems and will be exposed to various applications of analytic functions and conformal mapping in engineering.

TEXT BOOKS:

1.	Bali N. P and Manish Goyal, **"A Text book of Engineering Mathematics**", Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
2.	Grewal. B.S, **"Higher Engineering Mathematics**", 41st Edition, Khanna Publications, Delhi, 2011.

REFERENCES:

1.	Dass, H.K., and Er. Rajnish Verma, "**Higher Engineering Mathematic**s", S. Chand Private Ltd., 2011.
2.	Glyn James, "**Advanced Modern Engineering Mathematics**", 3rd Edition, Pearson Education, 2012.
3.	Peter V. O,,Neil, "**Advanced Engineering Mathematics**", 7th Edition, Cengage learning, 2012.
4.	Ramana B.V, "**Higher Engineering Mathematics**", Tata McGraw Hill Publishing Company, New Delhi, 2008.
5.	Sivarama Krishna Das P. and Rukmangadachari E., "**Engineering Mathematics**", Volume II, Second Edition, PEARSON Publishing, 2011.

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2		3					3			3	2	1
CO2	3	2	2		3					3			3	2	1
CO3	3	2	2		3					3			3	2	1
CO4	3	2	2		3					3			3	2	1
Average	3	2	2		3					3			3	2	1
Round off	3	2	2		3					3			3	2	1

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MBS202	APPLIED PHYSICS	L	T	P	C
Mechanical Engineering		3	0	0	3

OBJECTIVES:

- To become proficient in basics of crystals, their structures and defects in crystals
- To understand the fundamentals of nuclear forces, models and classification of matter
- To learn the fundamentals of magnetic, dielectric and superconducting materials
- To understand the fundamentals of acoustics and vibrations
- To know the basics of advanced materials and their applications

UNIT I	CRYSTALLOGRAPHY	9

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances – crystal imperfections: point defects, line defects - Burger vectors – role of imperfections in plastic deformation. Bragg's law of X-ray diffraction – powder crystal method.

UNIT II	NUCLEAR AND PARTICLE PHYSICS	9

Nuclear properties and forces - Nuclear models - Shell model - Nuclear reaction - Radioactivity - types and half-life - Stellar nucleosynthesis. Fundamental forces - Particle physics - classification of matter - quark models - neutrino properties and their detection.

UNIT III	MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS	9

Classification of magnetic materials– ferromagnetism – domain theory – types of energy – hysteresis – hard and soft magnetic materials – ferrites - dielectric materials – types of polarization – Langevin-Debye equation – frequency effects on polarization - dielectric breakdown – insulating materials – Ferroelectric materials - superconducting materials – type-I and type-II superconductor and their properties.

UNIT IV	ACOUSTICS & VIBRATIONS	9

Introduction to Acoustics -reverberation – reverberation time – Sabine's formula – acoustics of buildings – ultrasonics – production of ultrasonics using piezoelectric method –magnetostriction method-applications.

Fundamentals of vibrations:Simple harmonic motion, combination of two simple harmonic motions, beats.

UNIT V	ADVANCED MATERIALS	9

Nanomaterials: introduction and properties – synthesis – chemical vapour deposition – ball milling – applications. Carbon nanotubes: structure and properties – synthesis– arc method – pulsed laser deposition- applications.

Shape memory alloys (SMA): One way and two-way memory effect- pseudoelasticity – Ni-Ti alloy - applications.
TOTAL:45 PERIODS
OUTCOMES:

•	Students will understand the basics of crystals, their structures and defects in crystals
•	Students will be able to experience the behaviour of matter at atomic scale, role of nuclear and particle physics in applications like radioactivity and nuclear reactions.
•	Students will also acquire various materials knowledge like magnetic, dielectric and superconducting.
•	Students will understand the acoustics of building, ultrasonics and vibration.
•	Students will also get an exposure to nanomaterials synthesis, carbon nano tubes and shape memory alloys.

TEXTBOOKS:	
1.	*A. Marikani, "Engineering Physics", PHI Learning Pvt., India, 2009.*
2.	*S. Mani Naidu, "Applied Physics", Pearson Publisher, India, 2010.*
3.	*Uma Mukherji, "Engineering Physics", Alpha Science International Ltd., Oxford, U.K.*
4.	*K. Rajagopal, "Engineering Physics", PHI, New Delhi, 2011.*
5.	*P. Mani, "Engineering physics", Dhanam Publications, 2017*

REFERENCES:	
1.	*Concepts of Modern Physics. Arthur Beiser, Tata McGraw-Hill, New Delhi (2010)*
2.	*Introduction to Nanotechnology, C.P. Poole and F.J. Owens, Wiley, New Delhi (2007).*
3.	*Fundamentals of Physics II, R. Shankar, Yale University Press, New Haven and London (2016).*
4.	*Fundamentals of Physics, 6th Edition, D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, New York (2001).*
5.	*Callister's materials Science and Engineering, R. Balasubramaniam, Wiley India Pvt. Ltd., 2014*
6.	*Nuclear Physics, S.N. Ghoshal, Chand & Company Ltd., New Delhi, 1994.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**2**										**3**	**2**	
CO2	**3**	**2**	**2**										**3**	**2**	
CO3	**3**	**2**	**2**										**3**	**2**	
CO4	**3**	**2**	**2**										**3**	**2**	
CO5	**3**	**2**	**2**										**3**	**2**	
Average	**3**	**2**	**2**										**3**	**2**	
Round off	**3**	**2**	**2**										**3**	**2**	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MBS203	APPLIED CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make students conversant with water parameters, boilers, need for water treatment and acquire basic knowledge in spectroscopy and its applications.
- Students ought to be aware of fundamental principles behind different electrochemical reactions, corrosion of materials, methods to prevent corrosion and industrial importance of alloys.
- To learn the chemistry behind polymers, synthesis, merits, demerits and its applications in various field.
- To acquire basic knowledge in non-conventional energy resources and the chemical reactions involved in cell, batteries and function of lubricants.
- To learn the chemistry behind fuels and combustion.

UNIT I WATER TECHNOLOGY AND ANALYTICAL TECHNIQUES 9

Water Technology: Characteristics – alkalinity and its significance – hardness (problems) - types and estimation by EDTA method – potable water treatment – boiler feed water - requirements – disadvantages of using hard water in boilers (Scales & Sludge, Boiler corrosion, Priming & Foaming, Caustic embrittlement) – water treatment – Internal treatment – external treatment – Demineralization process – desalination – reverse osmosis.

Analytical Techniques: Electromagnetic spectrum – Beer-Lambert's law - Fundamentals of spectroscopy – (Instrumentation) of UV-Visible, AAS, Flame photometry.

UNIT II ELECTROCHEMISTRY, CORROSION AND ALLOYS 9

Electrochemistry: Electrochemical cells – reversible and irreversible cells – EMF – measurement of EMF – single electrode potential – Nernst equation (Problems) – reference electrode – standard hydrogen electrode and calomel electrode – electrochemical series and its applications.

Corrosion: Corrosion – Pilling Bedworth rule - dry corrosion - electrochemical corrosion – types (galvanic, pitting, differential aeration) – factors influencing corrosion – corrosion control methods – sacrificial anode method – impressed current cathodic method – protective coatings – paints – constituents – functions – metallic coatings – electroplating (Cu) and electro less plating (Ni).

UNIT III POLYMERS AND COMPOSITES 9

Polymers: Definition – classification – functionality – polymerization – degree of polymerization – types (addition, condensation, copolymerization) – mechanism (free radical) – plastics – thermoplastics and thermosetting plastics – preparation, properties and uses of individual polymers (PVC, TEFLON, Nylon-6,6, Nylon-6, PET, epoxy resin) – rubber - vulcanization of rubber – applications - Biopolymers – Properties and its applications (Polylactic acid) – Conducting polymers - Properties and its applications (Polyacetylene)

Composites: definition – types - polymer matrix composites – Fibre Reinforced Polymers – applications – advanced composite materials – physical and chemical properties – applications.

UNIT IV NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES - LUBRICANTS 9

Nuclear energy – fission fusion reactions – light water nuclear reactor for power generation – breeder reactor – solar energy conversion – solar cells – wind energy – batteries: alkaline batteries – lead–acid accumulator, Ni-Cd ,and Li-ion batteries – fuel cells – H_2-O_2 fuel cell - principles and applications – advantages and disadvantages.

Lubricants: Lubricants - mechanism of lubrication, classification and properties of lubricants (viscosity index, flash and fire points, cloud and pour points, oilyness), Additives for lubricants, synthetic lubricants, Greases – Preparation & properties (consistency, drop point) and uses.

UNIT V FUELS AND COMBUSTION 9

Classification - Calorific value – coal – analysis of coal (Proximate and Ultimate) – metallurgical coke – manufacture by Otto-Hoffmann method – petroleum – manufacture of synthetic petrol (Bergius method) – Knocking –octane number – diesel oil – cetane number – Power alcohol - natural gas - compressed natural gas (CNG) – Liquefied petroleum gas (LPG) – Producer gas – water gas. **Combustion of fuels:** theoretical calculation of calorific value – calculation of stoichiometry of fuel and air ratio – ignition temperature - explosive range – flue gas analysis (ORSAT apparatus)
TOTAL : 45 PERIODS

COURSE OUTCOMES

On completion of the course the student will be able to,

1.	apply the knowledge of basic science in identifying, to formulate and to solve the engineering problems.
2.	analyze water borne problems faced in boilers, water treatment methods and analytical techniques and its applications.
3.	understand polymerization reactions and electrochemical reactions and its applications.
4.	Obtain knowledge in various renewable energy resources, Batteries, fuel cells, lubricants and its applications.
5.	acquire in-depth knowledge in fuels and combustion.

TEXT BOOKS:

1	*Vairam S, Kalyani P and SubaRamesh.,"Engineering Chemistry"., Wiley India PvtLtd.,New Delhi., 2011*
2	*Dara S.S,UmareS.S."Engineering Chemistry", S. Chand & Company Ltd., New Delhi , 2010*

REFERENCES:

1.	*Pahari A and Chauhan B., "Engineering Chemistry"., Firewall Media., New Delhi., 2010.*
2.	*Jain and jain , 16th editin, "Engineering Chemistry" Dhanpat Rqai Publishing Co.*
3.	*Foster R., Ghassemi M., Cota A., "Solar Energy", CRC Press, 2010.*
4.	*Physical Chemistry, P.W. Atkin (ELBS, Oxford Press).*
5.	*Sivasankar B, "Engineering Chemistry", Tata Mc Graw-Hill Publishing Company Ltd, New Delhi , 2008.*

Mapping of COs, POs and PSOs:

	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	**2**		**2**		**1**			**1**			**1**	**1**			
CO2	**2**	**1**	**3**		**1**			**1**	**1**		**2**	**1**			
CO3	**2**		**1**		**1**			**1**	**1**		**2**	**1**	**2**		**1**
CO4	**2**		**3**		**2**			**1**	**1**		**2**	**1**	**1**		**1**
CO5	**2**		**1**		**2**			**1**	**1**		**2**	**1**	**1**		**1**
Average	**2**		**2**		**1**			**1**			**1**	**1**			
Round off	**2**	**1**	**3**		**1**			**1**	**1**		**2**	**1**			
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20ZHS204	TECHNICAL ENGLISH	L	T	P	C
	(Common to MECH, EEE, ECE & CSE)	2	0	0	2

OBJECTIVES:

- To be able to acquire vocabulary by way of reading skills.
- To be able to write iterative as well as recursive programs.
- To be able to represent data in arrays, strings and structures and manipulate them through a program.
- To be able to declare pointers of different types and use them in defining self- referential structures.
- To be able to create, read and write to and from simple text files.

UNIT I	VOCABULARY BUILDING	6

The concept of Word Formation - Root words from foreign languages and their use in English - Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. - Synonyms, antonyms, and standard abbreviations

UNIT II	BASIC WRITING SKILLS	6

Sentence Structures - Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence - Organizing principles of paragraphs in documents - Techniques for writing precisely

UNIT III	IDENTIFYING COMMON ERRORS IN WRITING	6

Subject-verb agreement - Noun-pronoun agreement - Misplaced modifiers - Articles - Prepositions - Redundancies - Clichés

UNIT IV	NATURE AND STYLE OF SENSIBLE WRITING	6

Describing - Defining - Classifying - Providing examples or evidence - Writing introduction and conclusion

UNIT V	WRITING PRACTICES	6

Comprehension - Précis Writing - Essay Writing

TOTAL : 30 PERIODS

OUTCOMES: At the end of the course , the students will be able to

1.	Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

2.	Participate effectively in formal and informal conversations; introduce themselves and express their opinions in English.
3.	Comprehend conversations and deliver short talks in English.
4.	Write essays and descriptions of any kind in English.
5.	Prepare reports, graph presentation and Technical writing.

TEXT BOOKS:

1.	On Writing Well. William Zinsser. Harper Resource Book. 2001
2.	Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
3.	Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.

REFERENCES:

1.	*Richards, C. Jack .**Interchange Students'** Book-2 New Delhi: CUP, 2015.*
2.	*Bailey ,Stephen. Academic Writing: **A Practical guide for students** .New York: Rutledge, 2011.*
3.	*Seely, John. **The Oxford guide to writing & Speaking**. New York.1998.*
4.	*Bhatia M.P ,**A Handbook of APPLIED GRAMMAR** ,M.I Publications, AGRA, Sixth Edition*

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1					**3**				**3**						**1**
CO2					**3**				**3**						**1**
CO3					**3**				**3**						**1**
CO4					**3**				**3**						**1**
CO5					**3**				**3**						**1**
Average					**3**				**3**						**1**
Round off					**3**				**3**						**1**

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20ZMC205	CONSTITUTION OF INDIA	L	T	P	C
	(Common to all Branches)	**1**	**0**	**0**	**0**

OBJECTIVES:

0. To provide understanding of basic concepts of Indian Constitution and various organs created by the constitution including their functions.

UNIT I **INTRODUCTION** **5**

Constitution‟ Definition and Classification - Constitutional Organs - Indian Constitution: Sources and constitutional history, Salient features of Indian Constitution - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy Rule of Law - Separation of powers Constitution - Doctrine of Basic Structure.

UNIT II **UNION GOVERNMENT & STATE GOVERNMENT AND THEIR ADMINISTRATION** **5**

Distribution of Powers between Center and States Structure of the Indian Union: Federalism, Centre-State -relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha. Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

UNIT III **LOCAL ADMINISTRATION AND ELECTION COMMISSION** **5**

District‟s Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy Emergency Provisions - Amendment of Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women

TOTAL : 15 PERIODS

COURSE OUTCOMES On completion of this course, students will be able to

1. Understand the basic concepts of Indian Constitution and various organs created by the constitution including their functions.

TEXT BOOKS:

1. V.N. Shukla, **“Constitution of India”,** EBC, 13th Edition, 2017.
2. M.P. Jain, **“Indian Constitutional Law”,** LexisNexis, 8th Edition, 2018.
3. H.M.Seervai, “**Constitution of India**”, LexisNexis, Second edition, 2014.

REFERENCES:

1. *DD Basu’s, **“Shorter Constitution of India”,** Lexisnexis, 14 th Edition, 2016*
2. *https://www.india.gov.in/my-government/constitution-india/constitution-india-full-text*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1			1		1	3			1	2	1	2		2	1
Average			1		1	3			1	2	1	2		2	1
Round off			1		1	3			1	2	1	2		2	1

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MES206	PROGRAMMING IN PYTHON	L	T	P	C
		3	0	0	3

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, and 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; Lists as 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, mergesort, histogram.

UNIT V FILES, MODULES, PACKAGES 9

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

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1. Develop algorithmic solutions to simple computational problems.
2. Read, write, execute by hand simple Python programs.

3.	Structure simple Python programs for solving problems and Read and write data from/to files in Python Programs.
4.	Decompose a Python program into functions.
5.	Represent compound data using Python lists, tuples, and 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.
3.	Dr.A.Kannan, Dr.L.Sairamesh, "Problem Solving and Python programming", United Global Publishers Pvt. Ltd., 2017.

REFERENCES:	
1.	*Robert Sedgewick, Kevin Wayne, Robert Dondero, "**Introduction to Programming in Python: An Inter-disciplinary Approach",** Pearson India Education Services Pvt. Ltd., 2016.*
2.	*Timothy A. Budd, **"Exploring Python",** Mc-Graw Hill Education (India) Private Ltd., 2015.*
3.	*Kenneth A. Lambert, **"Fundamentals of Python: First Programs",** CENGAGE Learning, 2012.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
CO2	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
CO3	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
CO4	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
CO5	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
Average	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
Round off	**3**	**2**	**2**		**3**					**3**			**3**	**2**	**1**
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MES208	PROGRAMMING IN PYTHON LABORATORY	L	T	P	C
		0	0	3	1.5

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, and dictionaries.
•	Read and write data from/to files in Python.

LIST OF EXPERIMENTS:

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton,,s method).
3. Exponentiation (power of a number).
4. Find the maximum of a list of numbers.
5. Linear search and Binary search.
6. Selection sort, Insertion sort.
7. Merge sort.
8. First n prime numbers.
9. Multiply matrices.
10. Programs that take command line arguments (word count).
11. Find the most frequent words in a text read from a file.
12. Simulate elliptical orbits in Pygame.
13. Simulate bouncing ball using Pygame.

PLATFORM NEEDED

- Python 3 interpreter for Windows/Linux

TOTAL : 60 PERIODS

OUTCOMES:

On completion of this course, students will be able to

1.	Write, test, and debug simple python programs and Implement with conditionals and loops.
2.	Develop python programs step-wise by defining functions and calling them.
3.	Use python lists, tuples, dictionaries for representing compound data and read and write data from/to files in python.

COURSE ARTICULATION MATRIX:

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	3		2								2	1	3
CO2		2	3		1									1	3
CO3	2	2	3	2	1								2	1	3
Average	**1.3**	**3**	**3**	**.67**	**1.3**								**1.3**	**1**	**3**
Round off	**1**	**3**	**3**	**1**	**1**								**1**	**1**	**3**

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20ZBS209	CHEMISTRY LABORATORY	L	T	P	C
	(Common to MECH, EEE, ECE & CSE)	0	0	3	1.5

OBJECTIVES:

1.	To make students conversant with hands on water parameter analysis.
2.	To make the student to acquire practical skills in the corrosion in metals.
3.	To acquaint the students with the determination of molecular weight of a polymer by Ostwald viscometer.
4.	To make the student acquire practical skills in analytical instruments.

LIST OF EXPERIMENTS:

1. Determination of total hardness of given water sample by EDTA method.
2. Determination of alkalinity in given water sample.
3. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
4. Conductometric titration using mixture of acids and strong base.
5. Determination of strength of in given hydrochloric acid using pH meter.
6. Estimation of sodium present in water using flame photometer.
7. Estimation of Zn present in effluent using Atomic Absorption Spectroscopy(AAS)
8. Corrosion experiment – weight loss method
9. Estimation of iron content of the given solution using potentiometer meter.
10. Estimation of iron content of the given sample using Spectro photometer (thiocyanate method).\

(Note: A minimum of SIX experiments shall be offered) List of equipments for a batch of 30 students

1. Flame photometer - 5 nos
2. Weighing balance - 5 nos
3. Conductivity meter ; Potentiometer; pH meter- 9 nos each.
4. Ostwald viscometer - 30 nos
5. Atomic Absorption Spectrophotometer - 1 no.

Common apparatus: Pipette, Burette, Burette stand, Standard volumetric flask, funnel, Conical flask, porcelain tiles, dropper, reagent bottles, glass rod, beaker, wash bottle, test tube (30 nos each)

COURSE OUTCOMES	At the end of the course students should be able to
1.	The students will be outfitted with hands-on knowledge in the qualitative and quantitative chemical analysis of water quality related parameters, corrosion studies, heavy metal analysis, etc.

REFERENCES:	
1.	*Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., **"Vogel's Textbook of practical organic chemistry",** LBS Singapore 1994.*
2.	*Jeffery G.H., Bassett J., Mendham J.and Denny vogel's R.C, "**Text book of quantitative analysis chemical analysis"**, ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.*
3.	*Kolthoff I.M., Sandell E.B. et al. **"Quantitative chemical analysis",** Mcmillan, Madras 1980.*
4.	*Daniel R. Palleros, **"Experimental organic chemistry"** John Wiley & Sons, Inc., New York 2001.*

Mapping of COs, POs and PSOs:															
	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	2	1		1			2	1		1	1	1	1	1
Average	1	2	1		1			2	1		1	1	1	1	1
Round off	1	2	1		1			2	1		1	1	1	1	1
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20LES210	WORKSHOP PRACTICES	L	T	P	C
	(Common to MECH, EEE, ECE and CSE Branches)	1	0	4	3

COURSE OBJECTIVES:

- To make various basic prototypes in the carpentry trade such as Lap joint, Lap Tee joint, Dove tail joint, Mortise & Tenon joint and Cross-Lap joint
- To make various welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint.

LIST OF EXPERIMENTS:

1. Introduction to use of tools and equipment in Carpentry, Welding, Foundry and Sheet metal
2. Safety aspects in Welding, Carpentry and Foundry
3. Half lap Joint and Dovetail Joint in Carpentry
4. Welding of Lap joint, Butt joint and T-joint
5. Preparation of Sand mold for cube, conical bush, pipes and V pulley
6. Fabrication of parts like tray, frustum of cone and square box in sheet metal
7. Electrical wiring – simple house wiring
8. Plumbing
9. CNC Machines demonstration and lecture on working principle.
10. Additive manufacturing demonstration and lecture on working principle.

Lecture: 15 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 75 Periods

COURSE OUTCOMES:	on completion of this course, students will be able to
1	Use tools and equipment used in Carpentry, Welding, Foundry and Sheet metal.
2.	Make half lap joint dovetail joint in carpentry and welded lap joint, butt joint and T-joint
3	Prepare sand mould for cube, conical bush, pipes and V pulley.
4	Fabricate parts like tray, frustum of cone and square box in sheet metal
5	Carry out minor works/repair related to electrical wiring and plumbing.

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2		3					3			3	2	1
CO2	3	2	2		3					3			3	2	1
CO3	3	2	2		3					3			3	2	1
CO4	3	2	2		3					3			3	2	1
CO5	3	2	2		3					3			3	2	1
Average	3	2	2		3					3			3	2	1
Round off	3	2	2		3					3			3	2	1

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20ZHS211	COMMUNICATION ENGLISH LABORATORY	L	T	P	C
	(Common to MECH & CSE)	0	0	2	1

OBJECTIVES:

- To develop their communicative competency in English with specific reference to their speaking and listening.
- To enhance their ability to communicate effectively in interviews, Group Discussion and Day to day life communication.
- To comprehend a different types of accent and use them in their communication

UNIT I	PRONUNCIATTION PRACTICE	6

Verbal Ability, Articulation of sounds- Intonation-Stress and Rhythm-Conversation practice-listening Various lectures

UNIT II	COMMUNICATION AT WORKPLACE	6

Creative writing. Writing job applications - cover letter- resume- e-mails- memos- reports.Writing abstracts- summaries- interpreting visual texts.

UNIT III	ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS	6

International English Language Testing System (IELTS)- Test of English as a Foreign Language (TOEFL)- Civil Service(Language related part) –English for competitive examinations

UNIT IV	INTERVIEW SKILLS	6

Different types of Interview format- answering questions- offering information- mock interviews- Body languages.

UNIT V	SOFT SKILLS	6

Motivation- emotional intelligence-Multiple intelligences- managing changes- time management- leadership straits- team work- career planning- creative and critical thinking

TOTAL HOURS	30 Hrs

OUTCOMES: At the end of the course, the students will be able to

6.	Face interviews, group discussions and other language parameters in the job market
7.	Write any competitive examinations which cover language part in it.
8.	Take part in any English conversations of any kind in English. Flawlessly without fear and shyness.
9.	Write articles for newspapers and magazines or any write-up in English without grammar mistakes.

10.	Come out with leadership qualities, team work and career planning and will also possess critical and creative thinking.
TEXT BOOKS:	
1.	Communication Skills for Engineers and Scientists, PHI Learning PVT.LTD, Delhi, 2014.
2.	Communication Skills and Soft Skills An Integrated Approach, Dorling Kindersley (INDIA) PVT.LTD, New Delhi, 2012.
3.	Soft Skills, MJP Publishers,Chennai, 2010.
REFERENCES:	
5.	*Craven, Miles. Listening Extra-A resource book of multi-level skills activities. Cambridge University Press, 2004.*
6.	*Seely, John. The Oxford guide to writing & Speaking. New Delhi: Oxford University Press,20*
7.	*Comfort, Jeremy, et al. Speaking Effectively: Developing speaking skills for Business English. Cambridge University Press, Cambridge: Reprint 2011.*
8.	*Dutt P. Kiranmai and RajeevanGeetha. Basic Communication Skills, Foundation Books:2013*

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1					**3**				**3**						**1**
CO2					**3**				**3**						**1**
CO3					**3**				**3**						**1**
CO4					**3**				**3**						**1**
CO5					**3**				**3**						**1**
Average					**3**				**3**						**1**
Round off					**3**				**3**						**1**
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20ZBS301	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

OBJECTIVES

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I	PARTIAL DIFFERENTIAL EQUATIONS	9+3

Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order partial differential equations - Lagrange's linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II	FOURIER SERIES	9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT III	APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	9+3

Classification of PDE – Method of separation of variables - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV	FOURIER TRANSFORMS	9+3

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V	Z - TRANSFORMS AND DIFFERENCE EQUATIONS	9+3

Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform

LECTURE: 45 TUTORIAL: 15 TOTAL : 60 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	The understanding of the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

TEXT BOOKS:	
1.	Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 3rd Edition, 2016
2.	Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi, 2017.
3.	Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" Vol. II & III, S.Viswanathan Publishers Pvt Ltd., 1998.

REFERENCES:	
1.	Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", Laxmi Publications Pvt Ltd, 9th Edition 2016.
2.	Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2018.
3.	Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2016
4.	Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.
5.	Ray Wylie C and Barrett .L.C, "Advanced Engineering Mathematics", 6th Edition, Tata McGraw Hill Education Pvt Ltd, New Delhi, 2012.

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1		1			1	1	2		2	3	2	
CO2	3	2	1		1			1	1	2		2	3	2	
CO3	3	2	1		1			1	1	2		2	3	2	
Average	3	2	1		1			1	1	2		2	3	2	
Round off	3	2	1		1			1	1	2		2	3	2	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MES302	ENGINEERING MECHANICS	L	T	P	C
		3	1	0	4

OBJECTIVES

- To make the students to apply static equilibrium of rigid bodies both in two dimensions and also in three dimensions.
- To comprehend the effect of friction on equilibrium.
- To understand the geometrical properties of surfaces and solids
- To understand various terms involved in Projectiles.
- To apply dynamic equilibrium of particles in solving basic problems.

UNIT I	INTRODUCTION TO MECHANICS AND FORCE CONCEPTS	9+3

Principles and Concepts – Laws of mechanics – system of forces – resultant of a force system – resolution and composition of forces –Lami's theorem – moment of a force – physical significance of moment –Varignon's theorem – resolution of a force into force and couple-– force in space – addition of concurrent force in space – equilibrium of a particle in space.

UNIT II	BASIC STRUCTURAL ANALYSIS ANDFRICTION	9+3

Beams and types of beams -Simple Trusses - Method of Joints - Method of Sections. Friction resistance – classification of friction – laws of friction – coefficient of friction – angle of friction - angle of repose – cone of friction –free body diagram – advantages – equilibrium of a body on a rough inclined plane – non- concurrent force system – ladder friction – rope friction – wedge friction-virtual work method.

UNIT III	GEOMETRICAL PROPERTIES OF SECTION	9+3

Centroids – determination by integration – moment of inertia – theorems of moment of inertia – product of inertia – principal moment of inertia of plane areas – radius of gyration- Mass moment inertia of simple solids.

UNIT IV	BASICS OF DYNAMICS - KINEMATICS	9+3

Kinematics and kinetics – displacements, velocity and acceleration – equations of motion – rectilinear motion of a particle with uniform velocity, uniform acceleration, varying acceleration – motion curves – motion under gravity –relative motion – curvilinear motion of particles – projectiles – angle of projection – range – time of flight and maximum height-kinematics of rigid bodies.

UNIT V	BASICS OF DYNAMICS - KINETICS	9+3

Newton's second law of motion – linear momentum – D'Alembert's principle, dynamics equilibrium – work energy equation of particles – law of conservation of energy – principle of work and energy. Principles of impulse and momentum – equations of momentum – laws of conservation of momentum. impact – time of compression, restitution, collision – co-efficient of restitution – types of impact – collision of elastic bodies by direct central impact and oblique impact – collision of small body with a massive body – kinetic energy of a particle-kinetics of rigid body rotation.

LECTURE: 45 TUTORIAL: 15 TOTAL : 60 PERIODS	
OUTCOMES:	On completion of this course, students will be able to
1.	Explain the different principles of mechanics and to solve engineering problems dealing with forces.
2.	Apply the concepts of friction to solve various problems dealing with friction
3.	Explain the different geometrical properties of various sections.
4.	Solve problems in rigid body dynamics (kinematic systems).
5.	Solve problems in rigid body dynamics (kinetic systems).
TEXT BOOKS:	
1.	Beer F.P and Johnston Jr. E.R., "**Vector Mechanics for Engineers (In SI Units): Statics and Dynamics"**, 11th Edition, Tata McGraw-Hill Publishing company, New Delhi (2015).
2.	Bhavikatti S. S. and Rajashekarappa, K.G., **"Engineering Mechanics**", New Age International (P) Limited Publishers, 2017.
3.	Natesan, S.C., "**Engineering Mechanics**", Umesh publications, New Delhi, 2002
REFERENCES:	
1.	*Hibbeller, R.C and Ashok Gupta, **"Engineering Mechanics:** Statics and Dynamics", 11th Edition, Pearson Education 2010.*
2.	*Irving H. Shames and Krishna MohanaRao. G**., "Engineering Mechanics – Statics and Dynamics"**, 4th Edition, Pearson Education 2006.*
3.	*Meriam J. L. and Kraige L. G., **"Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2"**, 4th Edition, John Wiley & Sons,1996.*
4.	*Rajasekaran S. and Sankarasubramanian G., **"Engineering Mechanics Statics and Dynamics",** 3rd Edition, Vikas Publishing House Pvt. Ltd., 2009.*
5.	*Kumar, K.L., **"Engineering Mechanics",** 3rd Revised Edition, Tata McGraw-Hill Publishing company, New Delhi 2008.*

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1		1			1	1	2		2	3	2	
CO2	3	2	1		1			1	1	2		2	3	2	
CO3	3	2	1		1			1	1	2		2	3	2	
CO4	3	2	1		1			1	1	2		2	3	2	
CO5	3	2	1		1			1	1	2		2	3	2	
Average	3	2	1		1			1	1	2		2	3	2	
Round off	3	2	1		1			1	1	2		2	3	2	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC303	MANUFACTURING TECHNOLOGY I	L	T	P	C
		3	0	0	3

OBJECTIVES

- To help students to acquire knowledge about different metal casting processes.
- To acquire knowledge on various joining processes like welding, brazing, soldering, etc.
- To enable them to understand various bulk deformation processes like forging, rolling, extrusion, etc.
- To understand various operations performed in sheet metals.
- To provide knowledge about various manufacturing techniques to fabricate plastic components.

UNIT I	METAL CASTING PROCESSES	9

Introduction to concepts of manufacturing process -sand casting – sand moulds -type of patterns – pattern materials – pattern allowances, simple numerical problems – types of moulding sand – properties – core making – methods of sand testing –riser and gating design, simple numerical problems– moulding machines – types of moulding machines - melting furnaces- principles of special casting processes: shell-investment-pressure die casting-centrifugal casting-co_2 process – sand casting defects

UNIT II	JOINING PROCESSES	9

Fusion welding processes – types of gas welding – equipments used – flame characteristics – filler and flux materials - arc welding equipments - electrodes –coating and specifications – principles of resistance welding – spot/butt, friction welding and friction stir welding – percussion welding – flux cored – submerged arc welding – electro slag and gas welding – TIG welding-MIG welding-brazing, soldering and adhesive bonding-weld defects.

UNIT III	BULK DEFORMATION PROCESSES	9

Hot working and cold working of metals – forging processes – open and close die forging – types of forging machines – typical forging operations – rolling of metals, simple numerical problems – flat strip rolling – types of rolling mills – tube piercing – principles of extrusion – types of extrusion – hot and cold extrusion – principle of rod and wire drawing.

UNIT IV	SHEET METAL PROCESSES	9

Sheet metal characteristics – shearing, bending and drawing operations – stretch forming operations– formability of sheet metal – test methods –special forming processes-working principle and applications – hydro forming – rubber pad forming – metal spinning– introduction of explosive forming, magnetic pulse forming, peen forming.

UNIT V	POWDER METALLURGY AND MANUFACTURE OF PLASTIC COMPONENTS	9

Introduction to powder metallurgy- Production of powders – mixing, blending, compacting, sintering and hot pressing - applications. Types and characteristics of plastics – moulding of thermoplastics and thermosets – working principles and typical applications – injection moulding – plunger and screw machines – compression moulding, transfer moulding –thermoforming.

TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Apply the principles of metal casting for engineering applications.
2.	Select suitable joining process for real time applications.
3.	Applying bulk deformation processes according to industrial needs.
4.	Explain and use appropriate metal forming operations in industries.
5.	Explore power metallurgy technique and concepts of plastic component manufacturing.

TEXT BOOKS:	
1.	Sharma P.C**., "A Text book of Production Technology"**, S. Chand and Co. Ltd., 2009.
2.	Kalpakjian S., **"Manufacturing Engineering and Technology"**, Pearson Education India 7thEdition, 2013.
3.	HajraChoudhary S.K and HajraChoudhury. AK., "**Elements of workshop Technology**",volume I and II, Media promoters and Publishers Private Ltd, Mumbai, 1997

REFERENCE:	
1.	*R.K. Rajput, "**A Text Book ofManufacturing Technology"**, Laxmi Publication Pvt Ltd 2nd Edition, 2017.*
2.	*Roy. A. Lindberg, "**Processes and Materials of Manufacture"**, PHI / Pearson Education, 4th Edition, 2008.*
3.	*Gowri P. Hariharan, A.SureshBabu, "**Manufacturing Technology I**", Pearson Education, 2008.*
4.	*M. Adithan and A.B.Gupta, "**Manufacturing Technology"**, New Age International Pvt Ltd, 2003.*
5.	*P. N. Rao, "**Manufacturing Technology Foundry, Forming and Welding"**, Tata McGraw Hill 3rd Edition, 2009.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	1	1		1	1		1	1	2		1	2	2	
CO2	3	1	1		1	1		1	1	2		1	2	2	
CO3	3	1	1		1	1		1	1	2		1	2	2	
CO4	3	1	1		1	1		1	1	2		1	2	2	
CO5	3	1	1		1	1		1	1	2		1	2	2	
Average	3	1	1		1	1		1	1	2		1	2	2	
Round off	3	1	1		1	1		1	1	2		1	2	2	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC304	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	1	0	4

OBJECTIVES

- To enable students to understand the basic principles of classical thermodynamics and prepare them to apply basic conversion principles of mass and energy to closed and open systems.
- To understand second law of thermodynamics and apply it to various systems.
- To make them aware of various gas laws and thermodynamic relations.
- To impart knowledge on properties of pure substances and to analyse various vapour power cycles.
- To explore various laws of gas mixtures.

UNIT I	CONCEPT OF THERMODYNAMICS	9+3

Basic definitions, microscopic and macroscopic approach, types of systems – thermodynamic processes – point and path functions – thermodynamic equilibrium – quasi-static process. Heat and work – zeroth law – first law of thermodynamics – applications to closed and open systems – steady flow processes – applications.

UNIT II	SECOND LAW OF THERMODYNAMICS AND ENTROPY	9+3

Second law of thermodynamics – Kelvin-Plank and Clausius statements-Carnot cycle – heat engines – refrigerators – heat pumps- efficiency and COP – entropy – principle of increase in entropy – availability- reversibility and irreversibility – applications.

UNIT III	IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS	9+3

Properties of ideal gas- ideal and real gas comparison- equations of state for ideal and real gases- reduced properties- compressibility factor– generalised compressibility chart and its use - Maxwell relations, Tds equations, difference and ratio of heat capacities, energy equation, Joule-Thomson coefficient, Clausius Clapeyron equation, phase change processes. Simple calculations.

UNIT IV	PROPERTIES OF STEAM AND VAPOUR POWER CYCLE	9+3

Properties of steam – use of steam tables and Mollier chart – dryness fraction calculations. Basic Rankine cycle – Rankine cycle with reheating and regeneration – application of binary vapour cycle.

UNIT V	GAS MIXTURES	9+3

Mole and mass fraction, Dalton's and Amagat's Law. Properties of gas mixture – molar mass, gas constant, density, and change in internal energy, enthalpy, entropy and Gibbs function.

LECTURE: 45 TUTORIAL: 15	TOTAL : 60 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Apply the first law of thermodynamics for simple open and closed systems under steady conditions.
2.	Apply second law of thermodynamics to open and closed systems and calculate entropy and availability.
3.	Explain the characteristics of gases and derive simple thermodynamic relations of ideal and real gases.
4.	Apply Rankine cycle to steam power plant and compare few cycle improvement methods.
5.	Explain the characteristics of gas mixtures and calculate the various properties of gas mixtures.

TEXT BOOKS:	
1.	Nag P.K., "**Engineering Thermodynamics**", 6th Ed., Tata McGraw - Hill, Delhi, 2017.
2.	Yunus Cengel, "**Thermodynamic**s" Tata McGraw - Hill Company, 8th Edition, 2014.
3.	Holman J.P., **"Thermodynamics**" Tata McGraw - Hill Company, 2000.

REFERENCES:	
1.	*Kothandaraman C.P., **"Thermal Engineering",** DhanpatRai& Sons, 2013.*
2.	*Arora C.P, "**Thermodynamics**", Tata McGraw-Hill, New Delhi, 2007.*
3.	*Rajput R.K. **"Thermal Engineering"** Laxmi Publications 8th Edition. 2010.*
4.	*Ballaney P.L., **"Thermal Engineering",** Khanna Publisher. 1996.*
5.	*Mahesh. M. Rathore, "**Thermal Engineering**", Tata McGraw - Hill Education Private Limited 1st edition, 2010.*

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2										3	2	
CO2	3	3	2										3	2	
CO3	3	3	2										3	2	
CO4	3	3	2										3	2	
CO5	3	3	2										3	2	
Average	3	3	2										3	2	
Round off	3	3	2										3	2	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPC305	FLUID MECHANICS AND FLUID MACHINERY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To enable students to understand the basic principles of fluid mechanics and basic fluid properties.
- To understand and analyse fluid kinematics and dynamic problems.
- To get knowledge on flow through pipes and to know the importance of dimensional analysis.
- To conduct the performance study and selection of pumps for different applications
- To analyse various types of hydraulic turbines.

UNIT I	FLUID PROPERTIES	9

Units and dimensions – fluid properties – density, specific gravity, viscosity, surface tension, capillarity, compressibility and bulk modulus – Pascal's Law – pressure measurements – manometers - Fluid statics - Total pressure and centre of pressure on submerged surfaces.

UNIT II	FLUID KINEMATICS AND DYNAMICS	9

Types of fluid flow and flow lines – control volume – continuity equation in one-dimension and three dimension – velocity potential and stream function -energy equation – Euler and Bernoulli's equations – applications of energy equations- flow meters.

UNIT III	FLOW THROUGH PIPES AND DIMENSIONAL ANALYSIS	9

Laminar flow through circular conduits and circular annuli-boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor- Moody diagram- commercial pipes- minor losses – flow through pipes in series and parallel- hydraulic and energy gradient – methods of dimensional analysis – dimensionless parameters- application of dimensionless parameters – model analysis.

UNIT IV	PUMPS	9

working principle - discharge, work done and efficiencies – gear, centrifugal and reciprocating pumps - work done and efficiencies - negative slip - flow separation conditions - air vessels - indicator diagram and its variation - savings in work done.

UNIT V	HYDRAULIC TURBINE	9

Classification – construction, working principles and design of Pelton wheel, Francis and Kaplan turbines - head, losses, work done and efficiency - specific speed - operating characteristics - governing of turbines.

TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Explain different fluid properties and apply mathematical knowledge to predict the properties and

	characteristics of a fluid at rest.
2.	Identify type of fluid flow patterns, describe continuity equation and other fundamental equations involved in fluid flow and analyze a variety of practical fluid flow and measuring devices.
3.	Explain boundary layer concepts, analyse and calculate major and minor losses associated with pipe flow in piping networks and perform dimensional analysis.
4.	Analyse the performance parameters of a given centrifugal and reciprocating pump and selection of pumps for different applications.
5.	Select and analyze an appropriate turbine with reference to given situation in power plants and to conduct the performance test on different types of turbines.

TEXT BOOKS:

1.	Rajput R. K., **"A text Book of Fluid Mechanics and Machinery"**, S. Chand and Company, New Delhi, 2015.
2.	RamamruthamS.**"Hydraulics, Fluid Mechanics and Fluid Machines"**, Dhanpat Rai Publishing House (P) Ltd, New Delhi, 2012.
3.	Modi P. N. and Seth S. M., **"Hydraulics and Fluid Mechanics including Hydraulic Machines"**, Standard book house, Delhi, 2004.

REFERENCES:

1.	*Streeter V.L. and Wylie E. B., "**Fluid Mechanics**", McGraw Hill Publishing Co. 2017.*
2.	*Kumar K. L., "**Engineering Fluid Mechanics**", Eurasia Publishing House(p) Ltd., New Delhi,2010..*
3.	*R.K Bansal "**A Textbook of Fluid Mechanics and Hydraulic Machines**",Laxmi Publications (p) Ltd.,2017*
4.	*Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "**Fluid Mechanics and Machinery"**, 2011.*
5.	*Graebel W.P, "**Engineering Fluid Mechanics**", Taylor & Francis, Indian Reprint, 2011.*

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2										3	2	
CO2	3	3	2										3	2	
CO3	3	3	2										3	2	
CO4	3	3	2										3	2	
CO5	3	3	2										3	2	
Average	3	3	2										3	2	
Round off	3	3	2										3	2	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MES306	BASIC ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the principles of different diodes.
- To study about the methods of biasing of BJTs, and the basic applications of operational amplifiers
- To introduce the methods of implementing Boolean expression using gates, and the concepts of transducers.

UNIT I	SEMICONDUCTOR DIODE	9

PN junction diode, Diode approximations and applications, half-wave rectifier, Two-diode Full wave rectifier, Bridge rectifier, Capacitor filter circuit, Zener diode-Voltage regulators, LASER diode, LDR, LED, LCD, Photo Transistor, Opto Coupler.

UNIT II	BIPOLAR JUNCTION TRANSISTORS	9

BJT operation, Common Base, Common Emitter and Common Collector Characteristics, DC Load line and Bias Point, Fixed Bias, Collector to base bias, Voltage divider Bias, Stability factor, BJT as switch and amplifier, MOSFET.

UNIT III	INTRODUCTION TO OPERATIONAL AMPLIFIERS	9

Ideal OPAMP, Inverting and non-inverting OPAMP circuits, OPAMP applications: Voltage follower, addition, subtraction, Integration, differentiation, Comparators, Schmitt trigger, Precision rectifier, Peak detector, Clipper and Clamper.

UNIT IV	DIGITAL ELECTRONICS	9

Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NOR. Algebraic simplification, NOR implementations, NAND implementations. Half Adder, Full adder.

UNIT V	TRANSDUCERS	9

Introduction, Passive Electrical Transducers, Resistive Transducers, Resistance thermometers, Thermistor. Linear Variable Differential Transformer (LVDT).Active Electrical transducers, Piezoelectric Transducer, Photoelectric Transducer.

TOTAL : 45 PERIODS

COURSE OUTCOMES:	Upon Completion of the course the students will

1.	Apply the concept of diode in rectifiers, filter circuits.
2.	Explain the concept of BJT in amplifiers.
3.	Design simple electronic circuits using OPAMPS.
4.	Design and implement simple logic function using basic universal gates.
5.	Explain the basic principles of different types of transducers.

TEXT BOOKS:

1.	David A.Bell, "Electronic Devices and Circuits", Oxford University Press,5th Edition,2008.
2.	R.S.Sedha, "A Textbook of Electronic Devices and Circuits", 2nd Edition, S. Chand Publishing, 2008.

REFERENCES:

1.	*Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", 9th Edition, Pearson Education, 2007.*
2.	*D.P.Kothari, I.J. Nagrath, "Basic Electronics", McGraw Hill Education (India) Private Limited,2014.*
3.	*D.Schilling and C.Belove, " Electonic Circuits", 3rd Edition,McGraw Hill,1989.*
4.	*Anwar A. Khan and Kanchan K. Dey, "A First Course on Electronics", PHI, 2006.*
5.	*Singh, B. P, and Rekha Singh, "Electronic Devices and Integrated Circuits", Pearson Education, 2006.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**2**	**2**								**3**	**3**		**1**
CO2	**3**	**1**		**1**								**2**	**2**		**1**
CO3	**3**	**2**	**3**	**2**								**2**	**2**		**2**
CO4	**3**	**2**	**3**	**2**								**2**	**2**		**2**
CO5	**3**	**1**		**1**								**2**	**2**		**1**
Average	**3**	**1.6**	**1.6**	**1.6**								**2.2**	**2.2**		**1.4**
Round off	**3**	**2**	**2**	**2**								**2**	**2**		**1**

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC308	FLUID MECHANICS AND FLUID MACHINERY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES

- To help the students in finding the various flow properties of fluids.
- To estimate the flow measurements using flow measuring equipment's.
- To conduct performance tests on pumps and turbines and draw the performance curves.

LIST OF EXPERIMENTS:

1. Determination of Darcy's friction factor.
2. Determination of the Coefficient of discharge of given Orifice meter.
3. Determination of the Coefficient of discharge of given Venturi meter.
4. Calculation of the rate of flow using Rota meter.
5. Performance study on Gear oil Pump.
6. Conducting experiments and drawing the characteristic curves of centrifugal pump/ submersible pump.
7. Conducting experiments and drawing the characteristic curves of reciprocating 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:45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Conduct tests on various fluid flow devices which are used for calculating flow properties like friction factor, coefficient of discharge and flow rate.
2.	Conduct performance tests on gear oil, centrifugal and reciprocating pumps draw the performance curves.
3.	Conduct performance tests on Pelton, Francis and Kaplan turbines and draw the performance curves.

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2						3				3	3	1
CO2	3	2	2						3				3	3	1
CO3	3	2	2						3				3	3	1
Average	3	2	2						3				3	3	1
Round off	3	2	2						3				3	3	1

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC309	MACHINE DRAWING	L	T	P	C
		0	0	4	2

OBJECTIVES

•	To help the students to get knowledge on Limits, Fits, Tolerances, Geometric Dimensioning and Tolerancing.
•	To develop sectional views of fasteners, joints and couplings and various machine elements
•	To draw assembly of machine parts using Computer Aided Drawing software's.

LIST OF EXERCISES:

1. Introduction to "Limits, Fits, Tolerances, Geometric Dimensioning and Tolerancing" and corresponding symbols.
2. Preparation of drawing for keys, keyways and cotter joints.
3. Preparation of drawing for knuckle joints and threaded fasteners.
4. Preparation of drawing foot step ball bearing, foot step journal bearing.
5. Preparation of assembly drawing for screw jack.
6. Preparation of drawing of stop valve –safety valve.
7. Preparation of drawing of tailstock – tool head of shaper – machine vice –connecting rod.
8. Preparation of drawing for flange and universal coupling (using any CAD software).
9. Preparation of part and assembly drawing for Plummer block (using any CAD software).

TOTAL:60 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Explain limits, fits, tolerances, geometric dimensioning and tolerancing for machine parts and assembly, identify the symbols associated and follow the drawing standards.
2.	Draw assembly drawings of machine parts like cotter joint, knuckle joint, footstep bearing, screw jack, safety vale and tails stock.
3.	Draw assembly drawings of machine parts using Computer Aided Drawing software's.

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2		2		2	2			2	2	2		3	2	1
CO2	2		2		2	2			2	2	2		3	2	1
CO3	2		2		2	2			2	2	2		3	2	1
Average	2		2		2	2			2	2	2		2	2	1
Round off	2		2		2	2			2	2	2		2	2	1

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC401	THERMALENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To apply the thermodynamic concepts into various thermodynamic cycles.
- To understand the principles and working of IC engines.
- To apply the thermodynamic concepts into steam nozzles and turbines.
- To apply the thermodynamic concepts into air compressors
- To analyse refrigeration and air-conditioning systems. Learn to use Steam Table, Mollier Chart, Compressibility Chart and Psychrometric Chart.

UNIT I THERMODYNAMIC CYCLES **9**

Air standard cycles – Otto, Diesel, Dual and Brayton cycles – air standard efficiency – mean effective pressure – P-V and T-S diagrams-comparison of cycles.

UNIT II I.C. ENGINES **9**

I.C engine - 2 stroke and 4 stroke engines – valve and port timing diagrams. Fuel ignition, cooling and lubrication system for spark ignition and compression ignition engines -Cetane and Octane rating of fuels – combustion, knocking and detonation, scavenging and supercharging – performance characteristics of I.C. engines.

UNIT III STEAM NOZZLES AND TURBINES **9**

Flow through nozzles, shape of nozzle, effect of friction, critical pressure ratio and supersaturated flow. Impulse and reaction turbines – compounding, velocity diagrams for single stage turbines.

UNIT IV AIR COMPRESSOR **9**

Reciprocating compressors – effect of clearance – multi stage – optimum intermediate pressure and perfect inter-cooling – rotary, centrifugal and axial flow compressors.

UNIT V REFRIGERATION AND AIR CONDITIONING **9**

Air refrigeration cycles, simple vapour compression refrigeration cycle – sub cooling and super heating. Vapour absorption system. Principles of air conditioning – types of air conditioning system - Psychometric properties, psychometric charts, Property calculations of air vapour mixtures by using chart and expressions– Psychometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Apply thermodynamic concepts to different air standard cycles, analyze and compare, solve problems
2.	Outline 2 stroke and 4 stroke engines, valve and port timing diagrams. Explain performance characteristics of I.C. engines
3.	Assess the functioning of steam nozzle and the effect of friction- problem solving. Assess the functioning of steam turbines and compounding.
4.	Compare single and multistage reciprocating air compressor and explain the effect of clearance volume and solve problems. Explain the working principle of rotary, centrifugal and axial

	flow compressors.
5.	Explain the working principles of vapour compression and absorption refrigeration and air conditioning system, calculate the properties of moist air and its use in psychometric processes.

TEXT BOOKS:	
1.	Rajput R.K. **"Thermal Engineering"** Laxmi Publications (P) Ltd., 2017.
2.	DomkundwarandKothandaraman C.P.**"Thermal Engineering"** Khanna Publishers, New Delhi, 2010.
3.	Mahesh M Rathore, **"Thermal Engineering"**TataMcGraw Hill, New Delhi,2010.

REFERENCES:	
1.	*Rudramoorthy R. **"Thermal Engineering"**Tata McGraw-Hill, New Delhi,2017.*
2.	*Sarkar B. K.**"Thermal Engineering"** Tata McGraw-Hill, New Delhi, 2017.*
3.	*Ganesa,V.**"Internal Combustion Engines"** Tata McGraw-Hill, New Delhi, 2017.*
4.	*Ramalingam K.K. **"Thermal Engineering"** SCITECH Publications (India) Pvt. Ltd., 2009.*
5.	*Arora C.P. **"Refrigeration and Air Conditioning"**Tata McGraw-Hill Publishers, 2017.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**									**2**	**3**	**2**	
CO2	**3**	**3**	**2**									**2**	**3**	**2**	
CO3	**3**	**3**	**2**									**2**	**2**	**2**	
CO4	**3**	**3**	**2**									**2**	**2**	**2**	
CO5	**3**	**3**	**2**									**2**	**3**	**2**	
Average	**3**	**3**	**2**									**2**	**3**	**2**	
Round off	**3**	**3**	**2**									**2**	**3**	**2**	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MHS402	HUMAN VALUES AND PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- *To understand the capacity of making value judgments in real life situations and to overcome the crisis of values encountered in everyday life.*

UNIT I	HUMAN VALUES	9

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality

UNIT II	ENGINEERING ETHICS	9

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.

UNIT III	ENGINEERING AS SOCIAL EXPERIMENTATION	9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study

UNIT IV	SAFETY, RESPONSIBILITIES AND RIGHTS	9

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies. 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 - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE), India.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1. *Develop an ethical behavior under all situations*
2. *Estimate the impact of self and organization's actions on the stakeholders and society.*
3. *Discuss the ethical issues related to engineering*
4. *Realize the responsibilities and rights in the society*
5. *Apply ethics in society*

TEXT BOOKS:

1. *Mike Martin and Roland Schinzinger, **"Ethics in Engineering"**, McGraw-Hill, New York 1996.*
2. *Govindarajan M, Natarajan S, Senthil Kumar V. S, **"Engineering Ethics"**, Prentice Hall of India, New Delhi, 2004.*

3.	*Tripathi A N, **"Human values"** , New Age international Pvt. Ltd., New Delhi, 2002*

REFERENCES:

1.	*Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004 4.*
2.	*2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Learning, United States, 2000 .*
3.	*3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.*
4.	*Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**2**												**1**		
CO2	**2**												**1**		
CO3	**2**												**1**		
CO4	**2**												**1**		
CO5	**2**												**1**		
Average	**2**												**1**		
Round off	**2**												**1**		

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC403	STRENGTH OF MATERIALS	L	T	P	C
		3	1	0	4

OBJECTIVES

- To Summarize the concepts of stress and strain due to gradual load, suddenly applied load and impact load
- To draw shear force and bending moment diagrams for different types of beams under different types of loads.
- To apply theory of bending and to evaluate principle stresses for complex stress condition
- To evaluate slope and deflection for different types of beams and to apply Rankine formula for columns.
- To evaluate stresses and strain energy induced in the shafts & helical springs due to torsion.

UNIT I	STRESS AND STRAIN	9+3

Stress and strain at a point-tension, compression, shear stresses - Hooke's law - compound bars – lateral strain - Poisson's ratio -volumetric strain - bulk modulus - relationship among elastic constants – stress strain diagrams for mild steel, cast iron-ultimate stress - yield stress-factor of safety - thermal stresses - thin cylinders - strain energy due to axial force - resilience- stress due to gradual load, suddenly applied load and impact load.

UNIT II	SHEAR FORCE AND BENDING MOMENT	9+3

Beams – types of beams - types of loads, supports - shear force – bending moment – shear forces and bending moment diagrams for cantilever, simply supported and over hanging beams with concentrated , uniformly distributed and uniformly varying load-relationship between rate of loading, shear force, bending moment- point of contra flexure.

UNIT III	THEORY OF BENDING AND COMPLEX STRESSES	9+3

Theory of bending-bending equation-section modulus-stress distribution at a cross section due to bending moment and shear force for cantilever, simply supported beams with point, UDL loads (rectangular, circular, I & T sections only) -combined direct and bending stresses, kernel of section (rectangular, circular sections only). 2D state of stress – 2D normal and shear stresses on any plane-principal stresses and principal planes-principal strains and direction-Mohr's circle of stress.

UNIT IV	DEFLECTION OF BEAMS AND THEORY OF LONG COLUMNS	9+3

Determinations of deflection curve – relation between slope, deflection and radius of curvature – slope and deflection of beam at any section by double integration, Moment Area and Macaulay's method - concept of conjugate beam method (theory only)- Euler's theory of long columns-expression of crippling load for various end conditions-effective length-slenderness ratio-limitations of Euler equation - Rankine formula for columns.

UNIT V	THEORY OF TORSION	9+3

Torsion of shafts - torsion equation - polar modulus- stresses in solid and hollow circular shafts - torsional rigidity - power transmitted by the shaft – importance of angle of twist - strain energy due to torsion - modulus of rupture –torsional resilience – combined bending and torsion- stresses in helical springs - deflection of helical spring.

LECTURE: 45 TUTORIAL : 15 TOTAL : 60 PERIODS	
OUTCOMES:	On completion of this course, students will be able to
1.	Analyze Hooke's law stress strain diagrams and elastic constants for different materials.
2.	Draw shear force and bending moment diagrams for different beams under different loading conditions and analyze relationship between rate of loading, shear force and bending moment.
3.	Determine complex stresses in beams under different loading conditions analyze the stress distribution at different cross sections due to bending moment and shear force.
4.	Evaluate the slope and deflection for different types of beams and apply Rankine's theory for columns.
5.	Apply the concepts of torsion and evaluate stresses and strain energy induced in the shafts & helical springs due to torsion
TEXT BOOKS:	
1.	Bansal R.K., "**Strength of Materials**", Laxmi Publications (P) Ltd., 2018
2.	Ramamrutham S and Narayan R, **"Strength of Materials"**, Dhanpat Rai and Sons, New Delhi, 2000.
REFERENCES:	
1.	*Hibbeler R.C., "**Mechanics of Materials**", Pearson Education, Low Price Edition, 2007*
2.	*Jindal U C, **"Textbook on Strength of Materials"**, Asian Books Pvt. Ltd., Learning India, 2013.*
3.	*EgorP.Popov "**Engineering Mechanics of Solids**" Prentice Hall of India, New Delhi, 2001*
4.	*Subramanian R., "**Strength of Materials**", Oxford University Press, Oxford Higher Education Series,*
5.	*Sadhu Singh, **"Strength of Materials"**,Khanna Publishers, New Delhi, 2016*

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	1										3		1
CO2	3	2	2										3		1
CO3	3		3		2								3	3	1
CO4	3		3		1								3	3	1
CO5	3		2		2								3	3	1
Average	3	1	2.2		1								3	1.8	1
Round off	3	1	2		1								3	2	1

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC404	ENGINEERING MATERIALS AND METALLURGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To identify and select suitable materials for various engineering applications and summarize phase evaluations and Interpret the different phase diagrams
- To summarize various heat treatments and surface treatment processes and Interpret the transformation diagrams
- To classify ferrous and non-ferrous metals and provide outline of material specification and standards.
- To classify nonmetallic materials, composites and smart materials.
- To categorize mechanical properties for engineering applications and summarize welding metallurgy.

UNIT I	CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS	9

Constitution of alloys – solid solutions, substitutional and interstitial -crystal physics – phase diagrams, isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, iron – iron carbide equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application

UNIT II	HEAT TREATMENT AND SURFACE TREATMENT	9

Definition – full annealing, process annealing, stress relief, recrystallisation - spheroidizing – normalising, hardening and tempering of steels – austempering, martempering - isothermal transformation diagrams – cooling curves superimposed on I.T diagram- TTT, CCR - hardenability, Jominy end quench test - case hardening, carburising, nitriding, cyaniding, carbonitriding–flame and induction hardening.

UNIT III	FERROUS AND NON-FERROUS METALS	9

Plain carbon steels – alloy steels - effect of alloying elements (Mn, Si, Cr, Mo, V , Ni, Ti& W) on properties of steel - stainless and tool steels – gray, white, malleable, spheroidal graphite - alloy cast irons – heat resistant steels and die steels. Copper, aluminium, magnesium, titanium - important alloys - their composition, properties and applications - material specification and standards.

UNIT IV	NON-METALLIC MATERIALS & SMART MATERIALS	9

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes)- Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON.

Composites-Classifications- Metal Matrix and FRP - Applications of Composites. Introduction to smart materials – classifications - smart sensors and actuators – applications

UNIT V	MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS AND WELDING METALLURGY	9

Introduction to Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), hardness tests, Impact test - IZOD and CHARPY, fatigue and creep failure mechanisms.

Weldability – heat distribution during welding and thermal effects on parent metals – HAZ – factors affecting HAZ	
	TOTAL : 45 PERIODS
OUTCOMES:	On completion of this course, students will be able to
1.	Explain alloys and phase diagram, Iron-Iron carbon diagram and steel classification
2.	Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes
3.	Explain the properties of ferrous and nonferrous materials and their application. Clarify the effect of alloying elements on ferrous and non-ferrous metals
4.	Summarize the properties and applications of non metallic materials, composites and smart materials.
5.	Explain the testing of mechanical properties and Summarize the welding metallurgy.
TEXT BOOKS:	
1.	V. Raghavan **"Materials Science And Engineering"**, Fifth Edition, PHI learning 2011.
2.	Sydney H.Avner, **"Introduction to Physical Metallurgy",** Tata McGraw Hill Book Company, 1994.
3.	Inderjit Chopra, **"Smart Structures Theory**" Cambridge University press 2014.
REFERENCES:	
1.	*O.P.Khanna ,**"Material Science And Metallurgy",** DhanpatRai Publication ,2011*
2.	*William D Callister **"Material Science and Engineering",** Wiley India pvt Ltd 2007.*
3.	*Kenneth G.Budinski and Michael K.Budinski "**Engineering Materials**" Prentice-Hall of India Private Limited, 4th Indian Reprint, 2002.*
4.	*Lakhtin Yu., "**Engineering Physical Metallurgy and Heat Treatment**", Mir Publisher,1985.*
5.	*Higgins R.A.,**"Engineering Metallurgy",** 5th edition, EIbs,1983.*
6.	*Sindo Kou **"Welding Metallurgy",** Wiley India pvt Ltd 2003.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**		**3**									**3**	**2**	
CO2	**3**	**2**	**2**	**3**	**2**						**2**		**3**	**2**	
CO3	**3**	**2**		**2**									**3**	**2**	
CO4	**3**	**3**	**3**	**3**	**2**								**3**	**2**	
CO5	**3**	**2**		**1**	**2**						**2**		**3**	**2**	
Average	**3.0**	**2.2**	**5.0**	**2.4**	**1.2**						**0.8**		**3.0**	**2.0**	
Round off	**3**	**2**	**1**	**2**	**1**						**1**		**3**	**2**	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC405	KINEMATICS OF MACHINES	L	T	P	C
		3	1	0	4

OBJECTIVES

- To make the students to understand the basics of mechanisms.
- To draw the velocity and acceleration diagram for simple mechanisms.
- To construct cam profile for given follower motion.
- To understand basics of gear and to develop gear trains for required application.
- To get knowledge to select appropriate type of friction drives for a specific application.

UNIT I	BASICS OF MECHANISMS	9+3

Classification of mechanisms – basic kinematic concepts and definitions – degree of freedom, mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – kinematic inversions of four barchain and slider crank chains – limit positions – mechanical advantage – transmission angle – description of some common mechanisms – quick return mechanisms- solving of simple problems.

UNIT II	KINEMATIC ANALYSIS	9+3

Displacement, velocity and acceleration analysis on simple mechanisms – graphical and analytical techniques- instantaneous center of velocity – Coriolis component – Klein's construction for slider crank chain.

UNIT III	KINEMATICS OF CAM MECHANISMS	9+3

Classification of cams and followers – terminology and definitions – displacement diagrams uniform velocity, parabolic, simple harmonic and cycloidal motions – derivatives of follower motions – layout of plate cam profiles – specified contour cams – circular arc and tangent cams – pressure angle and undercutting – sizing of cams.

UNIT IV	GEARS AND GEAR TRAINS	9+3

Law of toothed gearing – involutes and cycloidal tooth profiles –spur gear terminology and definitions–gear tooth action – contact ratio – interference and undercut. Helical, bevel, worm. Gear trains – Speed ratio, train value – parallel axis gear trains – epicyclic gear Trains.

UNIT V	FRICTION DRIVES	9+3

Belt and rope drive – open and cross belt drive – belt materials – creep and slip - ratio of tensions – effect of centrifugal force – condition for maximum power – friction in journal bearing - flat pivot bearing - friction clutches – single plate – multi plate – cone clutches-brakes - shoe brake and internal expanding brake only.

LECTURE: 45 TUTORIAL : 15 TOTAL : 60 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Explain various terminologies of kinematic mechanism, calculate mobility of given mechanism and designing a simple mechanism for practical applications.
2.	Analyze position, velocity and acceleration kinematics of mechanisms and drawing velocity and acceleration diagrams for different mechanisms.
3.	Draw displacement diagram and cam profile diagram for different type of configuration and motions of a follower and construct cam profile for given follower motion.
4.	Select a gear depending on a need and develop gear trains for required application.

5.	Examine friction in machine elements, Select the appropriate type of friction drives for a specific application.

TEXT BOOKS:	
1.	Rattan S. S, **"Theory of Machines"**, Tata McGraw -Hill Publishers, New Delhi, 2014.
2.	Thomas Bevan, **"Theory of Machines"**, Pearson Education Limited, 2010
3.	John J Uicker, Gordan R Penncok& Joseph E Shigley,**"Theory of Machines and Mechanisms"**, Mcgraw Hill Inc,2010.

REFERENCES:	
1.	*V.P.Singh, "**Theory of Machines**", Dhanapatrai and Sons, 2017*
2.	*George H.Maritn, "**Kinematics and Dynamics of Machines",** Waveland PrInc, 2002.*
3.	*R L Norton, "**Kinematics and Dynamics of Machinery"**, McGraw-Hill, 2017.*
4.	*C. E. Wilson, P. Sadler, "**Kinematics and Dynamics of Machinery"**, 3rd ed. , Pearson, 2014.*
5.	*Khurmi, R.S., "**Theory of Machines**",14th Edition, S Chand Publications, 2005*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2	1									3	3	
CO2	3	3	2	1									3	3	
CO3	3	3	2	1									3	3	
CO4	3	3	2	1									3	3	
CO5	3	3	2	1									3	3	
Average	3.0	3.0	2.0	1.0									3.0	3.0	
Round off	3	3	2	1									3	3	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20ZMC406	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
	(ECE/EEE/CSE/MECH)	1	0	0	0

OBJECTIVES:

- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I	ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY (CO-a &b)	7

concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers- types of ecosystem (forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) - energy flow in the ecosystem – ecological succession processes –types – Introduction to biodiversity definition: genetic, species and ecosystem diversity – bio-geographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – 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, etc.

UNIT II	ENVIRONMENTAL POLLUTION (CO-a &c)	3

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 .

Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III	NATURAL RESOURCES (CO-a &d)	5

Forest resources: Use and over-exploitation, deforestation – Water resources: Use and overutilization of surface and ground water– Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems– Energy resources: renewable and non renewable energy sources, use of alternate energy sources.– Land resources- land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources.

Field study of local area to document environmental assets – river / forest / grassland / hill

TOTAL : 15 PERIODS

COURSE OUTCOMES

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.

1.	Ability to apply the knowledge of environmental science in identifying, to formulate and to

	solve the environmental problems.
2.	Public awareness of environmental function is at infant stage.
3.	Ignorance and incomplete knowledge has led to misconceptions.
4.	Development and improvement in std. of living has led to serious environmental disasters.
TEXT BOOKS:	
1.	*Gilbert M.Masters, „Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2004.*
2.	*Benny Joseph, „Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.*
REFERENCES:	
1	*Cunningham, W.P. Cooper, T.H. Gorhani,* ***„Environmental Encyclopedia"****, Jaico Publ., House, Mumbai, 2001.*
2	*Rajagopalan, R, „****Environmental Studies-From Crisis to Cure"****, Oxford University Press 2005.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1			1		1	3			1	2	1	2		2	1
CO2			1		1	3			1	2	1	2		2	1
CO3			1		1	3			1	2	1	2		2	1
CO4			1		1	3			1	2	1	2		2	1
Average			1		1	3			1	2	1	2		2	1
Round off			1		1	3			1	2	1	2		2	1

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC408	STRENGTH OF MATERIALS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES

- To demonstrate various destructive testing methods like Tension, compression, impact test, etc.
- To determine mechanical Properties of various materials like Mild Steel, Brass, Copper and Aluminium etc.
- To demonstrate the tension and compression test on springs.

LIST OF EXPERIMENTS

1. Tension Test on steel rods using Universal Testing Machine.
2. Bending Test on rolled steel Joist Beam.
3. Double shear test on mild steel rod.
4. Torsion Test on Mild steel rod
5. Tension and Compression Test on Springs
6. Deflection test on simply supported aluminium beam
7. Hardness tests on metals like Mild Steel, Brass, Copper and Aluminium
8. Bend Test on Steel rod
9. Compression Test
10. Impact test-Izod and Charpy

TOTAL : 45 PERIODS

OUTCOMES:

On completion of this course, students will be able to

1. Demonstrate various destructive testing methods like tension, compression, impact test, etc
2. Explore the deflection and bending behaviour of different types of beams.
3. Examine the Mechanical Properties of different materials and characterize materials based their test results.

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3		2	3				2	2	2	2	2	3	2	2
CO2	3		2	2				2	2	2	2	2	3	2	3
CO3	3		2	2				2	2	2	2	2	3	2	2
Average	3		2	2.3				2	2	2	2	2	3	2	2.3
Round off	3		2	2				2	2	2	2	2	3	2	2

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC409	THERMAL ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To study the value timing and port timing diagram of IC Engines
- To study the performance of IC engines (2/4 stroke, diesel/petrol with various loading methods)
- To study the performance of reciprocating air compressor (single and multi stage)
- To study the performance of steam generator and steam turbine
- To study the performance of refrigeration and air conditioning system

LIST OF EXPERIMENTS:

1. Valve timing and port timing diagrams of single cylinder diesel and petrol engines.
2. Determination of flash point and fire point of various fuels / lubricants.
3. Performance test on 4 stroke diesel engine with mechanical loading.
4. Performance test on 4 stroke diesel engine with electrical loading.
5. Performance test on 4 stroke diesel engine with hydraulic loading.
6. Heat balance test on 4 stroke diesel engine.
7. Retardation test to find frictional power of a diesel engine.
8. Morse test on multi cylinder petrol engine.
9. Performance and energy balance test on a steam generator.
10. Performance and energy balance test on steam turbine.
11. Performance test on single and twin stage reciprocating air compressor.
12. Determination of COP of a vapour compression refrigeration system.
13. Determination of COP of air –conditioning system.
14. Performance test in a vapour absorption refrigeration system.

TOTAL:45 PERIODS

OUTCOMES:

On completion of this course, students will be able to

1.	Conduct tests on two and four stroke engine and analyze port timing and valve timing diagram.
2.	Conduct tests on IC engines and evaluate the performance (2/4 stroke, diesel/petrol with various methods of loading)
3.	Conduct experiments and evaluate the performance of steam boiler, steam turbine, air compressors, refrigerator and air-conditioner.

MAPPING OF COs, POs and PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**									**2**	**3**	**2**	
CO2	**3**	**3**	**2**									**2**	**3**	**2**	
CO3	**3**	**3**	**2**									**2**	**3**	**2**	
Average	**3**	**3**	**2**									**2**	**3**	**2**	
Round off	**3**	**3**	**2**									**2**	**3**	**2**	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC501	DESIGN OF MACHINE ELEMENTS	L	T	P	C
(Use of PSG Design data book is permitted)		3	1	0	4

OBJECTIVES

- To make the students to apply the Design methodology for machine elements.
- To Design shafts and couplings for power transmission.
- To Design the threaded fasteners, bolted joints and welded joints for pressure vessels and structures.
- To Design the various types of springs like helical, leaf springs and Flywheels under constant loads and varying loads.
- To Design various types of bearings like Rolling contact and Sliding contact bearings.

UNIT I	INTRODUCTION TO MACHINE DESIGN	9+3

Introduction to the Design process – Factors influencing machine design – selection of materials based on mechanical properties - preferred numbers – Limits, Fits, tolerances - Principal stresses - Theories of failure – Factor of safety –stress concentration – Direct , Bending and Torsional loading – Design for variable loading.

UNIT II	DESIGN OF SHAFTS AND COUPLINGS	9+3

Design of solid and hollow shafts based on strength, rigidity - critical speed – Keys, keyways and splines - Rigid and flexible couplings.

UNIT III	DESIGN OF TEMPORARY AND PERMANENT JOINTS	9+3

Threaded fasteners - Bolted joints subjected to eccentric loading, Knuckle joints, Cotter joints – Design of welded joints, Riveted joints for structures.

UNIT IV	DESIGN OF ENERGY STORING ELEMENTS	9+3

Design of various types of springs, optimization of helical springs - rubber springs - Design of flywheels considering stresses in rims and arms, for engines and punching machines.

UNIT V	DESIGN OF BEARINGS	9+3

Sliding contact and rolling contact bearings - Design of hydrodynamic journal bearings, McKee's Equation. Sommerfield Number, Raimondi & Boyd graphs, - Selection of Rolling Contact bearings.

LECTURE: 45 TUTORIAL : 15 TOTAL : 60 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Apply the principles of design to solve problems dealing with static and variable loads.
2.	Design shafts and couplings for various industrial applications.
3.	Estimate the load carrying capacity of threads, welds and rivet joints.
4.	Select and Design Springs and flywheels for various applications.
5.	Apply the concept of selection and design rolling and sliding contact bearings.

TEXT BOOKS:	
1.	Bhandari V.B, **"Design of Machine Elements"**, Fourth Edition, Tata McGraw-Hill Book Co, 2017.
2.	Shigley J.E and Mischke C. R., **"Mechanical Engineering Design"**, Eleventh Edition, Tata McGraw-Hill , 2020.
3.	Robert C. Juvinall and Kurt M. Marshek, **"Fundamentals of Machine Design"**, 7th edition, Wiley, 2017
REFERENCES:	
1.	*Sundararajamoorthy T. V. Shanmugam.N., **"Machine Design"**, Anuradha Publications, Chennai, 2018*
2.	*Orthwein W., **"Machine Component Design"**, Jaico Publishing Co, 2003*
3.	*, Terry E. Shoup and Lee E. Hornberger, **"Design of Machine Elements"** 8th Edition, Printice Hall, 2003.*
4.	*Alfred Hall, Halowenko, A and Laughlin, H., **"Machine Design"**, Tata McGraw-Hill BookCo.(Schaum's Outline), 2010.*
5.	*Robert L. Norton, **"Machine design An integrated approach"**, Sixth edition , Pearson education, 2020.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**2**	**2**	**3**					1		1			**3**	**2**	
CO2	**2**	**2**	**3**					1		**1**			**3**	**2**	
CO3	**2**	**2**	**3**					1		**1**			**3**	**2**	
CO4	**2**	**2**	**3**					1		**1**			**3**	**2**	
CO5	**2**	**2**	**3**					1		1			**3**	**2**	
Average	**2**	**2**	**3**					1		**1**			**3**	**2**	
Round off	**2**	**2**	**3**					1		**1**			**3**	**2**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPC502	HEAT AND MASS TRANSFER	L	T	P	C
(use of approved HMT data book is permitted)		3	1	0	4

OBJECTIVES

•	To understand the mechanisms conduction heat transfer under steady and transient conditions, determine resistance and heat transfer rate. To understand the concepts of heat transfer through extended surfaces
•	To understand the concept of convective heat transfer under steady state conditions,
•	To understand the mechanism and laws of radiative heat transfer to determine the amount of radiation heat exchange between surfaces.
•	To analyse the phase change heat transfer and sizing of heat exchanger.
•	To evaluate the mass transfer through diffusion and convection mechanism.

UNIT I	CONDUCTION	9+3

General Differential equation of Heat Conduction– Cartesian and Polar Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction.

UNIT II	CONVECTION	9+3

Principles of convection – convection boundary layer – laminar and turbulent flow – empirical relations for external and internal forced convection flows – flat plate, cylinders, spheres – empirical relations for free convection flows – horizontal cylinders, horizontal plates, vertical planes, inclined surfaces and enclosed spaces.

UNIT III	RADIATION	9+3

Nature of thermal radiation – radiation intensity – relation to emission, irradiation and radiosity – black body radiation – loss of radiation – emissivity – surface emission – Kirchoff's law – gray surface – view factor – radiation exchange between black surfaces – radiation exchange between gray surfaces – electrical analogy – radiation shields.

UNIT IV	CONDENSATION, BOILING AND HEAT EXCHANGERS	9+3

Condensation and Boiling – Film wise and drop wise condensation – Film condensation on a vertical plate – Regimes of Boiling – Forced convection boiling- Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors –Heat transfer Analysis: LMTD method - NTU method.

UNIT V	MASS TRANSFER	9+3

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.

LECTURE: 45 TUTORIAL: 15 TOTAL : 60 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Determine the resistance and steady state conduction heat transfer rate in Cartesian and Polar Coordinates for different surface configurations and thermal analysis on extended surfaces
2.	Apply free and forced convective heat transfer correlations to internal and external flows

	through/over various surface configurations and solve problems.
3.	Explain basic laws for Radiation and apply these principles to radiative heat transfer between different types of surfaces with and without radiative shields to solve problems
4.	Explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems.
5.	Explain Fick's Law of Diffusion and apply diffusive and convective mass transfer equations and correlations to solve problems for different applications

TEXT BOOKS:	
1.	P. K. Nag, **"Heat Transfer"** Tata McGraw Hill Publishing Company Limited. 3rd edition 2011.
2.	C. P. Kothandaraman and S. Subramanyan, **"Heat and Mass Transfer Data Book",** 8th Edition, New Age International Publishers 2014.

REFERENCES:	
1.	*Yunus A. Cengel, **"Heat Transfer-A Practical Approach"** Tata McGraw Hill Publishing Company Limited. 3rd edition. 2007.*
2.	*Frank P. Incropera and David P. Dewitt, **"Fundamentals of Heat and Mass Transfer"**, 8th Edition, John Wiley & Sons 2016.*
3.	*Y. V. C. Rao, **"Heat Transfer"**, First Edition, Universities Press (India) Limited, 2001.*
4.	*Sarit K. Das, **"Process Heat Transfer"**, Narosa Publishing House, 2009.*
5.	*S. P. Venkateshan, **"First Course in Heat Transfer"**, 6th edition, Ane Books Publishers, 2004.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**										**3**	**3**	
CO2	**3**	**3**	**2**										**3**	**3**	
CO3	**3**	**3**	**2**										**3**	**3**	
CO4	**3**	**3**	**2**										**3**	**3**	
CO5	**3**	**3**	**2**										**3**	**3**	
Average	**3**	**3**	**2**										**3**	**3**	
Round off	**3**	**3**	**2**										**3**	**3**	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC503	MANUFACTURING TECHNOLOGY II	L	T	P	C
		3	0	0	3

OBJECTIVES

- To help students to acquire knowledge about the theory of metal cutting process.
- To acquire knowledge on Lathes, Shaping and planning machines.
- To enable them to understand the principles and operations of Drilling, Broaching and Grinding machines.
- To understand principle and working of Milling and Gear generation machines.
- To provide knowledge about various Modern manufacturing process.

UNIT I	THEORY OF METAL CUTTING	9

Mechanism of metal cutting – types – cutting force – chip formation – Merchant's circle diagram – calculations – tool geometry – machinability-thermal aspects – tool wear – tool life – cutting tool materials – cutting fluids – types.

UNIT II	AUTOMATS, SHAPING AND PLANING MACHINES	9

Lathe, Capstan and turret lathes – construction - indexing mechanism - operations - working principle of single and multi - spindle automats – shaping and planning machines – types – construction - mechanism – principle of operation – different shaping operations - work holding devices.

UNIT III	DRILLING, BROACHING AND GRINDING MACHINES	9

Drilling machines – specifications, types - feed mechanism, operations – drill tool nomenclature – broaching – specifications, types, tool nomenclature, broaching operations – grinding – types of grinding machines – grinding wheels, specifications – bonds – mounting and reconditioning of grinding wheels.

UNIT IV	MILLING AND GEAR GENERATING MACHINES	9

Milling – specifications – types - cutter nomenclature – types of cutters – milling processes – indexing – gear forming in milling – gear generation - gear shaping and gear hobbing – specifications - cutters–coated tools & inserts- cutting spur and helical gears - bevel gear generators – gear finishing methods.

UNIT V	NC,CNC AND RPT	9

Numerical Control (NC) machine tools – CNC types, constructional details, special features, machining centre, part programming fundamentals CNC – manual part programming– Introduction to RPT.

TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to

1.	Apply the theory of metal cutting in real life machining.
2.	Explore the operating mechanisms of lathe, shaping and planning machine.
3.	Compare the working principles of drilling, boring and grinding machines.
4.	Understand the principles, operation and working of milling and gear generating machine.
5.	Explain the concept of NC,CNC and RPT.
TEXT BOOKS:	
1.	HajraChoudhry S. K. and Bose S. K., **"Workshop Technology Vol II"**, Media Promoters and Publishers Pvt. Ltd., Bombay, 2004
2.	P.N. Rao, "**Manufacturing Technology Foundry, Forming and Welding"**, Tata McGraw - Hill 3rd Edition, 2009
REFERENCES:	
1.	*SeropeKalpakjian and Steven R. Schmid, "**Manufacturing Engineering and Technology**", 7th edition, Prentice Hall, 2013.*
2.	*Jain R. K. and Gupta S. C. , "**Production Technology**", Khanna Publishers, New Delhi, 1999.*
3.	*Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J.White, **"Machine Tool Practices"**, 8thEdition,Pearson, 2005.*
4.	*Roy. A. Lindberg, **"Process and Materials of Manufacture"**, Fourth Edition, PHI / Pearson Education 2006.*
5.	*Sharma P.C., **"A Text Book of Production Technology"**, S.Chand& Company Ltd., New Delhi, 10th revised* edition, *2010*

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**2**	**1**	**1**			1		1			**2**	**1**	**2**	**2**	**1**
CO2	**2**	**1**	**1**			1		1			**2**	**1**	**2**	**1**	**1**
CO3	**1**	**1**	**1**			1		1			**2**	**1**	**2**	**2**	**1**
CO4	**1**	**2**	**1**			1		1			**2**	**1**	**2**	**2**	**1**
CO5	**1**	**1**	**1**			1		1			**1**	**1**	**1**	**1**	
Average	**1.4**	**1.2**	**1**			1		1			**1.8**	**1**	**1.8**	**1.6**	**0.8**
Round off	**1**	**1**	**1**			1		1			**2**	**1**	**1**	**2**	**1**
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPC504	METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students to explain the basics of metrology.
- To explore different types of linear and angular measuring instruments.
- To explain the various form measurement techniques.
- To explain various power, flow and temperature measurements.
- To provide them the latest advances in metrology.

UNIT I	BASICS OF METROLOGY	9

Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment –their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control – Types of standards – Introduction to interferometry - Reliability and Calibration – Readability and Reliability.

UNIT II	LINEAR MEASUREMENTS	9

Linear Measuring instruments - Vernier instruments - micrometer, height gauge, dial indicators, Bore gauges, Slip gauges, Comparators -Mechanical, Electrical, Optical and Pneumatic, Optical Projector.

UNIT III	ANGULAR AND FORM MEASUREMENTS	9

Angle measuring instruments - Bevel protractor, Spirit level, Sine bar, Autocollimator, Angle dekkor - Applications. Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications – Limit gauges.

UNIT IV	MEASUREMENT OF POWER, FLOW AND TEMPERATURE	9

Force, torque, power - mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturi meter, Orifice meter, rota meter, pitot tube – Temperature: bimetallic strip, thermocouples, Electrical resistance thermometer – Pressure measurement.

UNIT V	ADVANCES IN METROLOGY	9

Tool maker's microscope - Computer controlled CMM - Universal measuring machine - Automatic and multidimensional inspection machine - Computer aided inspection -Machine vision measurement system -Laser interferometer – Introduction to Clean room.

TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Interpret the need, errors and types of measurement.
2.	Identify and compare various linear and angular measuring instruments.

3.	Identify and compare various form measurement techniques.
4.	Explain the principle of measuring power, flow and temperature.
5.	Explain the recent advances in metrology.
TEXT BOOKS:	
1.	Jain.R.K., **"Engineering Metrology"**, 21st edition, Khanna Publishers, Delhi, 2018.
2.	Gupta. I.C., **"Engineering Metrology"**, Dhanpatrai Publications, 2018
3.	Mikell Groover **"Automation, Production Systems, and Computer-integrated Manufacturing"** Pearson, edition four, 2016.
REFERENCES:	
1.	*Charles Reginald Shotbolt, **"Metrology for Engineers"**, 5th edition, Cengage Learning EMEA, 1990.*
2.	*Gayler G. N. and Shotbolt C. R., **"Metrology for Engineers",** ELBS 2000.*
3.	*Thomas G. Beckwith, Roy D, Marangoni, John H.Lienhard V., **"Mechanical Mesurements",** Addison WeleyPublishing Company, 2004.*
4.	*W. Whyte, "**Clean Room Technology, Fundamental of Design, Testing and Operation**" second edition, 2010.*
5.	*Herbert Freeman**, "Machine Vision for Inspection and Measurement**", Academic Press, INC, 1989.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**2**	**1**	**1**								**1**		**2**	**1**	
CO2	**2**	**1**	**1**								**1**		**2**	**1**	
CO3	**2**	**1**	**1**								**1**		**2**	**1**	
CO4	**2**	**1**	**1**								**1**		**2**	**1**	
CO5	**2**		**1**		**2**						**1**		**2**	**1**	
Average	**2**	**0.8**	**1**		**0.4**						**1**		**2**	**1**	
Round off	**2**	**1**	**1**		**0**						**1**		**2**	**1**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPC508	MANUFACTURING PROCESSES AND METROLOGY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To practice the various operations that can be performed in lathe, drilling, milling and shaping machines.
- To do Gear cutting using milling and hobbing machines and to perform operations in Grinding machines.
- To familiarize the students on the working of various measuring instruments and to perform measurements of parts to check the quality.

LISTOFEXPERIMENTS:

MANUFACTURING LABORATORY

1. Facing, plain, step and taper turning.
2. Knurling and chamfering and thread cutting (external).
3. Counter sinking ,drilling and boring
4. Contour milling using vertical milling machine.
5. Spur gear cutting in milling machine.
6. Gear generation in Hobbing machine.
7. Plain Surface grinding.

METROLOGY LABORATORY

1. Tool Maker's Microscope
2. Comparator
3. Sine Bar
4. Gear Tooth Vernier Caliper
5. Surface Finish Measuring Equipment
6. Vernier Height Gauge
7. Temperature, Force and torque Measurement
8. Machine Vision Measurement systems

TOTAL:45 PERIODS

OUTCOMES:

On completion of this course, students will be able to

1. Demonstrate and fabricate different types of components using the machine tools.
2. Set up machines like lathe shaper, grinding and milling machine for various applications.
3. Handle different measurement instrument and to perform measurements to check quality of parts.

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**2**	**1**	**2**	**1**				2	2		**1**	**1**	**2**	**2**	**1**
CO2	**2**	**1**	**2**	**1**				2	2		**1**	**1**	**2**	**2**	**1**
CO3	**2**	**1**	**2**	**1**				2	2		**1**	**1**	**2**	**2**	**1**
Average	**2**	**1**	**2**	**1**				2	2		**1**	**1**	**2**	**2**	**1**
Round off	**2**	**1**	**2**	**1**				2	2		**1**	**1**	**2**	**2**	**1**

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC509	HEAT AND MASS TRANSFER LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES

•	To study the heat transfer phenomena, predict the relevant coefficient using implementation
•	To study the performance of heat exchanger
•	To study the performance of HC refrigeration system, fluidized bed cooling tower and thermal collectors.

LIST OF EXPERIMENTS:

HEAT TRANSFER EXPERIMENTS:

1. Thermal conductivity measurement using guarded plate apparatus.
2. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
3. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
4. Determination of heat transfer coefficient under forced convection from a tube.
5. Determination of Thermal conductivity of composite wall.
6. Determination of Thermal conductivity of insulating powder.
7. Heat transfer from pin-fin apparatus (natural & forced convection modes).
8. Determination of Stefan – Boltzmann constant.
9. Determination of emissivity of a grey surface.
10. Effectiveness of Parallel/counter flow heat exchanger.

REFRIGERATION AND AIR CONDITIONING EXPERIMENTS:

1. Performance test in a HC Refrigeration System.
2. Performance test in a Fluidized Bed Cooling Tower
3. Devices for thermal collectors and storage

TOTAL: 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Conduct tests on heat conduction apparatus and evaluate thermal conductivity of materials
2.	Conduct tests on natural and forced convective heat transfer apparatus and evaluate convective heat transfer coefficient.
3.	Conduct tests on radiative heat transfer apparatus and evaluate Stefan Boltzmann constant and emissivity.
4.	Conduct tests to evaluate the performance of parallel/counter flow heat exchanger apparatus and thermal collectors
5.	Conduct tests to evaluate the performance of HC Refrigeration System and Fluidized Bed Cooling Tower

MAPPING OF COs, POs AND PSOs:															
	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2						3		2		2	2	1
CO2	2	2	2						3		2		2	2	1
CO3	2	2	2						3		2		2	2	1
CO4	2	2	2						3		2		2	2	1
CO5	2	2	2						3		2		2	2	1
Average	2	2	2						3		2		2	2	1
Round off	2	2	2						3		2		2	2	1
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPR510	**PROJECT I /** WINTER INTERNSHIP	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

OBJECTIVES	
•	To provide opportunity to explore a problem or issue of particular personal or professional interest.
•	To address the problem or issue through focused study and applied research under the direction of a faculty member.
•	To synthesize and apply the knowledge and skills acquired in his/her academic program to real-world issues and problems.
•	To improve ability to think critically and creatively, to solve practical problems,
•	To make reasoned and ethical decisions, and to communicate effectively.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews in that any one review will be conducted with external examiner.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

(or)

A Minimum of 2 weeks internship in reputed organization during summer vacation

TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1	Identify the real time Engineering problems in their day to day life.
2	Apply the knowledge and skills acquired in their courses to a specific problem or issue
3	Think critically and creatively to address and help solve these professional or social issues and to further development.
4	Refine research skills and demonstrate their proficiency in written and oral communication skills.
5	Take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.

MAPPING OF COs, POs AND PSOs:															
	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**	**3**	**1**	1	2	3	3	**2**	**3**	**2**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**1**	1	2	3	3	**2**	**3**	**2**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	2	2	3	3	**3**	**3**	**2**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**2**	2	2	3	3	**3**	**3**	**2**	**3**	**3**	**2**
CO5	**2**	**2**	**2**	**1**	**2**	2	3	3	3	**2**	**3**	**2**	**3**	**3**	**2**
Average	**2.8**	**2.8**	**2.6**	**2.6**	**1.6**	1.6	2.2	3	3	**2.4**	**3**	**2**	**3**	**3**	**2**
Round off	**3**	**3**	**3**	**3**	**2**	2	2	3	3	**2**	**3**	**2**	**3**	**3**	**2**
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPC601	DYNAMICS OF MACHINERY	L	T	P	C
		3	1	0	4

OBJECTIVES

- To explain the force-motion relationship in components subjected to external forces and analysis of standard mechanisms
- To determine the balancing mass of rotating and reciprocating systems.
- To explain the Vibration isolation and vibration measurement and analyses the effect of free and forced vibration.
- To understand the governor mechanism for speed control of machines.
- To provide insight on gyroscope effect

UNIT I	FORCE ANALYSIS	9+3

Dynamic force analysis – Inertia force and Inertia torque– D Alembert's principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels.

UNIT II	BALANCING	9+3

Static and dynamic balancing – balancing of rotating masses–Balancing of Reciprocating masses - Primary and secondary unbalanced forces-partial balancing of unbalanced primary force-partial balancing of Locomotives-Variation of tractive force, Swaying couple and Hammer blow.

UNIT III	FREE VIBRATION	9+3

Basic features of vibratory systems –degrees of freedom– free vibration – equations of motion – natural frequency – types of damping – damped vibration - critical speeds of simple shaft – Torsional systems: single, two rotor systems.

UNIT IV	FORCED VIBRATION	9+3

Response of one degree of freedom systems to periodic forcing – Harmonic disturbances – Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation vibration measurement.

UNIT V	MECHANISMS FOR CONTROL	9+3

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes – Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

Introduction to ADAMS – solving basic dynamics problems using ADAMS

LECTURE: 45 TUTORIAL : 15 TOTAL : 60 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Calculate static and dynamic forces of mechanisms
2.	Calculate the balancing masses and their locations of reciprocating and rotating masses.
3.	Compute the frequency of free vibration

4.	Compute the frequency of forced vibration and damping coefficient.
5.	Calculate the speed and lift of the governor and estimate the gyroscopic effect on automobiles, ships and airplanes.
TEXT BOOKS:	
1.	Rattan, S.S, **"Theory of Machines"**, 3rdEdition, Tata McGraw-Hill, 2009.
2.	Uicker, J.J., Pennock G.R and Shigley, J.E., **"Theory of Machines and Mechanisms"**, 3rdEdition, Oxford University Press, 2009.
3.	Thomas Bevan, **"Theory of Machines"**, 3rdEd., CBS Publishers and Distributors, 2005
REFERENCES:	
1.	*Ghosh. A and Mallick, A.K., **"Theory of Mechanisms and Machines"**, Affiliated East-West Pvt. Ltd., New Delhi, 1988.*
2.	*V.Ramamurthi, **"Mechanics of Machines"**, Narosa Publishing House, 2002*
3.	*Khurmi, R.S.,**"Theory of Machines"**, 14th Edition, S Chand Publications, 2005.*
4.	*Cleghorn. W. L, **"Mechanisms of Machines"**,2nd Edition, Oxford University Press, 2015*
5.	*Robert L. Norton, **"Kinematics and Dynamics of Machinery"**, 5th Edition, Tata McGraw-Hill, 2012.*

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2		1						1		3	2	
CO2	3	3	1		2						1		3	1	
CO3	3	3	2		1						1		3	3	
CO4	3	3	1		1						1		3	3	
CO5	3	3	2		3						1		3	3	1
Average	3.0	3.0	1.6		1.6						1.0		3.0	2.4	0.2
Round off	3	3	2		2						1		3	2	0

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC602	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	1	0	4

OBJECTIVES

- To make the students to understand the basics concepts of finite element analysis.
- To provide them in depth knowledge in approximate methods in structural mechanics problems.
- To understand one dimensional finite element analysis with various types of elements.
- To get exposed to plane problems in engineering analysis including two dimensional finite element analysis.
- To understand the usage of higher order element in finite element analysis.

UNIT I INTRODUCTION 9+3

Historical background-basic concept of FEM – discretization of 1D, 2D and 3D Domains, mesh refinement, convergence requirements - gradient and divergence theorems - boundary and initial value problems – simple case studies.

UNIT II CHARACTERISTIC MATRICES AND LOAD VECTORS 9+3

One dimensional governing equations - structural and heat transfer problems - variational method-variation calculus – weighted residual methods - Galerkin's method - Ritz method - generalized coordinate's approach - principle of minimization of potential energy - simple case studies.

UNIT III ONE DIMENSIONAL PROBLEMS 9+3

Derivation of shape functions, Stiffness matrices and force vectors - Assembly of Matrices - shape function characteristics - problems in axial load members, trusses, heat transfer through composite walls and fins - Gauss elimination and Cholesky'smethods of solving equations-simple case studies.

UNIT IV TWO DIMENSIONAL PROBLEMS 9+3

Derivation of shape functions for CST and LST triangular and rectangular elements, Stiffness matrices and force vectors-Pascal's triangle- concept of plane stress and plain strain and axi-symmetry. Structural and heat transfer application -introduction to coupled field analysis - simple case studies.

UNIT V HIGHER ORDER ELEMENTS 9+3

Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions – Jacobian transformation - Serendipity and Lagrangian elements – Numerical integration - Matrix solution technique - simple case studies.

LECTURE : 45 TUTORIAL : 15 TOTAL : 60 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Explain the basics of finite element formulation, outline the requirements for convergence and analyze the various types of problems which can be solved using finite element analysis.
2.	Explain the numerical methods involved in Finite Element analysis and apply Rayleigh-Ritz, weighted residual methods to solve engineering problems.
3.	Apply finite element formulations to solve one dimensional Problems, derive shape functions and

	analyze linear 1D problems like bars, trusses and heat transfer through composite walls and fins.
4.	Apply finite element formulations to solve two dimensional Problems and solve linear 2D structural and heat transfer problems.
5.	Apply finite element method to solve problems using iso parametric element.
TEXT BOOKS:	
1.	Tirupathi R. Chandrupatla and Ashok D. Belegundu**,"Introduction to Finite Element in Engineering"**, PearsonEducation ,2003
2.	Reddy. J.N., **"An Introduction to the Finite Element Method"**, 3rdEdition, Tata McGraw-Hill,2005
3.	Seshu, P, **"Text Book of Finite Element Analysis"**, Prentice-Hall of India Pvt. Ltd., New Delhi,2007.
REFERENCES:	
1.	*BhattiAsghar M, "**Fundamental Finite Element Analysis and Applications**", John Wiley &Sons,2005 (Indian Reprint 2013)*
2.	Larry J. Segerlind, **"Applied Finite element Analysis"**, 2nd Ed, John Wiley & Sons, 1987
3.	*David V.Hutton**"Fundamentals of finite element Analysis"** McGraw Hill Inc, Newyork, 2004.*
4.	*Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, **"Concepts and Applications of Finite Element Analysis"**, 4th Edition, Wiley Student Edition, 2002.*
5.	*Singiresu.S.Rao, **"The Finite Element Method in Engineering"**, ButterWorth Heinemann, 2001.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2	1									3	3	
CO2	3	3	2	1									3	3	
CO3	3	3	2	1									3	3	
CO4	3	3	2	1									3	3	
CO5	3	3	2	1									3	3	
Average	3.0	3.0	2.0	1.0									3.0	3.0	
Round off	3	3	2	1									3	3	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPC603	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To summarize the principle, methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies.
- To explain the characteristics of the different materials those are used in Additive Manufacturing.
- To summarize the Liquid based and Solid based additive manufacturing technologies.
- To summarize other additive manufacturing technologies like 3D printer, ballistic particle method, Shape deposition modelling, Reverse engineering.
- To explain with the post processing and tooling methods of additive manufacturing technologies.

UNIT I	INTRODUCTION	9

Overview – History – Need-Classification -Additive Manufacturing Technology in product development-Materials for Additive Manufacturing Technology – Tooling - Applications.

UNIT II	CAD & REVERSE ENGINEERING	9

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Software's for Additive Manufacturing Technology: MIMICS, MAGICS.

UNIT III	LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS	9

Classification – Liquid based system – Stereo-lithography Apparatus (SLA)- Principle, process, advantages and applications - Solid based system –Fused Deposition Modelling - Principle, Process, Advantages and Applications, Laminated Object Manufacturing.

UNIT IV	POWDER BASED ADDITIVE MANUFACTURING SYSTEMS	9

Selective Laser Sintering – Principles of SLS process - Process, advantages and applications, 3D Printing - Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting.

UNIT V	MEDICAL AND BIO-ADDITIVE MANUFACTURING	9

Customized implants and prosthesis: Design and production - Bio-Additive Manufacturing-Computer Aided Tissue Engineering (CATE) – Case studies.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1. Compare different additive manufacturing methods and explain the effects of the Additive Manufacturing technologies.

2.	Explain the applications of CAD in tool path generation.
3.	Compare liquid and solid based additive manufacturing systems and summarize advantages and applications
4.	Explain powder based additive manufacturing systems.
5.	Explain the medical and bio additive manufacturing systems.
TEXT BOOKS:	
1.	Chua C.K., Leong K.F., and Lim C.S**., "Rapid prototyping: Principles and applications"**, 3rd Edition, World Scientific Publishers, 2010.
2.	Gebhardt A., **"Rapid prototyping"**, Hanser Gardener Publications, 2003.
3.	Steinar Westhrin Kill **"Additive Manufacturing: Design, Methods, and Processes",** Pan Stanford Publishing Pte.Ltd.2017.
REFERENCES:	
1.	*Liou L.W. and Liou F.W., **"Rapid Prototyping and Engineering applications: A tool box forprototype development"**, CRC Press, 2007.*
2.	*Kamrani A.K. and Nasr E.A., **"Rapid Prototyping: Theory and practice",** Springer, 2006.*
3.	*Hilton P.D. and Jacobs P.F., **"Rapid Tooling: Technologies and Industrial Applications",** CRCpress, 2000.*
4.	*Ian Gibson, David Rosen, Brent Stuck**,"Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing",** Springer, 2015.*
5.	*AmitBandyopadhyay, Susmita Bose**, "Additive Manufacturing",** CRC Press, 2015**.**

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	2										3	2	
CO2	3	2	2										3	2	
CO3	3	2	2										3	2	
CO4	3	2	2										3	2	
CO5	3	2	2										3	2	
Average	3.0	2.0	2.0										3.0	2.0	
Round off	3	2	2										3	2	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPC608	SIMULATION LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES

- To make the students to analyse various structural problems using CAE software's.
- To analyse various thermal and heat transfer problems using CAE software's.
- To solve simple problems using Mat lab, CFD and Multi body dynamics software's.

LISTOFEXPERIMENTS:

A. SIMULATION

1. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables.
2. Use of Mat lab to solve simple problems in vibration.
3. Mechanism Simulation using Multi body Dynamic software.

B. ANALYSIS

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi – symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.
10. Buckling analysis of column.
11. Coupled thermal and structural analysis.
12. Simple CFD analysis problems.

TOTAL:45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Simulate simple engineering problems using MATLAB and perform mechanism simulation using Multi body Dynamic software.
2.	Analyze the stresses and strains induced in plates, brackets, trusses, cylindrical shells, beams and simulate heat transfer problems using software tools.
3.	Analyze the natural frequency and mode shapes of 2D components and beams and carry out simple flow problems using simulation and analysis software's.

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	3				2				3	3	
CO2	3	3	3	2	3				2				3	3	
CO3	3	3	3	2	3				2				3	3	
Average	3.0	3.0	3.0	2	3				2.0				3.0	3.0	
Round off	3	3	3	2	3				2				3	3	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC609	DYNAMICS OF MACHINERY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES

•	To explain and demonstrate the principles of kinematic mechanisms.
•	To perform experiments on governors and gyroscope systems and able to analyse its efficiencies.
•	To explain the principles of vibrating system and to determine the performance of a vibrating system.

LIST OF EXPERIMENTS

Part A

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 Fly wheel 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

Part B

1. Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.
2. Determination of torsional natural frequency of single and Double Rotor systems.
3. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
4. (a)Balancing of rotating masses. (b) Balancing of reciprocating masses.

Part C (Experiments in Vibration Measurement Kit)

1. Modal of Simply Supported Beam
2. Modal of Cantilever Beam
3. Natural Frequency and Modal of Disc
4. Damping Ratio of Simply Supported Beam (half-power bandwidth method & Attenuation method)
5. Nature Frequency of Simple Supported Beam (Method of Sine Wave Sweeping)
6. Nature Frequency of Cantilever Beam (Method of Sine Wave Sweep)
7. Active & Passive Vibration Isolation
8. Vibration with Single & Double Absorber
9. Vibration with Oil Damper
10. Natural Frequency and Mode Shape of Two & Multi degree of Freedom String

Part D

Modeling and Analysis of Basic Dynamic Systems using ADAMS tool (Min 2 Models)

	TOTAL: 45 PERIODS
OUTCOMES:	On completion of this course, students will be able to
1.	Demonstrate the principles of kinematics of machinery.
2.	Demonstrate the principles of dynamics of machinery.
3.	Measure dynamic parameters using Vibration measurement kit and create model of dynamic Systems

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	3		1		1				2		3	3	1
CO2	3	2	3		1		1				2		3	3	1
CO3	3	1	3	3	1		1				2		3	3	1
Average	3.0	1.7	3.0	1.0	1.0		1.0				2.0		3.0	3.0	1.0
Round off	3	2	3	1	1		1				2		3	3	1
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MHS610	SOFT SKILLS AND PERSONALITY DEVELOPMENT LABORATORY	L	T	P	C
	(BE - MECH)	0	0	3	1.5

OBJECTIVES

•	To help the students to improve the listening, speaking, reading and writing skills.
•	To make them prepare for national and international examinations and placements.
•	To help them to face the interviews and to improve soft skills.

UNIT I	LISTENING AND SPEAKING SKILLS	9

Conversational skills (formal and informal)-making effective presentations using computers, listening/watching debates, documentaries. Listening to lectures, discussions from TV/ Radio/ Podcast.

UNIT II	READING AND WRITING SKILLS	9

Reading different genres of tests ranging from newspapers to creative writing. Writing different types of Applications and complaints- Writing reviews – film appreciation- thesis writing –posture making- advertisement-magazine preparation

UNIT III	ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS	9

International English Language Testing System (IELTS) - Test of English as a Foreign Language (TOEFL) - Civil Service (Language related)- Verbal Ability.

UNIT IV	SOFTSKILLS	9

Motivation- emotional intelligence-Multiple intelligences- - career planning -creative and critical thinking.

UNIT V	EMPLOYABILITY AND CORPORATE SKILLS	9

Interview skills – Types of interview, preparation for interview, mock interview. Group Discussion leadership and co-ordination. Time management and effective planning- Stress management – causes and effect-stress relief techniques

TOTAL	45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1	Make presentations and participate in group discussions.
2	Take international examinations such as IELTS and TOEFL.
3	Successfully answer questions in interviews.
4	Create postures, advertisements and magazine making which are the parts of writing skills.
5	Write film – appreciation, book review and Thesis writing which are the part of analytical thinking and creative writing

MAPPING OF COs, POs AND PSOs:															
	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1					1		1	3	3						3
CO2					1		1	3	3						3
CO3					1		1	3	3						3
Average					1.0		1.0	3.0	3.0						3.0
Round off					1		1	3	3						3
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPC701	AUTOMATION IN MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the importance of automation in the of field machine tool based Manufacturing.
- To get the knowledge of various elements of hydraulic system and designing new hydraulic systems.
- To explore pneumatic systems and designing fluid power circuits
- To program programmable logic controllers.
- To design simple mechatronics systems.

UNIT I	INTRODUCTION TO AUTOMATION	8

Basic concepts of automated system -Elements of Automation - Advanced automated functions - Levels of automation - Current trends - Advantages and Limitations of Automation -CAD, CAM, CIM - Rigid automation: Part handling, Machine tools - Flexible automation: Computer control of Machine Tools and Machining Centers -Adaptive Control, Automated Material handling - Flexible fixturing - Low Cost Automation – Assembly Automation.

UNIT II	HYDRAULIC SYSTEMS	9

Industrial Hydraulics: Principles of hydraulics, Hydraulic fluids, Filtration technology, Hydraulic pumps, Hydraulic valves, and hydraulic actuators, Proportional valves. Hydraulic Systems: Design considerations for hydraulic circuit, Standards in circuit diagram representation, Power pack design layout, Basic hydraulic circuits such as regenerative circuits, sequencing circuit, meter in and meter out circuit, Design of reservoir based on heat transfer considerations, Design of accumulators and intensifiers, Selection of standard components for hydraulic circuits.

UNIT III	PNEUMATIC SYSTEMS AND DESIGN OF FLUID POWER CIRCUITS	10

Operational principles and application of pneumatic systems, air compressors, Pneumatic cylinders and air motors, Pneumatic valves, Design of pneumatic circuits, hydro-pneumatic, Control in pneumatic system. Design of Fluid Power Circuit: Design method consideration for sequential circuits - intuitive circuit design method - cascade method - sequential logic circuit design using KV method - compound circuit design -step counter design.

UNIT IV	PROGRAMMABLE LOGIC CONTROLLERS	9

PLC Hardware- Electrical Design and Construction - Logical Sensors - Presence detection- Continuous Sensor-continuous actuators- PLC operation - Latches, Timers, Counters, Internal relays, Shift Registers, Master and Jump Controls,Analog Inputs and Outputs – PLC- programming- Programming Methods - Programming the PLC using Ladder diagram - Design Cases.

UNIT V	MECHATRONICS SYSTEM DESIGN	9

Introduction and components of mechatronics, sensors, and actuators. Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Mechatronics in Engineering Design, Traditional and mechatronics design, Applications - Pick and Place robots, Car park barriers, Bar code reader, Wind screen wiper wing stepper motor control– Traffic Control interface - IOT applications – Industry

4.0.Case studies: Coin counters, Robot walking machine.	
	TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Get a comprehensive picture of computer based automation of manufacturing operations Explain the key elements of automation.
2.	Explain the various elements of hydraulic systems and designing new hydraulic power circuits
3.	Design fluid power circuits
4.	develop programs for PLC using ladder logic.
5.	Design the mechatronics systems for various applications.

TEXT BOOKS:	
1.	Mikell P. Groover, "**Automation, Production Systems, and Computer-integrated Manufacturing"**, Pearson Education, 5th Edition, 2018.
2.	Brian Morris, **"Automatic Manufacturing Systems Actuators, Controls and Sensors"**, McGraw Hill, New York, 1994.
3.	Hugh Jack,"**Automating Manufacturing Systems with PLCs"**, Free Software Foundation, 2005.

REFERENCES:	
1.	*W. Bolton, "**Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering"**, Pearson,2011.*
2.	*David W. Pessen, **"Industrial Automation Circuit Design and Components"**, John Wiley, New York, 1990.*
3.	*Rajput R. K., **"Robotics and Industrial Automation"**, S. Chand and Company, 2008.*
4.	*Rohner. P, **"Automation with Programmable Logic Controllers"**, Macmillan /McGraw Hill, New York, 1996.*
5.	*Mujumdar S.R., **"Oil Hydraulic Systems: Principles and Maintenance",.** Tata McGraw-Hill Education, 2002.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	1		2	1					1	2	3	2	
CO2	2	2	1		2	1					1	2	3	2	
CO3	2	2	1		2	1					1	2	3	2	
CO4	2	2	1		2	1					1	2	3	2	
CO5	2	2	1		2	1					1	2	3	2	
Average	2	2	1		2	1					1	2	3	2	
Round off	2	2	1		2	1					1	2	3	2	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPC702	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
(Use of PSG Design data book is permitted)		3	0	0	3

OBJECTIVES

- To make the students to design the flexible elements of a transmission system.
- To design clutch and brake system.
- To design spur and helical gears of transmission system.
- To design bevel and worm gears.
- To design gear box for different applications.

UNIT I	DESIGN OF FLEXIBLE ELEMENTS	9

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

UNIT II	FRICTION CLUTCHES AND BRAKES	9

Design of plate clutches – axial clutches-cone clutches - Band and Block brakes - external shoe brakes – Internal expanding shoe brakes.

UNIT III	SPUR AND HELICAL GEARS	9

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur &helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane- crossed helical gear terminology - estimating the size of the pair of crossed-helical gears.

UNIT IV	BEVEL AND WORM 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.

UNIT V	GEAR BOX	9

Geometric progression - standard step ratio - ray diagram, kinematic layout - design of sliding mesh and constant mesh gear box - introduction to planetary gear box.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Design various flexible elements of a machine.
2.	Apply the concept of clutch and brake in new design.
3.	Design spur and helical gears for various applications.
4.	Design Bevel and worm gears of a transmission system.
5.	Develop and design gear box for various applications.

TEXT BOOKS:	
1.	Bhandari V.B, **"Design of Machine Elements"**, Fourth Edition, Tata McGraw-Hill Book Co, 2017.
2.	Shigley J.E and Mischke C. R., **"Mechanical Engineering Design"**, Eleventh Edition, Tata McGraw-Hill , 2020.
3.	Md. Jalaludeen , "**Machine Design, Volume II, Design of Transmission Systems"**, 4th edition, Anuradha Publications, 2014.
REFERENCES:	
1.	*Sundararajamoorthy T. V. Shanmugam.N., **"Machine Design"**, Anuradha Publications, Chennai, 2018.*
2.	*Orthwein W, **"Machine Component Design"**, Jaico Publishing Co, 2003.*
3.	*Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, **"Design of Machine Elements"** 8th Edition, Printice Hall, 2003.*
4.	*Alfred Hall, Halowenko, A and Laughlin, H., **"Machine Design"**, Tata McGraw-Hill BookCo.(Schaum's Outline), 2010.*
5.	*Robert L. Norton, **"Machine design An integrated approach"**, Sixth edition , Pearson education, 2020.*

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	2									3	2	
CO2	3	3	3	2									3	2	
CO3	3	3	3	2									3	2	
CO4	3	3	3	2									3	2	
CO5	3	3	3	2									3	2	
Average	3	3	3	2									3	2	
Round off	3	3	3	2									3	2	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPC708	CAD/CAM AND MECHATRONICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To help the students to develop 2D and 3D models of machine elements using modelling software.
- To prepare CNC part programming and to perform manufacturing in CNC machines.
- To apply the fundamental principles of programmable controllers to the solution of practical problems.

LIST OF EXPERIMENTS

3D GEOMETRIC MODELING

1. Introduction of 3D Modelling software

Creation of 3D assembly model of following machine elements using 3D Modelling software

2. Plummer Block
3. Screw Jack
4. Universal Joint
5. Stuffing box
6. Connecting rod

MANUAL PART PROGRAMMING

(i) Part Programming - CNC Machining Centre

a) Linear Cutting.

b) Circular cutting.

c) Cutter Radius Compensation.

(ii) Part Programming - CNC Turning Centre

a) Straight, Taper and Radius Turning.

b) Thread Cutting.

c) Rough and Finish Turning Cycle.

MECHATRONICS

1. Stepper motor interface.
2. Speed control of DC motor.
3. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits.
4. PLC control of electro-pneumatic and electro-hydraulic systems.

TOTAL:60 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Develop 2D and 3D models using modelling software.
2.	Prepare CNC part programming and perform manufacturing in CNC machines.
3.	Apply the fundamental principles of programmable controllers to the solution of practical problems.

MAPPING OF COs, POs AND PSOs:															
	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2	3	1		2	2	1	1	1	2	2	1
CO2	3	2	2	2	2	1		2	2	1	1	1	2	2	1
CO3	3	2	2	2	2	1		2	2	1	1	1	2	2	1
Average	3	2	2	2	2.3	1		2	2	1	1	1	2	2	1
Round off	3	2	2	2	2	1		2	2	1	1	1	2	2	1
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPR709	PROJECT II	L	T	P	C
		0	0	6	3

OBJECTIVES

•	To provide opportunity to explore a problem or issue of particular personal or professional interest.
•	To address the problem or issue through focused study and applied research under the direction of a faculty member.
•	To synthesize and apply the knowledge and skills acquired in his/her academic program to real-world issues and problems.
•	To improve ability to think critically and creatively, to solve practical problems,
•	To make reasoned and ethical decisions, and to communicate effectively.

It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews in that any one review will be conducted with external examiner.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 90 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1	Identify the real time Engineering problems in their day to day life.
2	Apply the knowledge and skills acquired in their courses to a specific problem or issue
3	Think critically and creatively to address and help solve these professional or social issues and to further development.
4	Refine research skills and demonstrate their proficiency in written and oral communication skills.
5	Take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.

MAPPING OF COs, POs AND PSOs:															
	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	3	1	1	2	3	3	2	3	2	3	3	2
CO2	3	3	3	3	1	1	2	3	3	2	3	2	3	3	2
CO3	3	3	3	3	2	2	2	3	3	3	3	2	3	3	2
CO4	3	3	3	3	2	2	2	3	3	3	3	2	3	3	2
CO5	2	2	2	1	2	2	3	3	3	2	3	2	3	3	2
Average	2.8	2.8	2.6	2.6	1.6	1.6	2.2	3	3	2.4	3	2	3	3	2
Round off	3	3	3	3	2	2	2	3	3	2	3	2	3	3	2
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPR808	PROJECT III	L	T	P	C
		0	0	12	6

OBJECTIVES

•	To provide opportunity to explore a problem or issue of particular personal or professional interest.
•	To address the problem or issue through focused study and applied research under the direction of a faculty member.
•	To synthesize and apply the knowledge and skills acquired in his/her academic program to real-world issues and problems.
•	To improve ability to think critically and creatively, to solve practical problems,
•	To make reasoned and ethical decisions, and to communicate effectively.

It is intended t start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews in that any one review will be conducted with external examiner.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 180 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1	Identify the real time Engineering problems in their day to day life.
2	Apply the knowledge and skills acquired in their courses to a specific problem or issue
3	Think critically and creatively to address and help solve these professional or social issues and to further development.
4	Refine research skills and demonstrate their proficiency in written and oral communication skills.
5	Take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.

MAPPING OF COs, POs AND PSOs:															
	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	3	1	1	2	3	3	2	3	2	3	3	2
CO2	3	3	3	3	1	1	2	3	3	2	3	2	3	3	2
CO3	3	3	3	3	2	2	2	3	3	3	3	2	3	3	2
CO4	3	3	3	3	2	2	2	3	3	3	3	2	3	3	2
CO5	2	2	2	1	2	2	3	3	3	2	3	2	3	3	2
Average	2.8	2.8	2.6	2.6	1.6	1.6	2.2	3	3	2.4	3	2	3	3	2
Round off	3	3	3	3	2	2	2	3	3	2	3	2	3	3	2
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE001	INTERNAL COMBUSTION ENGINES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students to understand the underlying principles of operation of different IC Engines and components.
- To understand the working of engine auxiliary systems.
- To analyse the combustion aspects of SI Engines.
- To understand the combustion aspects of CI Engines.
- To provide knowledge on pollutant formation, control, alternate fuel etc.

UNIT I	SPARK IGNITION ENGINES	9

Mixture requirements - Feedback Control Carburettors – Properties of Fuel - Injection systems – Mono point and Multipoint injection – Gasoline Direct Injection – Ignition Systems-Stages of combustion - Normal and Abnormal combustion-Knock - Factors affecting knock - Combustion Chambers.

UNIT II	COMPRESSION IGNITION ENGINES	9

Diesel Fuel Injection Systems - Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Introduction to Turbocharging.

UNIT III	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, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission norms and Driving cycles. EGR – Lean burning.

UNIT IV	ALTERNATIVE FUELS	9

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications.

UNIT V	RECENT TRENDS	9

Air assisted Combustion, Homogeneous Charge Compression Ignition Engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems - Hybrid Electric Vehicles – NOx adsorbers -Onboard Diagnostics.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Analyse the combustion characteristics of SI engine.
2.	Evaluate the combustion characteristics of CI engine.
3.	Understand the sources of pollutants and methods of controlling emissions.
4.	Learn the different alternative fuels.

5.	Apply the latest technologies of engine system.
TEXT BOOKS:	
1.	V Ganesan, Internal Combustion Engines (Fourth Edition)Tata McGraw-Hill Education Pvt. Ltd, 2017
2.	Ramalingam. K.K., **"Internal Combustion Engine Fundamentals",**Scitech Publications, 2002
3.	S. S. Thipse, **"Internal Combustion Engines"**, Jaico Publishing House, 2010.
REFERENCES:	
1.	*Mathur. R.B. and R.P. Sharma, **"Internal Combustion Engines",**DhanpatRai& Sons 2007.*
2.	*Duffy Smith, **"Auto Fuel Systems",** The Good Heart Willcox Company, Inc., 1987.*
3.	*Eric Chowenitz, **"Automobile Electronics",** SAE Publications, 1995*
4.	*H. N. Gupta,**"Fundamentals of Internal Combustion Engines",** 2nd Edition, PHI Learning Pvt. Ltd. Delhi, 2013.*
5.	*Shyam K. Agrawal **"Internal Combustion Engines",** newagepublishers, 2006.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**2**									**1**	**2**	**2**	
CO2	**3**	**2**	**2**									**1**	**2**	**2**	
CO3	**3**	**2**	**2**									**1**	**2**	**2**	
CO4	**3**	**2**	**2**									**1**	**2**	**2**	
CO5	**3**	**2**	**2**									**1**	**2**	**2**	
Average	**3**	**2**	**2**									**1**	**2**	**2**	
Round off	**3**	**2**	**2**									**1**	**2**	**2**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE002	MECHATRONICS SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge about the various elements and techniques involved in mechatronics systems.
- To understand the working of 8085 microprocessor and 8051 microcontroller.
- To provide knowledge on programmable peripheral interface.
- To understand the working of programmable logic controller.
- To provide knowledge on actuators and to design mechatronic systems for a given application.

UNIT I	INTRODUCTION	9

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light Sensors.

UNIT II	MICROPROCESSOR AND MICROCONTROLLER	9

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 –introduction to 8051, Arduino, Case studies.

UNIT III	PROGRAMMABLE PERIPHERAL INTERFACE	9

Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.

UNIT IV	PROGRAMMABLE LOGIC CONTROLLER	9

Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

UNIT V	ACTUATORS AND MECHATRONIC SYSTEM DESIGN	9

Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management System – Automatic car park barrier.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Identify the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology.
2.	Discuss the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes of Microprocessor and Microcontroller.

3.	Elucidate Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing.
4.	Explain the architecture, programming and application of programmable logic controllers to problems and challenges in the areas of Mechatronic engineering.
5.	Distinguish various Actuators and Mechatronics system using the knowledge and skills acquired through the course and also from the given case studies.
TEXT BOOKS:	
1.	Bolton, **"Mechatronics",**Printice Hall, 2008.
2.	Ramesh S Gaonkar, **"Microprocessor Architecture, Programming, and Applications with the 8085"**, 5th Edition, Prentice Hall, 2008.
3.	Bradley D.A, Dawson D, Buru N.C and Loader A.J, **"Mechatronics"**, Chapman and Hall, 1993.
REFERENCES:	
1.	*Michael B.Histand and Davis G.Alciatore, **"Introduction to Mechatronics and Measurement systems"**, McGraw Hill International edition, 2007.*
2.	*Smaili.A and Mrad.F ,**"Mechatronics Integrated Technologies for Intelligent Machines",** Oxford University Press, 2007.*
3.	*DevadasShetty and Richard A. Kolk, **"Mechatronics Systems Design"**, PWS publishing company, 2007.*
4.	*Krishna Kant, **"Microprocessors & Microcontrollers"**, Prentice Hall of India, 2007.*
5.	*Clarence W, de Silva, "**Mechatronics**" CRC Press, First Indian Re-print, 2013.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**2**									**1**	**2**	**2**	
CO2	**3**	**2**	**2**									**1**	**2**	**2**	
CO3	**3**	**2**	**2**									**1**	**2**	**2**	
CO4	**3**	**2**	**2**									**1**	**2**	**2**	
CO5	**3**	**2**	**2**									**1**	**2**	**2**	
Average	**3**	**2**	**2**									**1**	**2**	**2**	
Round off	**3**	**2**	**2**									**1**	**2**	**2**	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPE003	MICROPROCESSORS IN AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To help the students to understand the fundamentals of microprocessors.
- To learn various cycles and interfacing methods.
- To get knowledge on assembly language programming.
- To Familiarise different types of convertors and data communication methods.
- To explore digital control techniques.

UNIT I	FUNDAMENTALS OF MICROPROCESSORS	9

Number Systems, codes, digital electronics: Logic Gates, combinational circuits design, Flip-flops, Sequential logic circuits design: Counters, Shift registers. Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals.

UNIT II	CYCLES AND INTERFACING	9

Machine cycles, instruction cycle and timing states, instruction timing diagrams, Memory interfacing.

UNIT III	ASSEMBLY LANGUAGE PROGRAMMING	9

Addressing modes, Instruction set, simple programs in 8085; Concept of Interrupt, Need for Interrupts, Interrupt structure, Multiple Interrupt requests and their handling, Programmable interrupt controller; Interfacing peripherals: Programmable peripheral interface (8255).

UNIT IV	CONVERTORS AND DATA COMMUNICATION	9

Interfacing Analog to Digital Converter & Digital to Analog converter, Multiplexed seven segments LED display systems, Stepper Motor Control, Data Communication: Serial Data communication (8251), Programmable Timers (8253); 8086/8088 Microprocessor and its advanced features.

UNIT V	DIGITAL CONTROL	9

Introduction to Digital Control: Sampling theorem, Signal conversion and Processing, Z Transform, Digital Filters, Implementation of Digital Algorithm.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Understand the fundamentals of microprocessors.
2.	Analyse various cycles and interfacing methods.
3.	Perform assembly language programming.
4.	Design different types of convertors and data communication methods.
5.	Explore various digital control techniques.

TEXT BOOKS:	
1.	Nagoorkani**, "MICROPROCESSORS & MICROCONTROLLERS",** Tata McGraw Hill Educatinpvt.Ltd. 2012.
2.	Godse A. P., **"Microprocessors & Microcontrollers",** TECHNICAL PUBLICATION (2016)
3.	A K Guptha, **"Industrial Automation and Robotics"**, Laxmi Publications-New Delhi, 2013.
4.	Bradley D.A, Dawson D, Buru N.C and Loader A.J, **"Mechatronics"**, Chapman and Hall, 1993.
REFERENCES:	
1.	*Michael B.Histand and Davis G.Alciatore, **"Introduction to Mechatronics and Measurement systems"**, McGraw Hill International edition, 2007.*
2.	*DevadasShetty and Richard A. Kolk, **"Mechatronics Systems Design"**, PWS publishing company, 2007.*
3.	*Krishna Kant, **"Microprocessors & Microcontrollers"**, Prentice Hall of India, 2013*
4.	*S. G. Tzafestas,**"Microprocessors in Signal Processing, Measurement and Control",**Springer, 2011.*
5.	*John Crisp,**"Introduction to Microprocessors and Microcontrollers",** Elsevier, 2004*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**2**									**1**	**2**	**2**	
CO2	**3**	**2**	**2**									**1**	**2**	**2**	
CO3	**3**	**2**	**2**									**1**	**2**	**2**	
CO4	**3**	**2**	**2**									**1**	**2**	**2**	
CO5	**3**	**2**	**2**									**1**	**2**	**2**	
Average	**3**	**2**	**2**									**1**	**2**	**2**	
Round off	**3**	**2**	**2**									**1**	**2**	**2**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE004	PROCESSING OF COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students to understand different processing methods and various types of composites.
- To get knowledge on processing of polymer matrix composites.
- To explore various types of metal matrix composites and their processing techniques.
- To familiarise ceramic matrix composites and special composites.
- To study the mechanics used to analyse the 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. Applications of various types of composites. Fibber production techniques for glass, carbon and ceramic fibres. Introduction to Nano composites.

UNIT II	POLYMER MATRIX COMPOSITES	9

Polymer resins – thermosetting resins, thermoplastic resins – reinforcement fibres – rovings – woven fabrics – non woven random mats – various types of fibres. PMC processes – hand layup processes – spray up processes – compression moulding – reinforced reaction injection moulding – resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), Glass Fibre Reinforced Plastics (GFRP). Laminates- Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates.-applications of PMC in aerospace, automotive industries.

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 – volume fraction – rule of mixtures. Processing of MMC – powder metallurgy process – diffusion bonding – stir casting – squeeze casting, a spray process, Liquid infiltration In-situ reactions-Interface-measurement of interface properties- applications of MMC in aerospace, automotive industries.

UNIT IV	CERAMIC MATRIX COMPOSITES AND SPECIAL 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. Sintering – Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing). Applications of CMC in aerospace, automotive industries- Carbon /carbon composites – advantages of carbon matrix – limitations of carbon matrix carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol-gel technique- Processing of Ceramic Matrix composites.

UNIT V	MECHANICS OF COMPOSITES	9
Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi Isotropic Laminates. Determination of Lamina stresses within Laminates.		
		TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Understand different techniques to process different types of composites and know the limitations of each process.
2.	Learn the processing techniques of polymer matrix composites.
3.	Understand various types of metal matrix composites and their processing techniques.
4.	Get knowledge on processing techniques of ceramic matrix composites and special composites.
5.	Use of Mathematical techniques to predict the macroscopic properties of different Laminates.

TEXT BOOKS:	
1.	M. Balasubramanian, **"Composite Materials and Processing"**, CRC Press; 1 edition (16 May 2017).
2.	Chawla K. K., **"Composite materials",** Second Edition, Springer – Verlag, 1998.
3.	Mathews F. L. and Rawlings R. D., **"Composite Materials: Engineering and Science"**, 1st Edition, Chapman and Hall, London, England, 1994.

REFERENCES:	
1.	G. Piatti, **"Advances in composite materials"**, Applied Science Publishers Ltd., London, (1978).
2.	Autar K. Kaw, **"Mechanics of Composite Materials",** Taylor & Francis- india; Second Edition edition (2006).
3.	Srinivasan K., **"Composite Material : Production Properties Testing"**, Narosa (2009)**.**
4.	V.V. Vasiliev and E.V. Morozov, **"Mechanics and Analysis of Composite Materials",** Elsevier Science Ltd, (2001).
5.	K.K. Chawala, **"Ceramic matrix composites"**, Chapman & Hall, London, 1st ed., (1993).

MAPPING OF COs, POs AND PSOs:															
	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2									1	2	2	
CO2	3	2	2									1	2	2	
CO3	3	2	2									1	2	2	
CO4	3	2	2									1	2	2	
CO5	3	2	2									1	2	2	
Average	3	2	2									1	2	2	
Round off	3	2	2									1	2	2	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE005	COMPUTER AIDED DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students to understand fundamentals of computer graphics.
- To gain knowledge on geometric modelling techniques.
- To learn various visual realism techniques and algorithms.
- To familiarise assembly modelling.
- To understand various cad standards.

UNIT I	FUNDAMENTALS OF COMPUTER GRAPHICS	9

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations homogeneous coordinates - Line drawing -Clipping- viewing transformation.

UNIT II	GEOMETRIC MODELLING	9

Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves- Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep.

UNIT III	VISUAL REALISM	9

Hidden – Line-Surface-Solid removal algorithms – shading – colouring – computer animation.

UNIT IV	ASSEMBLY OF PARTS	9

Assembly modelling – interferences of positions and orientation – tolerance analysis-mass property calculations – mechanism simulation and interference checking.

UNIT V	CAD STANDARDS	9

Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images-Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALSetc. - communication standards.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Understand fundamentals computer graphics.
2.	Apply various geometric modelling techniques.
3.	Learn visual realism techniques and hidden line, surface and solid removal algorithms.
4.	Understand assembly modelling techniques and tolerance analysis.
5.	Explore various cad standards.

TEXT BOOKS:

1.	Zeid Ibrahim, **"CAD/CAM Theory and Practices**", 2nd Edition, McGraw Hill International Edition, 2009.
2.	P. Radhakrishnan and S. Subramanyan, Raju. V.,**"CAD/CAM/CIM"** New Age International(P) Ltd, New Delhi – 2002.
3.	Mikell P. Groover, Emory W. Zimmers, Jr. **"CAD/CAM"**, 5th Impression Pearson Education, New Delhi, 2008.

REFERENCES:

1.	*William M Neumann and Robert F.Sproul**"Principles of Computer Graphics",** McGraw HillBook Co. Singapore, 1989.*
2.	*Chris McMahon and Jimmie Browne **"CAD/CAM Principles", "Practice and Manufacturing management "** Second Edition, Pearson Education, 1999.*
3.	*David Bedworth, **"Computer Integrated Design and Manufacturing"**, TMH, New Delhi,1998*
4.	*Foley, Wan Dam, Feiner and Hughes - **"Computer graphics principles & practice"** Pearson Education - 2003.*
5.	*Donald Hearn and M. Pauline Baker, **"Computer Graphics"**,Prentice Hall Inc.,2002.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**2**									**1**	**2**	**2**	
CO2	**3**	**2**	**2**									**1**	**2**	**2**	
CO3	**3**	**2**	**2**									**1**	**2**	**2**	
CO4	**3**	**2**	**2**									**1**	**2**	**2**	
CO5	**3**	**2**	**2**									**1**	**2**	**2**	
Average	**3**	**2**	**2**									**1**	**2**	**2**	
Round off	**3**	**2**	**2**									**1**	**2**	**2**	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPE006	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide students the knowledge of optimization techniques and approaches.
- To enable them to understand the various transportation and network models.
- To understand the different Inventory models.
- To study the various queueing models and its applications.
- To understand the different decision models and apply them for optimization.

UNIT I	LINEAR MODELS	9

Introduction to Operations Research – Linear Programming - Mathematical Formulation – Graphical method – Simplex method – Duality – Two Phase Simplex method .

UNIT II	TRANSPORTATION AND NETWORK MODELS	9

Transportation Assignment Models – Traveling Salesman problem - Network models – Shortest route – Minimal spanning tree – Maximum flow models – Project network – CPM and PERT networks – Critical path scheduling.

UNIT III	INVENTORY MODELS	9

Inventory models – Various Costs and Concepts – EOQ – Deterministic inventory models – Production models – Stochastic Inventory models – Buffer stock.

UNIT IV	QUEUEING MODELS	9

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi-server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation – Sequencing models.

UNIT V	DECISION MODELS	9

Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life – Single / Multi variable search technique.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Interpret the concepts of Linear programming techniques.
2.	Apply the concept of CPM, PERT and sequencing models for engineering problems.
3.	Explain the concept of different Inventory models and its applications in engineering.
4.	Apply the concept of queueing models for different problems.
5.	Analyze various decision models and apply for various applications.

TEXT BOOKS:	
1.	Sharma, S. D. **"Operations Research"**, 2nd Ed., kedarNath Ram Nath& Co. Meerut, 1998.
2.	P. K. Gupta, D. S. Hira, **"Problems in Operations Research (Principles and Solutions)"**, S. Chand & Co. Ltd., 2003.
3.	TahaHamdy A., **"Operations Research",** 8thEd. , Prentice Hall of India Pvt. Ltd. , 2007.
REFERENCES:	
1.	*DharaniVenkatakrishnan. S. **"Operations Research" (Principles and Problems)**, 5th Edition, Keerthi Publishing House Pvt. Ltd., 1996.*
2.	*Don. T. Phillips, Ravindren, A and James Solberg**," Operations Research"**, 2nd Edition, John Wiley & Sons, 1987.*
3.	*Hillier and Libeberman, **"Operations Research"**, Holden Day, 1986*
4.	*Budnick F. S., **"Principles of Operations Research for Management"**, 2nd Richard D Irwin, 1990.*
5.	*Panneerselvam. K, **"Operation Research"**, 2nd Edition, Prentice Hall of India, 2006.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**2**								**2**	**1**	**2**	**2**	
CO2	**3**	**2**	**2**								**2**	**1**	**2**	**2**	
CO3	**3**	**2**	**2**								**2**	**1**	**2**	**2**	
CO4	**3**	**2**	**2**								**2**	**1**	**2**	**2**	
CO5	**3**	**2**	**2**								**2**	**1**	**2**	**2**	
Average	**3**	**2**	**2**								**2**	**1**	**2**	**2**	
Round off	**3**	**2**	**2**								**2**	**1**	**2**	**2**	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPE007	THEORY OF METAL CUTTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students to understand the concept and basic mechanics of metal cutting.
- To understand the nomenclature of standard machine tools.
- To understand the various thermal aspects of cutting fluids.
- To analyse the cutting tool materials, tool life and tool wear.
- To design the cutting tools.

UNIT I	ORTHOGONAL CUTTING	9

Introduction - Machining fundamentals – Metal Cutting - Chip formation - types of chips - Chip breakers - Expression for Shear plane angle - Cutting force and velocity relationship - Ernst and Merchant Upper bound solution - Lee and Shaffer Lower bound solution - Oxley's thin shear zone model - Stress and Strain in the chip - Energy consideration in machining.

UNIT II	OBLIQUE CUTTING	9

Direction of Chip flow - Normal, Velocity and Effective Rake angles - Relationship between rake angles - Cutting ratios in oblique cutting - Shear angle and Velocity relationship - Stabler's rule.

UNIT III	THERMAL ASPECTS AND CUTTING FLUIDS	9

Heat distributions in machining - Experimental determination and Analytical calculation of cutting tool temperature - Cutting fluids - Effects of cutting fluid - Functions - Requirements - Types and Selection of Cutting Fluids.

UNIT IV	CUTTING TOOL MATERIALS, TOOL LIFE AND TOOL WEAR	9

Essential requirements of tool materials – development of tool materials - Tool wear and Tool life - Machinability - Economics of metal machining - Theory of Chatter.

UNIT V	DESIGN OF CUTTING TOOLS	9

Nomenclature of Single point and Multi point cutting tools - Design of Turning tool, Drills and Milling cutters.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Applying the orthogonal metal cutting theory in engineering.
2.	Evaluating the oblique metal cutting theory in engineering.
3.	Learn Heat distributions in machining and cutting fluids.
4.	Understand the essential requirements of tool material and its life.
5.	Design the cutting tools for metal removal process.

TEXT BOOKS:	
1.	Bhattacharyya A., **"Metal Cutting Theory and Practice"**, Central Book Publishers, Calcutta, 1984.
2.	Juneja B L., Sekhon G. S., **"Fundamentals of Metal Cutting and Machine Tools"**, New Age International (P) Limited, 1995.
3.	Shaw M C., **"Metal Cutting Principles"**, Oxford Press, 1984.
REFERENCES:	
1.	*David A. Stephenson, John S. Agapio, **"Metal Cutting Theory and Practice",** CRC Press, 2006.*
2.	*Armarego E.J.A., Brown R.H., **"The Machining of Metals"**, Prentice Hall Inc., 1969.*
3.	*Geoffrey Boothroyd, Knight W.A., **"Fundamentals of Machining and Machine Tools"**, Marcel Dekkor, New York, 1989.*
4.	*Rodin P., **"Design and Production of Cutting Tools"**, MIR Publishers, 1968.*
5.	*P C Sharma, **"A Textbook of Production Engineering", S**. Chand & Company Ltd. New Delhi 2008.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**									**1**	**2**	**2**	
CO2	**3**	**3**	**2**									**1**	**2**	**2**	
CO3	**3**	**3**	**2**									**1**	**2**	**2**	
CO4	**3**	**3**	**2**									**1**	**2**	**2**	
CO5	**3**	**3**	**2**									**1**	**2**	**2**	
Average	**3**	**3**	**2**									**1**	**2**	**2**	
Round off	**3**	**3**	**2**									**1**	**2**	**2**	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPE008	WELDING TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the student to understand the basics of welding technology.
- To understand the basic concepts of welding metallurgy.
- To understand welding techniques for various materials.
- To learn the various advanced welding processes.
- To acquire the knowledge of testing of weldments.

UNIT I	GAS AND ARC WELDING PROCESSES	9

Fundamental principles – Air-acetylene welding, Oxy-acetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electro-slag welding processes - advantages, limitations and applications.

UNIT II	RESISTANCE WELDING PROCESSES	9

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications.

UNIT III	SOLID STATE WELDING PROCESSES	9

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications.

UNIT IV	OTHER WELDING PROCESSES	9

Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser beam welding, Friction stir welding, Underwater welding, Welding automation in aerospace, nuclear and surface transport vehicles, Cold metal transfer and explosive welding.

UNIT V	DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS	9

Various weld joint designs - Heat affected zone – Weldability of different materials – Weld defects - destructive and non-destructive testing for weldments. Demonstration of SMAW, GMAW, GTAW & Robotic GMAW processes

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Compare different types of Welding processes.
2.	Analyse the principles of resistance welding processes.
3.	Understand the concept of solid state welding process.
4.	Analyse the weldablity and weld defects.
5.	Learn different testing methods for weldment.

TEXT BOOKS:	
1.	Parmer R.S., **"Welding Engineering and Technology",** 1st edition, Khanna Publishers, NewDelhi, 2008.
2.	Parmer R.S., **"Welding Processes and Technology"**, Khanna Publishers, New Delhi, 1992.
3.	Little R.L., **"Welding and welding Technology"**, Tata McGraw Hill Publishing Co., Ltd., NewDelhi, 34th reprint, 2008.
REFERENCES:	
1.	*Schwartz M.M. **"Metals Joining Manual"**. McGraw Hill Books, 1979.*
2.	*Tylecote R.F. **"The Solid Phase Welding of Metals"**. Edward Arnold Publishers Ltd. London,1968.*
3.	*Nadkarni S.V. **"Modern Arc Welding Technology"**, 1st edition, Oxford IBH Publishers, 2005.*
4.	*Christopher Davis. **"Laser Welding- Practical Guide".**Jaico Publishing House, 1994.*
5.	*Davis A.C., **"The Science and Practice of Welding"**, Cambridge University Press, Cambridge,1993*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**									**1**	**2**	**2**	
CO2	**3**	**3**	**2**									**1**	**2**	**2**	
CO3	**3**	**3**	**2**									**1**	**2**	**2**	
CO4	**3**	**3**	**2**									**1**	**2**	**2**	
CO5	**3**	**3**	**2**		**3**							**1**	**2**	**2**	
Average	**3**	**3**	**2**									**1**	**2**	**2**	
Round off	**3**	**3**	**2**		**3**							**1**	**2**	**2**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE009	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students to understand vapour compression and vapour absorption system Operation.
- To analyse the refrigeration cycles and methods for improving Performance.
- To acquire the knowledge on components of refrigeration systems.
- To design air conditioning systems using cooling load calculations.
- To explore the application of refrigeration and air conditioning systems.

UNIT I	INTRODUCTION	9

Introduction to Refrigeration - Unit of Refrigeration and C.O.P. – Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT II	VAPOUR COMPRESSION REFRIGERATION SYSTEM	9

Vapour compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – sub cooling and super heating- effects of condenser and evaporator pressure on COP- multi pressure system – low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT III	OTHER REFRIGERATION SYSTEMS	9

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic -Vortex and Pulse tube refrigeration systems.

UNIT IV	PSYCHOMETRIC PROPERTIES AND PROCESSES	9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature, Thermodynamic wet bulb temperature, Psychometric chart, Psychometric of air-conditioning processes, mixing of airstreams.

UNIT V	AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION	9

Air conditioning loads- Outside and inside design conditions- Heat transfer through structure- Solar Radiation- Electrical appliances- Infiltration and ventilation- internal heat load-Apparatus selection-fresh air load-Human comfort & IAQ principles- effective temperature & chart-calculation of summer &winter air conditioning load- Classifications- Layout of plants- Air distribution system- Filters- Air-conditioning Systems with Controls- Temperature, Pressure and Humidity sensors, Actuators &Safety controls.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1. Analyze common basics of refrigeration systems and refrigerants.

2.	Elucidate the concept of vapor compression refrigeration system and solve problems on it.
3.	Learn the components and working of other refrigeration and air conditioning systems
4.	Evaluate different psychometric properties and processes.
5.	Perform heating and cooling load calculations.

TEXT BOOKS:

1.	Arora, C. P., **"Refrigeration and Air Conditioning",** 3rd ed., McGraw Hill, Delhi, 2010.
2.	Manohar Prasad., **"Refrigeration and Air Conditioning",** 2nd ed., New Age Int., 2011.
3.	Rex Milter, Mark R.Miller,**"Air conditioning and Refrigeration",** McGraw Hill 2006.

REFERENCES:

1.	*Roy J. Dossat, "**Principles of Refrigeration**", 4th edition, Pearson Education Asia, 2009.*
2.	*Stoecker, W. F. and Jones J. W., "**Refrigeration and Air Conditioning**", McGraw Hill, New Delhi, 1986.*
3.	*AhmadulAmeen., **"Refrigeration and Air Conditioning",**1st edition, prentice-hall of India Private limited New Delhi 2006.*
4.	*Jones W. P., "**Air conditioning engineering**", 5thedition,Elsevier Butterworth-Heinemann, 2001.*
5.	*Wilbert F. Stoecker, Jerold W. Jones., **"Refrigeration and Air Conditioning",** McGraw-Hill 1982.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**									**1**	**2**	**2**	
CO2	**3**	**3**	**2**									**1**	**2**	**2**	
CO3	**3**	**3**	**2**									**1**	**2**	**2**	
CO4	**3**	**3**	**2**									**1**	**2**	**2**	
CO5	**3**	**3**	**2**									**1**	**2**	**2**	
Average	**3**	**3**	**2**									**1**	**2**	**2**	
Round off	**3**	**3**	**2**									**1**	**2**	**2**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE010	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To help the students to learn the various cycles of coal based thermal power plants.
- To gain knowledge on diesel, gas turbine and combined cycle power plants.
- To familiarise the basics of nuclear engineering and various types of reactors.
- To learn how to get power from renewable energy sources.
- To Understand energy, economic and environmental issues of power plants.

UNIT I	COAL BASED THERMAL POWER PLANTS	9

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II	DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS	9

Otto, Diesel, Dual &Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III	NUCLEAR POWER PLANTS	9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR),CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV	POWER FROM RENEWABLE ENERGY	9

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, SolarPhoto Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V	ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS	9

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, Relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Learn the various cycles of coal based thermal power plants.
2.	Gain knowledge on diesel, gas turbine and combined cycle power plants.
3.	Understand the basics of nuclear engineering and various types of reactors.

4.	Design power plants to get energy from renewable energy sources.
5.	Analyse energy, economic and environmental issues of power plants.
TEXT BOOKS:	
1.	Nag. P.K., "**Power Plant Engineering**", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2.	Arora.S.C and Domkundwar.S, **"Power Plant Engineering",**DhanpatRai& Sons, New Delhi, 2015.
3.	Ramalingam.K.K, **"Power Plant Engineering",**Scitech Publication Pvt. Ltd, 2015.
REFERENCES:	
1.	*El-Wakil. M.M., "**Power Plant Technology",** Tata McGraw – Hill Publishing Company Ltd.,2010.*
2.	*Black & Veatch, Springer, "**Power Plant Engineering",** 1996.*
3.	*Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "**Power Plant Engineering**", Second Edition, Standard Handbook of McGraw – Hill, 1998.*
4.	*Godfrey Boyle, "**Renewable energy",** Open University, Oxford University Press in association with the Open University, 2004.*
5.	*Drbal, Larry F. Boston, Patricia G. Westra, Kayla L. Black, Veatch, "**Power Plant Engineering**", Kluwer Academic Pub., 1995*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**									**1**	**2**	**2**	
CO2	**3**	**3**	**2**									**1**	**2**	**2**	
CO3	**3**	**3**	**2**									**1**	**2**	**2**	
CO4	**3**	**3**	**2**									**1**	**2**	**2**	
CO5	**3**	**3**	**2**									**1**	**2**	**2**	
Average	**3**	**3**	**2**									**1**	**2**	**2**	
Round off	**3**	**3**	**2**									**1**	**2**	**2**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE011	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
	(Use of Approved Gas table is Permitted)	3	0	0	3

OBJECTIVES:

- To provide students with an insight into the applications of compressible flows and the fundamentals of jet propulsion system.
- To enable them to formulate and solve problems in one –dimensional steady compressible flow.
- To derive the conditions for change in pressure, density and temperature for flows through normal and oblique shocks.
- To analyse the performance of jet propulsion system.
- To analyse the performance of space propulsion system.

UNIT I	BASIC CONCEPTS	9

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers.

UNIT II	FLOW THROUGH DUCTS	9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – Variation of flow properties.

UNIT III	NORMAL AND OBLIQUE SHOCKS	9

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl –Meyer relations – Applications.

UNIT IV	JET PROPULSION	9

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and Turbo prop engines – Applications of jet propulsion.

UNIT V	SPACE PROPULSION	9

Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Explain the basic concepts of compressible flow and jet propulsion.
2.	Solve problems of Rayleigh and Fanno flow.
3.	Apply the concept of normal and oblique shocks for various applications.
4.	Apply the concept of jet propulsion in turbojet, turbofan and turboprop engines.
5.	Analyse the concept of space propulsion of rockets.

TEXT BOOKS:	
1.	Yahya, S. M. **"Fundamentals of Compressible Flow"**, 6th Edition, New Age International (P) Limited, NewDelhi, 2018.
2.	Somasundaram. PR. S. L., **"Gas Dynamics and Jet Propulsions"**, New Age InternationalPublishers, 1996.
3.	Ganesan. V., **"Gas Turbines"**, Tata McGraw Hill Publishing Co., New Delhi, 1999.
REFERENCES:	
1.	*Anderson, J. D., "**Modern Compressible flow**", 3rd Edition, McGraw Hill, 2003.*
2.	*Babu. V., "**Fundamentals of Gas Dynamics**", ANE Books India, 2008.*
3.	*Hill. P. and C. Peterson, "**Mechanics and Thermodynamics of Propulsion**", Addison – Wesley Publishing company, 1992.*
4.	*Zucrow. N. J., "**Principles of Jet Propulsion and Gas Turbines**", John Wiley, New York, 1970.*
5.	*Shapiro. A. H.," **Dynamics and Thermodynamics of Compressible fluid Flow",** John wiley, New York, 1953.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**									**1**	**2**	**2**	
CO2	**3**	**3**	**2**									**1**	**2**	**2**	
CO3	**3**	**3**	**2**									**1**	**2**	**2**	
CO4	**3**	**3**	**2**									**1**	**2**	**2**	
CO5	**3**	**3**	**2**									**1**	**2**	**2**	
Average	**3**	**3**	**2**									**1**	**2**	**2**	
Round off	**3**	**3**	**2**									**1**	**2**	**2**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE012	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To help the students to understand the method of process planning.
- To explore various process planning activities.
- To learn importance of costing and estimation and different types of estimates.
- To evaluate production cost estimation of different types of shops.
- To calculate machining time for different machining processes.

UNIT I	INTRODUCTION TO PROCESS PLANNING	9

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection.

UNIT II	PROCESS PLANNING ACTIVITIES	9

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies. Introduction to CAPP and ERP.

UNIT III	INTRODUCTION TO COST ESTIMATION	9

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of overhead charges- Calculation of depreciation cost.

UNIT IV	PRODUCTION COST ESTIMATION	9

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop.

UNIT V	MACHINING TIME CALCULATION	9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1	Select the process, equipment and tools for various industrial products.
2	Prepare process planning activity chart.
3	Explain the concept of cost estimation.
4	Compute the job order cost for different type of shop floor.
5	Calculate the machining time for various machining operations.

TEXT BOOKS:	
1.	Peter scalon, **"Process planning, Design/Manufacture Interface"**, Elsevier science technology Books, Dec 2002.
2.	Sinha B.P, **"Mechanical Estimating and Costing",** Tata-McGraw Hill publishing co, 1995.
3.	B. Vijayaramanath, C.Elanchezhian, R.Kesavan, **"Process Planning and Cost Estimation"**, New Age International (P) Limited, (2008).
REFERENCES:	
1.	*Chitale A.V. and Gupta R.C., **"Product Design and Manufacturing"**, 2nd Edition, PHI, 2002.*
2.	*Ostwalal P.F. and Munez J., **"Manufacturing Processes and systems"**, 9th Edition, John Wiley, 1998.*
3.	*Russell R.S and Tailor B.W, **"Operations Management"**, 4th Edition, PHI, 2003.*
4.	*Mikell P. Groover, **"Automation, Production, Systems and Computer Integrated Manufacturing",** Pearson Education 2001.*
5.	*K.C. Jain & L.N. Aggarwal, **"Production Planning Control and Industrial Management",**Khanna Publishers 1990.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**2**	**2**				**2**		**2**			**2**	**1**	**2**	**2**	
CO2	**2**	**2**				**2**		**2**			**2**	**1**	**2**	**2**	
CO3	**2**	**2**				**2**		**2**			**2**	**1**	**2**	**2**	
CO4	**2**	**2**				**2**		**2**			**2**	**1**	**2**	**2**	
CO5	**2**	**2**				**2**		**2**			**2**	**1**	**2**	**2**	
Average	**2**	**2**				**2**		**2**			**2**	**1**	**2**	**2**	
Round off	**2**	**2**				**2**		**2**			**2**	**1**	**2**	**2**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE013	LEAN MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students to study the concept and implementation of lean manufacturing.
- To learn the Sustainable engineering concepts.
- To analyse the multi attributes decision making methods
- To understand the concept of lean manufacturing management.
- To explore the applications in lean manufacturing.

UNIT I	INTRODUCTION	9

Objectives of lean manufacturing-key principles and implications of lean manufacturing traditional vs. lean manufacturing – Lean benefits.

UNIT II	LEAN MANUFACTURING CONCEPTS	9

Value creation and waste elimination- Major kinds of waste- pull production – different models of pull production-continuous flow – Kaizen – Worker involvement; Part family- Production flow analysis – Composite part concept – Machine cell design -Case studies.

UNIT III	LEAN MANUFACTURING TOOLS & METHODOLOGIES	9

Standard work -communication of standard work to employees -standard work and flexibility - visual controls-quality at the source- 5S principles –preventive maintenance-total quality management-total productive maintenance -changeover/setup time -batch size reduction.

UNIT IV	VALUE STREAM MAPPING	9

The *as-is* diagram-the future state map-application to the factory simulation scenario-line balancing -poke yoka- Kanban – overall equipment effectiveness -JIT - elements of JIT -Kanban system.

UNIT V	IMPLEMENTING LEAN	9

Road map-Senior management Involvement-best practices- reconciling lean with other systems - Toyota production system-lean six sigma-lean and ERP-lean with ISO9001:2000.

TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Evaluate the objectives and benefits of lean manufacturing.
2.	Explain various lean manufacturing concepts with case studies.
3.	Learn various lean manufacturing tools and methodologies.
4.	Analyse about value stream mapping techniques.
5.	Learn the best practices used for implementation of lean manufacturing system.

TEXT BOOKS:	

1.	Michael L George, David T Rowlands, Bill Kastle, **"What is Lean Six Sigma",**McGraw Hill Inc., New York, 2004.
2.	Askin R.G, Goldberg J.B, **"Design and Analysis of Lean Production Systems",** JohnWiley & Sons, New York, 2003.
3.	S. R. Devadasan, V. Sivakumar, R. Murugesh, P. R. Shalij, **"Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities",** PHI Learning Private limited, New Delhi, 2012.

REFERENCES:	
1.	*Joseph A De Feo, William W BearnardJuran Institute, **"Six Sigma Break Throughand Beyond",** Tata McGraw Hill, New Delhi, 2004.*
2.	*Richard B Chase F Robert Jacobs and Nicholas J Aquilano, **"Operations Management for Competitive Advantage",** McGraw Hill Inc., New York, 10th Edition, 2003.*
3.	*Dennis P. Hobbs, **"Lean Manufacturing Implementation: A Complete Execution Manual for Any Size",** J. Ross Publishing, 2005.*
4.	*Micheal Wader, **"Lean Tools: A Pocket guide to Implementing Lean Practices",** Productivity and Quality Publishing Pvt Ltd, 2002.*
5.	*Akhilesh N. Singh, **"Lean Manufacturing: Principles to Practice",** L.B. Associates, 2010.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**1**									**1**	**2**	**2**	
CO2	**3**	**2**	**1**									**1**	**2**	**2**	
CO3	**3**	**2**	**1**									**1**	**2**	**2**	
CO4	**3**	**2**	**1**									**1**	**2**	**2**	
CO5	**3**	**2**	**1**									**1**	**2**	**2**	
Average	**3**	**2**	**1**									**1**	**2**	**2**	
Round off	**3**	**2**	**1**									**1**	**2**	**2**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE014	DESIGN OF JIGS, FIXTURES AND PRESS TOOLS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To help the students explore the various locating and clamping methods.
- To design and development of jigs and fixtures for given component.
- To understand press working terminologies and elements of cutting dies.
- To design bending and drawing dies.
- To understand the functions and design principles of various forming techniques like bending, forming, drawing, etc.

UNIT I	LOCATING AND CLAMPING PRINCIPLES	9

Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – 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	9

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – 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	9

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- 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 AND DRAWING DIES	9

Difference between bending 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 redrawing and combination dies – Blank development for axi-symmetric, rectangular and elliptic parts – Single and double action dies.

UNIT V	OTHER FORMING TECHNIQUES	9

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.

	TOTAL : 45 PERIODS
OUTCOMES: On completion of this course, students will be able to	
1.	Explore various locating and clamping principles.
2.	Explore the functions and design of Jigs & Fixtures.
3.	Analyze functions and design Press work and cutting die.
4.	Evaluate functions and design of press working and elements of cutting dies.
5.	Apply functions and various design to other forming techniques.
TEXT BOOKS:	
1.	Joshi, P.H. **"Jigs and Fixtures"**, Second Edition, Tata McGraw Hill, NewDelhi, 2004.
2.	Joshi P.H **"Press tools - Design and Construction"**, wheels publishing, 1996.
3.	Cyril Donaldson, George H. LeCain, V. C. Goold, JoyjeetGhose, **"Tool Design"**, Fourth Edition, Tata McGraw Hill Publishing Co., Ltd., NewDelhi, 2012.
REFERENCES:	
1.	*Venkataraman. K., **"Design of Jigs Fixtures & Press Tools"**, Tata McGraw Hill,2005.*
2.	*Donaldson, Lecain and Goold**"Tool Design"**, 3rd Edition, Tata McGraw Hill, 2000.*
3.	*Kempster, **"Jigs and Fixture Design"**, Third Edition, Hoddes and Stoughton, 1974.*
4.	***"Design Data Hand Book"**, PSG College of Technology, Coimbatore.*
5.	*Hoffman **"Jigs and Fixture Design"**, Thomson Delmar Learning, Singapore, 2004.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**									**1**	**2**	**2**	
CO2	**3**	**3**	**2**									**1**	**2**	**2**	
CO3	**3**	**3**	**2**									**1**	**2**	**2**	
CO4	**3**	**3**	**2**									**1**	**2**	**2**	
CO5	**3**	**3**	**2**									**1**	**2**	**2**	
Average	**3**	**3**	**2**									**1**	**2**	**2**	
Round off	**3**	**3**	**2**									**1**	**2**	**2**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE015	MECHANICAL VIBRATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students to understand different types of vibration.
- To make them to understand the sources of vibration and noise in automobiles.
- To make design modifications to reduce the vibration and noise and improve the life of the components.
- To analyze the Single Degree, Two Degree and Multi degree of Freedom Systems.
- To study the numerical methods for vibration analysis.

UNIT I	BASICS OF VIBRATION	9

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and nonlinear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT II	BASICS OF NOISE	9

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT III	AUTOMOTIVE NOISE SOURCES	9

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise and assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.

UNIT IV	CONTROL TECHNIQUES	9

Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT V	SOURCE OF NOISE AND CONTROL	9

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, and sound transmission through barriers.

TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Explore the causes, source and types of vibrations in machineries.
2.	Gaining knowledge in basics and measurement of noise.
3.	Design and develop vibrations and noise control systems.
4.	Explain the various control techniques of dampers and shock absorbers.

5.	Learn about various sources of noises and its control.
TEXT BOOKS:	
1.	SingiresuS.Rao, **"Mechanical Vibrations",** 5th Edition, Pearson Education, 2010
2.	William T. Thomson, Marie Dillon Dahleh, ChandramouliPadmanabhan, **"Theory of Vibration with Application",** 5th Edition Pearson Education, 2011
3.	David Bies and Colin Hansen, "**Engineering Noise Control – Theory and Practice",**4th Edition,E and FN Spon, Taylore&Francise e-Library, 2009
REFERENCES:	
1.	*Benson H. Tongue, **"Principles of Vibrations",** 2nd Edition, Oxford University, 2007*
2.	*Grover. G.T., **"Mechanical Vibrations",**Nem Chand and Bros., 1996*
3.	*Julian Happian-Smith - **"An Introduction to Modern Vehicle Design"- Butterworth-Heinemann,2004***
4.	*Rao, J.S and Gupta, K., **"Introductory course on Theory and Practice of Mechanical Vibration",** 2nd Edition, New Age International Publications, 2010*
5.	*Shabana. A.A**., "Theory of vibrations – An introduction",** 2nd Edition, Springer, 2010*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**									**1**	**2**	**2**	
CO2	**3**	**3**	**2**									**1**	**2**	**2**	
CO3	**3**	**3**	**2**									**1**	**2**	**2**	
CO4	**3**	**3**	**2**									**1**	**2**	**2**	
CO5	**3**	**3**	**2**									**1**	**2**	**2**	
Average	**3**	**3**	**2**									**1**	**2**	**2**	
Round off	**3**	**3**	**2**									**1**	**2**	**2**	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPE016	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To help the students to understand the basics of management and organizations.
- To get knowledge on various planning techniques.
- To explore various organising methods.
- To Familiarise different directing techniques.
- To Learn and differentiate various types of controlling techniques.

UNIT I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	9

Definition of Management – Science or Art – Manager vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II	PLANNING	9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III	ORGANISING	9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV	DIRECTING	9

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.

UNIT V	CONTROLLING	9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

	TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Explore the basics of management and organizations
2.	Identify the nature and purpose of planning and to get knowledge on various planning

	techniques.
3.	Learn and implement various organising methods.
4.	Gain knowledge on different directing techniques.
5.	Analyse and learn various types of controlling techniques.

TEXT BOOKS:	
1.	JAF Stoner, Freeman R.E and Daniel R Gilbert **"Management",** 6th Edition, Pearson Education, 2004.
2	Stephen P. Robbins & Mary Coulter**, "Management",** Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.
3	Hill Charles W. L**., "Principles of Management",** Tata McGraw-Hill Education India, 2007.

REFERENCES:	
1.	*Harold Koontz & Heinz Weihrich,* ***"Essentials of Management",*** *Tata McGraw Hill, 1998.*
2.	*Tripathy PC & Reddy PN,* ***"Principles of Management",*** *Tata Mcgraw Hill, 1999.*
3.	*Robert Kreitner&MamataMohapatra,* ***"Management",****Biztantra, 2008.*
4.	*Stephen A. Robbins & David A. Decenzo& Mary Coulter,* ***"Fundamentals of Management",*** *7th Edition, Pearson Education, 2011.*
5.	*R. C. Bhatia,* ***"Principles of Management",****Sterling Publishers (25 February 2013).*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1						**2**	**2**	**2**	**2**	**2**	**3**	**1**			**2**
CO2						**2**	**2**	**2**	**2**	**2**	**3**	**1**			**2**
CO3						**2**	**2**	**2**	**2**	**2**	**3**	**1**			**2**
CO4						**2**	**2**	**2**	**2**	**2**	**3**	**1**			**2**
CO5						**2**	**2**	**2**	**2**	**2**	**3**	**1**			**2**
Average						**2**	**2**	**2**	**2**	**2**	**3**	**1**			**2**
Round off						**2**	**2**	**2**	**2**	**2**	**3**	**1**			**2**
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE017	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the construction and working principle of various parts of an automobile.
- To understand assembling and dismantling of engine parts and transmission system.
- To broaden the understanding of automotive architecture and performance.
- To introduce students about the transmission system.
- To familiarize about the wheels, tyres, and braking system.

UNIT I	VEHICLE STRUCTURE AND ENGINES	9

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines –components functionsand materials, variable valve timing (VVT).

UNIT II	ENGINE AUXILIARY SYSTEMS	9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by threeway catalytic converter system, Emission norms (Euro and BS).

UNIT III	TRANSMISSION SYSTEMS	9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT IV	STEERING, BRAKES AND SUSPENSION SYSTEMS	9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT V	ALTERNATIVE ENERGY SOURCES	9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Identify the different vehicle structure in automobile.
2.	Recognize the various engine auxiliary systems.
3.	Acquire knowledge on different transmission systems in automobile.

4.	Learn the functions of steering, suspension and braking systems.
5.	Analyze performance, combustion and emission characteristics of alternative fuels.
TEXT BOOKS:	
1.	Kirpal Singh, **"Automobile Engineering**", Vol. 1 & 2, Seventh Edition, Standard Publishers, NewDelhi, 1997.
2.	Jain K.K. and Asthana .R.B, **"Automobile Engineering"** Tata McGraw Hill Publishers, NewDelhi, 2002.
3.	Ramalingam, K. K, **"Automobile Engineering",**Scitech Publications, 2014.
REFERENCES:	
1.	*Newton, Steeds and Garet, **"Motor Vehicles",** Butterworth Publishers, 1989.*
2.	*Joseph Heitner, **"Automotive Mechanics",** Second Edition, East-West Press, 1999.*
3.	*Martin W, Stockel and Martin T Stockle, **"Automotive Mechanics Fundamentals",** The Goodheart –Will Cox Company Inc, USA, 1978.*
4.	*Heinz Heisler, **"Advanced Engine Technology",** SAE International Publications USA, 1998.*
5.	*Ganesan V. **"Internal Combustion Engines",** Third Edition, Tata McGraw-Hill, 2007.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**									**1**	**2**	**2**	
CO2	**3**	**3**	**2**									**1**	**2**	**2**	
CO3	**3**	**3**	**2**									**1**	**2**	**2**	
CO4	**3**	**3**	**2**									**1**	**2**	**2**	
CO5	**3**	**3**	**2**									**1**	**2**	**2**	
Average	**3**	**3**	**2**									**1**	**2**	**2**	
Round off	**3**	**3**	**2**									**1**	**2**	**2**	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MPE018	ENERGY CONSERVARION AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the students to understand the basic concepts of Energy Engineering and Management.
- To carryout energy accounting and balancing.
- To conduct energy audit and suggest methodologies for energy savings.
- To utilise the available resources in optimal ways.
- To understand and analyse the energy data of industries.

UNIT I	INTRODUCTION	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	ELECTRICAL SYSTEMS	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 and scope of Energy conservation(encon.) in Illumination.

UNIT III	THERMAL SYSTEMS	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.

UNIT IV	ENERGY CONSERVATION IN MAJOR UTILITIES	9

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets.

UNIT V	ENERGY ECONOMICS	9

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing – ESCO concept.

TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Apply the energy utilization at national and international levels.
2.	Analyze various energy conservation techniques in electrical systems.
3.	Learn various energy conservation techniques in Thermal systems.
4.	Create various energy conservation techniques in major utilities.
5.	Apply the economics of energy to real life problems.

TEXT BOOKS:	
1.	Callaghan P.W.O, **"Design and Management for Energy Conservation",**Pergamon Press, Oxford, 2003.
2.	Murphy W.R and McKay G**, "Energy Management",**Butterworths, London, 2007.
3.	Paul W. O'Callaghan, "**Energy Management**", McGraw-Hill Book Company, 1993.
REFERENCES:	
1.	*Witte. L.C., P.S. Schmidt, D.R. Brown, **"Industrial Energy Management and Utilisation",** Hemisphere Publ, Washington, 1988.*
2.	*Barney L. Capehart, Wayne C. Turner, William J. Kennedy, **"Guide to Energy Management"**, TheFaimont Press, 6th edition, 2008 Hemisphere, 2003.*
3.	*Dryden. I.G.C., **"The Efficient Use of Energy"**, Butterworths, London, 1982.*
4.	*Steve Doty, Wayne C. Turner, **"Energy Management Handbook"**, FairmontPress, 7th edition, 2009.*
5.	*Trivedi P.R and Jolka K.R, **"Energy Management",** Common Wealth Publication,2002.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**2**	**2**	**2**			**2**	**2**	**2**			**2**	**1**	**2**	**2**	
CO2	**2**	**2**	**2**			**2**	**2**	**2**			**2**	**1**	**2**	**2**	
CO3	**2**	**2**	**2**			**2**	**2**	**2**			**2**	**1**	**2**	**2**	
CO4	**2**	**2**	**2**			**2**	**2**	**2**			**2**	**1**	**2**	**2**	
CO5	**2**	**2**	**2**			**2**	**2**	**2**			**2**	**1**	**2**	**2**	
Average	**2**	**2**	**2**			**2**	**2**	**2**			**2**	**1**	**2**	**2**	
Round off	**2**	**2**	**2**			**2**	**2**	**2**			**2**	**1**	**2**	**2**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE019	INDUSTRIAL ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students to understand the basic concepts of robotics.
- To learn the concepts and techniques of robot manipulator and its kinematics.
- To learn the various end effectors and sensors.
- To understand the Robots cell design and programming.
- To explore the industrial applications of robot.

UNIT I	FUNDAMENTALS OF ROBOT	9

Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope, Types and Classification-Specifications-Pitch, Yaw, Roll, Joint notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT II	ROBOT DRIVE SYSTEMS AND END EFFECTORS	9

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, 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 III	SENSORS AND MACHINE VISION	9

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors – Piezo-electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors, Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors, Binary Sensors, Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data-Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications-Inspection, Identification, Visual Serving and Navigation.

UNIT IV	ROBOT KINEMATICS AND ROBOT PROGRAMMING	9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 D), Four Degrees of freedom (in 3D) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End effector commands and simple Programs.

UNIT V	IMPLEMENTATION AND ROBOT ECONOMICS	9

RGV, AGV, Implementation of Robots in Industries-Various Steps, Safety Considerations for Robot Operations - Economic Analysis of Robots.

	TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Analyse fundamentals of robotics.
2.	Explore the design concepts of robot drives and end effectors.
3.	Apply the concept of sensors and machine vision system.
4.	Learn the concept of Robot kinematics and write robot programming.
5.	Evaluate the safety and economics of robots.
TEXT BOOKS:	
1.	Klafter R.D., Chmielewski T.A and Negin M., **"Robotic Engineering** - An Integrated Approach",Prentice Hall, 2003.
2.	Groover M.P., **"Industrial Robotics -Technology Programming and Applications",** McGraw Hill, 2001.
3.	J. Norberto Pires., **"Industrial Robots Programming"**Springer, 2007.
REFERENCES:	
1.	*Craig J.J., **"Introduction to Robotics Mechanics & Control",** Pearson Education, 2008.*
2.	*Deb S.R., **"Robotics Technology and Flexible Automation"** Tata McGraw Hill, 1994.*
3.	*Koren Y., **"Robotics for Engineers",**McGraw Hill Book Co., 1992.*
4.	*Rajput R.K., "Robotics and Industrial Automation", S. Chand and Company, 2008.*
5.	*Janakiraman P.A., **"Robotics and Image Processing",** Tata McGraw Hill, 1995.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**									**1**	**2**	**2**	
CO2	**3**	**3**	**2**									**1**	**2**	**2**	
CO3	**3**	**3**	**2**									**1**	**2**	**2**	
CO4	**3**	**3**	**2**									**1**	**2**	**2**	
CO5	**3**	**3**	**2**									**1**	**2**	**2**	
Average	**3**	**3**	**2**									**1**	**2**	**2**	
Round off	**3**	**3**	**2**									**1**	**2**	**2**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE020	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students understand the Governing Equations and boundary conditions of various fluid dynamic problems.
- To introduce numerical modelling and its role in the field of fluid flow and heat transfer.
- To enable the students to understand the various discretization methods, solution procedures and turbulence modelling.
- To apply finite volume method for convection and diffusion problems.
- To analyse the finite volume approach to discretize the governing equations

UNIT I	GOVERNING EQUATIONS AND BOUNDARY CONDITIONS	9

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

UNIT II	FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION	9

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three –dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems onelliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

UNIT III	FINITE VOLUME METHOD FOR CONVECTION AND DIFFUSION	9

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

UNIT IV	FLOW FIELD ANALYSIS	9

Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – 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 – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	On completion of this course, students will be able toDerive governing equations of fluid

	dynamics by applying different boundary conditions.
2.	To enable the student understand finite difference and volume methods for diffusion.
3.	Apply finite volume method to solve convection diffusion problems.
4.	Learn the concept of flow field analysis.
5.	Creating different turbulence models and grid generation.
TEXT BOOKS:	
1.	Versteeg, H.K., and Malalasekera, W., "**An Introduction to Computational Fluid Dynamics: Thefinite volume method**", Pearson Education Ltd. 2nd Edition, 2007.
2.	Ghoshdastidar, P.S**., "Computer Simulation of flow and heat transfer**", Tata McGraw Hill Publishing Company Ltd., 1998.
3.	Anil W. Date, **"Introduction to computational fluid dynamics",**Cambridge University Press, Cambridge, 2009.
REFERENCES:	
1.	*Patankar, S.V. **"Numerical Heat Transfer and Fluid Flow",** Hemisphere Publishing Corporation,2004.*
2.	*Chung, T.J. **"Computational Fluid Dynamics",** Cambridge University, Press, 2002.*
3.	*Ghoshdastidar P.S., **"Heat Transfer",** Oxford University Press, 2005*
4.	*Muralidhar, K., and Sundararajan, T., **"Computational Fluid Flow and Heat Transfer",**NarosaPublishing House, New Delhi, 1995.*
5.	*Suhas.V. Patankar, **"Numerical Heat Transfer and Fluid Flow",** Hemisphere Publishing Corporation, 2009.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**									**1**	**2**	**2**	
CO2	**3**	**3**	**2**									**1**	**2**	**2**	
CO3	**3**	**3**	**2**									**1**	**2**	**2**	
CO4	**3**	**3**	**2**									**1**	**2**	**2**	
CO5	**3**	**3**	**2**									**1**	**2**	**2**	
Average	**3**	**3**	**2**									**1**	**2**	**2**	
Round off	**3**	**3**	**2**									**1**	**2**	**2**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE021	DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students to study the various factors influencing the manufacturability of components and the use of tolerances in manufacturing.
- To discover the application of this study to various forging, casting, welding and machining Processes.
- To help the students to design features to facilitate machining.
- To make the students to design features to facilitate casting.
- To help the students to design the components by considering environmental factors.

UNIT I	DESIGN PRINCIPLES FOR MANUFACTURABILITY	9

General design principles for manufacturability – strength and mechanical factors, mechanisms selection, evaluation method, process capability – feature tolerances–geometric tolerances – assembly limits –datum features – tolerance stacks.

UNIT II	FACTORS INFLUENCING FORM DESIGN	9

Working principle, material, manufacture, design- possible solutions - materials choice -influence of materials on form design - form design of welded members, forgings andcastings.

UNIT III	COMPONENT DESIGN - MACHINING	9

Design features to facilitate machining - drills - milling cutters - keyways – doweling procedures, counter sunk screws - reduction of machined area- simplification by separation - simplification by amalgamation - design for machinability - design foreconomy - design for clampability - design for accessibility - Design for assembly – Product design for manual assembly - Product design for automatic assembly – Robotic assembly.

UNIT IV	COMPONENT DESIGN - CASTING	9

Redesign of castings based on parting line considerations - minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification ofuneconomical design - modifying the design - group technology.

UNIT V	DESIGN FOR ENVIRONMENT	9

Introduction – environmental objectives – global issues – regional and local issues – basic DFE methods – design guidelines – lifecycle assessment method – techniques to reduce environmental impact –design for energy efficiency – design to regulations andstandards. Introduction to Green manufacturing.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Learn different principles of design for manufacture.
2.	Explore the various factors which are influencing the form design.

3.	Analyzing design for different aspects.
4.	Explore the components design involved in casting.
5.	Create the components which are best suited for environment.
TEXT BOOKS:	
1.	Robert Matousek, **" Engineering Design- A systematic approach"** , Blackie& Sons ltd., 1963.
2.	Harry Peck, **"Design for Manufacture"**, Pitman Publishers, 1983.
3.	O. Molloy, E.A. Warman, S. Tilley, **"Design for manufacture assembly",** Springer Science & Business Media. 1998.
REFERENCES:	
1.	*Bralla, **"Design for Manufacture handbook**, McGraw hill, 1999.*
2.	*Boothroyd, G, "Design for Assembly Automation and Product Design". New York, Marcel Dekker, 1980.*
3.	*Swift, K.G., **"Knowledge Based Design for Manufacture",**Kogan Page Ltd., 1987.*
4.	*Alan Redford and Chal, **"Design for Assembly-Principles and Procedures",** McGraw Hill International Europe, London, 1994.*
5.	*James G.Bralla, **"Hand Book of Product design for Manufacturing",** McGraw Hill Co., 1986.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**2**	**2**			**2**	**2**	**2**					**1**	**2**	**2**	
CO2	**2**	**2**			**2**	**2**	**2**					**1**	**2**	**2**	
CO3	**2**	**2**			**2**	**2**	**2**					**1**	**2**	**2**	
CO4	**2**	**2**			**2**	**2**	**2**					**1**	**2**	**2**	
CO5	**2**	**2**			**2**	**2**	**2**					**1**	**2**	**2**	
Average	**2**	**2**			**2**	**2**	**2**					**1**	**2**	**2**	
Round off	**2**	**2**			**2**	**2**	**2**					**1**	**2**	**2**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE022	NANO TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students to understand fundamental principles of nanomaterials.
- To understand various properties of nanomaterials.
- To familiarise the characterisation techniques of nanomaterials.
- To gain knowledge on various fabrication techniques.
- To explore various applications of nanomaterials.

UNIT I	FUNDAMENTAL PRINCIPLES	9

Definition, classification of functional nano materials - size and scale - units, scaling laws, atoms, molecules and clusters, supra molecules – nano scale phenomena - tunneling, chemical bonds, intermolecular forces, molecular and crystalline structure, hierarchical structures and functionalities - surfaces and interfaces, bulk to surface transition, self-assembly and surface reconstruction.

UNIT II	PROPERTIES OF NANOMATERIALS	9

Size dependence of properties - phenomena and properties of nanoscale - brief introduction to calculation approaches -mechanical / frictional properties, optical properties, electrical transport, magnetic properties.

UNIT III	NANOMATERIAL CHARACTERISATION	9

Principle, equipment, operation of Scanning electron microscopy, electron probe microscope, transmission electron microscopy, Auger electron spectroscopy, , x-ray spectroscopy.

UNIT IV	SYNTHESIS OF NANOMATERIALS	9

Fabrication techniques: self-assembly, self-replication, sol - gels, Langmuir - Blodgett thin films, nano lithography – bio inspired synthesis, micro fluidic processes, chemical vapour deposition metals: colloidal gold, silver and metal clusters - semiconductors: cadmium sulphide, silicon - fullerines / carbon nanotubes, nanocomposites, nanoporous materials, biological materials.

UNIT V	APPLICATIONS OF NANOMATERIALS	9

Nano electronics - nano sensors - environmental - biological - energy storage and fuel cells – energy and environment, heating and medical.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Understand the fundamental principles of nanomaterials.
2.	Learn various properties of nanomaterials.
3.	Get knowledge on characterisation techniques of nanomaterials.
4.	Explore various fabrication techniques
5.	Get knowledge various applications of nanomaterials.

TEXT BOOKS:	
1.	*Guozhongcao, **"Nano Structured and Nano Materials"**, Imperial College Press, 2006.* *Reference Books*
2.	Chris Binns, **"Introduction to Nanoscience and Nanotechnology",** Wiley, 1st edition, 2011.
3.	Jeremy Ramsden ,**"Nanotechnology: An Introduction",** William Andrew, 1st edition,2011.
REFERENCES:	
1.	*Gabor L. Hornyak, John J. Moore, H.F. Tibbals, **"Fundamentals of Nanotechnology",** CRC Press; 1 edition -2008*
2.	*Bharat Bhushan, **"Handbook of Nanotechnology",** Springer, 2004.*
3.	*Nalwa H.S., **"Handbook of Nano Structured Materials and Nano Technology", Vol. I – V,** Academic Press,*
4.	*Edelstein A.S. and Cammarata R.C., **"Nanomaterials – Synthesis, Properties and Applications"**, Institute of Physics Publishing, London, 1998.*
5.	*Dreselhaus M.S., Dreselhaus G., and Eklund P., **"Science of Fullerines and Nano Tubes**, Academic Press, 1996.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**									**1**	**2**	**2**	
CO2	**3**	**3**	**2**									**1**	**2**	**2**	
CO3	**3**	**3**	**2**									**1**	**2**	**2**	
CO4	**3**	**3**	**2**									**1**	**2**	**2**	
CO5	**3**	**3**	**2**									**1**	**2**	**2**	
Average	**3**	**3**	**2**									**1**	**2**	**2**	
Round off	**3**	**3**	**2**									**1**	**2**	**2**	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE023	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To facilitate the understanding of quality management principles and process.
- To understand needs of various TQM principles.
- To acquire knowledge on TQM tools and techniques.
- To implement and assure Quality in Management.
- To acquire knowledge about various quality standards

UNIT I	INTRODUCTION	9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, and Customer retention - Costs of quality.

UNIT II	TQM PRINCIPLES	9

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal- Continuous process improvement - PDCA 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, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV	TQM TOOLS AND TECHNIQUES II	9

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) -Taguchi quality loss function - Total Productive Maintenance (TPM) - Concepts, improvement needs - Performance measures -TQM and TPM similarities.

UNIT V	QUALITY SYSTEMS	9

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing -QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors.

TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Explore the various philosophies of TQM.
2.	Learn the various types TQM principles.
3.	Analyse the quality of seven tools and types of FMEA.
4.	Evaluate about control chart, TPM and QFD.

5.	Explore the international standards and TQM implementation.
TEXT BOOKS:	
1.	Dale H. Besterfiled, Et At., **"Total Quality Management",**Third Edition, Pearson Education Asia, Indian Reprint, 2006.
2.	Poornima M. Charantimath, **"Total Quality Management",** 2nd Edition, Pearson Publications, 2003
3.	L. Suganthi, Anand A. Samuel, **"Total Quality Management",** PHI Learning Pvt. Ltd. New Delhi, 2011.
REFERENCES:	
1.	*James R. Evans and William M. Lindsay, **"The Management and Control of Quality",** 8th Edition, First Indian Edition, Cengage Learning, 2012.*
2.	*Suganthi.L and Anand Samuel, **"Total Quality Management",** Prentice Hall. Ltd.,2006.*
3.	*Janakiraman. B and Gopal .R.K**., "Total Quality Management - Text and Cases",** Prentice Hall(India) Pvt. Ltd., 2006.*
4.	*R. S. Naagarazan,**"Total Quality Management",** New Age International, 2005.*
5.	*Jens J. Dahlgaard, Ghopal K. Khanji, Kai Kristensen **"Fundamentals of Total Quality Management",** Taylor and Francis, 2002.*

MAPPING OF COs, POs AND PSOs:															
	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**1**	**1**				**2**	**2**	**2**			**2**	**1**	**1**	**1**	**1**
CO2	**1**	**1**				**2**	**2**	**2**			**2**	**1**	**1**	**1**	**1**
CO3	**1**	**1**				**2**	**2**	**2**			**2**	**1**	**1**	**1**	**1**
CO4	**1**	**1**				**2**	**2**	**2**			**2**	**1**	**1**	**1**	**1**
CO5	**1**	**1**				**2**	**2**	**2**			**2**	**1**	**1**	**1**	**1**
Average	**1**	**1**				**2**	**2**	**2**			**2**	**1**	**1**	**1**	**1**
Round off	**1**	**1**				**2**	**2**	**2**			**2**	**1**	**1**	**1**	**1**
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MPE024	OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students to know the various unconstrained optimization techniques.
- To familiarise the constrained optimization techniques.
- To impart knowledge on advanced optimization techniques.
- To design various static applications.
- To explore different dynamic applications.

UNIT I	UNCONSTRAINED OPTIMIZATION TECHNIQUES	9

Introduction to optimum design - General principles of optimization – Problem formulation & their classifications - Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden section, Random, pattern and gradient search methods – Interpolation methods.

UNIT II	CONSTRAINED OPTIMIZATION TECHNIQUES	9

Optimization with equality and inequality constraints - Direct methods – Indirect methods using penalty functions, Lagrange multipliers - Geometric programming.

UNIT III	ADVANCE OPTIMIZATION TECHNIQUES	9

Multi stage optimization – dynamic programming; stochastic programming; Multi objective optimization, Genetic algorithms and Simulated Annealing techniques; Neural network &Fuzzy logic principles in optimization.

UNIT IV	STATIC APPLICATIONS	9

Structural applications – Design of simple truss members - Design applications – Design of simple axial, transverse loaded members for minimum cost, weight – Design of shafts and torsional Loaded members – Design of springs.

UNIT V	DYNAMIC APPICATIONS	9

Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms – Optimum design of simple linkage mechanisms.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Compare different unconstrained optimization techniques.
2.	Learn the constrained optimization techniques.
3.	Gain knowledge about advanced optimization techniques.
4.	Design and analyse various static applications.
5.	Design and analyse various dynamic applications.

TEXT BOOKS:	
1.	Rao, Singaresu, **S., "Engineering Optimization – Theory & Practice",** New Age International (P) Limited, New Delhi, 2000.
2.	Chander Mohan, Kusum Deep, **"Optimization Techniques",**New Age Science, 2009.
3.	A. K. Malik, S. K. Yadav, S. R. Yadav**, "Optimization Techniques",** I.K. International Publishing House Pvt. Limited, 2012.
REFERENCES:	
1.	*K. Deb, "**Optimization for Engineering Design Algorithms and Examples",** Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.*
2.	*L. R. Foulds, **"Optimization Techniques: An Introduction",** Springer, 1981.*
3.	*Cornelius T. Leondes, **"Optimization Techniques",** Academic Press; 1st edition (9 February 1998).*
4.	*Goldberg, D.E., **"Genetic algorithms in search, optimization and machine",**Barnen, Addison- Wesley, New York, 1989.*
5.	*Johnson Ray, C., **"Optimum design of mechanical elements",** Wiley, John & Sons, 1990.*

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2			1								2	2	
CO2	2	2			1								2	2	
CO3	3	2			1								2	2	
CO4	2	2			1								2	2	
CO5	2	2			1								2	2	
Average	2	2			1								2	2	
Round off	2	2			1								2	2	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MOE001	ENGINEERING ECONOMICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students to understand the fundamental economic concepts.
- To acquire basic knowledge on value engineering.
- To learn the different cash flow techniques.
- To acquire basic knowledge on different types of replacement and maintenance analysis.
- To learn the different depreciation methods.

UNIT I	INTRODUTION TO ECONOMICS	9

Introduction to Economics- Flow 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 - V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

UNIT II	VALUE ENGINEERING	9

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.

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.

TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Explore the different engineering economic principles.

2.	Explain the concept of time value of money
3.	Explain the concept of cash flow.
4.	Understand the type of replacement and maintenance analysis.
5.	Decide when to replace an asset and understand the concept of depreciation.

TEXT BOOKS:	
1.	Sasmita Mishra, **"Engineering Economics and Costing"** Eastern economy Edition, 2009.
2.	Panneer Selvam, R, **"Engineering Economics"**, Prentice Hall of India Ltd, New Delhi, 2001
3.	Ernest Dale, **"Management Theory and Practice"**, International Student Edition, McGraw Hill Publishing Co., New Delhi, 1973.

REFERENCES:	
1.	*Richard Pettinger, **"Mastering Organizational Behaviour"**, Macmillan Press,London, 2000.*
2.	*Chandran J. S, **"Organizational Behaviours"**, Vikas Publishing House Pvt. Ltd.,New Delhi, 1994.*
3.	*Gail Freeman - Bell and Janes Balkwill, "**Management in Engineering – Principles and Practive**", Prentice Hall of India Pvt.Ltd., 1998.*
4.	*Barathwal. R. R, "**Engineering Economics**", McGraw Hill, 1997.*
5.	*Zahid A khan: Engineering Economy, "**Engineering Economy**", Dorling Kindersley,2012*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1						**2**	**2**				**2**				**2**
CO2						**2**	**2**				**2**				**2**
CO3						**2**	**2**				**2**				**2**
CO4						**2**	**2**				**2**				**2**
CO5						**2**	**2**				**2**				**2**
Average						**2**	**2**				**2**				**2**
Round off						**2**	**2**				**2**				**2**

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MOE002	INDUSTRIAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain about various production system and various layouts.
- To explain and provides knowledge on Process Planning and Control.
- To discuss on various types of work study and work measurement.
- To discuss on various Inventory control techniques and material handling techniques.
- To explain the concept of system analysis and maintenance.

UNIT I	PRODUCTION SYSTEM	9

Industrial engineering - Concept, History and development, Applications, Roles of Industrial engineer. Production management, Industrial engineering versus production management, Operations Management. Production system – Analysis, Input output model, Productivity, Factors affecting productivity. Plant layout, Process layout, Product layout, Combination layout, fixed position layout, Flow pattern, and Workstation design

UNIT II	PROCESS PLANNING AND CONTROL	9

Process planning – definition, procedure, Process selection, Machine capacity, process sheet, process analysis, process chart – symbols, outline process chart, flow process chart. Group technology – functional and group layout, classification and coding system, formation of component family. Production planning, economic batch quantity, loading, scheduling. Production control – dispatching, routing. Progress control – bar, curve, gantt chart, route & schedule chart, line of balance

UNIT III	WORK STUDY	9

Work study – definition, need, advantages, objectives of method study and work measurement, method study procedure, flow diagram, string diagram, multiple activity chart, operation analysis, analysis of motion, principles of motion economy, design of work place layout & ergonomics, therbligs, SIMO chart, stop watch procedure, micro & macro motion study. Predetermined motion time system, work sampling – principle, procedure.

UNIT IV	INVENTORY MANAGEMENT	9

Inventory – control, classification, management, objectives, functions. Economic order quantity, inventory models, ABC analysis, Material Requirement Planning(MRPI), Manufacturing Resource Planning(MRP II), Operating cycle, Just in Time manufacturing system, KANBAN technique, lean manufacturing, Supply chain management. Material handling – functions, principles, Engineering and economic factors, Material handling equipment – selection, maintenance, types.

UNIT V	SYSTEM ANALYSIS AND MAINTENANCE	9

System concept - system analysis, systems engineering, techniques, applications. Value analysis – aim, technique, procedure, advantages, value engineering, value control, types of values. Re-engineering, Business process re-engineering. Plant maintenance – objectives, importance, maintenance engineer – duties, functions and responsibilities. Types – breakdown, scheduled, preventive, predictive.

	TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Design of Plant layout and material handling system.
2.	Prepare production planning and control activities such as work study, product planning, production scheduling, Inventory Control.
3.	Explain the ergonomics of manufacturing.
4.	Define the productivity management system and inventory management.
5.	Explain the system analysis and maintenance.
TEXT BOOKS:	
1.	O. P. Khanna, "**Industrial Engineering and Management",** Dhanpat Rai and Sons, New Delhi, 2008
2.	Samuel Eilon, "**Elements of Production Planning and Control",** McMillan and Co., Digitized, 2007.
3	Martand Telsang, "**Industrial Engineering and Production Management**", First edition,S. Chand and Company, 2000
REFERENCES:	
1.	J. A. Tompkins and J. A. White, "**Facilities planning"**, John Wiley, 2010.
2.	Benjamin W. Neibel, "**Motion and time study"**, Richard .D .Irwin Inc., 2006.
3.	Hamdy M. Taha, "**Operations Research, an Introduction"**, McMillan Co.,2008.
4.	Lee J. Krajewski, Larry P.Ritaman, "**Operations Management"**, Addison Wesley,2007.
5.	Ravi Shankar, "**Industrial Engineering and Management**", Golgotia Publications Pvt Ltd, NewDelhi, 2009.

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1						**2**	**2**	**2**		**2**	**2**				**2**
CO2						**2**	**2**	**2**		**2**	**2**				**2**
CO3						**2**	**2**	**2**		**2**	**2**				**2**
CO4						**2**	**2**	**2**		**2**	**2**				**2**
CO5						**2**	**2**	**2**		**2**	**2**				**2**
Average						**2**	**2**	**2**		**2**	**2**				**2**
Round off						**2**	**2**	**2**		**2**	**2**				**2**

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MOE003	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop and strengthen entrepreneurial quality and motivation in students.
- To impart basic entrepreneurial skills and understanding to run a business efficiently.
- To understand the various business world.
- To acquire the knowledge of finance and accounting.
- To understand the growth Strategies in small industry.

UNIT I	ENTREPRENEURSHIP	9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and entrepreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II	MOTIVATION	9

Major motives influencing an Entrepreneur – Achievement motivation training, Self-rating, Business games, 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	FINANCING AND ACCOUNTING	9

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, and Management of working Capital, Costing, Break Even Analysis, and Taxation – Income Tax, Excise Duty – Sales Tax, GST.

UNIT V	SUPPORT TO ENTREPRENEURS	9

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Gain knowledge and skills needed to run a business successfully.
2.	Apply motivation concept in all types of business.
3.	Analyse the business strategies.
4.	Apply the cost analysis and various taxation systems to real life problem.
5.	Know the government policies for small enterprises.

TEXT BOOKS:	
1.	Khanka. S.S., **"Entrepreneurial Development"** S.Chand & Co. Ltd., Ram Nagar, New Delhi,2013.
2.	Donald F Kuratko, **"Entreprenuership – Theory, Process and Practice",** 9th Edition, CengageLearning, 2014.
3.	S. Anil Kumar, **"Entrepreneurship Development",** New Age International Pvt. Ltd.2003.
REFERENCES:	
1.	*Hisrich R D, Peters M P, **"Entrepreneurship"** 8th Edition, Tata McGraw-Hill, 2013.*
2.	*Mathew J Manimala, **"Enterprenuership theory at cross roads: paradigms and praxis",** 2nd Edition Dream tech, 2005.*
3.	*Rajeev Roy, **"Entrepreneurship",**2nd Edition, Oxford University Press, 2011.*
4.	***"Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development",**2nd Edition, Institute of India, Ahmadabad, 1986.*
5.	*Ramachandran**, "Enterprenuership Development",** Tata McGraw-Hill Publishing company Ltd. New Delhi, 2009*

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1						**2**	**2**	**2**			**2**				**2**
CO2						**2**	**2**	**2**			**2**				**2**
CO3						**2**	**2**	**2**			**2**				**2**
CO4						**2**	**2**	**2**			**2**				**2**
CO5						**2**	**2**	**2**			**2**				**2**
Average						**2**	**2**	**2**			**2**				**2**
Round off						**2**	**2**	**2**			**2**				**2**

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MOE004	ELEMENTS OF PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the students to have overall view of project management techniques.
- To introduce students to project definition, management techniques, planning and scheduling.
- To understand the commercial aspects of projects.
- To apply project management principles in business situations to optimize resource utilization.
- To apply project management principles to time optimization.

UNIT I	PROJECT MANAGEMENT DEFINITIONS	9

Project Management – Definition –Goal - Lifecycles. Project Selection Methods. Project Portfolio Process – Project Formulation. Project Manager – Roles- Responsibilities and Selection – Project Teams.

UNIT II	PLANNING AND BUDGETING	9

The Planning Process – Work Break down Structure – Role of Multidisciplinary teams. Budget the Project – Methods. Cost Estimating and Improvement. Budget uncertainty and risk management.

UNIT III	SCHEDULING & RESOURCE ALLOCATION	9

PERT & CPM Networks - Crashing – Project Uncertainty and Risk Management – Simulation – Gantt Charts – Expediting a project – Resource loading and levelling. Allocating scarce resources - Goldratt's Critical Chain.

UNIT IV	CONTROL AND COMPLETION	9

The Plan-Monitor-Control cycle – Data Collecting and reporting – Project Control – Designing the control system. Project Evaluation, Auditing and Termination.

UNIT V	PROJECT ORGANISATION & CONFLICT MANAGEMENT	9

Formal Organisation Structure – Organisation Design – Types of project organizations. Conflict – Origin & Consequences. Managing conflict – Team methods for resolving conflict.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Demonstrate the core philosophy of project management.
2.	Explain concepts of planning, budgeting, scheduling & resource allocation.
3.	Possess the knowledge of project management techniques.
4.	Apply project management principles in business situations to optimize resource utilization and time optimization.

5.	Explore commercial and legal aspects of projects.
TEXT BOOKS:	
1.	Clifford Gray and Erik Larson, "**Project Management**", Tata McGraw Hill Edition, 2005.
2.	John M. Nicholas, "**Project Management for Business and Technology - Principles and Practice**", Second Edition, Pearson Education, 2006.
3.	Grag and Lawron, (2006), "**Project Management**", Tata McGraw Hill.
REFERENCES:	
1.	*Reck and Crane, (2000), "**Project Management**", Wiley Eastern.*
2.	*Gido and Clements, "**Successful Project Management**", Second Edition, Thomson Learning, 2003.*
3.	*Harvey Maylor, "**Project Management**", Third Edition, Pearson Education, 2006.*
4.	*Morris and Pritco, (2004), "**Managing Projects**", Wiley Eastern.*
5.	*Dennis Locke, (2000), "**Project Management**", Gower.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1						**2**	**2**	**2**			**2**				**2**
CO2						**2**	**2**	**2**			**2**				**2**
CO3						**2**	**2**	**2**			**2**				**2**
CO4						**2**	**2**	**2**			**2**				**2**
CO5						**2**	**2**	**2**			**2**				**2**
Average						**2**	**2**	**2**			**2**				**2**
Round off						**2**	**2**	**2**			**2**				**2**

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MOE005	NON DESTRUCTIVE TESTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study and understand the various Non-Destructive Evaluation and Testing methods.
- To learn the theory and industrial applications of NDT.
- To understand the concepts of thermography, eddy current testing and surface NDT methods.
- To obtain the knowledge on Ultrasonic testing and Acoustic Emission.
- To explore the principles of radiography.

UNIT I	OVERVIEW OF NDT	9

Non-Destructive Testing Versus Mechanical testing, Overview of NDT Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT – Unaided and aided visual inspection.

UNIT II	SURFACE NDE METHODS	9

Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT III	THERMOGRAPHY AND EDDY CURRENT TESTING	9

Thermography- Principles, Contact and non-contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT IV	ULTRASONIC TESTING AND ACOUSTIC EMISSION	9

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A-Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications.

UNIT V	INTRODUCTION TO SMART MATERIALS	9

Introduction to smart materials - classifications - smart sensors and actuators - direct and reverse effects of piezoelectric materials, shape memory alloys, electro/magneto rheological fluids and magnetostrictive materials - applications.

	TOTAL : 45 PERIODS
OUTCOMES:	On completion of this course, students will be able to
1.	Explore the need of Non-Destructive Testing methods.
2.	Explain the surface NDT methods.
3.	Apply the principles and operation of Thermography and Eddy current testing.
4.	Analysing the Ultrasonic testing and Acoustic Emission.
5.	Gain the knowledge about smart materials and applications
TEXT BOOKS:	
1.	Baldev Raj, T. Jayakumar, M. Thavasimuthu,**"Practical Non-Destructive Testing"**, Narosa Publishing House, 2009.
2.	Ravi Prakash, **"Non-Destructive Testing Techniques",** 1st revised edition, New Age International Publishers, 2010
3.	Jayamangal Prasad, C. G. Krishnadas Nair,**"Non-Destructive Test And Evaluation Of Materials",** Tata McGraw-Hill Publishing Company Ltd. 2008.
4.	Inderjit Chopra, **"Smart Structures Theory**" Cambridge University press 2014.
REFERENCES:	
1.	*ASM Metals Handbook, **"Non-Destructive Evaluation and Quality Control",** American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.*
2.	*Paul E Mix**, "Introduction to Non-destructive testing: a training guide",** Wiley, 2nd Edition New Jersey, 2005.*
3.	*Charles, J. Hellier, **"Handbook of Nondestructive evaluation"**, McGraw Hill, New York 2001.*
4.	*Barry Hull, Vernon John "**Non-Destructive Testing",** Springer, 1988.*
5.	*Amandeep Singh Wadhwa, Er. Harvinder Singh **"A Textbook of Engineering Material and Metallurgy"**, Laxmi Publications, 1st edition 2015.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1										3	12	
CO2	3	2	1										3	2	
CO3	3	2	1										3	2	
CO4	3	2	1										3	2	
CO5	3	2	1										3	2	
Average	3.0	2.0	1										3.0	2	
Round off	3	2	1										3	2	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MOE006	INTRODUCTION TO AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the construction and working principle of various parts of an automobile.
- To understand assembling and dismantling of engine parts and transmission system.
- To broaden the understanding of automotive architecture and performance.
- To introduce students about the transmission system.
- To familiarize about the wheels, tires, and automotive air conditioning.

UNIT I	VEHICLE STRUCTURE AND ENGINES	9

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines – Types - components functions and materials - variable valve timing (VVT).

UNIT II	ENGINE AUXILIARY SYSTEMS	9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT III	TRANSMISSION SYSTEMS	9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT IV	STEERING, BRAKES AND SUSPENSION SYSTEMS	9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT V	AUTOMOTIVE AIR CONDITIONING, WHEELS, TIRES AND ALTERNATIVE ENERGY SOURCES	9

Automotive air conditioning - Wheels and tires: Wheel quality, assembly, types of wheels, wheel rims, Construction of tires and tire specifications - Alternative Energy sources: Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell.

TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Identify the different components in vehicle structures and engines.

2.	Evaluating the various engine auxiliary systems.
3.	Understand components of transmission systems.
4.	Learn the functions of steering, suspension, braking systems, wheels and tires.
5.	Analysing performance, combustion and emission characteristics of alternative fuels
TEXT BOOKS:	
1.	Kirpal Singh, **"Automobile Engineering**", Vol. 1 & 2, Seventh Edition, Standard Publishers, NewDelhi, 1997.
2.	Jain K.K. and Asthana .R.B, **"Automobile Engineering"** Tata McGraw Hill Publishers, NewDelhi, 2002.
3.	Ramalingam, K. K, **"Automobile Engineering",** Scitech Publications, 2014.
REFERENCES:	
1.	*Newton, Steeds and Garet, **"Motor Vehicles",** Butterworth Publishers, 1989.*
2.	*Joseph Heitner, **"Automotive Mechanics",** Second Edition, East-West Press, 1999.*
3.	*Martin W, Stockel and Martin T Stockle, **"Automotive Mechanics Fundamentals",** The Goodheart –Will Cox Company Inc, USA, 1978.*
4.	*Heinz Heisler, **"Advanced Engine Technology",** SAE International Publications USA, 1998*
5.	*Ganesan V. **"Internal Combustion Engines",** Third Edition, Tata McGraw-Hill, 2007.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1										3	2	
CO2	3	2	1										2	3	
CO3	3	2	1										3	2	
CO4	3	2	1										3	2	
CO5	3	2	1										3	2	
Average	3.0	2.0	1										2.8	2.2	
Round off	3	2	1										3	2	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MOE007	INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students to understand basics of industrial automation.
- To explore various types of sensors and transducers.
- To get knowledge on electrical drives and machine vision system.
- To programme programmable logic controllers.
- To design simple mechatronics systems.

UNIT I	INTRODUCTION TO AUTOMATION	9

Industrial Automation - General Aspects – Advantages and Limitations of Automation –Application of Automation – Elements of Automation – Aims of Automation – Mechanisation and Automation – Types of Automation – Low Cost Automation – Assembly Automation Equipment .

UNIT II	SENSORS AND TRANSDUCERS	9

Introduction to sensors and transducers- classifications- Principle and working of Resistive, capacitive, inductive and resonant transducers- optical measurement systems-encoders, photo electric, vision sensor, Fiber optic transducers- solid state sensors and transducers-magnetic measurements, temperature measurements, Chemical measurements-piezoelectric – accelerometers - ultrasonic sensors and transducers- flow, distance, velocity measurements.

UNIT III	ELECTRICAL DRIVES AND MACHINE VISION	9

Electromagnetic Principles, Solenoids and Relays, Electrical drives -stepper motors, servo motors. Signal processing, A/D and D/A converters – Introduction to Data acquisition system - Proportional, Integral, Derivative and PID controller – Microcontroller. Introduction to machine vision system - Camera, Frame Grabber, Sensing and Digitizing Image Data- Lighting Techniques, Image Processing and Analysis, Applications.

UNIT IV	PROGRAMMABLE LOGIC CONTROLLERS	9

Programmable logic controller – Basic structure - Programming units - Memory – Input - Output Modules - Mnemonics – Latching- Timers – Internal relays - Counters – Shift Registers - Master and Jump Controls -Programming the PLC using Ladder diagram -Simple example of PLC application.

UNIT V	MECHATRONICS SYSTEM DESIGN AND APPLICATION	9

Mechatronics in Engineering Design, Traditional and mechatronics design, Applications - Pick and Place robots, Car park barriers, Bar code reader, Wind screen wiper wing stepper motor control– Traffic Control interface - IOT applications – Industry 4.0. Case studies: Coin counters, Robot walking machine.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1. Explain the key elements of automation.
2. Explore the Performance of commonly used sensors and transducers.

3.	Compare the different actuation systems, controllers and machine vision systems
4.	Understand the PLC and develop programs using ladder logic.
5.	Design the mechatronics systems for various applications.
TEXT BOOKS:	
1.	Bolton.W, **"Mechatronics"**, Addison Wesley, 4th Edition, New Delhi, 2010.
2.	Bradley.D.A, Dawson.D Burd N.C.and Loader A.J, **"Mechatronics"**, Chapman and Hall Publications, New York, 1993.
3.	Rajput R.K., **"Robotics and Industrial Automation"**, S.Chand and Company, 2008.
REFERENCES:	
1.	*Janakiraman P.A., **"Robotics and Image Processing"**, Tata Mc Graw Hill, 1995.*
2.	*David W. Pessen, **"Industrial Automation Circuit Design and Components"**, John Wiley, New York, 1990.*
3.	*Rohner.P, **"Automation with Programmable Logic Controllers"**, Macmillan /McGraw Hill, New York, 1996.*
4.	*Brian Morris, **"Automatic Manufacturing Systems Actuators, Controls and Sensors"**, McGraw Hill, New York, 1994.*
5.	*Jacob Fraden, **"Handbook of Modern Sensors Physics, Designs, and Applications"**, Third Edition, Springer-Verlag New York, 2004.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1										3	1	
CO2	3	2	1										3	1	
CO3	3	2	1										3	1	
CO4	3	2	1										3	1	
CO5	3	2	1										3	1	
Average	3.0	2	1										3.0	1	
Round off	3	2	1										3	1	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MOE008	INTRODUCTION TO COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the students to understand the properties and design of composite materials.
- To familiarize the different type of polymer matrix composites.
- To understand the various manufacturing techniques for metal matrix composites.
- To study the various manufacturing methods for ceramic matrix composites.
- To understand the geometrical aspects in Composite Materials.

UNIT I	INTRODUCTION TO REINFORCEMENT AND MATRIX INTERFACE	12

Reinforcement – Fibres – Glass fibre, Aramid fibre, Carbon fibre, boron fibre – Fabrication – Properties – Applications – Comparison of fibres – Particulate and whisker reinforcements. Matrix materials – Properties. Wettability – Effect of surface roughness – Interfacial bonding – Methods for measuring bond strength.

UNIT II	POLYMER MATRIX COMPOSITES	8

Types – Processing – Thermal matrix composites – Hand layup and spray technique, filament winding, Pultrution, resin transfer moulding, autoclave moulding – Thermoplastic matrix composites – Injection moulding, film stacking – Diaphragm forming – Thermoplastic tape laying. Glass fibre/polymer interface. Mechanical properties – Fracture. Applications.

UNIT III	METAL MATRIX COMPOSITES	8

Types. Important metallic matrices. Processing – Solid state, liquid state, deposition, insitu. Sic fibre / Titanium interface. Mechanical properties. Applications.

UNIT IV	CERAMIC MATRIX COMPOSITES	8

Ceramic matrix materials – Processing – Hot pressing, liquid infiltration technique, Lanxide process, insitu chemical reaction techniques – CVD, CVI, sol-gel process. Interface in CMCs. Mechanical properties – Thermal shock resistance – Applications.

UNIT V	GEOMETRICAL ASPECTS, FATIGUE AND CREEP IN COMPOSITE MATERIALS	9

Unidirectional laminas – Volume fraction and weight fraction – Woven roving, in-plane random fibres – Fibre length and fibre orientation distribution – Voids – Fibre orientation during flow. Fatigue – S-N curves – Fatigue behaviours of CMCs – Fatigue of particle and whisker reinforced composites – Hybrid composites – Thermal fatigue – Creep.

TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Analyse the fibre reinforced Laminate for optimum design.
2.	Explore the concepts of Polymer Matrix Composites.
3.	Discuss different Metal Matrix Composites properties and manufacturing process.

4.	Understand the different Ceramic Matrix Composites properties.
5.	Apply Fatigue and creep theory to study and analyse the Mechanical behaviour of Composites.
TEXT BOOKS:	
1.	Krishnan K Chawla, "**Composite Materials Science and Engineering**", Springer, 2001.
2.	Mathews F L and Rawlings R D, **"Composite Materials: Engineering and Science",** CRC Press and Woodhead Publishing Limited, 2002.
3.	Derek Hull, "**An introduction to Composite Materials**", Cambridge Univ. Press, 1988.
REFERENCES:	
1.	***"Handbook of Composites"*** *– American Society of Metals, 1990*
2.	*Gibson, R.F., "**Principles of Composite Material Mechanics",** Second Edition, McGraw-Hill, CRC press in progress, 1994.*
3.	Autar K. Kaw*, **"Mechanics of Composite Materials",** Second Edition, CRC Press, 2006*
4.	*Halpin, J.C.**, "Primer on Composite Materials, Analysis",** Technomic Publishing Co., 1984.*
5.	*Mallick, P.K. and Newman, S., **"Composite Materials Technology: Processes and Properties"**, Hansen Publisher, Munish, 1990.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	2										3	2	
CO2	3	2	2										3	1	
CO3	3	2	2										3	2	
CO4	3	2	2										3	1	
CO5	3	3	1										3	2	
Average	3.0	2.2	1.8										3.0	1.6	
Round off	3	2	2										3	2	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MOE009	INDUSTRIAL REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students to understand vapour compression and vapour absorption system Operation.
- To analyse the refrigeration cycles and methods for improving Performance.
- To acquire the knowledge on components of refrigeration systems.
- To design air conditioning systems using cooling load calculations.
- To explore the application of refrigeration and air conditioning systems.

UNIT I	INTRODUCTION	9

Introduction to Refrigeration and Air conditioning and its Practical applications - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT II	VAPOUR COMPRESSION REFRIGERATION SYSTEM	9

Vapour compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – sub cooling and super heating- effects of condenser and evaporator pressure on COP- multi pressure system – low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT III	OTHER REFRIGERATION SYSTEMS	9

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic -Vortex and Pulse tube refrigeration systems.

UNIT IV	PSYCHOMETRIC PROPERTIES AND PROCESSES	9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature, Thermodynamic wet bulb temperature, Psychometric chart, Psychometric of air-conditioning processes, mixing of airstreams.

UNIT V	AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION	9

Air conditioning loads- Outside and inside design conditions- Heat transfer through structure- Solar Radiation- Electrical appliances- Infiltration and ventilation- internal heat load-Apparatus selection-fresh air load-Human comfort & IAQ principles- effective temperature & chart-calculation of summer &winter air conditioning load- Classifications- Layout of plants- Air distribution system- Filters- Air-conditioning Systems with Controls- Temperature, Pressure and Humidity sensors, Actuators &Safety controls.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to	
1.	Analyse different refrigeration systems, air conditioning systems and refrigerants.
2.	Understand the applications of refrigeration and air conditioning systems.
3.	Learn the components and working of refrigeration and air conditioning systems
4.	Evaluate different psychometric properties and processes.
5.	Perform heating and cooling load calculations.
TEXT BOOKS:	
1.	Arora, C. P., "Refrigeration and Air Conditioning", 3rd ed., McGraw Hill, Delhi, 2010.
2.	Manohar Prasad., "Refrigeration and Air Conditioning", 2nd ed., New Age Int., 2011.
3.	Dick Wirz"Commercial Refrigeration for Air Conditioning Technicians" 3rd ed., Cengage learning 2016.
REFERENCES:	
1.	*Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.*
2.	*Wilbert F Stoecker "Industrial Refrigeration" Handbook 1st Edition, McGraw Hill,1998.*
3.	*Ahmadul Ameen., "Refrigeration and Air Conditioning", 1st edition, prentice-hall of India Private limited New Delhi 2006.*
4.	*Jones W. P., "Air conditioning engineering", 5th edition,Elsevier Butterworth-Heinemann, 2001.*
5.	*Stoecker, W. F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	**1**										3	2	
CO2	3	2	**1**										3	2	
CO3	3	2	**1**										3	2	
CO4	3	2	**1**										3	2	
CO5	3	2	**1**										3	2	
Average	3.0	2	**1**										3.0	2	
Round off	3	2	**1**										3	2	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MOE010	RENEWABLE ENERGY SOURCES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To get exposure on solar radiation and its environmental impact to power.
- To acquire basic knowledge on wind energy.
- To acquire basic knowledge on Geothermal energy.
- To explore about energy from biomass.
- To explore various energy storage methods.

UNIT I	SOLAR ENERGY	10

Solar energy – Conversion and transfer of solar energy – Sun-Earth angles – Measurement of solar radiation – Solar thermal collectors – General description and characteristics – Flat plate collectors, Solar concentrators- Solar PV and thermal systems-quantitative analysis.

UNIT II	WIND ENERGY	9

Wind energy – Principles of wind energy conversion – Site selection considerations –Wind power plant design – Types of wind power conversion systems – Operation, maintenance and economics.

UNIT III	GEOTHERMAL ENERGY	9

Geothermal energy – Availability, system development and limitations – Ocean thermal energy conversion – Wave and tidal energy– Scope and economics – Introduction to integrated energy systems.

UNIT IV	ENERGY FROM BIOMASS	9

Energy from biomass – Sources of biomass- Conversion of biomass into fuels- Pyrolysis, gasification and combustion – Aerobic and anaerobic bio-conversion – Properties of biomass- Properties and characteristics of biogas.

UNIT V	ENERGY STORAGE TECHNOLOGY	8

Energy storage – Sensible heat storage – Liquid media storage – Solid media storage – Dual media storage – Phase change energy storage – Storage capacity – Other storage technology.

TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Expalin the physics of solar radiation.
2.	Examine wind energy with its economic aspects
3.	Inference the energy sources like Geothermal energies, Wave and tidal energy.
4.	Appreciate and analyse energy from biomass.
5.	Analyse various energy storage methods.

TEXT BOOKS:

1.	J.A. Duffie and W.A. Beckman., "**Solar Energy Thermal Processes**", J. Wiley, 1994
2.	G.D. Rai., "**Non-conventional Energy Sources**", Khanna Publishers, 2003
3.	F. Kreith and J.F. Kreider., "**Principles of Solar Engineering**", McGraw Hill, 1978
REFERENCES:	
1.	A.A.M. Saigh (Ed)., "**Solar Energy Engineering**", Academic Press, 1977.
2.	K.M. Mittal., "**Non-conventional Energy Systems-Principles, Progress and Prospects**", Wheeler Publications, 1997
3.	G.N. Tiwari., "**Solar Energy-Fundamentals, Design, Modelling and Applications"**, Narosa Publishers, 2002
4.	Kothari D.P, Singhal K.C., **"Renewable energy sources and emerging technologies",** P.H.I, New Delhi, 2010

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	2										3	2	
CO2	3	2	2										3	2	
CO3	3	2	2										3	2	
CO4	3	2	2										3	2	
CO5	3	2	2										3	2	
Average	3.0	2.0	2.0										3.0	2.0	
Round off	3	2	2										3	2	

20MOE011	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide in depth knowledge in Principles of Environmental safety and its applications in various fields
- To provide the knowledge of safety precaution, Control of fire and explosion
- To expose the students to the Health, Hygiene, noise and vibration in industry

UNIT I	PLANT DESIGN AND LAYOUT AND CITING CRITERIA:	9

General and Environmental guidelines, Meteorological aspect, and Separation distances. Need for planning and Follow-up, Plant layout and Design, Generals principles for factory building, Plant and equipment layout and fire protection. Statutory provisions under the factories Act 1948 and rules, Indian Standard and national building code.

UNIT II	FIRE AND EXPLOSION. FIRE PHENOMENA :	9

Chemistry of fire, Stage of fire, Factors contributing to fire, Classification of fire, Common cause of industrial fires. Fire prevention and protection system, Special safety precaution, Control of fire and explosion in handling / processing flammable liquids, gases, vapors, mists, dusts etc. Fire emergency action plan and control room. NFPA code and standard, on-site emergency plan, off-site emergency plan.

UNIT III	ELECTRICITY SAFETY, LIGHTING (ILLUMINATION) AND COLOUR:	9

Electricity, its usefulness and hazards, statutory provisions, Indian standard, Effect of Electrical parameters on human body, safety measures for electric work, over load and other protection, Lighting (illumination) and colour : Principles of illumination, Types of Light: Natural and artificial, direct and indirect, and types of installation, Effects of colour on safety.

UNIT IV	MACHINE GUARDING, NOISE AND VIBRATION:	9

Requirement of machine guarding, Indian standard, Principals of machine Guarding, Types and selection of guard, Mechanical Tool, Inspection, testing & Maintenance. Noise and Vibration : Generation, Perception, Nature & Types of noise, Effect & Hazards of noise and vibration, Statutory provisions, control Method.

UNIT V	INDUSTRIAL HEALTH AND HYGIENE:	9

Occupational health hazard, Introduction & classification of health hazards. Dangerous properties of chemicals, dust, gases, fume, mists, vapors, smoke and aerosols and their health effects. Routes of human entry system, recognition, evolution and control basic hazards, and bio chemical action of toxic substance and toxicity, type and degrees of toxic effects, threshold limits of exposure (TLV), STEL, IDLH, Ld/LC etc. Physiology of work and occupational diseases

	TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Illustrate and familiarize the basic concepts, scope of engineering safety and Plant Design and Layout and Citing criteria
2.	Develop Electricity safety, lighting (illumination) and colour in industry.

3.	Appraise the importance of safety of employees while working with machineries.
4.	Understand the Machine Guarding, Noise and Vibration in industry
5.	Measure Industrial Health and Hygiene
TEXT BOOKS:	
1.	Philip E. Hagan, John Franklin Montgomery, James T. O'Reilly, "**Accident Prevention Manual**", NSC, Chicago, 2009.
2.	Charles D. Reese, **"Occupational Health and Safety Management"**, CRC Press, 2003.
3.	John V. Grimaldi and Rollin H. Simonds, "**Safety Management"**, All India Travelers Book seller, New Delhi, 1989.
REFERENCES:	
1.	*John Davies, Alastair Ross, Brendan Wallace, **"Safety Management: A Qualitative Systems Approach",** CRC Press, 2003.*
2.	*Health and Safety in welding and Allied processes, welding Institute, UK, High Tech. Publishing Ltd., London, 1989.*
3.	*Anil Mital, **"Advances in Industrial Ergonomics and Safety**", Taylor and Francis Ltd, London, 1989*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	2			2	2	2					3	2	
CO2	3	2	2			2	2	2					3	2	
CO3	3	2	2			2	2	2					3	2	
CO4	3	2	2			2	2	2					3	2	
CO5	3	2	2			2	2	2					3	2	
Average	3.0	2.0	2.0			2.0	2.0	2.0					3.0	2.0	
Round off	3	2	2			2	2	2					3	2	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MOE012	RAPID PROTOTYPING AND TOOLING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the fundamental Theory behind RP process.
- To study the Process parameters of different machine.
- To study different types of Rapid tooling.
- To learn how to prepare manufacturing DATA based on the industrial standards,.
- To learn The basics concept of different software used in RP system.

UNIT I	FUNDAMENTALS OF RPT	9

Definitions, evolution, CAD for RPT. Product design and rapid product development. The cost and effects of design changes during conceptual modeling, detail designing, prototyping, manufacturing and product release. Fundamentals of RPT technologies, various CAD issues for RPT. RPT and its role in modern manufacturing mechanical design. 3D solid modeling software and their role in RPT. Creation of STL or SLA file from a 3D solid model.

UNIT II	LIQUID AND POWDER BASED RP PROCESSES	9

Liquid based process: Principles of STL and typical processes such as the SLA process, solid ground curing and others - Powder based process: Principles and typical processes such as selective laser sintering and some 3D printing processes.

UNIT III	SOLID BASED RP PROCESSES	9

Principles and typical processes such as fused deposition modeling laminated object Modeling, Paper Laminated Technology, Multi-jet modelling System, Slicing Solid Manufacturing, Melted Extrusion Modelling, Multi fuctional RPM

UNIT IV	RAPID TOOLING	9

Rapid tooling -Indirect rapid tooling, Silicon Robber tooling, Aluminum filling epoxy tooling, Spray metal tooling, Direct rapid tooling, Quick cast process, copper Polyamide, DMILS – explanation, Prometals, sand casting tooling, Soft tooling & hard tooling,

UNIT V	REVERSE ENGINEERING AND INDUSTRY 4.0	9

3D scanning, 3D digitizing and Data fitting, High speed machining- Hardware and software - Applications: Evaluation, bench marking and various case studies. Basics of Industry 4.0

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Describe product development, conceptual design and classify rapid prototyping systems
2.	Explain the process parameters of liquid and powder based RP processes
3.	Demonstrate solid based RP Processes
4.	Make use of different rapid tooling techniques.

5.	Discuss 3D scanning, digitizing and Data fitting and basics of industry 4.0
TEXT BOOKS:	
1.	Paul F. Jacobs: "**Stereo lithography and other RP & M Technologies**", SME, NY 1996.
2.	Flham D. T & Dinjoy S.S "**Rapid Manufacturing**" Verlog London 2001.
3.	Chua C.K, Leong K.F and Lim C.S, "**Rapid Prototyping: Principles and Applications**", Second Edition, World Scientific, 2003
REFERENCES:	
1.	*Rafiq I. Noorani, Rapid Prototyping, "**Principles and Applications**", Wiley & Sons, 2006.*
2.	*Gurumurthi, **"Rapid prototyping materials**", IISc Bangalore.*
3.	*N.Hopkinson, R.J.M, Hauge, P M, Dickens, "**Rapid Manufacturing** – An Industrial revolution for the digital age", Wiley, 2006*
4.	*Ian Gibson, "**Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototying**", Wiley, 2006*
5.	*Pham. D.T., and Dimov. S.S., "**Rapid Manufacturing**", Springer Verlog 2001.*

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	2										3	2	
CO2	3	2	2										3	2	
CO3	3	2	2										3	2	
CO4	3	2	2										3	2	
CO5	3	2	2										3	2	
Average	3.0	2.0	2.0										3.0	2.0	
Round off	3	2	2										3	2	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20MOE013	WELDING TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

•	To make the student to understand the basics of welding technology.
•	To understand welding techniques for various materials.
•	To learn the various resistance welding processes.
	To gain knowledge about solid state welding processes.
•	To acquire the knowledge of advanced welding techniques and testing of weldments.

UNIT I	INTRODUCTION	9

Introduction of welding - Classification of welding and joints - Parts of weld joint – Nomenclature and symbol of welding joints, Heat source intensity, Shielding methods, Cleaning of edges, Safety Recommendations in Welding, ISO related welding standards.

UNIT II	ARC WELDING PROCESSES	9

Shielded metal arc welding and Equipments, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electro-slag welding processes – Advantages- Limitations and Applications. Welding of Similar and Dissimilar Metals.

UNIT III	RESISTANCE WELDING PROCESSES	9

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes, Advantages- Limitations and Applications.

UNIT IV	SOLID STATE WELDING PROCESSES	9

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes, Advantages- Limitations and Applications.

UNIT V	OTHER WELDING PROCESSES AND WELDING DEFECTS AND INSPECTION	9

Thermit welding, Electron beam welding, Laser beam welding, Friction stir welding, Underwater Welding, Welding Defects and Inspection, Residual Welding Stresses, Stress Relief Heat Treatment of Weldments, Welding Distortion and methods to prevent.

TOTAL : 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1.	Compare different types of Welding processes.
2.	Analyse the principles of resistance welding processes.

3.	Understand the concept of solid state welding process.
4.	Analyses of weld defects.
5.	Learn different testing methods for weldment.

TEXT BOOKS:	
1.	Parmer R.S., **"Welding Engineering and Technology",** 1st edition, Khanna Publishers, NewDelhi, 2008.
2.	Parmer R.S., **"Welding Processes and Technology"**, Khanna Publishers, New Delhi, 1992.
3.	Little R.L., **"Welding and welding Technology"**, Tata McGraw Hill Publishing Co., Ltd., NewDelhi, 34th reprint, 2008.
REFERENCES:	
1.	*Schwartz M.M. **"Metals Joining Manual"**. McGraw Hill Books, 1979.*
2.	*Tylecote R.F. **"The Solid Phase Welding of Metals"**. Edward Arnold Publishers Ltd. London,1968.*
3.	*Nadkarni S.V. **"Modern Arc Welding Technology"**, 1st edition, Oxford IBH Publishers, 2005.*
4.	*Christopher Davis. **"Laser Welding- Practical Guide".**Jaico Publishing House, 1994.*
5.	*Davis A.C., **"The Science and Practice of Welding"**, Cambridge University Press, Cambridge,1993*

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	2										3	2	
CO2	3	2	1										3	2	
CO3	3	2	1										3	2	
CO4	3	2	3										3	3	
CO5	3	2	1										3	2	
Average	3.0	2.0	1.6										3.0	2.2	
Round off	3	2	2										3	2	
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20MOE014	HEATING, VENTILATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To enable students to understand the basic principles of refrigeration and refrigeration systems.
- To acquire basic knowledge on Air conditioning.
- To impart knowledge on Cooling load calculations
- To acquire basic knowledge on Heating systems.
- To acquire basic knowledge on Air conditioning equipments and control systems.

UNIT I	PRINCIPLES OF REFRIGERATION, REFRIGERATION SYSTEMS	9

Principles of refrigeration -- Carnot refrigeration cycle -- unit of refrigeration – capacity -- coefficient of performance. Refrigeration systems -- vapour compression system — system components – compressors – condensers – expansion devices – evaporators.

UNIT II	AIR CONDITIONING	9

Psychrometry – psychrometric processes – determination of condition of air entering conditioned space. Air conditioning systems – summer, winter and year-round-year air conditioning systems -- central and unitary systems.

UNIT III	COOLING LOAD CALCULATIONS	9

Cooling load calculations – various heat sources contributing heat load – solar load -- equipment load --infiltration air load -- duct heat gain -- fan load.

UNIT IV	REFRIGERANTS AND ITS IMPACTS	9

Classification of Refrigerants, Refrigerant properties, Oil Compatibility, Environmental Impact-Montreal / Kyoto protocols-Eco Friendly Refrigerants, alternatives to HCFCS, Secondary Refrigerants

UNIT V	AIR CONDITIONING EQUIPMENTS AND CONTROL SYSTEMS	9

Air conditioning equipments and control systems – air filters – humidifiers – fan – blowers – control systems for temperature and humidity – noise control. Testing for leakage, Cause for faults and rectification.

TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Apply refrigeration principles to real life problems
2.	Analyze the principles of Air conditioning.
3.	Apply cooling load calculations in real life applications.
4.	Explore the different types of heating systems.

5.	Explore the Air conditioning equipments and control systems
TEXT BOOKS:	
1.	Rex Milter, Mark R.Miller, **"Air conditioning and Refrigeration",** , McGraw Hill, 2006
2.	Noman C. Harris, "**Modern Air conditioning Practice**" -McGraw-Hill, 2nd Edition, 1974
3.	Arora, C.P., "**Refrigeration & Air conditioning**"- McGraw Hill, 2nd Edition, 2000
REFERENCES:	
1.	Stoecker, W.F., "**Principles of Air conditioning**", industrial press, 2nd Edition, 1977.
2.	Laub, J.M., "**Heating & air conditioning of buildings**", Holt, Rinehart and Winston, 1963.
3.	Kell, J.R., and Martin, P.L., "**Air conditioning & Heating of buildings**", Architectural Press, 6th Edition, 2007
4.	**Carrier's Handbook for Design of Unit Air Conditioners**, Kenrick Place Media Ltd, 14th edition, 1996

MAPPING OF COs, POs AND PSOs:

	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1		1				1		1	2	3	2	
CO2	3	2	1		1				1		1	2	3	2	
CO3	3	2	1		1				1		1	2	3	2	
CO4	3	2	1		1				1		1	2	3	2	
CO5	3	2	1		1				1		1	2	3	2	
Average	3	2	1		1				1		1	2	3	2	
Round off	3	2	1		1				1		1	2	3	2	

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation