Department of Mechanical Engineering

Programme Educational Objectives (PEOs):

DEPARTMENT VISION

To provide a world class Mechanical Engineering education through innovation and excellence in Teaching and Research.

DEPARTMENT MISSION

- To impart high quality technical education and develop Mechanical Engineers with all round knowledge of multi-disciplinary branches of engineering and technology.
- To foster skill sets required to be a global professional in the areas of industry, research and technology management.

PEO I

To provide students with sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, analyze and solve engineering problems and to prepare them for graduate studies and for successful careers in industry.

PEO II

To impart students with skills for design, improvement and installation of Mechanical and allied integrated systems of men and material.

PEO III

To educate the students on designing the modern mechanical systems and expose them to industrial practices for better employability and adaptability.

PEO IV

To instill the values, skills, leadership and team spirit for comprehensive and wholesome personality, to promote entrepreneurial interest among students and to create a fervor for use of Engineering in addressing societal concerns.

Program Outcomes (POs)

Engineering Graduates will be able to:

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, review 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 modeling 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. **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.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. To innovate a Mechanical System which meets the desired specifications and requirements using CAE tools.
2. To explore alternate materials for automobile, manufacturing and process industries
3. To lead professional career in industries or an entrepreneur by applying Engineering and Management principles and practices.

CURRICULUM AND SYLLABUS
B.E. MECHANICAL ENGINEERING
REGULATIONS 2017
CHOICE BASED CREDIT SYSTEM
CURRICULUM

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS17151	Communicative English	HS	3	3	0	0	3
2.	MA17151	Engineering Mathematics I	BS	5	3	2	0	4
3.	PH17151	Engineering Physics	BS	3	3	0	0	3
4.	CY17151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE17151	Problem Solving and Python Programming	ES	3	3	0	0	3
6.	GE17152	Engineering Graphics	ES	6	2	0	4	4
PRACTICALS								
7.	GE17161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8.	GE17162	Physics and Chemistry Laboratory	BS	4	0	0	4	2
TOTAL				**31**	**17**	**2**	**12**	**24**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS17251/ HS17252	Technical English/Professional communicative English	HS	3	3	0	0	3
2.	MA17251	Engineering Mathematics II	BS	5	3	2	0	4
3.	PH17251	Materials Science	BS	3	3	0	0	3
4.	CY17251	Environmental Science and Engineering	HS	3	3	0	0	3
5.	EE17252	Basic Electrical, Electronics and Instrumentation Engineering	ES	3	3	0	0	3
6.	GE17251	Engineering Mechanics	ES	4	2	2	0	3
PRACTICALS								
1.	GE17261	Engineering Practices Laboratory	ES	4	0	0	4	2
2.	GE17262	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ES	4	0	0	4	2
TOTAL				**29**	**17**	**4**	**8**	**23**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA17351	Transforms and Partial Differential Equations	BS	5	3	2	0	4
2.	ME17301	Engineering Thermodynamics	PC	4	2	2	0	3
3.	ME17302	Kinematics of Machinery	PC	4	2	2	0	3
4.	ME17303	Manufacturing Technology - I	PC	3	3	0	0	3
5.	EE17351	Electrical Drives and Controls	ES	3	3	0	0	3
PRACTICAL								
6.	ME17311	Manufacturing Technology Laboratory - I	PC	4	0	0	4	2
7.	ME17312	Computer Aided Machine Drawing	PC	4	0	0	4	2
8.	HS17361	Interpersonal Skills/Listening & Speaking	EEC	2	0	0	2	1
9.	EE17361	Electrical Engineering Laboratory	ES	4	0	0	4	2
TOTAL				**33**	**13**	**6**	**14**	**23**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA17452	Statistics and Numerical Methods	BS	5	3	2	0	4
2.	ME17401	Fluid Mechanics and Machinery	PC	4	2	2	0	3
3.	ME17402	Strength of Materials	PC	4	2	2	0	3
4.	ME17403	Manufacturing Technology– II	PC	3	3	0	0	3
5.	ME17404	Thermal Engineering- I	PC	4	3	0	0	3
6.	GE17451	Total Quality Management	ES	3	3	0	0	3
PRACTICAL								
7.	ME17411	Manufacturing Technology Laboratory–II	PC	4	0	0	4	2
8.	ME17412	Strength of Materials and Fluid Mechanics and Machinery Laboratory	PC	4	0	0	4	2
9.	HS17461	Advanced Reading and writing	EEC	2	0	0	2	1
TOTAL				**32**	**16**	**6**	**10**	**24**

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ME17501	Design of Machine Elements	PC	4	2	2	0	3
2.	ME17502	Dynamics of Machines	PC	4	2	2	0	3
3.	ME17503	Metrology and Measurements	PC	3	3	0	0	3
4.	ME17504	Heat and Mass Transfer	PC	4	2	2	0	3
5.		Open Elective – I	OE	3	3	0	0	3
PRACTICAL								
6.	ME17511	Kinematics and Dynamics Laboratory	PC	4	0	0	4	2
7.	ME17512	Thermal Engineering Laboratory	PC	4	0	0	4	2
8.	ME17513	Metrology and Measurements Laboratory	PC	4	0	0	4	2
9.	ME17514	Design and Development Project - I	EEC	2	0	0	2	1
TOTAL				**32**	**12**	**6**	**13**	**22**

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ME17601	Automobile Engineering	PC	3	3	0	0	3
2.	ME17602	Design of Transmission Systems	PC	4	2	2	0	3
3.	ME17603	Thermal Engineering - II	PC	4	2	2	0	3
4.	**ME17604**	**Finite Element Analysis**	PC	3	3	0	0	3
5.	ME17605	Elements of Computer Aided Design	PC	3	3	0	0	3
6.		Professional Elective – I	PE	3	3	0	0	3
PRACTICAL								
7.	ME17611	C.A.D. / C.A.M. Laboratory	PC	4	0	0	4	2
8.	HS17661	Professional Communication	EEC	4	0	0	4	2
9.	ME17612	Design and Development Project - II	EEC	4	0	0	4	2
TOTAL				**32**	**16**	**4**	**12**	**24**

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ME17701	Mechatronics	PC	3	3	0	0	3
2.	**ME17702**	**Hydraulics and Pneumatics**	PC	4	2	2	0	3
3.	ME17703	Process Planning and Cost Estimation	PC	3	3	0	0	3
4.		Professional Elective – II	PE	3	3	0	0	3
5.		Professional Elective – III	PE	3	3	0	0	3
PRACTICAL								
6.	ME17711	Simulation and Analysis Laboratory	PC	4	0	0	4	2
7.	ME17712	Automation Laboratory	PC	4	0	0	4	2
8.	ME17713	Comprehension	EEC	2	0	0	2	1
9.	ME17714	Technical Seminar/ In plant Training	EEC	2	0	0	2	1
TOTAL				**28**	**14**	**2**	**12**	**21**

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Open Elective – II	OE	3	3	0	0	3
2.		Professional Elective– IV	PE	3	3	0	0	3
3.		Professional Elective – V	PE	3	3	0	0	3
PRACTICAL								
4.	ME17811	Project Work	EEC	20	0	0	20	10
			TOTAL	**29**	**9**	**0**	**20**	**19**

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 180

SUMMARY OF CREDITS

Sl. No.	Subject Area	Credits per semester								Credits Total
		I	II	III	IV	V	VI	VII	VIII	
1	HS	3	6	-	-	-	-	-	-	9
2	BS	12	7	4	4	-	-	-	-	27
3	ES	9	10	5	3	-	-	-	-	27
4	PC	-	-	13	16	18	17	13	-	77
5	PE	-	-	-	-	-	3	6	6	15
6	OE	-	-	-	-	3	-	-	3	06
7	EEC	-	-	1	1	1	4	2	10	19
	Total	24	23	23	24	22	24	21	19	180
8	Non- Credit / Mandatory									

PROFESSIONAL ELECTIVES FOR B.E. MECHANICAL ENGINEERING

SEMESTER VI

ELECTIVE I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ME17E61	Composite Materials and Mechanics	PE	3	3	0	0	3
2.	ME17E62	Unconventional Machining Processes	PE	3	3	0	0	3
3.	ME17E63	Renewable Sources of Energy	PE	3	3	0	0	3
4.	ME17E64	Quality Control and Reliability Engineering	PE	3	3	0	0	3
5.	GE17E51	Human Values and Professional Ethics	PE	3	3	0	0	3

SEMESTER VII

ELECTIVE II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ME17E71	Introduction to Power Plant Engineering	PE	3	3	0	0	3
2.	ME17E72	Refrigeration and Air conditioning	PE	3	3	0	0	3
3.	ME17E73	Welding Technology	PE	3	3	0	0	3
4.	ME17E74	Design of Jigs, Fixtures and Press Tools	PE	3	3	0	0	3
5.	ME17E75	Gas Dynamics and Jet Propulsion	PE	3	3	0	0	3

ELECTIVE III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ME17E76	Robotics	PE	3	3	0	0	3
2.	ME17E77	Computational Fluid Dynamics	PE	3	3	0	0	3
3.	ME17E78	Computer Integrated Manufacturing Systems	PE	3	3	0	0	3
4.	ME17E79	Non-Destructive Testing and Evaluation	PE	3	3	0	0	3
5.	GE17E52	Entrepreneurship Development	PE	3	3	0	0	3

SEMESTER-VIII

ELECTIVE IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ME17E81	Production Planning and Control	PE	3	3	0	0	3
2.	EC17E63	Micro Electro Mechanical Systems	PE	3	3	0	0	3
3	ME17E82	Operations Research	PE	3	3	0	0	3
4.	ME17E83	Design of pressure vessels & piping	PE	3	3	0	0	3
5.	ME17E84	Introduction to Nano Science	PE	3	3	0	0	3

ELECTIVE V

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ME17E85	Advanced I.C. Engines	PE	3	3	0	0	3
2.	GE17551	Principles of Management	PE	3	3	0	0	3
3.	ME17E86	Additive Manufacturing	PE	3	3	0	0	3
4.	ME17E87	Mechanical Vibration and Noise Control	PE	3	3	0	0	3
5.	ME17E88	Energy Engineering and Management	PE	3	3	0	0	3

LIST OF OPEN ELECTIVES OFFERED TO STUDENTS OF DEPARTMENT OF MECHANICAL ENGINEERING

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	OAE1701	Introduction to Aeronautical Engineering	OE	3	0	0	3
2	OAE1702	Fundamentals of Jet Propulsion	OE	3	0	0	3
3	OAE1703	Introduction to space flight	OE	3	0	0	3
4	OAE1704	Industrial Aerodynamics	OE	3	0	0	3
5	OAT1702	Automotive Sensors and Actuators	OE	3	0	0	3
6	OAT1703	Elements of Electric and Hybrid vehicles	OE	3	0	0	3
7	OAT1704	Fundamentals of Automotive Electronics	OE	3	0	0	3
8	OBM1701	Anatomy and Physiology for Engineers	OE	3	0	0	3
9	OBM1702	Biomaterials and Artificial Organs	OE	3	0	0	3
10	OBM1703	Basics of Biosensors and Biophotonics	OE	3	0	0	3
11	OBM1704	Fundamentals of Medical Instrumentation	OE	3	0	0	3
12	OBM1705	Engineering Mechanics for Medical Applications	OE	3	0	0	3
13	OBT1701	Basic Bioinformatics	OE	3	0	0	3

14	OBT1702	Application of Biotechnology in Product Development	OE	3	0	0	3	
15	OBT1703	Food and Nutrition	OE	3	0	0	3	
16	OBT1704	Medical Sciences for Engineers	OE	3	0	0	3	
17	OBT1705	Biotechnology for Environmental protection	OE	3	0	0	3	
18	OBT1706	Fermentation Technology	OE	3	0	0	3	
19	OCH1701	Introduction to Fertilizer Technology	OE	3	0	0	3	
20	OCH1702	Introduction to Petroleum Technology	OE	3	0	0	3	
21	OCH1703	Unit operations in Environmental Engineering	OE	3	0	0	3	
22	OCH1704	Process Technology	OE	3	0	0	3	
23	OCH1705	Petrochemical Processing	OE	3	0	0	3	
24	OCH1706	Recent trends in water treatment	OE	3	0	0	3	
25	OCE1701	Disaster Management	OE	3	0	0	3	
26	OCE1702	Coastal Zone Management	OE	3	0	0	3	
27	OCE1703	Smart Structures and Smart Materials	OE	3	0	0	3	
28	OCE1705	Basics of Architecture	OE	3	0	0	3	
29	OCE1706	Global Warming and Climate Change	OE	3	0	0	3	
30	OCS1701	Web Design and Management	OE	3	0	0	3	
31	OCS1702	Mobile Application Development	OE	3	0	0	3	
32	OCS1703	Fundamentals of Database	OE	3	0	0	3	
33	OCS1704	Web Programming with XML	OE	3	0	0	3	
34	OCS1705	IoT and its Applications	OE	3	0	0	3	
35	OCS1706	Programming in C	OE	2	0	2	2	
36	OCS1707	Programming in C++	OE	2	0	2	2	
37	OCS1708	Java Programming	OE	2	0	2	2	
38	OCS1709	Computer Programming	OE	2	0	2	2	
39	OIT1701	Data Science	OE	3	0	0	3	
40	OIT1702	Advanced Python Programming	OE	3	0	0	3	
41	OIT1703	Business Intelligence	OE	3	0	0	3	
42	OIT1704	Computer Vision	OE	3	0	0	3	
43	OIT1705	Cyber Security	OE	3	0	0	3	
44	OIT1706	Machine Learning and R Programming	OE	3	0	0	3	
45	OEE 1701	Renewable Power Generation Systems	OE	3	0	0	3	
46	OEE1702	Electrical Safety and Quality Assurance	OE	3	0	0	3	
47	OEE1703	Sensors and Transducers	OE	3	0	0	3	
48	OEE1704	Electric Power Utilization	OE	3	0	0	3	
49	OEE1705	Electrical Machines	OE	3	0	0	3	
50	OEC1701	MEMS and its applications	OE	3	0	0	3	
51	OEC1702	Consumer Electronics	OE	3	0	0	3	
52	OEC1703	Digital Image Processing and its applications	OE	3	0	0	3	

53	OEC1704	Pattern Recognition and Artificial Intelligence	OE	3	0	0	3
54	OEC1705	Electronics Engineering	OE	3	0	0	3
55	OMT1702	Elements of Automation	OE	3	0	0	3
56	OMT1703	Bio- Mechatronics	OE	3	0	0	3
57	OMT1705	Mobile Robotics	OE	3	0	0	3
58	OMA1701	Computer based Numerical methods	OE	3	0	0	3
59	OMA1702	Number theory and applications	OE	3	0	0	3
60	OPH1701	Materials Synthesis and Characterization Techniques	OE	3	0	0	3
61	OPH1702	Nanophysics	OE	3	0	0	3
62	OCY1701	Green Chemistry in Energy and Environment	OE	3	0	0	3
63	OCY1702	Interface Chemistry and Engineering	OE	3	0	0	3
64	OGE1701	Human Rights	OE	3	0	0	3
65	OGE1702	Foreign Language - Japanese	OE	3	0	0	3
66	OGE1703	Foreign Language - German	OE	3	0	0	3
67	OGE1704	Foreign Language - French	OE	3	0	0	3

SEMESTER I

HS17151 COMMUNICATIVE ENGLISH L T P C
COMMON TO ALL BRANCHES OF B.E. / B.TECH. PROGRAMMES 3 0 0 3

OBJECTIVES:

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

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 9

Reading- short comprehension passages, practice in skimming-scanning and predicting. Writing- completing sentences- developing hints. Listening- short texts- short formal and informal conversations. Speaking- introducing oneself - exchanging personal information- Language development- Wh Questions- asking and answering yes or no questions. Subject - Verb agreement – regular and irregular verbs. Vocabulary development- prefixes- suffixes- articles.

UNIT II GENERAL READING AND FREE WRITING 9

Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register. Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures. Listening- telephonic conversations. Speaking – sharing information of a personal kind—greeting – taking leave. Language development – prepositions, conjunctions. Vocabulary development - guessing meanings of words in context.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 9

Reading- short texts and longer passages (close reading). Writing- understanding text structure - use of reference words and discourse markers-coherence-jumbled sentences. Listening – listening to longer texts and filling up the table- product description- narratives from different sources. Speaking- asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- direct vs indirect questions. Vocabulary development – single word substitutes- adverbs.

UNIT IV READING AND LANGUAGE DEVELOPMENT 9

Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing- letter writing, informal or personal letters-emails-conventions of personal email. Listening- listening to dialogues or conversations and completing exercises based on them. Speaking- speaking about oneself- speaking about one's friend. Language development- Tenses- simple present-simple past- present continuous and past continuous. Vocabulary development- synonyms-antonyms- phrasal verbs.

UNIT V EXTENDED WRITING 9

Reading- longer texts- close reading. Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing. Listening – listening to talks- conversations. Speaking – participating in conversations- short group conversations. Language development-modal verbs- present/ past perfect tense. Vocabulary development-functional uses of tenses.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions.
- Comprehend conversations and short talks delivered in English
- Express ideas about oneself freely
- Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2015.
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES:

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

MA17151 ENGINEERING MATHEMATICS – I L T P C

Common to all branches of B.E. / B.Tech. programmes 3 2 0 4

OBJECTIVES:

- To learn the basics and concepts of traditional calculus.

- To provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions.
- To understand the concepts of single variable and multivariable calculus that plays an important role in the field of science, engineering & technology.

UNIT I MATRICES **15**

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

UNIT II DIFFERENTIAL CALCULUS **15**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT III FUNCTIONS OF SEVERAL VARIABLES **15**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS **15**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts – Bernoulli's formula, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT V MULTIPLE INTEGRALS **15**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course students will be able to:

- Apply the concept of Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices for solving problems
- Use the techniques of differentiation to differentiate functions and to apply the concept of differentiation to solve maxima and minima problems.
- To apply the concept of Partial differentiation for functions two or more variables and use different techniques for solving problems.
- Solve problems involving integration using different methods such as substitution, partial fractions, by parts .
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.

REFERENCES:

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.

4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.
6. T. Veerarajan, Engineering Mathematics I & II, McGraw Hill Education, 3rd Edition, 2012.

PH17151 ENGINEERING PHYSICS L T P C
Common to all branches of B.E. / B.Tech. programmers 3 0 0 3

OBJECTIVE:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I PROPERTIES OF MATTER 9

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams –area moment of inertia - bending moment – cantilever - applications – uniform and non-uniform bending- I-shaped girders - stress due to bending in beams.

UNIT II WAVES AND OPTICS 9

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers: population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) –CO_2 laser - Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibers (material, refractive index, mode) – losses associated with optical fibers - fiber optic sensors: pressure and displacement.

UNIT III THERMAL PHYSICS 9

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation –rectilinear heat flow – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunneling (qualitative) – electron microscope – scanning tunneling microscope.

UNIT V CRYSTAL PHYSICS 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 -reciprocal lattice - coordination number and packing factor for SC, BCC, FCC, and HCP –Polymorphism and allotropy: diamond and graphite structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Apply the knowledge of basic properties of matter and its applications in Engineering and Technology.
- Use the concepts of waves and optical devices and their applications in fiber optics.
- Use the concepts of thermal properties of materials and their applications in heat exchangers.

- Use the advanced physics concepts of quantum theory and its applications in electron microscope and material sciences.
- Apply the basic knowledge of crystallography in materials preparation and device fabrication.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. &Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.
4. Arthur Besier and S. RaiChoudhury,Concepts of Modern Physics (SIE), 7th edition, McGraw-Hill Education, 1994.
5. *R. Murugeshan and Kiruthiga Sivaprasath, Modern Physics, S.Chand, 2015.*

CY17151 ENGINEERING CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

- To acquire knowledge on characteristics of boiler feed water and water treatment techniques.
- To develop an understanding on surface chemistry and its applications
- To develop an understanding of the basic concepts of phase rule and its applications towards alloying
- To acquire knowledge on different types of fuels and its characteristics.
- To obtain knowledge on batteries and fuel cell.

UNIT I WATER AND ITS TREATMENT 9

Hardness of water – types – expression of hardness – units– boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) - External treatment – ion exchange process, zeolite process – potable water treatment – break point chlorination - desalination of brackish water - Reverse Osmosis – UASB process (Upflow Anaerobic Sludge Blanket).

UNIT II SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption - types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – Preparation and applications of activated carbon (up flow and down flow process) -applications of adsorption on pollution abatement.

Catalysis – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

UNIT III PHASE RULE, ALLOYS AND COMPOSITES 9

Phase rule - introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

Alloys - definition- properties of alloys- significance of alloying- functions and effect of alloying elements- nichrome and stainless steel (18/8) – heat treatment of steel.

Composites- polymer matrix composites -metal matrix composites-ceramic matrix composites.

UNIT IV FUELS AND COMBUSTION 9

Fuels - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture

of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gas (LPG) - power alcohol and biodiesel.
Combustion of fuels - introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range.

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Batteries - components – Characteristics – voltage , current , capacity, electrical storage density, energy density, discharge rate – types of batteries – primary battery (dry cell)- secondary battery (lead acid battery, Ni- Cd battery,lithium-ion-battery) .Fuel cells – H_2-O_2 fuel cell, methanol oxygen fuel cell, Proton exchange membrane fuel cell – SOFC and Biofuel cells.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Get familiarized on water treatment techniques.
- Apply adsorption phenomena on various fields.
- Analyse alloying composition based on phase rule concept.
- Apply the role of fuels in day today applications.
- Design batteries and fuel cells.

TEXT BOOKS:

1. P. C. Jain and Monika Jain, "Engineering Chemistry" 17th edition, DhanpatRai Publishing Company (P) LTD, New Delhi, 2015
2. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. PrasantaRath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.
4. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", 12th edition, S. Chand & Company LTD, New Delhi, 2015.

GE17151 PROBLEM SOLVING AND PYTHON PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To develop an understanding of algorithmic problem solving
- 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

Introduction to computers - characteristics - basic organization of a computer – algorithms - building blocks of algorithms (instructions/statements, state, control flow, functions) - notation (pseudo code, flow chart, programming language) - algorithmic problem solving - simple strategies for developing algorithms (iteration, recursion).

UNIT II DATA, EXPRESSIONS, STATEMENTS AND CONTROL FLOW 9

Python interpreter and interactive mode - values and types - data types – variables – keywords - expressions and statements - python I/O - operators - precedence of operators – comments. Conditionals: conditional (if) - alternative (if-else) - chained conditional (if-elif-else) – nested conditional. Iteration: while – for - break – continue – pass. Illustrative programs: exchange the values of two variables - circulate the values of n variables - test for leap year.

UNIT III FUNCTIONS 9

Function calls – type conversion – math function – composition - definition and use - flow of execution - parameters and arguments. Fruitful functions: return values – parameters - scope: local and global - recursion. Strings: string slices – immutability - string functions and methods - string comparison. Illustrative programs: square root – GCD – exponentiation - sum the array of numbers - linear search - binary search.

UNIT IV COMPOUND DATA: LISTS, TUPLES AND DICTIONARIES 9

Lists - list operations - list slices - list methods - list loop – mutability – aliasing - cloning lists - list parameters. Tuples – immutable - tuple assignment - tuple as return value. Dictionaries: operations and methods – dictionaries and tuples – dictionaries and lists. Advanced list processing - list comprehension. Illustrative programs: Sorting.

UNIT V FILES, MODULES AND PACKAGES 9

Files and exception: file operation - text files - reading and writing files - format operator- command line arguments - errors and exceptions - handling exceptions – writing modules – packages. Illustrative programs: word count - copy file – case studies.

OUTCOMES:

Upon completion of the course, students will be able to

- Develop algorithmic solutions to simple computational problems.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples and dictionaries.
- Read and write data from/to files in Python programs.

TEXT BOOK:

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/)

REFERENCES:

1. Anita Goel, Ajay Mittal, "Computer Fundamentals and programming in C", Pearson India Publisher, First edition, 2013.
2. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd. 2015.
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
6. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
7. The Python Tutorial, https://docs.python.org/2.7/tutorial/

GE17152 ENGINEERING GRAPHICS L T P C
2 0 4 4

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.
- To study different type of projections, and practice him on free hand sketching.

CONCEPTS AND CONVENTIONS (Not for Examination) 1

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

UNIT I PLANE CURVES AND FREEHAND SKETCHING 7+12

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves- Construction of helical curve.
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 SURFACE 6+12

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

UNIT III PROJECTION OF SOLIDS 5+12

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5 +12

Sectioning of above solids 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. Development of lateral surfaces of solids with cut-outs and holes.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6 + 12

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 - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

TOTAL: 90 PERIODS

OUTCOMES:

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

- Perform freehand sketching of basic geometrical constructions and multiple views of objects.
- Do the conic curves and special curves.
- Do orthographic projection of lines and plane surfaces.
- Draw projections, solids, and development of surfaces.
- Prepare isometric and perspective sections of simple solids.

TEXT BOOK:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
3. 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.
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

PUBLICATION OF BUREAU OF INDIAN STANDARDS:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

SPECIAL POINTS APPLICABLE TO END SEMESTER EXAMINATIONS ON ENGINEERING GRAPHICS:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

GE17161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- Be familiar with the use of office package, exposed to presentation and visualization tools.
- 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 PROGRAMS

1. Search, generate, manipulate data using Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem Solving using Algorithms and Flowcharts
4. Compute the GCD of two numbers.
5. Find the square root of a number (Newton's method)
6. Exponentiation (power of a number)
7. Linear search and Binary search
8. First n prime numbers
9. Find the maximum of a list of numbers
10. Sorting
11. Removing all the duplicate elements in a list
12. Multiply matrices

13. Programs that take command line arguments (word count)
14. Find the most frequent words in a text read from a file
15. Mini Project

TOTAL: 60 PERIODS

PLATFORM NEEDED
Python 3 interpreter for Windows/Linux

OUTCOMES:
Upon completion of the course, students will be able to
1. Develop documentation, presentation and visualization charts.
2. Implement Python programs with conditionals and loops.
3. Develop Python programs step-wise by defining functions and calling them.
4. Use Python lists, tuples and dictionaries for representing compound data.
5. Read and write data from/to files in Python.

GE17162	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVE:
- 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 – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:
On completion of the course, students will be able to
- Apply the principle of elasticity viz Young's modulus & rigidity modulus of Engineering materials.
- Apply the principle elasticity in determining compressibility of liquids using ultrasonic waves
- Apply the principle of optics in fiber optical communication.
- Apply thermal properties of various insulating materials in engineering applications.
- Use the basic instruments like vernier caliber, micrometer and microscope for various basic measurements.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

OBJECTIVES:
- To acquire practical skills in the determination of water quality parameters.
- To gain the knowledge about spectrophotometer and flame photometer.
- To acquire knowledge on the determination of corrosion rate.

LIST OF EXPERIMENTS: CHEMISTRY LABORATORY (Any 7 Experiments)
1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.

2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Determination of strength of given hydrochloric acid using pH meter.
6. Estimation of iron content of the given solution using potentiometer.
7. Conductometric titration of strong acid vs strong base.
8. Determination of strength of acids in a mixture of acids using conductivity meter.
9. Estimation of copper content of the given solution by Iodometry.
10. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
11. Estimation of sodium and potassium present in water using flame photometer.
12. Corrosion experiment-weight loss method.

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course, students will be able to

- Apply the quantitative chemical analysis of water quality related parameters.
- Analyse characteristics of water.
- Measure the corrosion rate in metals.
- Apply instrumentation skills in analysing metallic elements in water.
- Analyse quantitatively the strength of acids and bases in water.

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{TH} edition, 2014)

SEMESTER II

HS17251	TECHNICAL ENGLISH	L T P C
		3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION TECHNICAL ENGLISH 9

Listening- listening to talks mostly of a scientific/technical nature and completing information-gap exercises. Speaking –asking for and giving directions. Reading – reading short technical texts from journals-newspapers. Writing- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations. Vocabulary Development- technical vocabulary. Language Development –subject verb agreement - compound words.

UNIT II READING AND STUDY SKILLS 9

Listening- listening to longer technical talks and completing exercises based on them. Speaking – describing a process. Reading – reading longer technical texts- identifying the various transitions in a text- paragraphing. Writing- interpreting charts, graphs. Vocabulary Development-vocabulary used in formal letters/emails and reports. Language Development- impersonal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING AND GRAMMAR 9

Listening- listening to classroom lectures/ talks on engineering/technology. Speaking – introduction to technical presentations. Reading – longer texts both general and technical, practice in speed reading.

Writing-Describing a process, use of sequence words. Vocabulary Development- sequence words. Misspelled words. Language Development- embedded sentences

UNIT IV REPORT WRITING 9

Listening- listening to documentaries and making notes. Speaking – mechanics of presentations. Reading – reading for detailed comprehension. Writing- email etiquette- job application – cover letter. Résumé preparation(via email and hard copy)- analytical essays and issue based essays. Vocabulary Development- finding suitable synonyms-paraphrasing. Language Development- clauses- if conditionals.

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 9

Listening- TED talks; Speaking –participating in a group discussion. Reading– reading and understanding technical articles. Writing– writing reports- minutes of a meeting- accident and survey. Vocabulary Development- verbal analogies, foreign words and phrases Language Development- reported speech, common errors in English.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.
- Write error free language.

TEXT BOOKS:

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES:

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

HS17252 PROFESSIONAL ENGLISH COMMUNICATION L T P C
3 0 0 3

OBJECTIVES:

- To prepare students to be competent in a global business environment.
- To think accurately, clearly and deeply in communicative contexts.
- To improve career opportunities – get English language skills that are needed to be successful.

UNIT-I CRITICAL/ INFORMATIONAL LISTENING 9

Short conversations or Monologues – Listening for specific information- Conversations or Monologues with factual information- listen to fill up missing information- business related discussions or interview(two or more speakers).

UNIT-II CONVERSATIONAL/ PRESENTATION SKILLS 9

Speak about oneself - Face-to-face speaking for real-life context – pick and talk - personal opinion on business related topics- mini presentations on a business theme- discussion with another candidate on business related topics.

UNIT-III INTENSIVE/ EXTENSIVE READING AND INTERPRETING 9

Short texts (signs,messages,emails,labels and notes) -Short descriptions-graph or chart. Reading to find factual information- decision making from a written text- a leaflet or a newspaper- magazine or article- reading to understand correct grammar, contextually- reading to understand the structure of a text-read and transfer information from memos, advertisements, notices.

UNIT-IV FORMAL COMMUNICATION 9

Business Correspondence - writing business letters to people outside the company. Internal Company Communication- a note, a message, a memo or an email.

UNIT – V VERBAL ABILITY/ FUNCTIONAL GRAMMAR 9

Grammar – tenses – concord- prepositions – articles- punctuations. Vocabulary – advanced vocabulary – synonyms and antonyms. Sentence correction – sentence completion - cloze passage - verbal reasoning: analogies, meaning-usage match.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Listen to, understand and give opinions in meetings.
- Apply for new jobs and develop their career.
- Write short business messages and reports.
- Use language in both official and unofficial contexts.
- Speak effectively in business communication

TEXT BOOKS:

1. Board of Editors. Sure Outcomes. A Communication Skills Course for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad, 2013.

REFERENCES:

1. Hartley, Mary."The Power of Listening," JaicoPublishing House; First Edition. 2015.
2. Chambers, Harry. "Effective Communication Skills for Scientific and Technical Professionals," Persues Publishing, Cambridge, Massachusetts, 2000.
3. Lesikar V. Raymond, Flatley E. Marie, Rentz, Kathryn and Pande, Neerja. "Business Communication," Eleventh Edition, Tata McGraw Hill Education Private Limited.2013.

MA17251 ENGINEERING MATHEMATICS – II

L	T	P	C
3	2	0	4

OBJECTIVES:

- To handle practical problems arising in the field of engineering and technology.
- To solve problems using the concept of Matrices, Vectors calculus, complex analysis, Laplace transforms.

UNIT I MATRICES 15

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

UNIT II VECTOR CALCULUS 15

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTIONS 15

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c,\ cz, \frac{1}{z}, z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 15

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

UNIT V LAPLACE TRANSFORMS 15

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

On completion of the course students will be able to:

- Apply the concept of Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices for solving problems.
- Use the concept of Gradient, divergence and curl of a vector point function and related identities in different areas of Engineering.
- Evaluate line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Use the concept of Analytic functions, conformal mapping and complex integration for solving problems.
- Use Laplace transform and inverse transform techniques in solving differential equations.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3rd Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

PH17251	MATERIALS SCIENCE	L T P C 3 0 0 3

OBJECTIVE:

- To introduce the essential principles of materials science for mechanical and related Engineering applications.

UNIT I PHASE DIAGRAMS 9

Solid solutions - Hume Rothery's rules - The phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions – free energy composition curves for binary systems - microstructural change during cooling.

UNIT II FERROUS ALLOYS AND HEAT TREATMENT 9

The iron-carbon equilibrium diagram - phases, invariant reactions - microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - diffusion in solids - Fick's laws - phase transformations - TTT-diagram for eutectoid steel – pearlitic, baintic and martensitic transformations - tempering of martensite - heat treatment of steels - annealing - normalizing - quenching and tempering - case hardening - induction, flame and laser hardening - carburizing, cyaniding, carbonitriding and nitriding.

UNIT III MECHANICAL PROPERTIES 9

Tensile test - plastic deformation mechanisms - slip and twinning - role of dislocations in slip - strengthening methods - strain hardening - refinement of the grain size - solid solution strengthening - precipitation hardening - creep resistance - creep curves - mechanisms of creep - creep-resistant materials - fracture - the Griffith criterion - critical stress intensity factor and its determination - fatigue failure - fatigue tests - methods of increasing fatigue life - hardness - Rockwell and Brinell hardness - Knoop and Vickers microhardness.

UNIT IV MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS 9

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, properties.

UNIT V NEW MATERIALS 9

Ceramics – types and applications – Composites: classification, role of matrix and reinforcement – processing of fiber reinforced plastics – Metallic glasses – types , glass forming ability of alloys – Inoue criteria – melt spinning process – applications - Shape memory alloys – phases, shape memory effect, pseudoelastic effect – NiTi alloy – applications – Nanomaterials – preparation: bottom up and top down approaches (outline only) – properties and applications – carbon nanotubes: types.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Use various phase diagrams and their applications.
- Analyze Fe-Fe3C phase diagrams, various microstructures and alloys.
- Use mechanical properties of materials.
- Apply magnetic, dielectric and superconducting properties of materials.
- Use the basic of ceramics, composites and nano materials for designing of components.

TEXT BOOKS:

1. Balasubramaniam, R. "Callister's Materials Science and Engineering". Wiley India Pvt. Ltd., 2014.
2. Raghavan, V. "Physical Metallurgy: Principles and Practice". PHI Learning, 2015.
3. Raghavan, V. "Materials Science and Engineering : A First course". PHI Learning, 2015.

REFERENCES:

1. Askeland, D. "Materials Science and Engineering". Brooks/Cole, 2010.
2. Smith, W.F., Hashemi, J. &Prakash, R. "Materials Science and Engineering". Tata McGraw Hill Education Pvt. Ltd., 2014.
3. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Narosa Publishing House, 2009.

CY17251 ENVIRONMENTAL SCIENCE AND ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To find the scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To study the importance of environment by assessing its impact on the human world.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the forest ecosystem - grassland ecosystem - desert ecosystem - aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – Significance of medicinal plants - biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT II ENVIRONMENTAL POLLUTION 10

Definition - causes, effects and control measures of Air pollution (Atmospheric chemistry - Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry- Mitigation procedures - Control of particulate and gaseous emission, Control of SO_2, NO_X, CO and HC) - Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance - Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – Marine pollution - Noise pollution - Thermal pollution - Nuclear hazards– e-Waste – toxic substances in e-waste – risks related to toxic substances – role of an individual in prevention of pollution – pollution case studies.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources - energy production from waste materials. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a

resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins –Biochemical degradation of pollutants, Bioconversion of pollutants.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization environmental ethics: Issues and possible solutions – Principles of green chemistry - nuclear accidents and holocaust, case studies – wasteland reclamation – consumerism and waste products – environment protection act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labelling of environmentally friendly products (Ecomark). Enforcement machinery involved in environmental legislation- central and state pollution control boards - disaster management: floods, earthquake, cyclone and landslides. Public awareness and case studies.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – Dengue fever- Swine flu – women and child welfare – Environmental impact analysis (EIA)- GIS-remote sensing - role of information technology in environment and human health – Case studies. Effect of Radiation from computing devices.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Solve problems that cannot be solved by mere laws.
- Get familiarized with ecological balance.
- Get public awareness of environment at infant stage.
- Find ways to protect the environment and play proactive roles.
- Develop and improve the standard of better living.

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. R.K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standard", Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', JaicoPubl.,House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice Hall of India PVT LTD, New Delhi, 2007.

EE17252	**BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING**	**L T P C** **3 0 0 3**

OBJECTIVES:

To impart knowledge on

- DC circuits
- AC circuits
- Principle of operations of various electrical machines
- Working principle of different types of electronic devices
- Basic principle of operations of measuring instruments

UNIT I DC CIRCUITS 9

Basic circuit components -, Ohms Law - Kirchoff's Law – Instantaneous Power – Inductors - Capacitors – Independent and Dependent Sources - steady state solution of DC circuits - Nodal analysis, Mesh analysis- Thevinin's Theorem, Norton's Theorem, Maximum Power transfer theorem- Linearity and Superposition Theorem.

UNIT II AC CIRCUITS 9

Introduction to AC circuits – waveforms and RMS value – power and power factor, single phase and three-phase balanced circuits – Three phase loads - housing wiring, industrial wiring, materials of wiring

UNIT III ELECTRICAL MACHINES 9

Principles of operation and characteristics of; DC machines, Transformers (single and three phase), Synchronous machines , three phase and single phase induction motors.

UNIT IV ELECTRONIC DEVICES & CIRCUITS 9

Types of Materials – Silicon & Germanium- N type and P type materials – PN Junction –Forward and Reverse Bias –Semiconductor Diodes –Bipolar Junction Transistor – Characteristics –-Field Effect Transistors – Transistor Biasing –Introduction to operational Amplifier –Inverting Amplifier –Non Inverting Amplifier –DAC – ADC .

UNIT V MEASUREMENTS & INSTRUMENTATION 9

Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical - ,Classification of instruments - Types of indicating Instruments - multimeters –Oscilloscopes- – three-phase power measurements– instrument transformers (CT and PT)

TOTAL: 45 PERIODS

OUTCOMES:

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

- understand the DC circuits
- analyze the AC circuits
- understand the working principles of electrical machines
- comprehend the concepts of various electronic devices
- choose appropriate instruments for electrical measurement for a specific application

TEXT BOOKS

1. Leonard S Bobrow, " Foundations of Electrical Engineering", Oxford University Press, 2013
2. D P Kothari and I.J Nagarath, "Electrical Machines "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint ,2016
3. Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2008

REFERENCES

1. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007
2. John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006
3. Allan S Moris, "Measurement and Instrumentation Principles", Elseveir, First Indian Edition, 2006
4. Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2006
5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009
6. N K De, Dipu Sarkar, "Basic Electrical Engineering",Universities Press (India)Private Limited 2016

GE17251 ENGINEERING MECHANICS L T P C
2 2 0 4

OBJECTIVES:

- To understand the basics of mechanics and apply the concept of equilibrium to solve problems of concurrent forces
- To apply the concept of equilibrium to solve problems of rigid bodies
- To calculate center of gravity and moment of inertia of surfaces and solids
- To solve problems involving friction
- To solve problems involving kinematics and kinetics of rigid bodies in plane motion.

UNIT I STATICS OF PARTICLES 12

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES 12

Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III PROPERTIES OF SURFACES AND SOLIDS 12

Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES 12

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND RIGID BODY DYNAMICS 12

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL: 60 PERIODS

OUTCOMES:

On the successful completion of the course, students will be able to

- Enumerate the basic of concept of mechanics
- Solve problems in engineering systems using the concept of static equilibrium
- Determine the centroid of objects such as areas and volumes, center of mass of body and moment of inertia of composite areas
- Solve problems involving frictional phenomena in machines
- Solve problems involving kinematics and kinetics of rigid bodies in plane motion

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

REFERENCES:

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
3. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.
4. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
5. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

GE17261 ENGINEERING PRACTICES LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:

(b) Model making – Trays and funnels.
(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to fabricate carpentry components
- Ability to connect pipe connections including plumbing works.
- Ability to use welding equipments to join the structures.
- Ability to fabricate electrical circuits
- Ability to fabricate electronics circuits.

EE17262	BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVE:

- To study and validate the principles of operation of DC motors.
- To understand the principles of operation of AC motors.
- To study the principles of operation of Transformer and its testing methods.
- To study the applications of PN junction Diode.
- To obtain the characteristics of various transducers.

LIST OF EXPERIMENTS:

1. Load test on DC Shunt Motor and DC series motor
2. Load test on Single phase Transformer
3. Load test on Induction motor (single, three phase)

4. Regulation of 3phase Alternator
5. Diode based application circuits
6. Transistor based application circuits
7. Study of Logic gates and Flip-Flops
8. Characteristics of LVDT
9. Characteristics of RTD
10. Characteristics of Thermistor

TOTAL: 60 PERIODS

OUTCOMES:

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

- Draw the speed characteristic of different types of DC motors.
- Draw the speed characteristic of different types of AC machines.
- Obtain the performance parameters of Transformer.
- Design an application involving diodes and transistors.
- Obtain the characteristics of transducers.

III SEMESTER

MA17351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

L	T	P	C
3	2	0	4

OBJECTIVES

- To introduce Fourier series 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 15

Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order PDE: $f(p,q)=0, f(z,p,q)=0, z=px+qy+f(p,q), f(x,p)=f(y,q)$ -Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of homogeneous type.

UNIT II FOURIER SERIES 15

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

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 15

Classification of PDE – 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 15

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval'sidentity - Application to boundary value problems.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS **15**

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.

TOTAL: 75 PERIODS

OUTCOMES

On completion of the course students will be able to

- Develop skills to solve different types of partial differential equations
- Develop skills to construct Fourier series for different periodic functions and to evaluate infinite series.
- Classify different types of PDE and solve boundary value problems.
- Develop skills to solve differential equations using Fourier transform techniques.
- Solve difference equations using Z – transforms that arise in discrete time systems.

TEXT BOOKS

1. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt.Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.

REFERENCES:

1. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi
2. Publications Pvt Ltd, 2007.
3. Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
4. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
5. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
5. Ray Wylie C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
6. Datta K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt Ltd, Delhi, 2013.

ME17301 ENGINEERING THERMODYNAMICS

L	T	P	C
2	2	0	3

OBJECTIVES:

- To gain knowledge of Thermodynamics concept, I-law of Thermodynamics and its analysis.
- To acquire knowledge of II- law of Thermodynamics and its applications.
- To gain knowledge about properties of pure substances and steam power cycles.
- To gain in-depth knowledge of different equations for analysis of ideal and real gases.
- To gain knowledge of psychrometry and psychrometric processes

UNIT I BASIC CONCEPTS AND FIRST LAW **12**

Basic concepts - concept of continuum, comparison of microscopic and macroscopic approach. Path and point functions. Intensive and extensive, total and specific quantities. System and their types. Thermodynamic Equilibrium State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work .P-V diagram. Zeroth law of thermodynamics – concept of temperature and thermal equilibrium– relationship between temperature scales –new temperature scales. First law of thermodynamics –application to closed and open systems – steady and unsteady flow processes.

UNIT II SECOND LAW AND AVAILABILITY ANALYSIS 12

Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot cycle Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T- s diagram, Tds Equations, entropy change for - pure substance, ideal gases - different processes, principle of increase in entropy. Applications of II Law. High and low grade energy. Available and non- available energy of a source and finite body. Energy and irreversibility. Expressions for the energy of a closed system and open systems. Energy balance and entropy generation. Irreversibility. I and II law Efficiency.

UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 12

Formation of steam and its thermodynamic properties, p-v, p-T, T- v, T-s, h- s diagrams. p- v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, Binary and Combined cycles.

UNIT IV IDEAL GAS AND THERMODYNAMIC RELATIONS 12

Properties of Ideal gas- Equations of state for ideal gas- Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes. Simple Calculations

UNIT V GAS MIXTURES AND PSYCHROMETRY 12

Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture – Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications

TOTA : 60 PERIODS

OUTCOMES:

- Ability to Understand the first law of thermodynamics and can apply it to closed and open systems to calculate specified parameters such as work, heat transfer, internal energy, mass flow rate and enthalpy.
- Ability to Understand the second law of thermodynamics and can apply it to closed and open systems to calculate specified parameters such as work, heat transfer, or entropy.
- Have knowledge on the construction and principles governing the one-component pressure-volume-temperature diagrams. Also have thorough understanding of the basic concepts of vapour power cycles and the use of steam tables in the analysis of engineering devices and systems.
- Ability to understand the behaviour of Ideal and Real gases and the interrelationship between thermodynamic functions and solve practical problems.
- Ability to calculate the properties of gas mixtures and capable to calculate the psychrometric properties for various psychrometric processes.

TEXT BOOKS:

1. Nag.P.K., "Engineering Thermodynamics", 5th Edition, Tata McGraw-Hill, New Delhi, 2014.
2. Natarajan E., "Engineering Thermodynamics: Fundamentals and Applications", Anuragam Publications, 2012.

REFERENCES:

1. Cengel. Y and M.Boles, "Thermodynamics - An Engineering Approach", 7th Edition, Tata McGraw Hill, 2010.
2. Holman.J.P., "Thermodynamics", 3rd Edition, McGraw-Hill, 1995.
3. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2010.
4. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2004.
5. Van Wylen and Sonntag, "Classical Thermodynamics", Wiley Eastern, 1987.

ME17302 KINEMATICS OF MACHINERY

L	T	P	C
2	2	0	3

OBJECTIVES:

- Applying the basic knowledge in mechanism and layout of linkages in the assembly of a system / machine.
- Understanding the principles in analyzing the linkages with respect to the displacement, velocity, and acceleration at any point of a mechanism.
- To develop competency in drawing the cam profile and understand the follower motion.
- Creating the basic concepts of toothed gearing and kinematics of gear trains
- Evaluating the effects of friction in motion transmission and in machine components.

UNIT I BASICS OF MECHANISMS 12

Introduction: Classification of mechanisms - Basic kinematic concepts and definitions - Degree of freedom, Mobility - Kutzbach criterion, Gruebler's criterion - Grashof's Law - Kinematic inversions of four-bar chain and slider crank chains - Limit positions - Mechanical advantage -Transmission Angle. Special mechanisms - Quick return mechanisms, Straight line generators, Universal Joint - rocker mechanisms - Indicator diagrams - Hooke's Joint - Steering Mechanisms - Robotic Mechanisms - linkages - Simple Planar Linkages

UNIT II KINEMATICS OF LINKAGE MECHANISMS 12

Introduction: Displacement, velocity and acceleration analysis of simple mechanisms - Graphical method - Velocity and acceleration polygons - Velocity analysis using instantaneous centres, Relative velocity method, rubbing velocity - kinematic analysis of simple mechanisms -Acceleration due to Coincident points - Coriolis component of Acceleration - Introduction to linkage synthesis problem.

UNIT III KINEMATICS OF CAM AND FOLLOWER 12

Introduction: Classification of cams and followers - nomenclature and definitions - Displacement diagrams of follower motion - kinematic coefficients of follower - 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 12

Introduction: Gear Terminology - Law of toothed gearing - Characteristics of Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions - Gear tooth action - contact ratio - Centre distance variation - minimum number of teeth - Interference and undercutting. - Helical, Bevel - Worm - Rack and Pinion gears [Basics only]. Gear trains - Speed ratio, train value -Synthesis of Simple, compound and reverted gear trains - Analysis of Epicyclic gear trains.

UNIT V FRICTION IN MACHINE ELEMENTS 12

Introduction: Surface contacts - Sliding and Rolling friction - Friction drives - Friction in screw threads - Bearings and lubrication - Friction clutches - Belt and rope drives - Friction in brakes - Band and Block brakes.

OUTCOMES:

- Application of mechanism and linkages in the assembly of a system / machine.
- Solving the problems with respect to the displacement, velocity, and acceleration of any link at any point of a mechanism.
- To develop the design of few linkage mechanisms and cam mechanisms for specified output motions.
- Creating the basic concepts of toothed gearing and kinematics of gear trains
- Justify the effects of friction with respect to the application

TEXT BOOKS:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014.

2. Rattan, S.S, "Theory of Machines", 4th Edition, McGraw-Hill, 2014.

REFERENCES:

1. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2010.
2. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2015
3. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
4. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition, Affiliated East-West Pvt.
   Ltd., New Delhi, 2006.
5. Rao.J.S. and Dukkipati.R.V. "Mechanisms and Machine Theory", New Age International., New Delhi, 2006.

ME17303 MANUFACTURING TECHNOLOGY - I L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I METAL CASTING 9

Sand Casting : Sand Mould – Type of patterns - Pattern Materials – Pattern allowances –Moulding sand Properties and testing – Cores –Types and applications – Moulding machines– Types and applications; Melting furnaces : Blast and Cupola Furnaces; Principle of special casting processes : Shell - investment – Ceramic mould – Pressure die casting - Centrifugal Casting – Continuous casting, Vacuum casting- CO_2 process – Stir casting; Defects in Sand casting.

UNIT II JOINING PROCESS 9

Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas Tungsten arc welding Gas metal arc welding – Submerged arc welding – Electro slag welding; Operating principle and applications of: Resistance welding - Plasma arc welding – Thermit welding – Electron beam welding –Laser welding- Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: types, causes and cure. Adhesive bonding.

UNIT III METAL FORMING PROCESS 9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – forging operations. Rolling of metals– Types of Rolling – Flat strip rolling – shape rolling operations-Thread rolling, ring rolling – Defects in rolled parts. Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and cold extrusion.

UNIT IV SHEET METAL PROCESSES 9

Sheet metal characteristics – shearing, bending and drawing operations – Hemming and seaming – 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, Super plastic forming – Micro forming

UNIT V MANUFATURE OF PLASTIC COMPONENTS 9

Types and characteristics of plastics – Moulding of thermoplastics – working principles and typical applications – injection moulding – Plunger and screw machines – Compression moulding, Transfer

Moulding – Typical industrial applications – introduction to blow moulding –Rotational moulding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to explain the requirements, process, application and defects of sand casting and special casting processes.
- Ability to explain the working principles and applications of different arc welding processes, special welding process and defects associated with it.
- Ability to select the suitable process for manufacturing of components among forging, rolling, drawing, extrusion and its types.
- Ability to explain the principles and working of shearing, bending, drawing and forming in sheet metal.
- Ability to judge the suitability of a plastic manufacturing process based on application requirements.

TEXT BOOKS:

1. Hajra Chouldhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2010.
2. Kalpakjian. S, "Manufacturing Engineering and Technology", 7th Edition, Pearson Education India Edition, 2018.

REFERENCES:

1. Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006
2. Black J.T and Ronald A. Kosher, "Degarmos Materials and Processes, in Manufacturing" 12th Edition, Wiley Publishers, 2017.
3. Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2006.
4. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", Vol1, 4th Edition, Mcgraw Hill-2017.
5. Gowri P. Hariharan, A.Suresh Babu, "Manufacturing Technology I", Pearson Education, 2008.

EE17351	ELECTRICAL DRIVES AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the basic concepts of drives.
- To learn the characteristics of drives.
- To impart knowledge on the different methods of starting of D.C and induction motors.
- To know the conventional and solid-state speed control methods of DC drives.
- To provide knowledge on the conventional and solid-state speed control methods of AC drives.

UNIT I INTRODUCTION 8

Basic elements-Types of electric drives-factors influencing the choice of electrical drives-heating and cooling curves-Loading conditions and classes of duty-Selection of power rating for drive motors with regard to thermal overloading and load variation factors.

UNIT II DRIVE MOTOR CHARACTERISTICS 9

Mechanical Characteristics – Speed torque characteristics of various types of loads and drive motors- Braking of electrical motors – DC motors: Shunt, Series and Compound- Single Phase and three phase induction motors - Induction motors in traction systems.

Special Drives: SRM, BLDC Drive, Drives for Transportation and Traction system

UNIT III STARTING METHODS 8

Types of DC motor starters – Typical control circuits for Shunt and Series motors- Three phase squirrel cage and slip ring induction motors.

UNIT IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES 10

Speed Control of DC Series and Shunt motors- Armature and Field Control, Ward Leonard control system – Using Controlled rectifiers and DC choppers- applications.

UNIT V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES 10

Speed Control of three phase induction motor- Voltage control, Voltage / frequency Control, Slip power recovery scheme – Using Inverters and AC voltage regulators – applications.

TOTAL : 45 PERIODS

TEXT BOOK(S):

1. Vedam Subrahmaniam, "Electric Drives (Concepts and Applications)", Tata McGraw-Hill, 2011.
2. Nagrath.I.J. & Kothari.D.P, "Electrical Machines", Tata McGraw-Hill, 1998.

REFERENCE BOOK(S):

1. Pillai.S.K "A First Course on Electric Drives", New Age International Limited, 2012.
2. M.D.Singh, K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 2008.

OUTCOMES:

Students will be able to

- Obtain knowledge on the definition of drive, its types and its power rating depending on the duty on which it operates.
- Determine the speed –torque characteristics and braking techniques of dc and ac drives.
- Understand the starting methods of dc and induction motors.
- Realize solid state and conventional speed control of dc drives using rectifiers and choppers.
- Realize solid state and conventional speed control of ac drives using inverter and ac voltage controller.

ME17311 MANUFACTURING TECHNOLOGY LABORATORY - I

L	T	P	C
0	0	4	2

OBJECTIVES:

- To understand and practice the green sand moulding process.
- To study and practice various sheet metal operations.
- To Study and practice the fundamental operations performed in lathe
- To practice threading, knurling operations that can be performed in centre lathe.
- To equip practical knowledge of various operations performed in lathe using drilling tools.

LIST OF EXPERIMENTS

1. Making of mould using single piece pattern
2. Making of mould using split piece pattern
3. Funnel making using sheet metal
4. Tray making using sheet metal
5. Taper turning
6. External thread cutting
7. Internal thread cutting
8. Eccentric turning
9. Knurling
10. Drilling and boring

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to demonstrate the moulding process using moulding sand with different types of patterns.
- Ability to fabricate different types of components in sheet metal.
- Ability to perform various basic operations in lathe.
- Ability to make threaded components using lathe.
- Ability to perform drilling and its associated operations in lathe.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No	NAME OF EQUIPMENT	Qty.
1.	**SAND MOULDING FACILITY**	
1.1.	Moulding Table	5
1.2.	Moulding boxes, tools and patterns	5
2.	**SHEET METAL WORK FACILITY**	
2.1.	Hand Shear – 300 mm	1
2.2.	Bench Vice	5
2.3.	Tools for sheet metal work	5 set
3.	**MACHINE TOOL FACILITY**	
3.1.	Centre lathe	7

ME17312 COMPUTER AIDED MACHINE DRAWING

L	T	P	C
0	0	4	2

OBJECTIVES:

- To make the students understand and interpret drawings of machine components so as to prepare assembly drawings either manually and using standard CAD packages.
- To familiarize the students with Indian Standards on drawing practices and standard components.
- To draw various thread forms, different types of fasteners, Keys, Cotters, Knuckle and Riveted joints.
- To draw principal views, sectional views and two dimensional assemble views of different components with an emphasis by applying general projection principles using Computer Aided Drafting (CAD).
- To gain practical experience in handling 2D production drawings including assemblies and 3D geometrical modeling using software systems.

DRAWING STANDARDS

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

2-D DRAWINGS

Limits, Fits – Tolerancing of individual dimensions- Specification of Fits- Manual Preparation of production drawings and reading of part and assembly drawings.

CAD PRACTICE (USING APPLICATION PACKAGES)

Drawing, Editing, Dimensioning, Plotting Commands, Layering Concepts, Hatching, Detailing, Assembly, basic principles of GD&T (geometric dimensioning & tolerance)

ASSEMBLY DRAWING (MANUAL & USING APPLICATION PACKAGES)

Manual parts drawing and preparation of assembled views given part details for components followed by practicing the same using CAD packages. Suggested Assemblies: Shaft couplings – Plummer block – Screw jack – Universal Joint – Machine Vice – Stuffing box- safety Valves - Non-return valves- Connecting rod - Piston and crank shaft- Multi plate clutch- Preparation of Bill of materials and tolerance data sheet.

Use of standard CAD application packages is recommended from the point of view of requirement by industries. However to encourage our national efforts in indigenous development of software packages with focus on open source, students may be encouraged to work with "CollabCAD Software", developed by: National Informatics Centre (CAD Group), Govt. of India, A-Block, C.G.O. Complex, Lodhi Road, New Delhi 110003, 2003" www.collabcad.com

TOTAL: 60 PERIODS

OUTCOMES:

- Able to read engineering drawings with different views, including orthographic views, hidden lines and sectional views based on the standards of machine drawing practiced by Bureau of Indian standards (B.I.S).
- Able to recognize the basic principles and applications of fits, tolerancing, types of thread forms and fastening systems.
- Able to distinguish between different types of Keys, Riveted joints and the process of riveting.
- Able to draw 2D manual Production drawings, classify different types of machine components and their uses in mechanical industries.
- Able to draw different principal views, sectional views of the components or machine parts and their assemblies using CAD software.

REFERENCE BOOKS

1. Bhatt.N.D. and Panchal.V.M., "Machine Drawing", Charotar Publishing House, 388001, 53rd Edition, 2014.
2. P.S.G. Design Data Book. (Latest Edition)
3. K.R. Gopala Krishna., "Machine Drawing", Subhash publication.
4. Ajeet Singh, Machine Drawing Includes AutoCAD, Tata McGraw-hill, 2012.

		L	T	P	C
HS17361	**INTERPERSONAL SKILLS/LISTENING & SPEAKING**	**0**	**0**	**2**	**1**

OBJECTIVES

- To upgrade the learners' listening and speaking skills for educational purposes.
- To enhance the employability skills of the learners with a special focus on listening and speaking skills.

UNIT I INTRODUCTION 6

Importance of listening and Types of Listening – listening to TED Talks, lectures, etc. **Speaking**: group discussions on general topics like how to grow organic potted plants, to furnish an apartment inexpensively, etc. – **Phonetics**

UNIT II APPRECIATIVE LISTENING AND IMPROMPTU 6

Listening - Listening to motivational speeches, music and poetry. **Speaking** – pick and talk, short talks on any event on topics- a trip to remember, a job I'd love to have, etc. – **Vocabulary**: Collocation.

UNIT III INFORMATIVE LISTENING AND PERSUASIVE SPEAKING 6

Listening – Listening- to gather information such as facts, directions, news or instructions. **Speaking –** Persuasive speaking- convincing the audience with the speaker's view on the topics- food additives and unhealthiness, financial education is important in today's world, etc. – **Vocabulary**: Idioms and Phrases.

UNIT IV CRITICAL LISTENING AND SPEAKING ON SPECIAL OCCASION 6

Listening – Critical Listening- listening to examine and evaluate the message for logic and truth - televised debate, election campaign. **Speaking** – speech to commemorate a person or an event- speech of Introduction, etc. – **Vocabulary**: Foreign Words and Phrases.

UNIT V EMPATHETIC LISTENING AND DEMONSTRATIVE SPEAKING 6

Listening– Empathetic Listening – paying attention to another person with empathy – listening to problems and issues (videos). **Speaking –** Demonstrative speaking – Demonstrate a process using visual aids (charts, graphs, maps, pictures, etc.) – **Grammar**: Different types of Questions.

TOTAL: 30 PERIODS

OUTCOMES

On completion of the course students will be able to

- Identify the different types of listening and speaking for effective interpersonal communication.
- Discuss and respond to content of a listening passage.
- Comprehend and answer questions based on the texts/passages given.
- Understand different genres of texts and comprehend the materials to improve their vocabulary and are familiar with new words, phrases, sentence structures and ideas.
- Make inferences and predictions about spoken discourse.

REFERENCES:

1. "Technical Communication – Principles and Practice," Second Edition – Meenakshi Raman and Sangeetha Sharma, Oxford University Press, December, 2011.
2. "Interpersonal Skills: How to develop Interpersonal Skills for work and home," Henry Lee (Kindle Edition)
3. "Teaching the Core Skills of Listening and Speaking," Erik Palmer (Kindle Edition)

EE17361 ELECTRICAL ENGINEERING LABORATORY

L	T	P	C
0	0	3	2

OBJECTIVES:

- To conduct load test and to obtain the load characteristics of DC motors.
- To obtain the characteristics of DC Generator.
- To validate the principles of operation of AC motors by conducting load test.
- To obtain the load characteristics of single phase transformer by conducting load test.
- To obtain the regulation of Alternator.

LIST OF EXPERIMENTS

1. Load test on DC Shunt & DC Series motor
2. Load test on DC compound motor
3. O.C.C & Load characteristics of DC Shunt generator
4. Speed control of DC shunt motor (Armature, Field control)
5. Load test on single phase transformer
6. O.C & S.C Test on a single phase transformer
7. V curves and inverted V curves of synchronous Motor
8. Load test on three phase squirrel cage Induction motor

9. No load and blocked rotor test on three phase slip ring Induction Motor
10. Load test on single phase Induction Motor.
11. Study of DC & AC Starters.
12. Multi phase chopper.
13. Speed control of PMDC using full bridge converter.
14. Speed control of three phase induction motor using Inverter.

OUTCOMES:

Students will be able to

- Develop the basic wiring connection of electrical machines.
- Understand the principle and operation of electrical machines.
- Understand the working of Transformer.
- Demonstrate and evaluate the parameters of alternator.
- Realize the principle and operation of synchronous machine.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

- DC Shunt motor - 2
- DC Series motor - 1
- DC shunt motor-DC Shunt Generator set - 1
- DC Shunt motor-DC Series Generator set - 1
- Single phase transformer - 2
- Three phase alternator - 2
- Three phase synchronous motor - 1
- Three phase Squirrel cage Induction motor - 1
- Three phase Slip ring Induction motor - 1
- Single phase Induction motor – 1
- DC Compound motor – 1
- Inverter with Three phase induction motor – 1
- Multi quadrant chopper – 1
- Full bridge converter with PMDC - 1

SEMESTER IV

MA17452 STATISTICS AND NUMERICAL METHODS L T P C
3 2 0 4

OBJECTIVES:

- To provide the necessary basic concepts of a few statistical methods in designing and solving problems.
- To provide various numerical methods in solving problems that occur in the field of Engineering and Technology.

UNIT I TESTING OF HYPOTHESIS 15

Statistical hypothesis - Large sample testbased on Normal distribution for single mean and difference of means -Tests based on t, F and Chi-square test for single sample standard deviation. Chi-square tests for independence of attributes and goodness of fit.

UNIT II DESIGN OF EXPERIMENTS 15

One way and two way classifications - Completely randomized design – Randomized block design –Latin square design

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 15

Newton Raphson method – secant method – Gauss Jordan method – Iterative method of Gauss Seidel – Eigen value of a matrix by power method and by Jacobi method for symmetric matrix.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 15

Curve fitting (y=a+bx, y=a+bx+cx^2)-Lagrange's interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS 15

Taylor's series method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations – Finite difference methods for solving second order equations- Finite difference solution of one dimensional heat equation by explicit and implicit methods - Two dimensional Laplace equation.

TOTAL 75 PERIODS

OUTCOMES

On completion of the course students will be able to

- Obtain statistical data from experiments and able to analyze the same using statistical test.
- Design experiments using suitable ANOVA techniques and draw conclusions.
- Solve algebraic equations and eigen value problems that arise during the study of engineering problems.
- Use interpolation methods to solve problems involving numerical differentiation and integration
- To solve differential equations numerically that arise in course of solving engineering problems.

TEXT BOOKS:

1. T. Veerarajan, 'Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks' , Mc Graw Hill, 2016.
2. P. Kandasamy., Thilagavathi and K. Gunavathi., "Statistics and Numerical Methods" , S. Chand & Company Ltd. (2010).

REFERENCES:

1. Johnson. R.A., and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers",11th Edition, Pearson Education, , Asia, 2011.
2. Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2007.
3. Spiegel. M.R., Schiller. J., and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics", Tata McGraw Hill Edition, 2004.
4. Grewal. B.S., and Grewal. J.S., "Numerical Methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.
5. Gerald. C.F., and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, NewDelhi, 2006.
6. Chapra. S.C., and Canale. R.P, "Numerical Methods for Engineers", 7th Edition, McGrawHill, New Delhi, 2015.

ME17401 FLUID MECHANICS AND MACHINERY

L	T	P	C
2	2	0	3

OBJECTIVES:

- The applications of the conservation laws to flow through pipes and hydraulic machines are studied
- To understand the flow and losses in pipe flow.
- To understand the importance of dimensional analysis.
- To understand the importance of various types of flow in pumps.
- To understand the importance of various types of flow in turbine.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 13

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristic – concept of control volume - application of continuity equation, energy equation and momentum equation - **Ventuimeter and orificemeter - applications.**

UNIT II FLOW THROUGH CIRCULAR CONDUITS 13

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli-Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation – **Chezy's equation** –friction factor- Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel.

UNIT III DIMENSIONAL ANALYSIS 10

Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

UNIT IV THEORY OF HYDRO TURBO MACHINES AND POSITIVE DISPLACEMENT MACHINES 12

Theory of roto-dynamic machines - Classification– various heads & efficiencies– velocity components at entry and exit of the rotor - velocity triangles of turbines & pumps. Axial, radial and mixed flow turbines. Reciprocating pump- working principle – Rotary pumps –classification-– **Application of pumps and Turbines.**

UNIT V PUMPS AND TURBINES 12

Impact of jets - Euler's equation - Centrifugal pumps– working principle - work done by the impeller - performance curves - Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner – draft tube. Specific speed - unit quantities – performance curves for turbines – governing of turbines.

TOTAL: 60 PERIODS

OUTCOMES:

- The students can able to apply mathematical knowledge to predict the properties and characteristics of a fluid.
- The students can able to understand the concept of losses
- The students can able to apply the mathematical knowledge and the properties of fluid for Dimensional Analysis.
- Can critically analyse the performance of pumps and practical applications
- Can critically analyse the performance of turbines and practical applications .

TEXT BOOK:

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2013.
2. R.K.Bansal "Fluid Mechanics and Machinery", Lakshmi Publications, 2017.

REFERENCES:

1. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010
2. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi, 2016.
3. Robert W.Fox, Alan T. McDonald, Philip J. Pritchard, "Fluid Mechanics and Machinery", 2011.
4. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011.

		L T P C
ME17402	**STRENGTH OF MATERIALS**FLUIDMECHANICSANDMACHINERY	**2 2 0 3**

OBJECTIVES:

- To understand the behaviour of solid materials under various loadings and the subsequent stress-strain characteristics and to know about the Principal planes and stresses analytically and graphically using Mohr's circle.
- To get an idea about the various types of beams and their loading conditions along with the shear force, bending moment graphically and to understand the various theories of bending.
- To understand the torsion equation and deflection in the various cross section of the shaft and to study the different types of springs along with the shear stress including Wahl Factor.
- To understand the slope and beam deflection using various methods under normal loads and to study the column with different end conditions.
- To understand the deformation in thin, thick cylindrical and spherical shells subjected to internal pressure.
- To understand the stresses developed in bars, compounds bars, beams, shafts, cylinders and spheres.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 12

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads – Volumetric strains –Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 12

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over hanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stresses in beams – Shear flow.

UNIT III TORSION 12

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Maximum shear stress in spring section including Wahl Factor - Deflection of helical springs, carriage springs.

UNIT IV DEFLECTION OF BEAMS AND COLUMNS 12

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams – Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 12

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

TOTAL: 60 PERIODS

OUTCOMES:

- Students can able to understand the different types of stress and strain in bars of varying cross section and the need of Hooke's law along with elastic constants and can understand the biaxial stresses.
- Students can understand the various types of beams subjected to various load conditions and will be aware of shear force and bending moment diagram.
- Students can evaluate the torsion of various bars, shafts along with suitable power transmission and can able select the suitable springs for the desired applications along with proper dimension.
- Students can understand the elastic curve of Neutral axis of the beam under normal loads and evaluation of beam deflection and slope with various methods.
- Students can able to understand the construction of thin, thick cylindrical and spherical shells and their application and can understand the Lame's theorem.

TEXT BOOKS:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2017
2. Ferdinand P. Beer, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing ‘co. Ltd., New Delhi, 2017.

REFERENCES:

1. Egor. P.Popov “Engineering Mechanics of Solids” Prentice Hall of India, New Delhi, 2015
2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2016.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, SI Edition, 2018.
4. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2017.

ME17403 MANUFACTURING TECHNOLOGY– II

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the theory of Metal cutting, mechanisms of Tool wear, cutting tool materials and uses cutting fluids.
- To understand the construction, working principle of standard machine tools such as centre lathe also Special purpose lathes like capstan, turret, single and multiple spindle lathes.
- To know the construction, working principle of reciprocating special machine tools such as shaper, slotter and also milling machines.
- To know the principles, types and applications of grinding and broaching processes.
- To understand the constructional details, special features of NC, CNC machine tools and various types of programming for CNC machines.

UNIT I THEORY OF METAL CUTTING 9

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools – nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

UNIT II TURNING MACHNES 9

Centre lathe, constructional features, specification mechanisms, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout – Multi spindle automatic lathes.

UNIT III RECIPROCATING MACHINES, MILLING AND GEAR CUTTING 9

Shaper & slotter, – Construction - Types of operations. Types of drilling machines –Various operations performed in drilling machines. Drilling, reaming, boring and Tapping operations. Milling operations- types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling, hobbing and gear shaping processes –finishing of gears.

UNIT IV ABRASIVE PROCESSES AND BROACHING 9

Abrasive processes: grinding wheel – specifications and selection, types of grinding process– cylindrical grinding, surface grinding, centreless grinding and concepts of surface integrity. Truing and dressing of grinding wheel - broaching machines: broach construction - push, pull, surface and continuous broaching machines. Broaching tool nomenclature and types.

UNIT V CNC MACHINING 9

Numerical Control (NC) machine tools – CNC types, constructional details, special features, machining centre – Tool magazines and transfer systems, Automatic tool changer - Part programming fundamentals- CNC and manual part programming – micromachining – wafer machining

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to identify different parts of single point cutting tools, determine cutting force, chip thickness ratio and selecting the appropriate cutting tool materials.
- Ability to understand the working of different standard machine tools such as center lathe, semi-automatic and automatic lathes.
- Ability to explain the functioning of machines like shaper, slotter, milling machines and gear generation operations.
- Ability to explain the working and selection of suitable grinding process and broaching process.
- Ability to write the part program and execute the same to carry out simple operations using CNC trainer lathe and milling machine.

TEXT BOOKS:

1. Hajra Choudhury, "Elements of Workshop Technology", Vol.II.,15th Edition Media Promoters,2010.
2. Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", McGraw-Hill, New Delhi, 2017.

REFERENCES:

1. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J.White "Machine Tool Practices",10th Edition, Pearson, 2015.
2. HMT, "Production Technology", HMT Bangalore, 2017.
3. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", Taylor & Francis, 2005.
4. Roy. A.Lindberg, "Process and Materials of Manufacture," Fourth Edition,Pearson Education, 2015.

ME17404 THERMAL ENGINEERING- I

L	T	P	C
3	0	0	3

OBJECTIVES:

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes
- To know the concepts of various carburetors, ignition system of an IC engines.
- To know the concepts of various lubrication and cooling system of an IC engines.
- To familiarize with testing of an IC engines.
- To familiarize with fuels and combustion also the knocking in an engine.

UNIT I THERMODYNAMIC CYCLES & IC ENGINES 9

Determination of state's properties, terminologies and cycle efficiencies: Carnot cycle, Air standard cycles- Otto cycle, Diesel cycle, Dual cycle, comparison of Otto, diesel, and Dual Cycle. I C Engines - Classification. Principle and working of four stroke and two stroke petrol and diesel engines with P-V and T-S and valve and port timing diagrams. Comparison of petrol and diesel engines - two stroke and four stroke engines.

UNIT II FUEL SUPPLY AND IGNITION SYSYEMS 9

Working principles of carburetors, MPFI system. Battery and Magneto ignition type systems. Diesel fuel pumps and injector- working principle- CRDI system. Supercharging, turbo charging and its types – Working Principle.

UNIT III LUBRICATION AND COOLING SYSYEMS 9

Necessity of lubricating system**,** properties of lubricating oil; Methods and types of lubrication systems; wet sump and dry sump systems; necessity of engine cooling; disadvantages of over cooling. Cooling systems; air cooling, water cooling: radiators.

UNIT IV TESTING AND PERFORMANCE 9

Testing of IC engines-basics, engine measurements; air & fuel flow rate, constant speed and variable speed test, methods of estimating indicated power: Indicator diagram; Willan's line; Morse test, brake power, volumetric efficiency. Heat balance test. emission measurement, emission reduction techniques

UNIT V FUELS & COMBUSTION ENGINEERING 9

Chemical reactions, fuel properties, flue gas analysis, Heating values –HCF and LCF analysis. Minimum air flow requirement for combustion. Normal and abnormal combustion processes –knocking / detonation, Factors affecting knocking/detonation in SI and CI engines; Fuel ratings: Octane and Cetane numbers, adiabatic flame temperature calculation.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students able to

- Analyse the gas power cycle efficiencies and use of them in IC Engines.
- Explain the working of carburettor and various Ignition systems.
- Understand about various types of Lubrication and cooling systems.
- Analyze the performance parameters of an Internal combustion engine.
- Apply their knowledge on fuel properties and combustion characteristics.

TEXT BOOKS:

1. Ganesan.V, "Internal Combustion Engine", McGraw Hill Publishers Limited, New Delhi, 4th Edition , 2017.
2. Rudramoorthy R, "Thermal Engineering", McGraw Hill Publishers Co. Ltd., New Delhi, 2017.

REFERENCES:

1. Colin R Ferguson, "Internal Combustion Engines: Applied Thermosciences", Wiley and Sons, New York, 3rd Edition, 2015.
2. Kothandaraman.C.P and Domkundwar.S, "Thermodynamics and Thermal Engineering", Dhanpat Rai and Sons, New Delhi, 2016.
3. Edward F Obert, "Internal Combustion Engines", Interscience Publishers, 1971.
4. Rajput.R.K, "Thermal Engineering", Laxmi Publications (P) Limited, New Delhi, 10th Edition, 2017.

GE17451 TOTAL QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To facilitate the understanding of basic quality management in engineering.
- To facilitate the understanding of various principles of TQM.
- To be acquainted with management tools, six sigma and benchmarking.
- To be acquainted with quality functions, TPM concepts &continuous improvement tools.
- To learn various quality systems and TQM implementation in manufacturing and service sectors.

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, 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, Lean 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 Deployment (QFD) -Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures. POKA-YOKE.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9001:2015 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits – ISO 9000:2005, ISO 9004:2009 - TQM Implementation in manufacturing and service sectors. Quality System for Automotive Supplier TS 16949, Quality System for Telecom Industries - TL 9000

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to explain the importance of quality in engineering.
- Ability to explain various principles in TQM.
- Explore the knowledge of implementing various TQM tools.
- Ability to create rapport among workers to form a quality team.
- Ability to explain the benefits of implementing ISO-9000 & ISO-14000 in manufacturing and service sectors.

TEXT BOOK:

1. Dale H. Besterfiled, et at., "Total quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2011.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th
2. Edition, First Indian Edition, Cengage Learning, 2012.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

ME17411 MANUFACTURING TECHNOLOGY LABORATORY–II

L	T	P	C
0	0	4	2

OBJECTIVES:

- To study the functions various semi-automatic lathe machines.
- To acquire knowledge on shaper and milling machines and their applications.
- To understand the functions and operations performed in gear generation machines.
- To understand the applications of various grinding machines.
- To get the knowledge in developing the CNC part programs.

LIST OF EXPERIMENTS

1. Step turning, drilling and boring using Capstan / Turret late
2. Flange drilling

3. Cube formation using shaper
4. Key way cutting in slotter
5. Hexagonal milling using vertical milling machine
6. Spur gear cutting in milling machine
7. Helical gear cutting in milling machine
8. Gear generation in gear hobbing machine
9. Plain surface grinding
10. Cylindrical grinding
11. Tool angle grinding with tool and cutter grinder

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to demonstrate the use of capstan & Turret Lathe for various operations.
- Ability to machine components with different profiles using shaper and milling machine.
- Ability to use different machine tools for gear manufacturing operations.
- Ability to use various grinding machines for finishing process and to make cutting tools.
- Ability to develop CNC part programming.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No	NAME OF THE EQUIPMENT	Qty.
1	Capstan and Turret Lathes	1 No each
2	Horizontal Milling Machine	1
3	Vertical Milling Machine	1
4	Surface Grinding Machine	1
5	Cylindrical Grinding Machine	1
6	Radial Drilling Machine	1
7	Gear Hobbing Machine	1
8	Tool Makers Microscope	1
9	CNC Lathe	1
10	CNC Milling machine	1
11	Gear Shaping machine	1
12	Tool and cutter grinder	1

ME17412 **STRENGTH OF MATERIALS AND FLUID MECHANICS AND MACHINERY LABORATORY** **L T P C 0 0 4 2**

OBJECTIVES:

- To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads. This would enable the student to have a clear understanding of the design for strength and stiffness

LIST OF EXPERIMENTS

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals – Brinell, Vickers and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs

TOTAL: 30 PERIODS

OUTCOMES:

- Ability to perform different destructive testing
- Ability to characterize and compare different materials

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Universal Tensile Testing machine with double 1 shear attachment – 40 Ton Capacity	1
2	Torsion Testing Machine (60 NM Capacity)	1
3	Impact Testing Machine (300 J Capacity)	1
4	Brinell Hardness Testing Machine	1
5	Rockwell Hardness Testing Machine	1
6	Vickers Hardness Testing Machine	1
7	Spring Testing Machine for tensile and compressive loads (2500 N)	1
8	Metallurgical Microscopes	3
9	Muffle Furnace (800 C)	1

FLUID MECHANICS AND MACHINERY LABORATORY

OBJECTIVES:

- Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices and also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.,

LIST OF EXPERIMENTS

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

TOTAL: 30 PERIODS

OUTCOMES:

- Ability to use the measurement equipments for flow measurement
- Ability to do performance trust on different fluid machinery

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. NO.	NAME OF THE EQUIPMENT	Qty.
1	Orifice meter setup	1
2	Venturi meter setup	1
3	Rotameter setup	1
4	Pipe Flow analysis setup	1

5	Centrifugal pump/submergible pump setup	1
6	Reciprocating pump setup	1
7	Gear pump setup	1
8	Pelton wheel setup	1
9	Francis turbine setup	1
10	Kaplan turbine setup	1

HS17461 ADVANCED READING AND WRITING

L	T	P	C
0	0	2	1

OBJECTIVES:

- To enhance the employability skills of the learners with a special focus on critical thinking, reading and writing.
- To enhance proficiency in the language and the ability to write compare and contrast essays effectively.

UNIT I PRIMITIVE READING AND FREE WRITING 6

Reading – Primitive Reading: Reading stories. Skimming: browse through a book or a long passage, understand the gist of a text. **Writing**: Free writing – writing about oneself/ family/ native/ hobbies/ festivals, etc. **Grammar:** Sentence Structure.

UNIT II SCANNING AND EXPOSITORY WRITING 6

Reading - Scanning: Guessing meaning from the context, surveying the text. **Writing** – Narrative Writing: Narrating a story, incident or past events. **Grammar** – Imperative Sentences.

UNIT III INTENSIVE READING AND DESCRIPTIVE WRITING 6

Reading – Intensive Reading: Drawing inferences from the text, responding critically to the text. **Writing** – Descriptive Writing: an incident, place, person, process, etc. **Grammar** – Different kinds of adjectives.

UNIT IV EXTENSIVE READING AND COMPARATIVE WRITING 6

Reading – Extensive Reading: Reading wide range of articles for better understanding, etc. **Writing** – Compare and Contrast: two things/ places/ persons/ ideas, etc. **Grammar** – Connectives.

UNIT V INFERENTIAL WRITING AND ARGUMENTATIVE/ PERSUASIVE WRITING 6

Reading – Inferential Reading: draw upon prior knowledge, draw conclusions and make inferences. **Writing** – Argumentative and Persuasive Writing: establishing facts, forming and stating conclusions. **Grammar** – Conjunctions, Cohesive Devices.

TOTAL: 30 PERIODS

OUTCOMES

On completion of the course students will be able to

- Skim through columns and magazines and write on simple topics with proper sentence structures.
- Read comprehensively and understand the thoughts of the writer and report clearly in detail about the happenings around.
- Comprehend and answer questions based on the texts/passages given and write descriptive essays.
- Read different genres of texts and comprehend the materials to improve their vocabulary and are familiar with new words, phrases, sentence structures and ideas.

- Read between lines, draw conclusions with their prior knowledge on the subject and persuade their readers with their flawless writing skills.

REFERENCES:

1. Bridge to College Success – Intensive Academic Preparation for Advanced Students" – Robertson.1991.
2. "Source Work – Academic Writing from Sources" Second Edition - Dellahite, Haun.
3. Aebersold, Jo Ann and Field M. L. 1997, "From Reader to Reading teacher," Cambridge, Cambridge University Press, Anderson, R. C. 1996.
4. Bamford, Julian and Day, R. R. 1997, "Extensive Reading: What is it? Why Bother?" Language Teacher Online.

SEMESTER V

		L	T	P	C
ME17501	**DESIGN OF MACHINE ELEMENTS**	**2**	**2**	**0**	**3**

OBJECTIVES:

- To get knowledge in various steps involved in the Design Process
- To understand the principals involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data of machine design
- To learn to use catalogues and standard machine components
- To know the integrated design procedure of different machine elements for mechanical applications.

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 12

Introduction to the design process - factors influencing machine design, design consideration- standards and codes - selection of materials based on mechanical properties - Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – curved beams – crane hook and 'C' frame- Factor of safety - theories of failure – Design based on strength and stiffness – stress concentration – Design for variable loading.

UNIT II SHAFTS AND COUPLINGS 12

Design of solid and hollow Shaft –For Static and Varying Loads, For Strength and Rigidity-Design of Coupling-Types, Flange, Muff and Flexible Rubber Bushed Coupling– Keys, keyways and splines - Rigid and flexible couplings.

UNIT III TEMPORARY AND PERMANENT JOINT 12

Threaded fastners -Design of Bolts under Static Load, Design of Bolt with Tightening/Initial Stress, Design of Bolts subjected to Fatigue –Design of Riveted Joints and Welded Joints for structures- theory of bonded joints.

UNIT IV ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 12

Design of Helical Spring-leaf spring-Types, Materials,Static and Variable Loads. optimization of helical ,leaf springs - rubber springs – Design of Connecting Rods , crank shafts and piston.

UNIT V BEARING 12

Selection of Sliding contact and rolling contact bearings –- Antifriction Bearing-Types, Life of Bearing, Reliability Consideration -, McKee's Eqn., Sommerfield Number, Raimondi & Boyd - Design of hydrodynamic journal bearings- sliding contact and rolling contact bearings

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of this course the students can able to

- Get familiarized with the design data's and codes in general practice
- Formulate and analyze stresses and strains in machine elements and structures subjected to various loads.
- Do tolerance analysis and specify appropriate tolerances for machine design applications.
- Analyze and design structural joints
- Get familiarized with standards, safety, reliability, importance of dimensional parameters and manufacturing aspects in mechanical design

TEXT BOOK:

1. Bhandari V, "Design of Machine Elements", 4th Edition, McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 10th Edition, McGraw-Hill, 2014.

REFERENCES:

1. Sundararajamoorthy T. V. Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
2. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine components Design",4th Edition,John Wileyand Sons,2011.
3. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", McGraw-Hill Book Co.(Schaum's Outline), 2010.
4. Bernard Hamrock, Steven Schmid,Bo Jacobson, "Fundamentals of Machine Elements", 3rd Edition, SI Edition, CRC Press., 2014.

ME17502	DYNAMICS OF MACHINES	L T P C 2 2 0 3

OBJECTIVES:

- To derive the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To outline the undesirable effects of unbalances resulting from prescribed motions in mechanism. To conversant with balancing problems of machines
- To interpret the effect of free vibrations and forced vibration with the real models
- To develop analytical competency in solving vibration problems
- To justify the principles in mechanisms used for speed control and stability control.

UNIT I FORCE ANALYSIS 12

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 – Flywheels of punching presses- Dynamics of Cam-follower mechanism.

UNIT II BALANCING 12

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Approaches and equipment for measurement of unbalanced masses.

Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines – Balancing of linkages – Balancing machines-Field balancing of discs and rotors.

Self-study: Balancing of wheel / rotor on computerized balancing machine OR Demonstration of wheel balancing during a visit to industry / workshop.

UNIT III SINGLE DEGREE FREE VIBRATION 12

Basic concepts of S.H.M, Causes and effects of vibration - Degrees of freedom – Single degree of freedom – Free vibration – Equations of motion – Natural frequency – Types of Damping – Damped vibration– Torsional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems.

UNIT IV FORCED VIBRATION 12

Response of one degree freedom systems to periodic forcing – Harmonic disturbances –Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation vibration measurement- Selection of measuring instruments – accelerometer – dynamic properties and selection of structural materials for vibration control.

UNIT V MECHANISM FOR CONTROL 12

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.

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of this course the students can able:

- To predict the force analysis in mechanical system/ engine.
- To analyse unbalanced forces and bearing reactions for a system of rotating masses and reciprocating engines.
- To determine natural frequency of mechanical systems represented in lumped form.
- To select the critical speed shafts with unbalanced rotors and basic knowledge on measuring device.
- To identify the gyroscopic couple or effect for stabilization of ship, aeroplane, two wheeler and four wheeler vehicle.

TEXT BOOK:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”,3rd Edition, Oxford University Press, 2010.
2. Rattan, S.S, “Theory of Machines”, 3rd Edition, McGraw-Hill, 2014.

REFERENCES:

1. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2010.
2. Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2015
3. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
4. Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines", 3rd Edition, Affiliated East-West Pvt. Ltd., New Delhi, 2006.
5. Rao.J.S. and Dukkipati.R.V. "Mechanisms and Machine Theory", New Age International., New Delhi, 2006.

ME17503 METROLOGY AND MEASUREMENTS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic principles of measurements.
- To provide knowledge of various linear and angular measuring equipments and the procedures of measurement
- To provide knowledge on various Metrological equipments available to measure the dimension of the components.
- To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.
- To understand the basics and methods of measurement for power, flow and temperature.

UNIT I BASICSOFMETROLOGY 5

Introduction to Metrology – Generalised Measurement system - Need for measurement – Units and Standards - Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Static and Dynamic Response - Errors – Errors in Measurements – Types – Control – Calibration.

UNIT II LINEAR AND ANGULAR MEASUREMENTS 10

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure –Interchangeability and selective assembly – Angular measuring instruments – Types – Bevel protractor, clinometers, angle gauges, spirit levels, sine bar, sine centre – Angle alignment telescope – Autocollimator, Angle Dekkor – Applications, Comparators: Mechanical, electrical and Pneumatic.

UNIT III FORM MEASUREMENT 10

Measurement of Screw threads, Floating Carriage Micrometer, Measurement of Gears – tooth thickness, Constant Chord and Base Tangent method - Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.

UNIT IV ADVANCES IN METROLOGY 12

Basic concept of lasers- Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness & Alignment tests for machines. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Non contact measurement - Applications – Basic concepts of Machine Vision System – Element – Applications in quality inspection using 1D, 2D and 3D vision systems.

UNIT V MEASUREMENT OF POWER, FLOW AND TEMPERATURE 8

Force, torque, power - mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Readability.

TOTAL: 45 PERIODS

OUTCOMES:

- Can able to distinguish different measuring systems, standards and types of errors.
- Can get the knowledge of limit gauges, vernier caliper, GO-NOGO gauges, and Bevel Protractor & Sine bar.
- Able to visualize the recent trends in the measurements like CMM and laser interferometer.
- Able to understand terminologies, types and measurements of screw thread, gear teeth and surface texture.
- Can get the basics and methods of measurement for power, flow and temperature.

TEXT BOOKS:

1. Jain R.K. “Engineering Metrology”, Khanna Publishers, 2009.
2. Gupta. I.C., “A Text book of Engineering Metrology”, Dhanpatrai Publications, 2012.

REFERENCES:

1. Charles Reginald Shotbolt, “Metrology for Engineers”, 5th edition, Cengage Learning EMEA,1990.
2. Thomas E. Beckwith, “Mechanical Measurements”, Pearson Education, 2013.

		L	T	P	C
ME17504	**HEAT AND MASS TRANSFER**	**2**	**2**	**0**	**3**

OBJECTIVES:

- To understand the mechanisms of heat transfer under steady conditions in composite systems and fins.
- To understand the concepts of natural and forced convection in internal and external flows.
- To provide knowledge about the phase change heat transfer and heat exchangers
- To know the radiation and study the various laws of radiation, shape factor
- To study convective mass transfer and its types and applications.

UNIT I : CONDUCTION 12

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 – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts.

UNIT II : CONVECTION 12

Free and Forced Convection - Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over Plates and Cylinders and Internal flow through tubes.

UNIT III: PHASE CHANGE HEAT TRANSFER AND HEAT XCHANGERS 12

Nusselt's theory of condensation - Regimes of Pool boiling and Flow boiling. Correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors - Analysis – LMTD method - NTU method.

UNIT IV: RADIATION 12

Black Body Radiation – Grey body radiation - Shape Factor – Electrical Analogy – Radiation Shields. Radiation through gases.

UNIT V: MASS TRANSFER 12

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon the completion of this course students will be able to

- Apply steady state heat conduction problems for composite systems and fins.
- Solve problems in natural and forced convection for internal and external flows.
- Calculate the effectiveness of heat exchanger using LMTD and NTU methods.
- Illustrate radiation shape factors for various geometries.
- Demonstrate the phenomenon of diffusion and convective mass transfer.

TEXT BOOKS:

1. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 2015.

REFERENCES

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 2011.
2. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2011.
3. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International, 2010, 4th edition.
4. Ghoshdastidar, P.S, "Heat Transfer", Oxford, 2012.
5. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2011.

ME17511 KINEMATICS AND DYNAMICS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To understand how certain measuring devices are used for dynamic testing.

LIST OF EXPERIMENTS

1. a) Study of gear terminologies.
2. Experimental study of gear profile.
3. b) Study of gear parameters.
4. Experimental study of velocity ratios and no of teeth of simple, compound, Epicyclic and differential gear trains.
5. Study of Mechanisms.
    1. Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
    2. Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
    3. Motorized gyroscope – Study of gyroscopic effect and couple.
    4. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
    5. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
    6. Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.
    7. Determination of torsional natural frequency of single and Double Rotor systems.
    8. Vibration of Equivalent Spring mass system – undamped and damped vibration.
    9. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
    10. Balancing of rotating masses.
    11. Transverse vibration of Free-Free beam – with and without concentrated masses.
        1. Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.
        2. Determination of transmissibility ratio using vibrating table.

TOTAL: 60 PERIODS

OUTCOME:

- Ability to demonstrate the principles of kinematics and dynamics of machinery
- Ability to use the measuring devices for dynamic testing.

ME17512 THERMAL ENGINEERING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To study the performance characteristics of various engines
- To understand the need for proper IC engines
- To understand boiler and steam turbine operation
- To study the heat transfer characteristics of various heat transfer apparatus
- To study the performance of refrigeration cycle / components.

LIST OF EXPERIMENTS

I.C. ENGINE LAB **15**

1. Theoretical and Actual Valve Timing and Port Timing diagrams.
2. Determination of Flash Point and Fire Point of various fuels / lubricants.
3. Performance test of Reciprocating Air compressor

4. Performance and Heat Balance Test on 4 – stroke Diesel Engine.
5. Retardation Test on a Diesel Engine.

STEAM LAB **3**

1. Performance and Energy Balance Test on Steam Generators and Turbines.

HEAT TRANSFER LAB **18**

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

REFRIGERATION AND AIR CONDITIONING LAB **9**

1. Determination of COP of a refrigeration system
2. Performance test in a simple Air-Conditioning system
3. Performance test in a fluidized Bed Cooling Tower

TOTAL: 60 PERIODS

OUTCOMES:

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

- Understand the performance parameters of IC engines and their significance
- Understand the necessity and significance of a boiler trial
- Understand the performance parameters in a reciprocating compressor.
- Determine the heat transfer coefficient and performance of different heat transfer equipments
- Perform a load test on Refrigeration & Air- conditioning test rig to determine their effectiveness.

		L	T	P	C
ME17513	**METROLOGY AND MEASUREMENTS LABORATORY**	**0**	**0**	**4**	**2**

OBJECTIVES:

- To understand the basic principles of measurement.
- To understand the method of measurement and selection of linear measurement instruments.
- To know the selection of suitable angle measurement instruments.
- To learn various parameters of form measurement like screw thread, gear and surface roughness and usage of related instruments.
- To learn the basics and measurement procedure for mechanical parameters measurements.

LIST OF EXPERIMENTS

1. Tool Maker's Microscope
2. Mechanical Comparator
3. Sine Bar and Sine Centre
4. Gear Tooth Vernier Caliper
5. Floating gauge Micrometer
6. Co ordinate Measuring Machine
7. Surface Finish Measuring Equipment
8. Vernier Height Gauge
9. Bore diameter measurement
10. Force Measurement
11. Torque Measurement
12. Temperature measurement
13. Autocollimator

14. Vibration parameters measurement

TOTAL: 60 PERIODS

OUTCOMES:

- Able to understand the basic principles, errors in measurement and perform the calibration of instruments.
- Ability to measure various linear dimensions and selection of suitable instrument based on requirement.
- Able to conduct experiments and find the angle of given specimens using appropriate instrument.
- Able to handle and conduct experiments on form and surface measurement instruments and can interpret readings and values to find the various parameters of gear and screw thread parameters.
- Ability to select the suitable instrument and measure mechanical parameters like force, torque, temperature and vibration.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Micrometer	5
2	Vernier Caliper	5
3	Vernier Height Gauge	2
4	Vernier depth Gauge	2
5	Slip Gauge Set	1
6	Gear Tooth Vernier	1
7	Sine Bar and Sine Centre	1
8	Floating Carriage Micrometer	1
9	Profile Projector / Tool Makers Microscope	1
10	Mechanical Comparator	1
11	Autocollimator	1
12	Temperature Measuring Setup	1
13	Force Measuring Setup	1
14	Torque Measuring Setup	1
15	Coordinate measuring machine	1
16	Surface finish measuring equipment	1
17	Bore gauge	1
18	Internal Micrometer / Telescope gauge	1
19	Vibration meter	1

ME17514 DESIGN AND DEVELOPMENT PROJECT - I

L	T	P	C
0	0	2	1

OBJECTIVES:

- To acquaint with the process of applying basic engineering fundamental in the domain of practical applications
- To acquaint with the process of undertaking literature survey/industrial visit and identifying the problem
- To familiarize the software tools to design the different mechanical components
- To be trained to select the appropriate processes for making designed components.
- To inculcate the process of research and the process of solving the problem in a group.

GUIDELINES FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device / system / component(s) to be designed may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group with Title, Aim of the Project, Research Methodology, Component Design and Design calculations for the model to be fabricated, which will be reviewed and

evaluated thrice during third, Seventh and Eleventh week of the semester for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination, 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.

Scheme for Internal Evaluation:

S.No	Description	Marks
1.	Review – I	10
2.	Review – II	20
3.	Review – III	20

TOTAL: 30 PERIODS

OUTCOMES:

After successful completion of the course, student will be able to

- Apply to theoretical, experimental studies and frame the project methodology.
- Implement and design the mechanical components
- Use the suitable fabrication methods for making the working model of the design.
- Communicate the progress of the work through organizing presentations
- Prepare the project report and submit it for approved.

SEMESTER VI

ME17601 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 the working and types of engine auxiliary systems.
- To provide knowledge about the working and types of transmission systems.
- To understand the construction and working principle of steering, brakes and suspension systems.
- To have the knowledge about alternative sources of energy.

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 function 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 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

TOTAL: 45 PERIODS

OUTCOMES:

After successful completion of the course, student will be able to

- Demonstrate a basic understanding of engine functions, performance, and design methodology for frame, chassis etc.
- Understand the various fuel supply, ignition and performance improvement methods in IC engines and environmental issues.
- Demonstrate the knowledge of various parts of transmission systems and its mechanism.
- Understand the working of steering, brake and suspension systems.
- Demonstrate an understanding of technological, environmental, and social impacts of alternative energy sources.

TEXT BOOKS:

1. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Standard Publishers, New Delhi, 2014.
2. William H.Crouse and Donald L.Angline "Automotive Mechanics", Tata McGraw-Hill, 2017.

REFERENCES:

1. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2012.
2. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2017.
3. Srinivasan, "Automotive Mechanics", McGraw-Hill, 2004.
4. Ed May, "Automotive Mechanics", Tata McGraw-Hill,2017

ME17602 DESIGN OF TRANSMISSION SYSTEMS

L	T	P	C
2	2	0	3

OBJECTIVES:

- To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
- To understand the standard procedure available for Design of Transmission of Mechanical elements.
- To familiarize the students with the design of Friction drives, Gears, Speed reducers and other transmission systems
- To be acquainted with the terminology, geometry, basic kinematics concepts and design of cylindrical gears, brakes, clutches.
- To learn to use standard data and catalogues (Use of P S G Design Data Book permitted)

UNIT I DESIGN OF FLEXIBLE ELEMENTS 12

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

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 12

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

UNIT III BEVEL, WORM AND CROSS HELICAL GEARS 12

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

UNIT IV GEAR BOXES 12

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. – Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

UNIT V CAMS, CLUTCHES AND BRAKES 12

Cam Design: Types -pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes - external shoe brakes – Internal expanding shoe brake.

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to successfully design

- Flexible elements like belt, pulley, ropes, chain and sprockets.
- Spur and helical gears.
- Bevel, worm and cross helical gears
- Gear boxes for various applications
- Cams, clutches and brakes for given application.

TEXT BOOKS:

1. Bhandari V, “Design of Machine Elements”, 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 10th Edition, Tata McGraw-Hill, 2015.

REFERENCES:

1. Sundararajamoorthy T. V, Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, 2003.
2. Bernard Hamrock, Steven Schmid, Bo Jacobson, “Fundamentals of Machine Elements”, 3rd Edition, Tata McGraw-Hill Book Co., 2013.
3. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, 5 th Edition, Wiley, 2012.
4. Alfred Hall, Halowenko, A and Laughlin, H., “Machine Design”, Tata McGraw-Hill Book Co.(Schaum’s Outline), 2010
5. U.C.Jindal ,” Machine Design”, Pearson Publisher,, 2010

ME17603 THERMAL ENGINEERING - II

L	T	P	C
2	2	0	3

OBJECTIVES:

- To understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components.

- To provide knowledge on design aspects of Refrigeration & Air conditioning systems
- To apply the thermodynamic concepts for systems like Steam nozzle and turbines.
- To familiarize with the types and working principle of air compressors.
- To apply the thermodynamic concepts for various types of gas turbine.

UNIT I REFRIGERATION 12

Reversed Brayton cycle, air refrigeration, vapour compression refrigeration- use of T-s and p-h diagrams, problems, sub-cooling and superheating. Performance calculations of air vapour compression refrigeration systems. Vapour absorption refrigeration, adsorption cooling, evaporative cooling, Refrigerants- conventional and alternate types, designation and properties, working of Steam Jet Refrigeration-simple problems.

UNIT II AIR-CONDITIONING 12

Air-conditioning processes, Requirements for comfort and industrial air-conditioning, air washer, By-pass factor, summer and winter air conditioning systems, apparatus dew point, sensible heat factor, balancing of components, cooling load calculation-Estimation of cooling or heating load for building, Application-window type, split, package and centralized AC.

UNIT III STEAM NOZZLE AND STEAM TURBINE 12

Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio. Effect of friction. Metastable flow.

Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing

UNIT IV COMPRESSORS 12

Reciprocating compressor - Working principle-effect of clearance on volumetric efficiency, equations for shaft work and efficiencies, Multi-Stage Compression, inter-cooler, optimum intermediate pressure in a two stage compressor. Rotary compressor - Rotary positive displacement compressor- types-Roots Blower, Sliding Vane Compressor, Screw Compressor. Performance calculations.

UNIT V GAS TURBINES 12

Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combinations. Materials for Turbines.

TOTAL: 60 PERIODS

OUTCOMES:

Upon successful completion of this course the students will be able to

- Understand the working of various types of Refrigeration systems.
- Familiarize about Air- conditioning systems and perform cooling load calculations to determine heating loads.
- Understand the working of steam nozzle and turbine also analyzes their performance.
- Calculate the various efficiencies of the air compressors.
- Understand the working of Gas turbines and their performance.

TEXT BOOKS:

1. Sarao.A.S, “Thermal Engineering” , Satyaprakasan, New Delhi, 2016.
2. Rudramoorthy R, "Thermal Engineering", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2003.

REFERENCES:

1. Arora.C.P, “Refrigeration and Air conditioning”, McGraw Hills, New Delhi, 2017.
2. Kothandaraman.C.P and Domkundwar S, "Thermodynamics and Thermal Engineering", DhanpatRai and Sons, New Delhi, 2016.
3. Rajput.R.K, “Thermal Engineering”, Laxmi Publications (P) Limited, New Delhi, 10th Edition, 2017.
4. Sutton, G.P. “Rocket Propulsion Elements”, John Wiley, 8th edition 2010, New York.

5. Yahya, S.M., "Fundamentals of Compressible Flow with Aircraft and Rocket propulsion", New Age International (P) Limited, 4th Edition, 2012.

ME17604	FINITE ELEMENT ANALYSIS	L T P C 2 2 0 3

OBJECTIVES:

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To solve one dimensional problem in solid mechanics, heat transfer and vibrations.
- To solve two dimensional problems in solid mechanics, heat transfer and vibrations.
- To solve problems using plane stress, plane strain and axisymmetric conditions.
- To solve problems using isoparametric formulation.

UNIT I INTRODUCTION 12

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

UNIT II ONE-DIMENSIONAL PROBLEMS 12

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

UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS 12

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

UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 12

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.

UNIT V ISOPARAMETRIC FORMULATION 12

Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions – Serendipity elements – Numerical integration – Gauss Quadrature - Matrix solution techniques – Solutions Techniques to Dynamic problems –Determinant Search method- Guyan's technique- Static Condensation- Subspace iteration-Lanczos transformation- Computer Implementation - Introduction to Analysis Software.

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to

- understand the concepts of Mathematical Modeling of Engineering Problems.
- solve one dimensional problems in solid mechanics, heat transfer and vibrations.
- solve two dimensional problems in solid mechanics, heat transfer and vibrations.
- solve problems using plane stress, plane strain and axisymmetric conditions.
- solve problems using isoparametric formulation.

TEXT BOOK:

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

Delhi, 2007.

REFERENCES:

1. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butterworth Heinemann, 2004
2. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002
3. 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.
4. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div, 1990
5. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)
6. David Hutton, "Fundamentals of Finite Element Analysis" McGrawHill, 2005

ME17605 ELEMENTS OF COMPUTER AIDED DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide an overview of how computers are being used in mechanical component design
- To impart knowledge on computer graphics which are used routinely in diverse areas as science, engineering, medicine, etc.
- To Understand evolution and principle of CNC machine tools and its constructional features
- To Write simple programs for CNC turning and machining centres and to expose students to modern control systems (Fanuc, Heidenhain, Sinumerik etc.,)
- To impart knowledge on group technology, optimization algorithms, implementation of GT/CMS, Performance measurements and economical aspects of CMS.

UNIT I INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS 9

Product cycle and CAD/CAM- Design process- sequential and concurrent engineering Output primitives (points, lines, curves etc.,), 2-D & 3-D transformation (Translation, scaling, rotators) windowing - view ports - clipping transformation.

UNIT II CURVES AND SURFACES MODELLING 9

Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations.

Introduction to surfaces - Analytical surfaces: Plane surface, ruled surface, surface of revolution and tabulated cylinder – synthetic surfaces: Hermite, bi-cubic surface- Bezier surface and B-Spline surface- surface manipulations.

UNIT III NURBS AND SOLID MODELING 9

NURBS- Basics- curves, lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations – constructive solid Geometry - comparison of representations - user interface for solid modeling.

UNIT IV VISUAL REALISM 9

Hidden – Line – Surface – solid removal algorithms shading – coloring. Introduction to parametric and variational geometry based software's and their principles creation of prismatic and lofted parts using these packages.

UNIT V ASSEMBLY OF PARTS AND PRODUCT DATA EXCHANGE 9

Assembly modeling - interferences of positions and orientation - tolerances analysis – mass property calculations - mechanism simulation. Graphics and computing standards– Open GL Data Exchange standards – IGES, STEP etc– Communication standards.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course the students can able to

- Get familiarized with the computer graphics application in design
- Get familiarized with the various curves in surface modeling.
- Get familiarized with the various solid modeling technique.
- Get familiarized with the viewing techniques
- Get familiarized with the various data exchange format.

TEXT BOOKS:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007.
2. Donald Hearn and M. Pauline Baker. "Computer Graphics", Prentice Hall, Inc., 2012.

REFERENCES:

1. William M Neumann and Robert F.Sproull. "Principles of Computer Graphics", Mc Graw Hill Book Co. Singapore, 2001.
2. Foley, Wan Dam, Feiner and Hughes – Computer graphics principles & practices, Pearson Education – 2003.
3. Ibrahim Zeid and Subramanian R "CAD/CAM --Theory and Practice" - McGraw Hill, International Edititon, 2009.
4. Rao PN, " CAD / CAM Principles and Applications"- Mc Graw Hill Publisher, 2017.

		L	T	P	C
ME17611	**C.A.D. / C.A.M. LABORATORY**	**0**	**0**	**4**	**2**

OBJECTIVES:

- To gain practical experience in handling 2D drafting and 3D modelling software systems.
- To study the features of CNC Machine Tool.
- To expose students to modern control systems (Fanuc, Siemens etc.,)
- To know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre, CNC EDM and CNC wire-cut and studying of Rapid prototyping.

LIST OF EXPERIMENTS

1. 3D GEOMETRIC MODELLING **40 PERIODS**

LIST OF EXPERIMENTS

1. Introduction of 3D Modelling software

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

1. Flange Coupling
2. Plummer Block
3. Screw Jack
4. Universal Joint
5. Machine Vice
6. Stuffing box
7. Lathe Tailstock
8. Safety Valves
9. Non-return valves
10. Connecting rod
11. Piston
12. Crankshaft

* Students may also be trained in manual drawing of some of the above components

2. Manual Part Programming. **20 PERIODS**

1. **Part Programming - CNC Machining Centre**

a) Linear Cutting.

b) Circular cutting.

c) Cutter Radius Compensation.

d) Canned Cycle Operations.

2. **Part Programming - CNC Turning Centre**

a) Straight, Taper and Radius Turning.

b) Thread Cutting.

c) Rough and Finish Turning Cycle.

d) Drilling and Tapping Cycle.

3. Computer Aided Part Programming

1. CL Data and Post process generation using CAM packages.

2. Application of CAPP in Machining and Turning Centre.

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to develop 2D and 3D models using modeling softwares.
- Ability to understand the CNC control in modern manufacturing system.
- Ability to prepare CNC part programming and perform

		L	T	P	C
HS17661	**PROFESSIONAL COMMUNICATION**	**0**	**0**	**2**	**1**

OBJECTIVES:

- To help learners develop the basic reading ,writing and speaking skills
- To help learners establish dynamic corporate communication and relationship.

UNIT-I LISTENING **12**

Listening for understanding and information— Listening to TED TALKS/Interviews/TV News Programme/Discussions/Debates/Brief Lectures/Conversations. Listening to basic sounds of English/ Listening to fill up missing information/Listening to British, American, Australian and neutral accent of Indian English.

UNIT-II ORAL FLUENCY **12**

Speaking about oneself-articulating simple thoughts and ideas with clarity/participating in conversations-chats-dialogues. Group Discussions/ Mini Presentations on technical themes,non-technical themes and business themes/Trancode graphics orally/Participating in Debates-expressing individual opinions on current issues.

UNIT-III READING &WRITING **12**

Writing Agenda and minutes of meetings, Writing daily/periodic reports, Writing business / professional letters/ Business E-mail - Writing an Email Announcing a Meeting/Writing a description of a graph or chart/writing summaries/Reading Articles from journals/Reading Abstracts of Projects.

UNIT –IV ENGLISH FOR COMPETITIVE EXAMINATONS AT THE NATIONAL AND INTERNATIONAL LEVEL 12

Advance Vocabulary for GRE/TOEFL/IELTS/BEC- Correction of errors in Examinations like Civil Services, UPSC- Verbal ability- Troublesome Verbs, Pronouns, Adverbs, Adjectives and Prepositions.-Idioms and Phrases.

UNIT-V SOFT SKILLS 12

Attitude - Communication- Etiquette- Teamwork-Leadership Traits-Emotional Intelligence – Professional Ethics.

TOTAL: 60 PERIODS

OUTCOMES

On completion of the course students will be able to

- Recognize the importance of listening by various proposed listening activities
- Develop writing skills to meet the needs of global scenario
- Familiarize themselves with the need to speak effectively in different environments
- Disseminate professional information through appropriate means of communication
- Recognize and establish dynamic corporate communication and relationship.

REFERENCES

1. English for Engineers-Regional Institute of English, South India, Bangalore, published by Foundation Books, Chennai.

2. Interchange, Fourth Edition- Jack C .Richards et.al. - Cambridge University Press, Sri Maitrey Print Technology, Noida.

		L	T	P	C
ME17612	**DESIGN AND DEVELOPMENT PROJECT - II**	**0**	**0**	**2**	**1**

OBJECTIVES:

- To provide an opportunity to work in group on a topic / problem / experimentation.
- To encourage creative thinking process.
- To provide an opportunity to analyze and discuss the results to draw conclusions.
- To acquire and apply fundamental principles of planning and carrying out the work plan of the project through observations, discussions and decision making process.
- To enhance the presentation skills and develop the personality.

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GUIDELINES FOR REVIEW AND EVALUATION

The students who were grouped in Phase I after completing the Design part, now proceeds to the fabrication of the device / system / component(s) in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group with Title, Aim of the Project, Research Methodology, Component Design, Design Calculations, Cost Estimation, Bill of Materials, Fabrication Process and Conclusion of the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee thrice during third, seventh and eleventh week of that semester constituted by the Head of the Department. At the end of the semester examination, 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.

Scheme for Internal Evaluation:

S.No	Description	Marks
1.	Review – I	10
2.	Review – II	20
3.	Review – III	20

TOTAL: 30 PERIODS

OUTCOMES:

After completing the course, students will be able to:

- Students can relate theoretical, experimental studies and frame the project methodology.
- Students can able to implement and design the mechanical components
- Students can able to select the suitable fabrication methods for making the working model of the design.
- Students can able to communicate the progress of the work through organizing presentations
- Students can able to know how to prepare the project report and submit it for review.

SEMESTER VII

		L	T	P	C
ME17701	**MECHATRONICS**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To impart knowledge about the sensors used in Mechatronics systems
- To understand the working principle of Microprocessor and Microcontroller
- To study various Microcontroller peripheral interface devices.
- To program the PLC systems
- To study about the various Mechatronics systems.

UNIT I INTRODUCTION 12

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 8085 MICROPROCESSOR AND 8051 MICROCONTROLLER 10

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram.

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE 8

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 7

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 8

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:

Upon completion of the course, students will be able to

- Select suitable sensors and transducers for various applications.
- Understand the microcontroller architecture.
- Develop electronic systems using microcontroller.
- Understand and Selecting PLC for various applications in automation.
- Design and implement mechatronic based system for industrial applications.

TEXT BOOKS:

2. Bolton, "Mechatronics", Printice Hall, 2013
3. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Penram International Publishing Private Limited, 6th Edition, 2015.

REFERENCES:

1. Michael B.Histand and Davis G.Alciatore, "Introduction to Mechatronics and Measurement systems", McGraw Hill International edition, 2007.
2. Bradley D.A, Dawson D, Buru N.C and Loader A.J, "Mechatronics", Chapman and Hall, 1993.
3. Smaili.A and Mrad.F , "Mechatronics Integrated Technologies for Intelligent Machines", Oxford University Press, 2008.
4. Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", PWS publishing company, 2007.
5. Krishna Kant, "Microprocessors & Microcontrollers", Prentice Hall of India, 2007.
6. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013.

ME17702	HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the concepts of fluidics and fundamentals of the system.
- To learn the components of fluid power system and its application.
- To learn and understand the systems of Hydraulic circuits.
- To learn and design the components of Pneumatic circuits.
- To design Hydraulic and Pneumatic circuits and troubleshoot the problems caused in the fluid power system.

UNIT I FLUID POWER PRINCIPLES AND FUNDEMENTALS (REVIEW) 3

Introduction to Fluid power- Advantages and Applications- Fluid power systems – Types of fluids-Properties of fluids Basics of Hydraulics – Pascal's Law- Principles of flow – Work, Power and Torque. Properties of air– Perfect Gas Laws.

UNIT II HYDRAULIC SYSTEM AND COMPONENTS 13

Sources of Hydraulic power: Pumping Theory – Pump Classification- Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criterion of Linear, Rotary- Fixed and Variable displacement pumps, Hydraulic Actuators: Cylinders – Types and construction, Hydraulic motors Control Components: Direction control, Flow control and Pressure control valves- Types, Construction and Operation- Applications – Types of actuation. Accessories: Reservoirs, Accumulators, Intensifiers, Pressure Switches- Applications- Fluid Power ANSI Symbol.

UNIT III HYDRAULIC CIRCUITS 9

Industrial hydraulic circuits- Regenerative, Pump Unloading, Double- pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-safe, Speed control, Hydrostatic transmission, Accumulators, Electro hydraulic circuits, Mechanical Hydraulic servo systems.

UNIT IV PNEUMATIC SYSTEM 8

Compressors- Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Servo systems. Introduction to Fluidics, Pneumatic logic circuits.

UNIT V DESIGN OF HYDRALIC AND PNEMATIC CIRCUITS 12

Design of circuits using the components of hydraulic system for Drilling, Planning, Shaping, Punching, Press. – Selection, fault finding and maintenance of hydraulic components- Sequential circuit design for simple application using cascade method, Electro pneumatic circuits. Selection criteria of pneumatic components – Installation fault finding and maintenance of pneumatic components. Microprocessor and PLC- Applications in Hydraulic and Pneumatics- Low cost Automation – Hydraulic and Pneumatic power packs.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able

- To learn the concepts of fluidics and fundamentals of the system.
- To explore the knowledge of applications and components of Fluid Power System. .
- To analyze systems of Hydraulic circuits.
- To understand and analyze systems of Pneumatic circuits.
- To design, identify and troubleshoot the problems caused in the fluid power system.

TEXT BOOK

1. Anthony Esposito," Fluid Power with Applications", 7th Edition, Pearson Education, 2013.
2. Majumdar, S.R., "Oil Hydraulics Systems- Principles and Maintenance", McGraw Hill, 2017.

REFRENCES

1. Shanmugasundaram. K, "Hydraulic and Pneumatic controls", Chand & Co, 2009.
2. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Mc Graw Hill, 2017.
3. Dudelyt, A Pease and John J Pippenger, "Basic Fluid Power", Prentice Hall, 1987.
4. Srinivasan. R, "Hydraulic and Pneumatic Control", II Edition, Tata McGraw - Hill Education, 2012.

ME17703 PROCESS PLANNING AND COST ESTIMATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics concepts, factors and methods of process planning.
- To determine the various process parameters of production process and to enrich knowledge on workholding and process planning activities and documentation.
- To learn the step by step general procedure of cost estimation.
- To know the cost estimation procedure for various types of jobs.
- To attain the knowledge about machining time calculation of various machining process.

UNIT I INTRODUCTION TO PROCESS PLANNING 10

Introduction- Types of production – standardization, simplification –Break even analysis – production design and selection -Methods of process planning - Selection and analysis – Manual planning - CAPP – Variant approach - Generative approach - Processes analysis.

UNIT II PROCESS PLANNING ACTIVITIES 10

Drawing interpretation-Material evaluation – steps in process selection - Production equipment and tooling selection -Process parameters calculation for various production processes-Selection jigs and fixtures Selection of quality assurance methods - Set of documents for process planning -Economics of process planning- case studies

UNIT III INTRODUCTION TO COST ESTIMATION 8

Aims of costing and estimation - Functions and procedure -Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

UNIT IV PRODUCTION COST ESTIMATION 8

Estimation of Different Types of Jobs - Estimation of Forging Shop– Losses in forging – Forging cost, Estimation of Welding Shop– Electric welding – Gas cutting Estimation of Foundry Shop– Pattern cost - Casting cost -Estimation in sheet metal shop– Shearing and forming

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 – Super finishing processes -Lapping and Honing

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to

- construct the various charts / diagrams regarding movements and delays.
- compute standard time for completing a job
- make a standard and detailed process planning for a new product.
- differentiate between cost estimation and cost accounting.
- estimate the cost of a new product for various production processes like casting, welding, forging, forming and machining.

TEXT BOOKS:

1. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.
2. Banga.T.R and Sharma.S.C, “Estimating and Costing”, Khanna publishers, NewDelhi, 1986.
3. Narang.G.B.S and Kumar.V, “Production and Planning”, Khanna Publishers, New Delhi, 1995.

REFERENCES:

1. Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, 9th Edition, John Wiley, 1998.
2. Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.
3. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002

		L	T	P	C
ME17711	**SIMULATION AND ANALYSIS LABORATORY**	**0**	**0**	**4**	**2**

OBJECTIVES:

- To be able to understand and handle design problems in a systematic manner.
- To gain practical experience in handling of analyzing software systems.
- To be apply ANSYS software to solve real life problems.
- To expose students to understand Finite Element Analysis and uses of modern software.
- To gain practical experience in handling of simulation software’s.

LIST OF EXPERIMENTS

A. SIMULATION

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

B. ANALYSIS

1. Force and Stress analysis using link elements in Trusses.
2. Stress and deflection analysis in beams with different support conditions and compare with FEA solutions.
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. Import of simple components for stress analysis.

TOTAL: 60 PERIODS

OUTCOMES:

- Students able to analysis of Cantilever, Simply supported and fixed beams.
- Students able to do a stress analysis of solids like plate with circular hole, rectangular L bracket and Axi-symmetric components.
- Students can perform a mode frequency analysis of 2D components and beams and harmonic analysis to find response for forced vibration.
- Students able to solve thermal stress problems and can perform heat transfer problems.
- Students able to make Mathematical Model for real time problems in MATLAB.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. NO.	NAME OF THE EQUIPMENT	Qty.
1	Computers	30
2	Color Desk Jet Printer	01
3	Analysis Software	30 licenses
4	C / MATLAB	5 licenses

ME17712 AUTOMATION LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To impart knowledge about the PLC usage in automation
- To program and integrate Microprocessor and Microcontroller
- To familiarize the control of various motors using controllers.
- To impart knowledge about the PLC usage in automation
- To impart knowledge on HMI applications
- To understand SCADA applications in Mechatronics systems.

LIST OF EXPERIMENTS

1. To study the block diagram and input and output modules interfaces of Programmable Logic Controller.
2. Introduction to ladder programming and to implement basic logic gates.
3. Water level control with PLC programming.
4. Water level control with HMI.
5. Temperature control with PLC programming.
6. Temperature control with HMI.
7. Belt conveyor control with PLC programming.
8. Belt conveyor control with HMI.
9. Stepper motor control for linear applications using PLC programming.
10. Stepper motor control for linear applications using HMI.

11. Stepper motor control for Rotary applications using PLC programming.
12. Stepper motor control for Rotary applications using HMI.
13. Create a New SCADA for Temperature control application.
14. Create a New SCADA for Water level control application.

OUTCOMES:

Upon completion of the Laboratory, students will be able to

- Program PLC using ladder programming.
- Implement the automatic control using microcontroller systems.
- Design automated systems involving material handling and process control using HMI Systems.
- Develop material transport systems using microcontroller and PLC.
- Design SCADA based system for industrial applications.

		L	T	P	C
ME17713	**COMPREHENSION**	**0**	**0**	**2**	**1**

OBJECTIVES

- To encourage the students to comprehend the knowledge acquired from the first Semester to Sixth Semester of B.E Degree Course through periodic exercise.

METHOD OF EVALUATION

The students will be assessed 100% internally through weekly test with objective type questions on all the subject related topics

TOTAL: 30 PERIODS

OUTCOMES

- Ability to understand and comprehend any given problem related to mechanical engineering field.

		L	T	P	C
ME17714	**TECHNICAL SEMINAR/INPLANT TRAINING**	**0**	**0**	**2**	**1**

OBJECTIVES

- To develop the ability to understand and present any technical topic. To train the students in preparing report and to face reviews.

INPLANT TRAINING:

Student should undergo training for two weeks continuously in an industry with prior approval from the Head of the Department during their during the summer/Winter vacation before the start of seventh semester. The student has to submit the certificate received from the industry. Also the student has to submit the in plant training report and present a seminar about the training undergone before the Committee constituted by the Head of the Department for evaluation.

TECHNICAL SEMINAR:

To enrich the communication skills of the student and presentations of technical topics of interest, this course is introduced. In this course, a student has to present two recent advances in engineering/technology that will be evaluated by a Committee constituted by the Head of the Department.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

- On Completion of the course students will take on the challenges in the industry, prepare a presentation in a professional manner, and document all aspects.

SEMESTER VIII

ME17811	**PROJECT WORK**	**L T P C** **0 0 20 10**

OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 2 to 3 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the project work including Design calculations, Fabrication / Analysis, Testing/ Evaluation, Results and conclusions to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. 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

COURSE OUTCOMES:

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.
- Students will obtain a hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills and / or knowledge and working in at team.
- Students will take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.

PROFESSIONAL ELECTIVES FOR B.E. MECHANICAL ENGINEERING

SEMESTER VI

ELECTIVE I

ME17E61	**COMPOSITE MATERIALS AND MECHANICS**	**L T P C** **3 0 0 3**

OBJECTIVES:

To understand the fundamentals of composite material strength and its mechanical behaviour
To have the knowledge of the Polymer matrix composites, its manufacturing and its basic analysis.
To have knowledge of the Metal matrix composites, its manufacturing and its basic analysis.
To have knowledge of the Ceramic matrix composites, its manufacturing and its basic analysis.
To implement laminate constitutive equation to study the various properties of the composite materials.

UNIT I INTRODUCTION TO COMPOSITE MATERIALS 7

Definition-Matrix materials-polymers-metals-ceramics - Reinforcements: Particles, whiskers, inorganic fibers, metal filaments- ceramic fibers- fiber fabrication- natural composite wood, Jute - Advantages and drawbacks of composites over monolithic materials. Mechanical properties and applications of composites, Particulate-Reinforced composite Materials, Dispersion-Strengthened composite, Fiber-reinforced 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 (GRP). 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, advantages of MMC, limitations of MMC, rule of mixtures – Processing of MMC – Powder metallurgy process – Diffusion bonding – Stir casting – Squeeze casting. In-situ reactions – Interface – measurement of interface properties – Applications of MMC in aerospace, automotive industries.

UNIT IV CERAMIC MATRIX COMPOSITE & SPECIAL COMPOSITES 9

Need for CMC –Toughening Mechanism – Processing- 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 fiber – Chemical vapour deposition of carbon on carbon fiber perform – Sol-gel technique.

UNIT V INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS 11

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:

Upon completion of the course, students will be able to

- Understand the fundamentals of composite
- Know the types and various manufacturing methods of PMC.
- Know the types and various manufacturing methods of MMC.
- Know the types and various manufacturing methods of CMC.
- Calculate the composite properties using fundamentals of composite mechanics.

TEXT BOOKS:

1. M. Balasubramanian, Composite Material and Processing, 2017 , CRC Press.
2. Ronald Gibson, Principles of Composite materials and Mechanics, McGraw Hill Publication.

REFERENCES:

1. Robert.M.Jones, Mechanics of Composite Materials, 1999, Taylor and Francis.
2. Sanjak K. Mazumdar, Composites Manufacturing- Materials, Product and Process Engineering, 2002, CRC Press.
3. Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", University Press, (India) Pvt. Ltd., Hyderabad, 2004 (Reprinted 2008).
4. P.K. Mallick, FIBERREINFORCED COMPOSITES Materials, Manufacturing, and Design, CRC Press, 2007.

ME17E62 UNCONVENTIONAL MACHINING PROCESSES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the unconventional machining processes and their applications
- To learn about mechanical energy based processes and its process parameters
- To know the electrical energy based processes and its process parameters
- To be familiar with chemical and electro-chemical energy based processes and its process parameters
- To identify the thermal energy based processes and its process parameters

UNIT I INTRODUCTION 6

Unconventional machining Process — Historical background -Need -classification –Considerations in process selection, materials, applications.

UNIT II MECHANICAL ENERGY BASED PROCESSES 9

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining.(AJM, WJM, AWJM and USM) -Elements -mechanism of metal removal -Working Principles – equipment used – Process parameters – MRR- Applications and limitations – Abrasive flow finishing (AFF) and Magnetic Abrasive finishing (MAF).

UNIT III ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM)- General principles - mechanism of metal removal -Working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications and limitations –- Electric Discharge Grinding (EDG) and Electric Discharge Diamond Grinding(EDCG)

UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 11

Chemical machining and Electro-Chemical machining (CHM and ECM) –Fundamentals –Etchants – Maskant -techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipments-Surface Roughness and MRR Electrical circuit-Process Parameters-ECG and ECH - Applications and limitations – Electro chemical deburring (ECDe) and Electro stream drilling (ESD)

UNIT V THERMAL ENERGY BASED PROCESSES 10

Laser Beam machining (LBM) - Laser Beam drilling and Laser Beam Marking (LBD, LBM), Plasma Arc machining (PAM), Plasma Arc cutting and Plasma spraying (PAC, PS), -Electron Beam machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications and limitations -.

TOTAL: 45 PERIODS

OUTCOMES:

- To demonstrate the basic operation of various unconventional manufacturing processes.
- To apply the knowledge of Mechanical energy based processes in their projects and interpret the importance of different processes for various applications.
- To apply the knowledge of Electrical energy based processes in their projects and to identify the various parameters and their influence on the performance of the process
- To explain the various chemical machining processes and its effects on environment.
- To explain the Thermal energy based processes like Laser beam machining, Electron beam machining and Plasma Arc machining, cutting and spraying.

TEXT BOOKS:

1. Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2007
2. Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill, New Delhi, 2007.
3. Mishra.P.K, “Non-Conventional Machining”, The Institution of Engineers (India),
4. Text Book Series, New Delhi, 1997.

REFERENCES:

1. Benedict. G.F. “Nontraditional Manufacturing Processes”, Marcel Dekker Inc., New York,1987.

2. Mc Geough, "Advanced Methods of Machining", Chapman and Hall, London, 1998.
3. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing"
4. Prentice Hall of India Pvt. Ltd., 8thEdition, New Delhi , 2001.
5. V. K. Jain, Advanced Machining Processes, Allied Publishers, 2009.

ME17E63 RENEWABLE SOURCES OF ENERGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To instruct the importance of renewable energy sources and its utilization.
- To educate the students to understand the Wind energy technologies.
- To understand the basic engineering concepts of Bio Energy technologies
- To gain the knowledge about Ocean and Geothermal energy technologies
- To realize the concepts of New Renewable Source of Energy

UNIT I SOLAR ENERGY 9

Present renewable energy status in India - Solar radiation – Measurements of solar radiation and sunshine – Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT II WIND ENERGY 9

Wind data and energy estimation – Betz limit - Site selection for windfarms – Horizontal axis wind turbine – Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT III BIO - ENERGY 9

Bio resources – Biomass direct combustion – Biomass gasifier - Types of biomass gasifiers - 4Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

UNIT IV OCEAN AND GEOTHERMAL ENERGY 9

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

UNIT V NEW ENERGY SOURCES 9

Fuel cell – Principle - Types of fuel cells – Hydrogen energy – Properties – Hydrogen production – Storage – Transport and utilisation - Safety issues.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand and analyze the pattern of renewable energy resources.
- Understand the working principle of Wind energy technologies
- Appreciate the need of Bio Energy technologies
- Gain knowledge on Ocean and Geothermal energy technologies
- Economics of the utilization and environmental merits

TEXT BOOKS:

1. G.D. Rai, "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.
2. Twidell, J.W. & Weir, A., "Renewable Energy Resources", EFN Spon Ltd., UK, 3 rd Edison 2005

REFERENCES:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.
2. S.P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
3. G.N. Tiwari, "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015.
4. B.H. Khan, "Non-Conventional Energy Resources", The McGraw Hill companies, 2009
5. D.S. Chauhan, " Non-Conventional Energy Resources " New Age Publications 2012.

ME17E64	QUALITY CONTROL AND RELIABILITY ENGINEERING	L T P C 3 0 0 3

OBJECTIVES:

- To introduce the concept of SQC and control charts
- To understand process control charts and their application .
- To understand acceptance sampling procedure and their application.
- To learn the concept of reliability , maintainability and availability
- To understand the quality and reliability in Product design and analysis

UNIT I INTRODUCTION TO STATISTICAL QUALITY CONTROL 10

Introduction and definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation –Theory of control chart- uses of control chart – Control chart for variables – X chart and R chart - process capability analysis . Six sigma concepts

UNIT II PROCESS CONTROL FOR ATTRIBUTES 8

Control chart for attributes –control chart for non conformings – p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

UNIT III ACCEPTANCE SAMPLING 9

Lot by lot sampling – types – probability of acceptance Single sampling plans for attributes – double sampling - multiple sampling - sequential sampling - Military standards - The Dodge Roming sampling plans – Random sampling – producer"s Risk and consumer"s Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD.

UNIT IV LIFE TESTING – RELIABILITY 9

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

UNIT V QUALITY AND RELIABLITY 9

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles. Risk assessment – FMEA and Fault tree analysis.

TOTAL: 45 PERIODS

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

OUTCOMES:

Upon successful completion of this course, the students can able

- To apply the concept of SQC in process control for component production
- To draw the process control charts for attributes
- To understand the concepts of acceptance sampling for AQL and LTPD
- To understand the concept of reliability , maintainability, availability and OC curves
- To understand the various reliability improvement techniques , Product life cycle and FMEA

TEXT BOOKS:

1. Douglas.C. Montgomery, " Introduction to Statistical quality control", 4th edition, John Wiley 2001.
2. Srinath. L.S., "Reliability Engineering", Affiliated East west press, 1991.

REFERENCES:

1. John.S. Oakland. "Statistical process control", 5th edition, Elsevier, 2005
2. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993
3. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996
4. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, 2001.
5. Gupta. R.C, "Statistical Quality control", Khanna Publishers, 1997.
6. Besterfield D.H., "Quality Control", Prentice Hall, 1993.
7. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publishers, 1998.
8. Danny Samson, "Manufacturing & Operations Strategy", Prentice Hall, 1991.

GE17E51 HUMAN VALUES AND PROFESSIONAL ETHICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand morals and human values.
- To understand engineering ethics.
- To know the social responsibility as engineer
- To familiarize with professional rights.
- To familiarize with global issues.

UNIT I HUMAN VALUES 10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – 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-Case studies

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES 8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of this course, the students will be able to

- Comprehend morals and human values.
- Explain engineering ethics.
- Describe social responsibility as engineer
- Discuss professional rights.
- Comprehend global issues.

TEXTBOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013.
6. World Community Service Centre, " Value Education", Vethathiri publications, Erode, 2011

SEMESTER VII

ELECTIVE II

		L	T	P	C
ME17E71	**INTRODUCTION TO POWER PLANT ENGINEERING**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To gain knowledge about energy, economic and environmental issues of power plants
- To understand the working of various components, operations and maintenance of Steam power plants
- To know the working of various types of diesel, gas turbine and nuclear power plants
- To understand the construction and working of various types of renewable power plants
- To gain knowledge on Energy management and Energy Audit technique applicable to power plants

UNIT I ENERGY SCENARIO, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS **8**

Present Energy Scenario: World, India, Rajasthan and future prospects. 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.

UNIT II COAL BASED THERMAL POWER PLANTS 10

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. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III DIESEL, GAS TURBINE AND NUCLEAR CYCLE POWER PLANTS 10

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. 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, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V ENERGY MANAGEMENT 8

Energy management and audit, Energy and mass balance, Energy modeling, Energy conservation opportunities in Thermal, HVAC, Electrical, compressed air, Centrifugal pumps, Blowers. Waste heat recovery, CHP, Energy Efficient technologies, Energy conservation Building Codes

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course, the students will be able to

- Comprehend about energy, economic and environmental issues of power plants
- Explain the working of various components , operations and maintenance of Steam power plants
- Describe the working of various types of diesel, gas turbine & nuclear power plants
- Illustrate the construction and working of various types of renewable power plants
- Discuss Energy management and Energy Audit technique applicable to power plants

TEXT BOOK:

1. Domkundwar & Arora Domkundwar "Power Plant Engineering", Eighth edition, ISBN-10: 8177001957, Dhanpat Rai & Co. (P) Limited; 2016
2. Nag. P.K., "Power Plant Engineering", Fourth Edition, **ISBN:** 9789339204044, Tata McGraw – Hill Publishing Company Ltd., 2014.

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. John W. Twidell & Anthony D.Weir, 'Renewable Energy Resources'.

6. Geofrey Boyle, ' Renewable Energy: Power for a Sustainable Future', OUP in assn with Open University, 1996.
7. Combined Power Plants by J.H.Horlock Pergamon Press.
8. Hand book on Energy Management and Audit , TERI , New Delhi.

ME17E72 REFRIGERATION AND AIR CONDITIONING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the principle of operation and design aspects of Refrigeration & Air conditioning systems and components
- To understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
- To provide knowledge on other Refrigeration system
- To provide knowledge on design aspects Psychrometric process
- To provide knowledge on design aspects Air conditioning systems

UNIT 1 VAPOUR COMPRESSION REFRIGERATION SYSTEM 9

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- 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

UNIT II REFRIGERANTS AND COMPONENTS OF REFRIGERATION SYSTEMS 9

Refrigerants desirable properties – Classification - Nomenclature - ODP & GWP; 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- Thermoelectric refrigeration- Air refrigeration - Magnetic - Vortex and Pulse tube refrigeration systems

UNIT IV PSYCHROMETRIC 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 temp., Thermodynamics wet bulb temp., Psychrometric chart; Psychrometry of air-conditioning processes, mixing of air stream.

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. Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls, Filters.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Appreciate the principles of operation vapour compression refrigeration systems.
- Appreciate the principles of operation of different Refrigeration and Air conditioning systems in total as well as the significance of the various component system.
- Demonstrate the operations in different Refrigeration & Air conditioning systems.
- Design Refrigeration & Air conditioning systems.
- Demonstrate and design the load calculation

TEXT BOOKS:

1. Arora, C.P., “Refrigeration and Air Conditioning”, McGraw Hill, 3rd edition New Delhi, 2010.
2. Stoecker, W.F. and Jones J. W.,” Refrigeration and Air Conditioning”, McGraw Hill,
3. New Delhi, 1986.

REFERENCES:

1. Roy J. Dossat, “Principles of Refrigeration”, Pearson Education Asia, 5th ed, 2009.
2. “ASHRAE Hand book”, Fundamentals 2017
3. Jones W.P., “Air conditioning engineering”, Elsevier Butterworth-Heinemann, 5th ed, 2001.
4. Manohar Prasad, “ Refrigeration and Air Conditioning”, New Age International., 2009
5. R.K. Rajput, "A Textbook of Refrigeration and Air-Conditioning" S.Chand Publishing 2013
6. Ananthanarayanan, "Basic Refrigeration and Air Conditioning"McGraw Hill, 4th edition New Delhi

ME17E73 WELDING TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand principles, types, merits, demerits and application of gas and arc welding processes.
- To understand principles, types, merits, demerits and application of resistance welding processes.
- To understand principles, types, merits, demerits and application of solid state welding processes.
- To understand different other welding processes for the automation in aerospace, nuclear and surface transport vehicles.
- To be familiar with the weldability of various materials processes.

UNIT I GAS AND ARC WELDING PROCESSES 9

Fundamental principles – Oxy-acetylene welding, Types of Flames Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding CO_2 welding and Electro slag welding processes –Welding Defects - advantages, limitations and applications.

UNIT II RESISTANCE WELDING PROCESSES 9

Definition- Fundamentals-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

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

UNIT IV OTHER WELDING PROCESSES 9

Thermochemical welding-Thermit welding, Atomic hydrogen welding, Radiant Energy welding-Electron beam welding, Laser Beam welding, other welding process like Friction stir welding, Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles.

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

Various weld joint designs – Weldability of Aluminium, Copper, and Stainless steels. Destructive-(Tensile,Bend, Impact,Nickbreak,Hardness,Etch test) and nondestructive testing of weldments-(Leak,Stethoscope,X-ray and γ ray radiography, Magnetic particle testing, Liquid (Dye) penetrate test, Fluorescent penetrate, Ultrasonic inspection and Eddy current testing).

TOTAL: 45 HOURS

OUTCOMES:

Upon completion of this course, the students can able to

- Select appropriate type of gas or arc welding type for an application
- Select appropriate type of resistance welding type for an application
- Select appropriate type of solid state welding type for an application
- Use the other welding methods like thermit, electron beam, atomic hydrogen welding etc and its automation in industries.
- Identify the weldability of Al, Cu, stainless steels and conduct various non-destructive and non-destructive testing of weldments.

TEXT BOOKS:

1. Parmer R.S., "Welding Engineering and Technology", 1 st edition, Khanna Publishers, New Delhi, 2008.
2. Parmer R.S., "Welding Processes and Technology", Khanna Publishers, New Delhi, 1992. 87
3. Little R.L., "Welding and welding Technology", Tata McGraw Hill Publishing Co., Ltd., New Delhi, 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. AWS- Welding Hand Book. 8th Edition.Vol- 2. "Welding Process"
4. Nadkarni S.V. "Modern Arc Welding Technology", 1st edition, Oxford IBH Publishers, 2005.
5. Christopher Davis. "Laser Welding- Practical Guide".Jaico Publishing House, 1994.
6. Davis A.C., "The Science and Practice of Welding", Cambridge University Press, Cambridge, 1993
7. P.N.Rao – Manufacturing Tech – Tata McGraw Hill Publishing Company 2003
8. S.K.Garg – Welding Technology - University Science press -

ME17E74 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the locating and clamping principles.
- To design and develop jigs and fixtures for a given component.
- To understand press working terminologies and elements of cutting dies.
- To design and develop bending and forming dies.
- To develop knowledge in other forming techniques.

UNIT I LOCATING AND CLAMPING PRINCIPLES 8

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

UNIT II JIGS AND FIXTURES 10

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

UNIT III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 10

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops –

Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, **notching**, compound and progressive dies.

UNIT IV BENDING AND DRAWING DIES 10

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 – drawbeads, ironing – Design and development of bending, forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.

UNIT V OTHER FORMING TECHNIQUES 7

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke.

TOTAL: 45 PERIODS

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

OUTCOMES:

- Ability to understand the locating and clamping principles.
- Ability to design and develop jigs and fixtures for a given component.
- Ability to understand press working terminologies and elements of cutting dies.
- Ability to design and develop bending and forming dies.
- Ability to develop knowledge in other forming techniques.

TEXT BOOKS:

1. Joshi, P.H. “Jigs and Fixtures”, Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2004.
2. Joshi P.H “Press tools - Design and Construction”, wheels publishing, 1996

REFERENCES:

1. Venkataraman. K., “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, 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. Hoffman “Jigs and Fixture Design”, Thomson Delmar Learning, Singapore, 2004.
5. ASTME Fundamentals of Tool Design Prentice Hall of India.
6. Design Data Hand Book, PSG College of Technology, Coimbatore.
7. V.Balachandran, “Design of Jigs Fixtures & Press Tools”, Notion Press, 2015.

		L	T	P	C
ME17E75	**GAS DYNAMICS AND JET PROPULSION**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To understand the concept of compressible flow and isentropic flow through nozzles and diffusers
- To understand the flow through constant area ducts with heat transfer and friction and variation of fluid properties
- To understand the phenomenon of shock waves, its effect on flow and applications
- To gain knowledge of theory and analysis of jet propulsion and operating principles of various types of aircraft engines

- To understand theory of rocket propulsion, rocket engines, propellant feeding systems, equations and applications

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 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.

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:

Upon completion of this course the student will be able to

- Explain basic concepts of gas dynamics and analyze the compressible flow in ducts with area changes
- Understand and analyse the simple flows such as Fanno flow and Rayleigh flow with applications to nozzle.
- Derive the conditions for the change in pressure, density, temperature and strength of shock for flow through a normal and oblique shock.
- Describe the jet propulsion engines
- Explain about propellants and concepts of rocket propulsion system

TEXT BOOKS:

1. Anderson, J.D., "Modern Compressible flow", ISBN-10: 1259027422, 3rd Edition, McGraw Hill, 2017.
2. Yahya, S.M. "Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion", New Age International (P) Limited, New Delhi, Fifth edition, 2016.

REFERENCES:

1. Hill. P. and C. Peterson, "Mechanics and Thermodynamics of Propulsion", Addison –Wesley
2. Publishing company, Second Edition, 2016.
3. Zucrow. N.J., "Aircraft and Missile Propulsion", Vol.1 & II, John Wiley, 2013.
4. Zucrow. N.J., "Principles of Jet Propulsion and Gas Turbines", John Wiley, New York, 1970.
5. Sutton. G.P., "Rocket Propulsion Elements", John wiley, New York, 9th Edition, 2017.
6. Shapiro. A.H.," Dynamics and Thermodynamics of Compressible fluid Flow", John wiley,
7. New York, 1953.
8. Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 3rd Edition, 2017.
9. Somasundaram. PR.S.L., "Gas Dynamics and Jet Propulsions", New Age International
10. Publishers, 2008.

11. Babu. V., "Fundamentals of Gas Dynamics", ANE Books India, Second Edition, 2014.
12. Cohen. H., G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Longman Group Ltd., Seventh Edition, 2017.

ELECTIVE III

		L	T	P	C
ME17E76	**ROBOTICS**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors.
- To understand the working of Machine vision system.
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

UNIT I FUNDAMENTALS OF ROBOT 6

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

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Introduction- Types of actuators and Characteristics -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 12

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, Force and Torque Sensors-Wrist Sensors, Robotic 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 13

Robot kinematics - Forward Kinematics, Inverse Kinematics and Difference; Manipulator Kinematics-Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) 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 5

RGV,-Model Logic AGV-FMS-Navigation ,Types and applications-; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can be able to

- Understand the Robot Anatomy, Configurations of Robots and classifications of robot

- Apply the basic engineering knowledge of End Effectors, Grippers- (Mechanical, Pneumatic, Hydraulic) and the design of robotics.
- Understand the mechanisms of Sensors, Optical Encoders, Laser Range Meters, Image Processing and Analysis
- Write basic Programs for robot kinematic Mechanism
- Visualize the recent trends in Industrial Robot and industrial Safety

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.

REFERENCES:

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
2. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 1994.
3. Koren Y., "Robotics for Engineers", McGraw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
5. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.
6. Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2008.
7. Surender Kumar, "Industrial Robots and Computer Integrated Manufacturing", Oxford and IBH Publishing Co. Pvt. Ltd., 1991.
8. G.Kalivarathan ,K.Aravid – Robotics
9. Ganesh S.Hegde - Fundamentals of Robotics , University Science press.
10. Saecd.B and Niku – Introduction to Robotics (Analysis,systems,Applications) –Prentice Hall of India Pvt Ltd
11. C.Ray As fahl – Robots and Manufacturing Automation –Wiley Student Edition -2011.
12. John.J.Craig – Introduction to Robotics –Mechanics and Control –Addison Wesley.
13. Ashitava Ghosal Oxford University Press –Robotics –Fundamental Concepts & Analysis.

ME17E77	COMPUTATIONAL FLUID DYNAMICS	L T P C 3 0 0 3

OBJECTIVES:

- To analyze mathematical and computational methods for fluid flow and heat transfer simulations.
- To use the Finite difference and volume method for solving diffusion problems
- To use finite volume method for convection diffusion.
- To aassess the flow parameters in internal and external flows.
- To expose the students to various models in flow analysis.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 8

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

UNIT II FINITE DIFFERENCE 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 on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

UNIT III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 10

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:

Upon completion of this course, the students can able to

- Use the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems.
- Solve One, Two and Three -dimensional diffusion problems.
- Apply Finite volume method and solve the convection diffusion problems.
- Use finite volume method to solve fluid flow analysis.
- To know the various features used to solve turbulence problem in Software.

TEXT BOOKS:

1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics:
2. The finite volume Method", Pearson Education Ltd.Second Edition, 2007.
3. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer",
4. Tata McGraw Hill Publishing Company Ltd., 1998.

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", Narosa Publishing House, New Delhi, 1995.
5. ProdipNiyogi, Chakrabarty, S.K., Laha, M.K. "Introduction to Computational Fluid Dynamics", Pearson Education, 2005.
6. Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University Press, 2005.

		L	T	P	C
ME17E78	**COMPUTER INTEGRATED MANUFACTURING SYSTEMS**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.
- To gain knowledge about the basic manufacturing process , Production process , advanced manufacturing technology
- To gain knowledge on CAPP and PPC
- To gain knowledge in concept of GT and PFA

- To gain knowledge in concept of FMS and AGVs.

UNIT I INTRODUCTION 10

Introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Concurrent Engineering-CIM concepts – Computerized elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

UNIT II COMPUTERISED PROCESS PLANNING AND PRODUCTION PLANNING AND CONTROL 10

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

UNIT III CELLULAR MANUFACTURING 9

Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system, Multi Class Coding System – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

UNIT IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) 8

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

UNIT V INDUSTRIAL ROBOTICS 8

Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors and Grippers – Sensors in Robotics - Industrial Robot Applications –Pick and Place Robot-Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student will be able to

- Adopt the CIM concepts to improve Production Performance
- Use computers for the Production, Process and Material Requirement planning, also adopt strategies for Shop Floor and Inventory Control.
- Generate part families and to form appropriate cellular system design for similar parts.
- Adopt the FMS concepts for better flexibility in the Production activities.
- Identify the various types of Sensors in order to get suitable End Effectors.

TEXT BOOK:

1. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008.
2. Radhakrishnan P, Subramanyan S.and Raju V., “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

REFERENCES:

1. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India, 2003.

2. Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach"
3. Chapman & Hall, London, 1995.
4. Rao. P, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

ME17E79 NON-DESTRUCTIVE TESTING AND EVALUATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide the overview of NDT methods for material characterization and defect detection in manufacturing.
- To make familiar about the concept of surface NDT methods like liquid penetrate test and magnetic particles testing.
- To impart the knowledge on thermography and Eddy current testing.
- To render the knowledge about ultrasonic testing and Acoustic Emission testing.
- To provide the information about radiography, tomography and related topics.

UNIT I OVERVIEW OF NDT **7**

NDT Versus DESTRUCTIVE testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and de-merits, Various physical characteristics of materials and their applications in NDT., Visual inspection – Unaided and aided.

UNIT II SURFACE NDE METHODS **8**

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 Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING (ET) **10**

Thermography- Principles, Contact and noncontact 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 (UT) AND ACOUSTIC EMISSION (AE) **10**

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 RADIOGRAPHY (RT) **10**

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrometers, Exposure charts, Radiographic equivalence. Fluoroscopy- X-Ray-Radiography, Computed Radiography, Computed Tomography

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to

- Understand different NDT methods, characterization techniques, and defect detection.
- Explain about various surface NDT methods such as liquid penetrate test and magnetic particle testing.
- Get the knowledge regarding thermography and Eddy current testing.

- Understand the concept of Ultrasonic Testing and Acoustic Emission testing.
- Get the information related to radiography, tomography and related topics.

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

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. 4.ASNT,American Society for Non Destructive Testing,Columbus,Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing

GE17E52	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the meaning of Entrepreneur
- To know different motivation techniques
- To be familiarized with business opportunities
- To have knowledge about source of finance and analysis
- To know various supports for business

UNIT I ENTREPRENEURSHIP **9**

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur 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 IDENTIFICATION OF 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, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

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:

Upon completion of the course, students will be able to

- Explain the meaning of Entrepreneur
- Comprehend different motivation techniques
- Describe various business opportunities
- Identify sources of finance and to analyse
- Know various supports for business development

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", 9 th Edition, Cengage Learning, 2014.

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. Jain P C, "A Hand Book for New Entrepreneurs", Oxford University Press, 2010.

SEMESTER-VIII

ELECTIVE IV

		L	T	P	C
ME17E81	**PRODUCTION PLANNING AND CONTROL**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To understand the various components of production and product development.
- To understand the concepts and steps involved in work study.
- To identify various steps involved in product planning and process planning.
- To understand various components and functions of production scheduling.
- To attain adverse knowledge about inventory control & to explore recent trends like MRP and ERP

UNIT I INTRODUCTION 9

Objectives and benefits of planning and control-Functions of production control-Types of production job-batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational aspect-Durability and dependability aspect -Aesthetic aspect. Profit consideration Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT II WORK STUDY 9

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING 9

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning Steps in process planning-Quantity determination in batch production-Machine capacity, balancing Analysis of process capabilities in a multi product system.

UNIT IV PRODUCTION SCHEDULING 9

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling- Batch production scheduling-Product sequencing – Production Control systems-Periodic batch control-Material requirement planning kanban – Dispatching-Progress reporting and expediting Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to

- Visualize the various aspects in new product development.
- Construct the various charts / diagrams to identify unnecessary movements and delays and calculation of standard time to complete a job.
- Construct detailed process planning chart and perform analysis of process capabilities.
- Make a better scheduling & line balancing for aligning completion times and due dates.
- Use different methods of planning to control stocks in manufacturing organization and to supply the product in JIT.

TEXT BOOKS:

1. Martand Telsang, “Industrial Engineering and Production Management”, First edition, S. Chand and Company, 2000.
2. James.B.Dilworth,”Operations management – Design, Planning and Control for manufacturing and services” Mcgraw Hill International edition 1992.

REFERENCES:

1. Samson Eilon, “Elements of Production Planning and Control”, Universal Book Corpn.1984
2. Elwood S.Buffa, and Rakesh K.Sarin, “Modern Production / Operations Management”, 8th Edition, John Wiley and Sons, 2000.
3. Kanishka Bedi, “ Production and Operations management”, 2 nd Edition, Oxford university press, 2007.
4. Melynk, Denzler, “ Operations management – A value driven approach” Irwin Mcgraw hill.
5. Norman Gaither, G. Frazier, “Operations Management”, 9th edition, Thomson learning IE, 2007
6. Jain. K.C & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers, 1990.
7. Chary. S.N. “Theory and Problems in Production & Operations Management”, Tata McGraw Hill, 1995.
8. Upendra Kachru, “Production and Operations Management – Text and cases”, 1st Edition,

EC17E63 MICRO ELECTRO MECHANICAL SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To introduce electrostatic and magnetic sensors and actuators
- To introduce piezo resistive sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

UNIT I INTRODUCTION 9

Definition of MEMS, MEMS history and development - Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II SENSORS AND ACTUATORS-I 9

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic materials for MEMS and properties - Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys

UNIT III SENSORS AND ACTUATORS-II 9

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT IV MICROMACHINING 9

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT V POLYMER AND OPTICAL MEMS 9

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Passive MEMS - Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand and apply knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- Ability to understand the concept of electrostatic, magnetic sensors and actuators.
- Ability to understand the concept of piezo resistive sensors and actuators
- Ability to understand the concept different materials used for MEMS
- Ability to apply the knowledge of MEMS to disciplines beyond Electrical and Mechanical engineering.

TEXT BOOKS:

1. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006.
2. Stephen D Senturia, "Microsystem Design", Springer Publication, 2000.
3. Tai Ran Hsu, “MEMS & Micro systems Design and Manufacture” Tata McGraw Hill, New Delhi, 2002.

REFERENCES:

1. Nadim Maluf,“ An Introduction to Micro Electro Mechanical System Design”, Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, “ The MEMS Handbook”, CRC press Baco Raton, 2000
3. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD, 2002
4. James J.Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2010
5. Thomas M.Adams and Richard A.Layton, “Introduction MEMS, Fabrication and Application,” Springer 2012.
6. Marc Madou, “Fundamentals of Microfabrication”, CRC Press, 2002.
7. Nitaigour Premchand Mahalik, “MEMS”, McGraw Hill Education, 2014.

ME17E82	OPERATIONS RESEARCH	L T P C 3 0 0 3

OBJECTIVES:

The course is intended to build up necessary background and

- To create awareness about optimization techniques in utilization of resources and to formulate the linear programming model for industrial applications
- To provide knowledge and training in various applications of LPP like assignment model , transportation model , Network model and sequencing models
- To understand the deterministic and stochastic inventory models
- To understand the Single and Multi-server queuing models
- To provide knowledge about the various decision models

UNIT I LINEAR MODELS 15

Introduction to Operations Research - Scope , objectives , phases , models and limitations . Linear programming – formulation of LPP - Graphical method – Simplex algorithm – Artificial variables – Big M method – Two phase method – Duality formulation.

UNIT II TRANSPORTATION MODELS AND NETWORK MODELS 8

Transportation models - Finding basic feasible solution – LCM , NWC and VAM methods – Optimality test using MODI method .

Assignment Models – Hungarian method for optimal solution - Unbalanced problem - Traveling Salesman problem

Networks models – Shortest route – Minimal spanning tree – Project network – CPM and PERT networks – Critical path scheduling

Sequencing models - Processing n Jobs through 2 Machines – Processing n Jobs through 3 Machines – Processing 2 Jobs through m machines – Processing n Jobs through m Machines.

UNIT III INVENTORY MODELS 6

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

UNIT IV QUEUEING MODELS 6

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

UNIT V DECISION MODELS 10

Decision models – Game theory – Two person zero sum games - Pure and mixed strategy – Graphical solution - Algebraic solution – Method of Dominance

Replacement models – Replacement of Items that Deteriorate whose maintenance costs increase with time without change in the money value. Replacement of items that fail suddenly: individual replacement policy, group replacement policy technique – Dynamic Programming – Simple Problem.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able

- To Formulate a real-world problem as a mathematical linear programming model and solve it using techniques of LPP
- To build and solve specialized linear programming problems like Transportation Models Assignment Models and Network
- To know about the maintenance of inventory level and its calculations
- To Model a dynamic system as a queuing model and compute important performance Measures
- To solve the playing of game using pure and mixed strategy and to understand the Replacement policy

TEXT BOOK:

1. Taha H.A., "Operations Research", Sixth Edition, Prentice Hall of India, 2003.

REFERENCES:

1. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
2. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 1990.
3. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.
4. Hillier and Libeberman, "Operations Research", Holden Day, 1986
5.
6. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
7. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.

ME17E83	DESIGN OF PRESSURE VESSELS & PIPING	L	T	P	C
		3	0	0	3

OBJECTIVES:

At the end of the course, the student is expected to

- Understand the basic terminologies in pressure vessels.
- Identify the various types of stresses acting in a pressure vessel.
- Identify the design principles for pressure vessels including ASME standards.
- Understand the concept of buckling phenomenon in pressure vessels.
- Identify the various types of piping layout and carry out stress analysis in pipes.

UNIT I INTRODUCTION **3**

Methods for determining stresses – Terminology and Ligament Efficiency – Applications.

UNIT II STRESSES IN PRESSURE VESSELS **15**

Introduction – Stresses in a circular ring, cylinder – Membrane stress Analysis of Vessel Shell components – Cylindrical shells, spherical Heads, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

UNIT III DESIGN OF VESSELS **15**

Design of Tall cylindrical self-supporting process columns – Supports for short, vertical and horizontal vessels – stress concentration – at a variable Thickness transition section in a cylindrical vessel, about a

circular hole, elliptical openings. Theory of Reinforcement – pressure vessel Design. Introduction to ASME pressure vessel codes

UNIT IV BUCKLING OF VESSELS 8

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT V PIPING 4

Introduction – Flow diagram – piping layout and piping stress Analysis.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Comprehend the basic terminologies in pressure vessels.
- Determine the various types of stresses acting in a pressure vessel.
- Apply the design principles for pressure vessels including ASME standards.
- Explain the concept of buckling phenomenon in pressure vessels.
- Describe the various types of piping layout and carry out stress analysis in pipes.

TEXT BOOK:

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors, 2001.
2. Henry H. Bedner, "Pressure Vessels, Design Hand Book, CBS publishers and Distributors,1990.

REFERENCES:

1. Stanley, M. Wales, "Chemical process equipment, selection and Design. Butterworth's series in Chemical Engineering, 1988.
2. William. J., Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.
3. Sam Kannappan, Introduction to Pipe stress analysis, Krieger Publication, Florida 2nd Edition.

ME17E84 INTRODUCTION TO NANO SCIENCE

L	T	P	C
3	0	0	3

OBJECTIVES

- To familiarize about the science of nano materials
- To know the preparation of nano materials
- To know the available nano materials.
- To develop knowledge in characterization of nanomaterial
- To know the fields of application of nano materials

UNIT I INTRODUCTION 8

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thin films multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nano metal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

UNIT V APPLICATIONS 7

Nano InfoTech: Information storage- nano computer, molecular switch, super chip, nano crystal,Nano biotechlogy: nano probes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sun barrier products - In Photostat, printing, solar cell, battery

TOTAL: 45 PERIODS

OUTCOMES:

- Will familiarize about the science of nano materials
- Will demonstrate the preparation of nano materials
- Will know the available nano materials.
- Will develop knowledge in characteristic nanomaterial
- Will know the fields of application of nano materials.

TEXT BOOKS

1. Rajendra Kumar Goyal, Nanomaterials and Nanocomposites: Synthesis, Properties, Characterization Techniques, and Applications. CRC Press, 2017.
2. John Dinardo. N, “Nanoscale charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES

1. Timp .G, “Nanotechnology”, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia (Editor),“The Hand Book of Nano Technology, Nanometer Structure,Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

ELECTIVE V

		L	T	P	C
ME17E85	**ADVANCED I.C. ENGINES**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To understand the underlying principles of operation of different IC Engines.
- To understand the concept of pollutant formation.
- To provide the knowledge in engine exhaust emission control.
- To provide the knowledge in alternate fuels.
- To understand the recent developments in IC Engines.

UNIT I SPARK IGNITION ENGINES 9

Mixture requirements – Fuel injection systems – Mono point, Multipoint & Direct injection - 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 behavior – 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.

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

Homogeneous charge compression ignition engines –Dual fuel engine - Common Rail Direct Injection Systems - Hybrid Electric Vehicles – NOx Absorbers - Onboard Diagnostics – Electronic Engine Management, Data Acquisition System.

TOTAL: 45 PERIODS

OUTCOMES :

- Able to understand the stages of combustion, factors affecting knock, and the SI engine combustion process.
- Able to understand the stages of combustion, injection systems, Turbo charging, and combustion of CI engine process details.
- Able to understand the formation of emissions, methods of controlling and measuring emissions, Green House effect, Emission norms and Driving cycles.
- Able to understand the properties and suitability of alternate fuels, Engine modifications.
- Able to understand the HCC Ignition Engine, CRDI System, Duel-fuel engine, Hybrid Electric Vehicles, On board Diagnostics, Electronic Engine Management, and Data Acquisition System.

TEXT BOOKS:

1. Ganesan. V, "Internal Combustion Engines", Mcgraw Hill Education 4th Edition, 2012.
2. Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines", Dhanpat Rai Publications, July 2016.

REFERENCES:

1. John B. Heywood, “Internal Combustion Engine Fundamentals”, McGraw Hill Education, 2011
2. V.M. Domkundwar “A Course in Internal Combustion Engines”, Dhanpat Rai & Co, 2013.
3. Richard Stone “Introduction to Internal Combustion Engines” SAE International; 4th edition, 2012.
4. B. P. Pundi “Engine Emissions” Alpha Science International Ltd, 2007.

GE17551 PRINCIPLES OF MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide an introduction to management and types of business organisations.
- To provide the knowledge of planning, strategic management and decision making, their relevance, methodologies and benefits.

- To provide the knowledge of organizing and human resources management.
- To enrich about the directing and controlling functions in organisations.
- To provide knowledge on marketing management and international management.

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.

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.

UNIT IV DIRECTING AND CONTROLLING 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. 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.

UNIT V MARKETING AND MULTINATIONAL MANAGEMENT 9

Marketing management – marketing mix and strategies – pricing – product – channels of distribution – promotion – market research.

International management – stages of internationalism - the multinational company – reasons - modes of foreign investment – problems faced by international managers-management functions in international operations.

TOTAL: 45 PERIODS

OUTCOMES:

- Able to know the basic aspects of management thought, its evolution and various approaches.
- Able to provide policies and objectives for the organisation, and recommend appropriate tools and techniques.
- Able to carry out structuring and restructuring of organisations and to effectively manage the human resources of the organization.
- Able to carry out directing and controlling activities in organisations.
- Able to plan, organize, direct and control marketing management and international management activities in organisations.

TEXTBOOKS:

1. Harold Koontz & Heinz Weihrich, “Essentials of Management”, Tata McGraw Hill, 1998.
2. Tripathy PC & Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 1999.

REFERENCES:

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management" 7th Edition, Pearson Education, 2011.
2. Robert Kreitner & Mamata Mohapatra, " Management", Biztantra, 2008.
3. Joseph C.Messie, "Essentials ofManagement", Prentice Hall of India, New Delhi,2003.

ME17E86 ADDITIVE MANUFACTURING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know role of Additive manufacturing in product development
- To know the importance of CAD , reverse engineering and digitization techniques in additive manufacturing
- To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the various Additive Manufacturing technologies
- To be familiar with the characteristics and different types of the powder based Additive Manufacturing.
- To know the applications of additive manufacturing in medical and bio medical field

UNIT I INTRODUCTION 10

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

UNIT II CAD & REVERSE ENGINEERING 10

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 – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS.

UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS 10

Classification – Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications - Solid based system –Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS 10

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

UNIT V MEDICAL AND BIO-ADDITIVE MANUFACTURING 5

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

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able

- To understand the need of prototypes and its role in product development
- To understand the importance of CAD model , reverse engineering and digitization techniques
- To compare different method and discuss the effects of the liquid and solid based Additive Manufacturing technologies and analyze their characteristics
- To understand the different methods , process and applications of the powder based Additive Manufacturing technologies and analyze its characteristics
- To know the various applications of additive manufacturing in Medical and Bio additive manufacturing

TEXT BOOKS:

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
2. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.

REFERENCES:

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype 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", CRC press, 2000.

ME17E87 MECHANICAL VIBRATION AND NOISE CONTROL

L	T	P	C
3	0	0	3

OBJECTIVES:

- Understand the basic concepts of vibration of a system
- Understand the basic concepts of noise and its level in a system
- Identify the various sources of noise in an automotive
- Apply various techniques to control the vibration
- Identify the various types of noise induced and methods to control noise

UNIT I BASICS OF VIBRATION 9

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear 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, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

UNIT IV VIBRATION ISOLATION 9

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

UNIT V SOURCES OF NOISE AND ITS 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, sound transmission through barriers.

TOTAL:45 PERIODS

OUTCOMES:

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

- Appreciate the need and its relevance for vibration study

- Appreciate the need and its relevance for noise study
- Assess various noises in automotive.
- Control vibration with different methods
- Control various noises using different methods.

TEXT BOOKS:

1. Singiresu S.Rao - "Mechanical Vibrations", 5th Edition, Pearson Education, 2010
2. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 2009.

REFERENCES:

1. Benson H. Tongue, "Principles of Vibrations", 2nd Edition, Oxford University, 2007.
2. David Bies and Colin Hansen, "Engineering Noise Control – Theory and Practice", 4th Edition CRC Press; 4 edition (24 June 2009).
3. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, "Theory of Vibration with Application", 5th edition Pearson Education, 2011.
4. Bernard Challen and Rodica Baranescu - "Diesel Engine Reference Book" – Second Edition - Butterworth-Heinemann Ltd; 2 edition May 1999.
5. Julian Happian-Smith - "An Introduction to Modern Vehicle Design"- Butterworth- Heinemann, ISBN 0750-5044-3 – 2004.
6. Rao, J.S and Gupta, K., "Introductory course on Theory and Practice of Mechanical Vibration.

ME17E88 ENERGY ENGINEERING AND MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

At the end of the course, the student is expected to

- Understand and analyse the energy data of industries
- Carryout energy accounting and balancing
- Conduct energy audit and suggest methodologies for energy savings
- Understand and analyse the energy consumption of components
- Utilise the available resources in optimal ways

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 Encon in Illumination.

UNIT III THERMAL SYSTEMS **9**

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: 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 ECONOMICS **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Analyse the energy data of industries.
- Carry out energy accounting and balancing.
- Suggest methodologies for energy savings in electrical system.
- Suggest methodologies for energy savings in thermal system.
- Energy flows organisation. Supply side management. Demand side management

TEXT BOOKS:

1. Guide book for National Certification Examination for "Energy Managers and Energy Auditors" (4 Volumes). Available at www.beeindia.in
2. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

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