RAJALAKSHMI ENGINEERING COLLEGE
(An Autonomous Institution Affiliated to Anna University Chennai)

DEPARTMENT OF MECHATRONICS ENGINEERING
CURRICULUM AND SYLLABUS REGULATIONS – 2017
B.E.MECHATRONICS ENGINEERING

VISION:

To attain excellence in academics, research and technological advancement in Mechatronics Engineering with a concern for society.

MISSION:

- To impart high quality professional education and produce Mechatronics 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 automation, intelligent systems, robotics, research for technology management and to fulfill the expectations of industry and needs of the society.
- To inculcate entrepreneurial qualities for creating, developing and managing global engineering ventures.

Programme Educational Objectives (PEOs):

PEO I

Graduates will have comprehensive knowledge in the analytical, scientific and engineering fundamentals necessary to model, analyse and solve engineering problems and to prepare them for graduate studies and for successful careers in industry.

PEO II

Graduates will effectively design and develop products in the areas such as automation, manufacturing, Internet of Things, machine vision, system simulation, intelligent systems and robotics.

PEO III

Graduates will acquire Technical expertise, Leadership skills, Ethical practices and Team spirit with a concern towards greener society.

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 analyse 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)

Engineering Graduates will be able :

PSO 1: To innovate a Mechatronics system to meet the requirements and specifications.

PSO 2: To analyse and improve the performance of a Mechatronics system and enhance the intellectual capabilities of the system

PSO 3: To lead professional career in industries or an entrepreneur by applying Engineering and Management principles and practices**.**

CURRICULUM AND SYLLABUS

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	Technical English	HS	3	3	0	0	3
	HS17252	Professional English communication						
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								
7	GE17261	Engineering Practices Laboratory	ES	4	0	0	4	2
8	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	ME17401	Fluid Mechanics and Machinery	ES	4	2	2	0	3
3	ME17402	Strength of Materials	ES	4	2	2	0	3
4	MT17301	Electrical Machines and Drives	ES	3	3	0	0	3
5	MT17302	Digital Electronics and microprocessor	ES	3	3	0	0	3
6	MT17303	Analog Devices and Circuits	PC	3	3	0	0	3
PRACTICALS								
7	ME17412	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ES	4	0	0	4	2
8	MT17311	Electrical Machines and Drives Laboratory	ES	4	0	0	4	2
9	MT17312	Computer Aided Machine Drawing	PC	4	0	0	4	2
			TOTAL	**34**	**16**	**6**	**12**	**25**

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	MT17401	Manufacturing Processes	PC	3	3	0	0	3
3	MT17402	System Dynamics and Control	PC	3	3	0	0	3
4	MT17403	Embedded Systems And Microcontrollers	PC	3	3	0	0	3
5	MT17404	Sensors and Instrumentation	PC	3	3	0	0	3
PRACTICALS								
6	MT17411	Microprocessors and Microcontrollers for Automation Laboratory	PC	4	0	0	4	2
7	MT17412	Machining Processes Laboratory	PC	4	0	0	4	2
8	MT17413	Sensors and Instrumentation Laboratory	PC	4	0	0	4	2
9	HS17361	Interpersonal Skills - Listening & Speaking	EEC	2	0	0	2	1
			TOTAL	**31**	**15**	**2**	**14**	**23**

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MT17501	CNC Technology and Applications	PC	3	3	0	0	3
2	MT17502	Programming for automation Using C/C++	PC	3	3	0	0	3
3	MT17503	Thermodynamics and Heat Transfer	ES	3	3	0	0	3
4	MT17504	Theory of Machines and Mechanisms	PC	5	3	2	0	4
5	MT17505	Industrial Electronics and Applications	PC	3	3	0	0	3
PRACTICALS								
6	MT17511	Power Electronic Devices Laboratory	ES	4	0	0	4	2
7	MT17512	Dynamics Laboratory	PC	4	0	0	4	2
8	MT17513	Programming for automation Using C/C++ Laboratory	PC	4	0	0	4	2
9	MT17514	Mini Project	EEC	2	0	0	2	1
			TOTAL	**31**	**15**	**2**	**14**	**23**

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MT17601	Fundamentals of Machine Design	PC	3	3	0	0	3
2	MT17602	Design of Mechatronics System	PC	3	3	0	0	3
3	MT17603	Applied Hydraulics and Pneumatics	PC	3	3	0	0	3
4	MT17604	Industrial Automation	PC	3	3	0	0	3
5		Open Elective - I	OE	3	3	0	0	3
6		Professional Elective – I	PE	3	3	0	0	3
PRACTICALS								
7	MT17611	Applied Hydraulics and Pneumatics Laboratory	PC	4	0	0	4	2
8	MT17612	Industrial Automation Laboratory	PC	4	0	0	4	2
9	MT17613	Comprehension	EEC	4	0	0	4	2
			TOTAL	**30**	**18**	**0**	**12**	**24**

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	GE17451	Total quality management	HS	3	3	0	0	3
2	MT17701	Computer Aided Design and Manufacturing	PC	3	3	0	0	3
3	MT17702	Robotics and Machine Vision System	PC	3	3	0	0	3
4		Open Elective - II	OE	3	3	0	0	3
5		Professional Elective – II	PE	3	3	0	0	3
6		Professional Elective - III	PE	3	3	0	0	3
PRACTICALS								
7	MT17711	Computer Aided Engineering Laboratory	PC	4	0	0	4	2
8	MT17712	Robotics Laboratory	PC	4	0	0	4	2
9	MT17713	Project Work phase I	EEC	4	0	0	4	2
			TOTAL	**30**	**18**	**0**	**12**	**24**

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1		Professional Elective - IV	PE	3	3	0	0	3
2		Professional Elective – V	PE	3	3	0	0	3
PRACTICALS								
3	MT17811	Project Work phase II	EEC	16	0	0	16	8
			TOTAL	**22**	**6**	**0**	**16**	**14**

TOTAL NO. OF CREDITS: 180

PROFESSIONAL ELECTIVES (PE)*

SEMESTER VI ELECTIVE I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	GE17551	Principles of management	PE	3	3	0	0	3
2	ME17601	Automobile Engineering	PE	3	3	0	0	3
3	MT17E61	Medical Mechatronics	PE	3	3	0	0	3
4	MT17E62	Advanced Manufacturing Technology	PE	3	3	0	0	3
5	MT17E63	Introduction to Finite Element Analysis	PE	3	3	0	0	3

SEMESTER VII ELECTIVE II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	AE17701	Avionics	PE	3	3	0	0	3
2	EC17E65	Digital Image Processing	PE	3	3	0	0	3
3	ME17E64	Quality Control and Reliability Engineering	PE	3	3	0	0	3
4	MT17E71	Autonomous Mobile Robots	PE	3	3	0	0	3
5	MT17E72	Product Design and Development	PE	3	3	0	0	3

SEMESTER VII ELECTIVE III

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	ME17703	Process Planning and Cost Estimation	PE	3	3	0	0	3
2	ME17E86	Additive Manufacturing	PE	3	3	0	0	3
3	MT17E73	Smart Sensors and Micro Electro Mechanical Systems	PE	3	3	0	0	3
4	MT17E74	Automated Material Handling Systems	PE	3	3	0	0	3
5	MT17E75	Automotive Mechatronics	PE	3	3	0	0	3

SEMESTER VIII ELECTIVE IV

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	GE17E51	Human Values and Professional Ethics	PE	3	3	0	0	3
2	MT17E81	Intelligent Control Systems	PE	3	3	0	0	3
3	MT17E82	Virtual Instrumentation	PE	3	3	0	0	3
4	MT17E83	Programming for Robot Operating System	PE	3	3	0	0	3
5	MT17E84	Maintenance Engineering and condition Monitoring	PE	3	3	0	0	3

SEMESTER VIII ELECTIVE V

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	GE17E52	Entrepreneurship Development	PE	3	3	0	0	3
2	GE17E54	Intellectual Property Rights	PE	3	3	0	0	3
3	MT17E85	Internet Of Things For Mechatronics	PE	3	3	0	0	3
4	MT17E86	Optimization Techniques	PE	3	3	0	0	3
5	ME17E79	Non-Destructive Testing and Evaluation	PE	3	3	0	0	3

OPEN ELECTIVES

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	OAE1701	Introduction to Aeronautical Engineering	OE	3	3	0	0	3
2	OAE1702	Fundamentals of Jet Propulsion	OE	3	3	0	0	3
3	OAE1703	Introduction to space flight	OE	3	3	0	0	3
4	OAE1704	Industrial Aerodynamics	OE	3	3	0	0	3
5	OAT1702	Automotive Sensors and Actuators	OE	3	3	0	0	3
6	OAT1703	Elements of Electric and Hybrid vehicles	OE	3	3	0	0	3
7	OBM1701	Anatomy and Physiology for Engineers	OE	3	3	0	0	3
8	OBM1702	Biomaterials and Artificial Organs	OE	3	3	0	0	3
9	OBM1704	Engineering Mechanics for Medical Applications	OE	3	3	0	0	3
10	OBM1705	Basics of Biosensors and Biophotonics	OE	3	3	0	0	3
11	OBT1701	Basic Bioinformatics	OE	3	3	0	0	3
12	OBT1702	Biotechnology in Product Development	OE	3	3	0	0	3
13	OBT1703	Food and Nutrition	OE	3	3	0	0	3
14	OBT1704	Medical Sciences for Engineers	OE	3	3	0	0	3
15	OBT1705	Application of Biotechnology for Environmental protection	OE	3	3	0	0	3
16	OBT1706	Fermentation Technology	OE	3	3	0	0	3
17	OCH1701	Introduction to Fertilizer Technology	OE	3	3	0	0	3
18	OCH1702	Introduction to Petroleum Technology	OE	3	3	0	0	3
19	OCH1703	Unit operations in Environmental Engineering	OE	3	3	0	0	3
20	OCH1704	Process Technology	OE	3	3	0	0	3
21	OCH1705	Petrochemical Processing	OE	3	3	0	0	3
22	OCH1706	Recent trends in water treatment	OE	3	3	0	0	3
23	OCE1701	Disaster Management	OE	3	3	0	0	3
24	OCE1702	Coastal Zone Management	OE	3	3	0	0	3
25	OCE1703	Smart Structures and Smart Materials	OE	3	3	0	0	3

26	OCE1705	Basics of Architecture	OE	3	3	0	0	3
27	OCE1706	Global Warming and Climate Change	OE	3	3	0	0	3
28	OCS1701	Web Design and Management	OE	3	3	0	0	3
29	OCS1702	Mobile Application Development	OE	3	3	0	0	3
30	OCS1703	Fundamentals of Database	OE	3	3	0	0	3
31	OCS1704	Web Programming with XML	OE	3	3	0	0	3
32	OCS1705	IoT and its Applications	OE	3	3	0	0	3
33	OCS1706	Programming in C	OE	3	3	0	0	3
34	OCS1707	Programming in C++	OE	3	3	0	0	3
35	OCS1708	Java Programming	OE	3	3	0	0	3
36	OCS1709	Computer Programming	OE	3	3	0	0	3
37	OEE 1701	Renewable Power Generation Systems	OE	3	3	0	0	3
38	OEE1702	Electrical Safety and Quality Assurance	OE	3	3	0	0	3
39	OEE1704	Electric Power Utilization	OE	3	3	0	0	3
40	OEC1702	Consumer Electronics	OE	3	3	0	0	3
41	OEC1704	Pattern Recognition and Artificial Intelligence	OE	3	3	0	0	3
42	OEC1705	Electronics Engineering	OE	3	3	0	0	3
43	OIT1701	Data Science	OE	3	3	0	0	3
44	OIT1702	Advanced Python Programming	OE	3	3	0	0	3
45	OIT1703	Business Intelligence	OE	3	3	0	0	3
46	OIT1704	Computer Vision	OE	3	3	0	0	3
47	OIT1705	Cyber Security	OE	3	3	0	0	3
48	OIT1706	Machine Learning and R Programming	OE	3	3	0	0	3
49	OME1701	Design of Experiments	OE	3	3	0	0	3
50	OME1702	Industrial Safety	OE	3	3	0	0	3
51	OME1703	Quality Concept	OE	3	3	0	0	3
52	OME1705	Supply chain and Logistics Management	OE	3	3	0	0	3
53	OMA1701	Computer based Numerical methods	OE	4	2	0	2	3
54	OMA1702	Number theory and applications	OE	3	3	0	0	3
55	OPH1701	Materials Synthesis and Characterization Techniques	OE	3	3	0	0	3

56	OPH1702	Nanophysics	OE	3	3	0	0	3
57	OCY1701	Green Chemistry in Energy and Environment	OE	3	3	0	0	3
58	OCY1702	Interface Chemistry and Engineering	OE	3	3	0	0	3
59	OGE1701	Human Rights	OE	3	3	0	0	3
60	OGE1702	Foreign Language-Japanese	OE	3	3	0	0	3
61	OGE1703	Foreign Language-German	OE	3	3	0	0	3
62	OGE1704	Foreign Language-French	OE	3	3	0	0	3

SUMMARY

DEPARTMENT OF MECHATRONICS ENGINEERING											
	Subject Area	**Credits Per Semester**								Credits Total	Percentage %
	Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
1.	Humanities and Social Studies (HS)	3	6					3		12	7
2.	Basic Sciences (BS)	12	7	4	4					27	15
3.	Engineering Sciences (ES)	9	10	14		5				38	21
4.	Professional Core (PC)			7	18	17	16	10		68	38
5.	Professional Electives (PE)						3	6	6	15	8
6.	Open Electives (OE)						3	3		6	3
7.	Project Work/ Employability Enhancement Course (PR/EEC)				1	1	2	2	8	14	8
	TOTAL	**24**	**23**	**25**	**23**	**23**	**24**	**24**	**14**	**180**	
8.	Non-Credit*/ (Mandatory)										

* Non-Credit/ (Mandatory) - All students shall enroll, on admission, in any one of the personality and character development programmes (NCC/NSS/NSO/YRC) and undergo training for about 80 hours and attend a camp of about seven days. Apart from the above, the students may enroll for Professional Societies /STEM/Physical Education/Yoga/ATRIUM/ENACTUS/EDC etc

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:

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

CO1: Read articles of a general kind in magazines and newspapers.

CO2: Participate effectively in informal conversations; introduce themselves and their friends and express opinions.

CO3: Comprehend conversations and short talks delivered in English

CO4: Express ideas about oneself freely

CO5: Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

1. Board of Editors. Using English A Coursebook for Undergraduate Engineers and Technologists. Orient BlackSwan 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:

CO1: Apply the concept of Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices for solving problems

CO2: Use the techniques of differentiation to differentiate functions and to apply the concept of differentiation to solve maxima and minima problems.

CO3: To apply the concept of Partial differentiation for functions two or more variables and use different techniques for solving problems.

CO4: Solve problems involving integration using different methods such as substitution, partial fractions, by parts.

CO5: 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. Veerarajan T, 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. programmes)	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 and 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 – tunnelling (qualitative) – electron microscope – scanningtunnelling 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:

CO1: Apply the knowledge of basic properties of matter and its applications in Engineering and Technology.

CO2: Use the concepts of waves and optical devices and their applications in fiber optics.

CO3: Use the concepts of thermal properties of materials and their applications in heat exchangers.

CO4: Use the advanced physics concepts of quantum theory and its applications in electron microscope and material sciences.

CO5: 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. Murugeshan R and KiruthigaSivaprasath, Modern Physics, S.Chand, 2015.

CY17151 ENGINEERING CHEMISTRY L T P C

(Common to all branches of B.E. / B.Tech. programmes) 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:
CO1: Get familiarized on water treatment techniques.
CO2: Apply adsorption phenomena on various fields.
CO3: Analyse alloying composition based on phase rule concept.
CO4: Apply the role of fuels in day today applications.
CO5: Design batteries and fuel cells.

TEXT BOOKS:

1. Jain P C and Monika Jain, "Engineering Chemistry" 17th edition,DhanpatRai Publishing Company (P) LTD, New Delhi, 2015
2. Vairam S, Kalyani P 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. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.
4. Dara S S and Umare S S, "A Textbook of Engineering Chemistry", 12th edition, S. Chand & Company LTD, New Delhi, 2015.

GE17151 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
(Common to all branches of B.E. / B.Tech. programmes) 3 0 0 3

OBJECTIVES:

- To know the basics 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.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Develop algorithmic solutions to simple computational problems.

CO2: Structure simple Python programs for solving problems.

CO3: Decompose a Python program into functions.

CO4: Represent compound data using Python lists, tuples and dictionaries.

CO5: 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, Second 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
(Common to all branches of B.E. / B.Tech. programmes) 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:

CO1: Draw basic geometrical constructions of plane curves and freehand sketching of multiple views of objects.

CO2: Draw the orthographic projection of lines and plane surfaces.

CO3: Draw the projections solids.

CO4: Draw the true shape of the sectioned solid and development of surfaces.

CO5: Draw the 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 (Common to all branches of B.E. / B.Tech. programmes)

L	T	P	C
0	0	4	2

OBJECTIVES:

- To be familiar with the use of office package exposed to presentation and visualization tools.
- To implement Python programs with conditionals and loops.

- To use functions for structuring Python programs.
- To represent compound data using Python lists, tuples and dictionaries.
- To 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:

Hardware: PC with 2 GB RAM, i3 Processor
Software: Python 3 interpreter for Windows/Linux

OUTCOMES:

On successful completion of this course, the student will be able to:
CO1: Develop documentation, presentation and visualization charts.
CO2: Implement Python programs with conditionals and loops.
CO3: Develop Python programs stepwise by defining functions and calling them.
CO4: Use Python lists, tuples and dictionaries for representing compound data.
CO5: Read and write data from/to files in Python

GE17162	PHYSICS AND CHEMISTRY LABORATORY (Common to all branches of B.E. / B.Tech. programmes)	L T P C 0 0 4 2

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, and properties of matter.
- To impart practical skills in water quality parameter analysis, spectrophotometry, flame photometry and corrosion rate determination.

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

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.

OUTCOMES:

On completion of the course students will be able to

CO1: Calculate elastic properties of materials, such as Young's modulus & Rigidity modulus (of solids) and Bulk modulus (through compressibility of liquids).

CO2: Measure various optical and thermal properties of materials (such as wavelengths of spectral lines & Laser source, acceptance angle &numerical aperture of fiber optical cable and thermal conductivity of media).

CO3: Analyse water quality parameters.

CO4: Be familiar in the use of instruments for chemical analysis.

CO5: Measure the corrosion rate in metals.

TOTAL: 30 PERIODS

TEXTBOOKS:

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

SEMESTER II

LANGUAGE ELECTIVE

HS17251	**TECHNICAL ENGLISH**	**L T P C**
	(Common to all branches of B.E. /B. Tech. Programmes)	**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 TO 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-vocabularyused 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:

On completion of the course, students will be able to:
CO1: Read technical texts and write area- specific texts effortlessly.
CO2: Listen and comprehend lectures and talks in their area of specialisation successfully.
CO3: Speak appropriately and effectively in varied formal and informal contexts.
CO4: Write reports and winning job applications.
CO5: 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

Students can be asked to read Tagore and Chetan Bhagat for supplementary reading.

HS17252	PROFESSIONAL ENGLISH COMMUNICATION	L	T	P	C
	(Common to all branches of B.E./B.Tech. programmes)	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:

CO1: Listen to, understand and give opinions in meetings.

CO2: Apply for new jobs and develop their career.

CO3: Write short business messages and reports.

CO4: Use language in both official and unofficial contexts.

CO5: Speak effectively in business communication

TEXT BOOK:

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

REFERENCE BOOKS:

1. Hartley, Mary. "The Power of Listening," Jaico Publishing 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.

MA17251 ENGINEERING MATHEMATICS – II L T P C

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

OBJECTIVES*:*

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

UNIT I DIFFERENTIAL EQUATIONS **15**

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

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 (cubes and parallelepipeds).

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

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

OUTCOMES*:*

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

CO1: Apply various techniques in solving differential equations.

CO2: Use the concept of Gradient, divergence and curl of a vector point function and related identities in different areas of Engineering.

CO3: Evaluate line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.

CO4: Use the concept of Analytic functions, conformal mapping and complex integration for solving problems.

CO5: 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.
6. Veerarajan T, Engineering Mathematics I & II, McGraw Hill Education, 3rd Edition, 2012.

PH17251 MATERIALS SCIENCE L T P C
(Common to B.E. Mechanical, Aeronautical & Mechatronics) 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, bainitic 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, students will be able to:

CO1: Use various phase diagrams and their applications.
CO2: Analyze Fe-Fe_3C phase diagrams, various microstructures and alloys.
CO3: Use mechanical properties of materials.
CO4: Apply magnetic, dielectric and superconducting properties of materials.
CO5: 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
(Common to B.E. AERO, AUTO, BME, CIVIL, CSE, ECE, EEE, Mech & MCT and B.Tech – BT, IT, CHEMICAL & FT) **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 (Eco-mark). 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:

CO1: Solve problems that cannot be solved by mere laws.

CO2: Get familiarized with ecological balance.

CO3: Get public awareness of environment at infant stage.

CO4: Find ways to protect the environment and play proactive roles.

CO5: Develop and improve the standard of better living.

TEXTBOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', 2nd edition, Tata McGraw-Hill, New Delhi,2008.

2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCES :

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, 2007.
2. ErachBharucha, "Textbook of Environmental Studies", 3rd edition, Universities Press(I) Pvt, Ltd, Hydrabad, 2015.
3. Tyler G Miller and Scott E. Spoolman, "Environmental Science", 15th edition, Cengage Learning India PVT, LTD, Delhi, 2014.
4. Rajagopalan R, 'Environmental Studies-From Crisis to Cure', 3rdedition,Oxford University Press,2015.

BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING

EE17252 **(Common to Aero, Auto, Mech, MCT and Food Technology)** **L T P C 3 0 0 3**

OBJECTIVES:

- To impart knowledge on DC circuits.
- To understand the concepts of AC circuits.
- To acquire knowledge on principle of operations of various electrical machines.
- To understand the working principle of different types of electronic devices.
- To acquire knowledge on 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

CO1: Understand the DC circuits

CO2: Analyze the AC circuits

CO3: Understand the working principles of electrical machines

CO4: Comprehend the concepts of various electronic devices

CO5: 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
	(Common to Mech, Aero, Auto and MCT)	2	2	0	3

OBJECTIVES:

- To understand the basics of mechanics and apply the concept of equilibrium to solve problems of concurrent forces
- To understand the concept of equilibrium and to solve problems of rigid bodies
- To learn about the center of gravity and moment of inertia of surfaces and solids
- To learn the basic concepts of friction
- To learn the concepts in 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

CO1: Understand the basics of Mechanics.

CO2: Solve problems in engineering systems using the concept of static equilibrium

CO3: Determine the centroid of objects such as areas and volumes, center of mass of body and moment of inertia of composite areas

CO4: Solve problems involving kinematics and kinetics of rigid bodies in plane motion

CO5: Solve problems involving frictional phenomena in machines

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
(Common to all Branches of B.E/B.Tech) 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 15

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 earth resistance.

IV ELECTRONICS ENGINEERING PRACTICE 15

1. Study of Electronic components and equipments – Resistance measurement using colour coding, Study of Function Generator and CRO. Measurement of AC signal parameters (peak-peak, RMS, Time period & frequency).
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:

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

CO1: Fabricate carpentry components

CO2: Fit pipe connections including plumbing works.

CO3: Use welding equipment's to join the structures.

CO4: Construct different types of wiring circuits.

CO5: Construct electrical and electronic circuits.

BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION

GE17262	**ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
	(Common to Aero, Auto, Mech, MCT and Food Technology)	**0**	**0**	**4**	**2**

OBJECTIVES:

- 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

CO1: Draw the speed characteristic of different types of DC motors.

CO2: Draw the speed characteristic of different types of AC machines.

CO3: Obtain the performance parameters of Transformer.

CO4: Design an application involving diodes and transistors.

CO5: Obtain the characteristics of transducers.

SEMESTER III

MA17351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
(Common to B.E - AERO, AUTO, CIVIL, EEE, MECH, MCT and BTech - BT & FT) 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's identity - 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

CO1: Develop skills to solve different types of partial differential equations

CO2: Develop skills to construct Fourier series for different periodic functions and to evaluate infinite series.

CO3: Classify different types of PDE and solve boundary value problems.

CO4: Develop skills to solve differential equations using Fourier transform techniques.

CO5: 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", 43rd Edition, Khanna Publishers, Delhi, 2014.

REFERENCES:

1. Bali N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, LaxmiPublications Pvt Ltd, 2007.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
4. 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 IndiaPvt Ltd, Delhi, 2013.

ME17401	FLUID MECHANICS AND MACHINERY (Common to Mech, Auto and MCT)	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:

On the successful completion of the course, students will be

CO1: Able to apply mathematical knowledge to predict the properties and characteristics of a fluid.
CO2: Able to understand the concept of losses during flow of liquid.
CO3: Able to apply the mathematical knowledge and the properties of fluid for Dimensional Analysis.
CO4: Able to critically analyse the performance of pumps and practical applications
CO5: Able to critically analyse the performance of turbines and practical applications .

TEXT BOOKS:

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.

ME17402	STRENGTH OF MATERIALS (Common to Mech Auto and MCT)	L T P C 2 2 0 3

OBJECTIVES:

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

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:

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

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

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

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

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

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

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.

MT17301 ELECTRICAL MACHINES AND DRIVES L T P C
3 0 0 3

OBJECTIVES:

- To introduce techniques of magnetic-circuit analysis and introduce magnetic materials
- To familiarize the constructional details, the principle of operation, prediction of performance, the methods of testing the transformers and three phase transformer connections.
- To study the working principles of electrical machines using the concepts of electromechanical energy conversion principles and derive expressions for generated voltage and torque developed in all Electrical Machines.
- To study the working principles of DC machines as Generator types, determination of their no load/load characteristics, starting and methods of speed control of motors.
- To estimate the various losses taking place in D.C. Motor and to study the different testing methods to arrive at their performance.

UNIT I DC MACHINES 9

Constructional details - Principle - Self and separately excited generators - Characteristics of series and shunt generators. DC Motors: Types - Characteristics of series and shunt motors, starting methods.

UNIT II TRANSFORMERS 9

Constructional details - Types of windings - Principle of operation - EMF equation – Transformation ratio - Transformer on no-load and load - Equivalent circuit - Auto transformer.

UNIT III INDUCTION MACHINES 9

Three phase induction motors: Constructional details - Types of rotors - Principle of operation - Slip - Slip-torque characteristics - Condition for maximum torque - Losses and efficiency - Starters – Single Phase induction motors: Double field revolving Theory -Types-Applications

UNIT IV SYNCHRONOUS MACHINES 9

Constructional details - Types of rotors, operating characteristics - EMF equation – Synchronous reactance - Armature reaction - Voltage regulation - EMF, MMF, methods - Synchronous motor: Principle of operation - Torque equation - Starting methods - V and inverted V curves

UNIT V SPECIAL MACHINES 9

Stepper Motor - Construction – working - Switched Reluctance Motor (SRM) - Construction – working - Permanent Magnet DC (PMDC) Motor - Construction – working – Brushless Permanent Magnet DC (BLDC) Motors - Construction – working - Permanent Magnet Synchronous Motor (PMSM) Construction – working- Servo Motor - Construction – working.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of this subject,

CO1: The student will be able to draw the performance curves and select suitable DC machine for various applications.

CO2: Students will be able to select suitable transformer as per the load requirements.

CO3: Students will be able to compute the performance of induction motors and select suitable starters.

CO4: Students will be able to calculate various operating characteristics and draw performance curves for synchronous machines.

CO5: Students will be able to select suitable stepper and servo motor for different applications.

TEXT BOOKS:

1. Vukosavic, "Digital Control of Electrical Drives", Springer, Indian Reprint, 2010.
2. Vedam Subramaniam. "Electric Drives", Tata McGraw Hill , New Delhi , 2007.
3. De. N.K., & Sen. P.K “Electric Drives”, Prentice Hall India Pvt Limited 2002.
4. Theraja B.L and A.K.Theraja, A Text Book of Electrical Technology - Volume II, S.Chand and Company Ltd, New Delhi, 2008.

REFERENCES:

1. Janardanan E. G., “Special Electrical Machines” PHI Learning Private Limited, Delhi, 2014.
2. Crowder, "Electric Drives and Electromechanical Systems", Elsevier, Indian Reprint, 2009
3. Metha. V.K. & Rohit Metha, "Principle of Electrical Engineering", S.Chand & Co, 2006.
4. Dubey.G.K. “Fundamental Electrical Drives” 2nd Edition, Narosa Publications, 2002
5. Bhattacharya S.K. & Brinjinder Singh , "Control of Electrical Machines", New Age International Publishers, 2002.

MT17302 DIGITAL ELECTRONICS AND MICROPROCESSOR L T P C 3 0 0 3

OBJECTIVES:

- To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions
- To introduce the methods for simplifying Boolean expressions
- To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
- To introduce the concept of memories and programmable logic devices.
- To illustrate the concept of synchronous and asynchronous sequential circuits

UNIT I MINIMIZATION TECHNIQUES AND LOGIC GATES 9

Logic circuits using logic gates - NAND–NOR implementations – Multi level gate implementations- Multi output gate implementations. Boolean postulates and laws – De-Morgan’s Theorem - Principle of Duality - Boolean expression - Minimization of Boolean expressions – Minterm – Maxterm - Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don’t care conditions – Quine - Mc Cluskey method of minimization. Application – Temperature and pressure using logic gates.

UNIT II COMBINATIONAL CIRCUITS 9

Design procedure –Adder, Subtractor – Parallel binary adder, parallel binary Subtractor – Carry Look Ahead adder – BCD adder – Binary Multiplier – Multiplexer/ Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator. Application - control of water pumping using combinational circuit.

UNIT III SEQUENTIAL CIRCUITS 9

Latches, Flip-flops - SR, JK, D, T, – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops – Asynchronous Up/Down counter - Synchronous Up/Down counters – Design of

Synchronous counters: Mealy/Moore models - state diagram- State table –State minimization –State assignment - Excitation table and maps-Circuit implementation - Modulo–n counter, Registers – shift registers - Universal shift registers – Ring counter – Sequence generators. Application – Traffic Light controller.

UNIT IV MICROPROCESSOR 8085 9

Organization of 8085: Architecture, Internal Register Organization and Pin Configuration –Instruction Set of 8085 – addressing modes - instruction and machine cycles with states and timing diagram - 8085 assembly language programming.

UNIT V MEMORY AND I/O INTERFACING 9

Address space partitioning – address map – Address decoding – Designing decoder circuit for the given address map -I/O Interfacing- Data transfer schemes – programmed synchronous and asynchronous – Interrupt driven Transfer – interrupts- DMAs- Peripheral ICs: 8255, 8279 & 8251 A

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: Analyze different methods used for simplification of Boolean expressions.

CO2: Design and implement Combinational circuits.

CO3: Design and implement synchronous and asynchronous sequential circuits.

CO4: Write simple HDL codes for the circuits.

CO5: Design and implement different memory devices.

TEXT BOOK:

1. Morris Mano M., “Digital Design: With an Introduction to Verilog HDL”, 5th Edition, Pearson Education Pvt. Ltd., New Delhi, 2013.
2. Charles H.Roth. “Fundamentals of Logic Design”, 6th Edition, Thomson Learning, 2013.

REFERENCES:

1. John F.Wakerly, “Digital Design”, Fifth Edition, Pearson/PHI, 2017
2. John.M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2006.
3. Donald P.Leach and Albert Paul Malvino, “Digital Principles and Applications”, 8th Edition, TMH, 2014.
4. Thomas L. Floyd, “Digital Fundamentals”, 10th Edition, Pearson Education Inc, 2011
5. Donald D.Givone, “Digital Principles and Design”, TMH, 2003.

MT17303 ANALOG DEVICES AND CIRCUITS L T P C

3 0 0 3

OBJECTIVES:

- To study the IC fabrication procedure.
- To study characteristics; realize circuits; design for signal analysis using Op-amp ICs.
- To study the applications of Op-amp.
- To study internal functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits, ADCs.

UNIT I IC FABRICATION **9**

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realization of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance and FETs.

UNIT II CHARACTERISTICS OF OPAMP **9**

Ideal OP-AMP characteristics, DC characteristics, AC characteristics,, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp – Inverting and Non-inverting Amplifiers-V/I & I/V converters ,summer, differentiator and integrator.

UNIT III APPLICATIONS OF OPAMP **9**

Instrumentation amplifier, Log and Antilog Amplifiers, first and second order active filters, comparators, multivibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R- 2R ladder and weighted resistor types), A/D converters using opamps

UNIT IV APPLICATIONS OF ANALOG ICs **9**

Functional block, characteristics & application circuits with 555 Timer IC-566 voltage controlled oscillator IC; 565-phase lock loop IC, Analog multiplier ICs.

UNIT V VOLTAGE REGULATOR ICs **9**

IC voltage regulators –LM78XX,79XX Fixed voltage regulators - LM317, 723 Variable voltage regulators, switching regulator- SMPS- LM 380 power amplifier- ICL 8038 function generator IC.

TOTAL : 45 PERIODS

OUTCOMES

CO1: Ability to understand and analyse, linear and digital electronic circuits.

CO2: Learn different IC fabrication procedure.

CO3: Design Op-amp ICs for signal analysis.

CO4: Learn various applications of Op-amp.

CO5: Analyze various internal functional blocks and special ICs .

TEXT BOOKS:

1. David A.Bell, “Op-amp & Linear ICs”, Oxford, 2013.
2. Roy D Choudhary, Sheil B.Jain, “Linear Integrated Circuits”, 5th edition, New Age, 2018.
3. Ramakant A.Gayakward, “Op-amps and Linear Integrated Circuits”, IV edition, Pearson Education, 2015.

REFERENCES:

1. Fiore, “Opamps & Linear Integrated Circuits Concepts & Applications”,Cengage,2010.
2. Floyd ,Buchla, “Fundamentals of Analog Circuits, Pearson, 2013.
3. Jacob Millman, Christos C.Halkias, “Integrated Electronics - Analog and Digital circuits system”,Tata McGraw Hill, 2003.
4. Robert F.Coughlin, Fredrick F. Driscoll, “Op-amp and Linear ICs”, PHI Learning, 6th edition,2012

STRENGTH OF MATERIALS AND FLUID MECHANICS AND MACHINERY LABORATORY (Common to Mech and MCT)

ME17412	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:

CO1: Ability to perform different destructive testing

CO2: Ability to characterize and compare different materials

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:

CO3: Ability to use the measurement equipment for flow measurement

CO4: Ability to do performance trust on different fluid machinery

MT17311 ELECTRICAL MACHINES AND DRIVES LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To expose the students the operation of electric drives to gain hands on experience.
- To expose the students to the operation of D.C. machines and transformers and give them experimental skill.
- To expose the students to perform load test on D.C. shunt motor
- To expose the students to perform speed control test
- To expose the students to do characteristics of different electrical motors

LIST OF EXPERIMENTS

1. Load test on D.C. shunt motor.
2. Speed control of D.C. shunt motor.
3. Swinburne's test.
4. Load test on three phase induction motor.
5. No load and blocked rotor tests on three – phase induction motor.
6. Load test on single phase induction motor.
7. No load and blocked rotor tests on single phase induction motor.
8. Load test on Synchronous motors.
9. Performance characteristics of Stepper motor.
10. Performance characteristics of single phase transformer.

TOTAL: 60 PERIODS

OUTCOMES

CO1: Ability to perform load test on electric motors
CO2: Ability to perform speed control test
CO3: Ability to plot characteristics of different electrical motors
CO4: Ability to model and analyze electrical apparatus and their application to power system
CO5: Ability to operate of various electrical motors and transformers

MT17312 COMPUTER AIDED MACHINE DRAWING L T P C
0 0 4 2

OBJECTIVES:

- To introduce the students the Indian standard code of practice for engineering drawing and general symbols and abbreviation used on the drawing.
- To provide hands on experience to develop 2D and 3D models of engineering components.
- To provide knowledge to use Drawing/Modeling software.

LIST OF EXERCISES

CODES AND STANDARDS 3

Indian standard code of practice for engineering drawing – general principles of Presentation. Conventional representations of threaded parts, springs, gear and Common features. Abbreviations and symbols for use on technical drawings. Conventions for sectioning and dimensioning.

GEOMETRIC DIMENSIONING & TOLERANCING (GD&T) PRINCIPLES 6

Tolerances – types – representation of tolerances on drawing, fits – types – selection of Fits – allowance. Geometric tolerances – form and positional tolerances – datum, datum Features. Maximum material principle – symbols and methods of indicating it on drawing Surface finish symbols–welding symbols and methods of indicating it on drawing.

INTRODUCTION TO DRAFTING SOFTWARE 6

Introduction to the use of any drafting software – creation of simple geometric bodies using primitives (line, arc, circle etc.,) and editing for the drawing, Dimensioning and text writing, concept of layer creation and setting, line types.

MANUAL AND CAD DRAWING OF MACHINE ELEMENTS 45

Preparation of 2-D drawings using CAD software for components and assemblies of Plummer block, screw jack, machine vice, lathe tailstock, tool head of the shaper. Introduction to 3-D modeling solid and frame modeling.

TOTAL: 60 PERIODS

OUTCOMES:

CO1: Ability to develop engineering drawing and dimensioning for the industrial component using Indian Standard code of practice.

CO2: Able to implement Geometric Dimensioning & Tolerancing principles in production drawing.

CO3: Use CAD software for drafting machine components.

CO4: Understand working principles of different machine elements.

CO5: Ability to develop 2D and 3D models of the component using manual/software.

SEMESTER IV

MA17452	**STATISTICS AND NUMERICAL METHODS (Common to B.E. - AUTO, MECH & MCT)**	**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 test based 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

CO1: Obtain statistical data from experiments and able to analyze the same using statistical test.

CO2: Design experiments using suitable ANOVA techniques and draw conclusions.

CO3: Solve algebraic equations and Eigen value problems that arise during the study of engineering problems.

CO4: Use interpolation methods to solve problems involving numerical differentiation and integration

CO5: Solve differential equations numerically that arise in course of solving engineering problems.

TEXT BOOKS

1. Veerarajan T., 'Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks' , Mc Graw Hill, 2016.
2. Kandasamy P., 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", 11thEdition, Pearson Education, , Asia, 2011.
2. Walpole R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineersand 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, New Delhi, 2006.
6. Chapra S.C., and Canale. R.P, "Numerical Methods for Engineers", 7th Edition, McGraw Hill, New Delhi, 2015.

MT17401 MANUFACTURING PROCESSES L T P C
3 0 0 3

OBJECTIVES:

- To understand working principle of conventional and non-conventional casting, welding and metal working processes.
- To study the working of machining processes including non-conventional types.
- To learn about the production methods of thermo and thermosetting plastics.

UNIT I CASTING 8

Casting types, procedure to make sand mould, types of core making, moulding tools, machine moulding, special moulding processes – CO_2 moulding, shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting, casting defects.

UNIT II WELDING 8

Classification of welding processes. Principles of Oxy-acetylene gas welding. A.C metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermit welding, electron beam welding, laser beam welding, defects in welding, soldering and brazing.

UNIT III MACHINING 13

General principles (with schematic diagrams only) of working and commonly performed operations in the following machines: Lathe, Horizontal milling machine. Basics of CNC machines.

General principles and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, Electron beam machining and Laser beam machining.

UNIT IV FORMING PROCESS 9

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning, Powder metallurgy – Principal steps involved, advantages, disadvantages and limitations of powder metallurgy.

UNIT V FORMING AND SHAPING OF PLASTICS 7

Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines. Extrusion - Typical industrial applications – Thermoforming – Processing of Thermosets – Working principles and typical applications - Compression moulding – Transfer moulding – Bonding of Thermoplastics – Fusion and solvent methods – Induction and Ultrasonic methods

TOTAL: 45 PERIODS

OUTCOMES :

CO1: Recognise the principles and techniques of casting, forming, joining and finishing operations and be able to determine their suitability.

CO2: Calculate and understand appropriate single-point machining relationships taking tool material and machine constraints into consideration.

CO3: Recall the principles and appropriateness of non-traditional machining processes

CO4: Select a suitable manufacturing process in order to achieve the specified product performance and design criterion while considering cost.

CO5: Compare different manufacturing process and use this in industry for component production.

TEXT BOOKS:

1. Hajra Choudhury, “Elements of Workshop Technology”, Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005.
2. Nagendra Parashar B.S. and Mittal R.K., “Elements of Manufacturing Processes”, Prentice- Hall of India Private Limited, 2007.

REFERENCES:

1. Serope Kalpajian, Steven R.Schmid, “Manufacturing Processes for Engineering Materials”, 4th Edition, Pearson Education, Inc. 2007.
2. Jain. R.K. and S.C. Gupta, “Production Technology”, Khanna Publishers. 16th Edition, 2001.
3. “H.M.T. Production Technology – Handbook”, Tata McGraw-Hill, 2000.
4. Roy. A. Linberg, “Process and Materials of Manufacture”, PHI, 2000.
5. Adithan. M and A.B. Gupta, “Manufacturing Technology”, New Age, 2006.

MT17402 SYSTEM DYNAMICS AND CONTROL L T P C
3 0 0 3

OBJECTIVES:

- To introduce the elements of control system and their modeling using various Techniques.
- To perform time domain and frequency domain analysis of control systems required for stability analysis.
- To design the compensation technique that can be used to stabilize control systems.
- To introduce the state variable analysis method

UNIT I CONTROL SYSTEM MODELING 9

Basic Elements of Control System – Open loop and Closed loop systems - Differential equation - Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems – Modeling of Semi active suspension system, Reduction Techniques - Block diagram – Industrial Automatic Flow Process, Signal flow graph – Automatic telescope Control.

UNIT II TIME RESPONSE ANALYSIS 9

Time response analysis - First Order Systems - Impulse and Step Response - Analysis of second order systems - Steady state errors – P, PI, PD and PID Compensation, Analysis of Compensation in Mechatronics systems.

UNIT III FREQUENCY RESPONSE ANALYSIS 9

Frequency Response - Bode Plot, Polar Plot, Nyquist Plot - Frequency Domain specifications from the plots - Constant M and N Circles - Nichol's Chart - Use of Nichol's Chart in Control System Analysis. Compensators - Lead, Lag, and Lead-Lag Compensators. Case Study: Frequency response Analysis in Robot Manipulator.

UNIT IV STABILITY ANALYSIS 9

Stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus, Stability, Dominant Poles, Application of Root Locus Diagram - Nyquist Stability Criterion - Relative Stability. Case study: Stability Analysis of a Robot.

UNIT V STATE VARIABLE ANALYSIS 9

State space representation of Continuous Time systems – State equations – Transfer function from State Variable Representation – Solutions of the state equations - Concepts of Controllability and Observability – State space representation for Discrete time systems. Case Study: Controllability and Observability of an N – Link Robot.

TOTAL: 45PERIODS

OUTCOMES:

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

CO1: Write mathematical equations for model mechanical, electrical systems and can able to compute transfer function using block diagram and signal flow graph methods.

CO2: Analyse the 1st and 2nd order systems in time domain for Mechatronic Systems.

CO3: Perform time domain and frequency domain analysis of control systems required for stability analysis in Robot Control.

CO4: Design the compensation technique that can be used to stabilize Robot control systems.

CO5: Design controllability and observability for higher order systems

TEXTBOOK:

1. Nagrath J and M.Gopal, "Control System Engineering", New Age International Publishers, 6th Edition, 2017.
2. Levent Güvenç, Bilin Aksun Güvenç, Burak Demirel, Mümin Tolga Emirler, "Control of Mechatronic Systems", Institution of Engineering and Technology, 2017.

REFERENCES:

1. Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 9th Edition,2014.
2. Gopal M, "Control System – Principles and Design", Tata McGraw Hill, 4nd Edition, 2012.
3. Schaum's Outline Series, "Feed back and Control Systems" Tata McGraw-Hill, 2007.
4. Georg Pelz, "Mechatronic Systems Modeling and Simulation with HDLs", wiley Publication, 2003.
5. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", 13th Edition, Pearson Education Ltd, 2017.

MT17403 EMBEDDED SYSTEMS AND MICROCONTROLLERS L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on basics of embedded system architecture
- To provide essential knowledge on real time embedded operating system.
- To design and verify the various interfacing techniques with PIC microcontroller.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Embedded system Architecture - Design Process in Embedded system- Classification of Embedded system - Brief introduction to embedded microcontroller cores: CISC, RISC, ARM and DSP.

UNIT II REAL TIME OPERATING SYSTEM 9

Introduction to basic concepts of RTOS – Tasks and Data – Threads – Multiprocessing and Multitasking – Inter process Communication – Synchronization between process - Semaphores – Priority Inversion - Priority Inheritance – Queues – Pipes

UNIT III PIC MICROCONTROLLER 9

PIC Architecture – Programming Techniques – PIC Development Systems – Application Design – Program Debugging - Introduction to Arduino microcontroller, Raspberry Pi

UNIT IV INTERFACING WITH PIC MICROCONTROLLER 9

I/O Port Programming – Arithmetic, Logical Instructions and Programs – PIC 18 Timer – Serial Port Programming – Interrupt Programming – LCD and Keyboard Interfacing – Stepper Motor Interfacing – DC Motor Control.

UNIT V CASE STUDIES 9

Washing machines - Cruise control - antilock braking systems - satellite launch control – Pick and Place Robot - Home Automation using PIC.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to:
CO1: Exemplify the basic architecture and components of embedded system.
CO2: Determine the working of embedded system in real time.
CO3: Comprehend the components and logical working of PIC microcontroller.
CO4: Develop Interfacing circuits for real time applications using PIC microcontroller
CO5: Develop small embedded system for simple applications

TEXT BOOKS:

1. Raj Kamal, "Embedded Systems: Architecture, Programming and Design" Tata Mc Graw-Hill , 2015
2. Muhammad Ali Mazidi, Rolin D. McKinlay and Danny Causey, "PIC Microcontroller And Embedded Systems: Using Assembly And C For PIC 18", Pearson Education, 2016

REFERENCES:

1. Santanu Chattopadhyay, "Embedded system Design" 2nd Edition, PHI Learning Private Limited, 2013.
2. K C Wang, "Embedded and Real time Operating systems" Springer, 2017
3. Martin Bates, "PIC Microcontrollers An Introduction to Microelectronics", Third Edition, 2011
4. John B Peatman, "Design with PIC microcontrollers", Eighth Edition, Pearson Education, 2009

MT17404 SENSORS AND INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVES:

- To gain a knowledge of the basic laws governing the operation of electrical instruments and the measurement techniques.
- To discuss about units, standards, error analysis and characteristics of measurement systems.
- To get adequate knowledge about virtual instrumentation.

UNIT I SCIENCE OF MEASUREMENT 9

Units and Standards - Calibration techniques - Errors in Measurements - Generalized Measurement System - Static and dynamic characteristics of transducers - Generalized Performance of Zero Order and First Order Systems - Response of transducers to different time varying inputs. Classification of transducers

UNIT II MECHANICAL MEASUREMENTS 9

Temperature measurement: bimetallic thermometer - Pressure measurement: manometers - elastic transducers. Vacuum measurement: McLeod gauge - thermal conductivity gauge - Ionization gauge - Flow measurement: orifice – pitot tube - turbine flow meter - hot wire anemometer. Coordinate Measuring Machine – Laser measurement techniques – non contact measurements.

UNIT III ELECTRICAL MEASUREMENTS 9

Potentiometer - RTD - Thermistor - Thermocouple - Strain gauges - LVDT - RVDT – Capacitive transducers - Piezo electric transducer - Pyrometers - load cell - Hall effect transducers –Photoelectric transducers - Fiber optic transducers - Electromagnetic Transducers -Anemometers – Variable reluctance type transducers and hygrometer.

Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors - applications -Automobile, Aerospace, Home appliances, Manufacturing, Medical diagnostics, Environmental monitoring

UNIT IV SIGNAL CONDITIONING AND DATA ACQUISITION 9

Wheatstone and Schering bridges - Amplification - Filtering - V/I, I/V and I/P converters – Sample and Hold circuits - D/A converter (R -2R ladder and weighted resistor types) - A/D converter (Dual slope, successive approximation and flash types) - Data logging - Display devices: CRO, LED and LCD

UNIT V VIRTUAL INSTRUMENTATION 9

Introduction to LabVIEW - Graphical user interfaces - Data types - Data flow programming - Graphical programming - Palettes and tools Front panel objects - Functions and libraries - FOR Loops - WHILE Loops - CASE Structure - Arrays and Clusters - Attribute modes Local and Global variables - Data acquisition using DAQ card.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Recall the units and standards, their conversions, characteristics and error analysis of measurement systems.

CO2: Describe the different devices available in mechanical measurements

CO3: Classify and describe resistive, inductive and capacitive transducers which are used for measuring various parameters like displacement, temperature, humidity etc.

CO4: Design a signal conditioning circuit and data acquisition system

CO5: Develop the LabView program for various applications and to know the use of LabView and DAQ card

TEXT BOOKS:

1. Doeblin E.O, Measurement Systems: Applications and Design, Tata McGraw-Hill Publishing Company Limited, 2003.
2. Patranabis D, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Company Limited, New Delhi, 2011.

REFERENCES:

1. Thomas G. Beckwith, Roy D. Marangoni and Lienhard, “Mechanical Measurements, 6th edition Pearson Education India, 2013
2. Sawhney A.K and P.Sawhney, A Course on Mechanical Measurement Instrumentation and Control, Dhanpat Rai and Co, New Delhi, 2011.
3. Garry M. Johnson, Labview Graphical Programming, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.
4. Jeffrey Travis and Jim Kring, LabVIEW for Everyone: Graphical Programming made Easy and Fun, Tata McGraw Hill Publishing Company Limited, New Delhi, 2006.

MT17411 MICROPROCESSORS & MICROCONTROLLERS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To focus on the implementation of arithmetic operations using microprocessors and microcontroller.
- To simulate assembly language programs.
- To implement various on-chip and off-chip interfacing and algorithms.

LIST OF EXPERIMENTS

1. Arithmetic operations (addition, subtraction, multiplication, ascending, descending) using 8085 and 8051.
2. Generation of specified time delay and display in CRO/ DSO.
3. Analog to digital conversion in 8085.
4. Digital to analog conversion in 8085.
5. Interface MATRIX keyboard with 8085.
6. Stepper motor control using Microcontroller
7. DC motor controller interface using Microcontroller.
8. Interface an ADC and a temperature sensor to measure temperature using Microcontroller.
9. Flash a LED connected at a specified output port terminal using 8085.
10. Interface LCD with Microcontroller.
11. Interface an ADC and a strain gauge to measure the given load using Microcontroller.
12. Generation of waveform using embedded C software at a specified port terminal.
13. Interfacing of traffic light control systems
14. Keyboard/Display Interface
15. Rolling display and Flashing display

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to:
CO1: Develop simple programs using 8085 and 8051
CO2: Perform ADC and DAC Conversions
CO3: Develop interfacing circuits for real time applications
CO4: Develop simple programs using Embedded C softwares
CO5: Develop simple programs for Arduino and Raspberry Pi controllers

MT17412 MACHINING PROCESSES LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- Demonstration and study of the various machines. The Main emphasis will be on a complete understanding of the machine capabilities and processes.

LIST OF EXPERIMENTS
LATHE PRACTICE
Plain Turning
Taper Turning
Thread Cutting

Estimation of machining time for the above turning processes.

DRILLING PRACTICE
Drilling
Tapping
Reaming.

MILLING
Surface Milling.
Gear Cutting.
Contour Milling.

GRINDING
Surface Grinding
Tool Grinding

PLANNING AND SHAPING
Cutting Key Ways.
Dove tail machining.

TOTAL: 60 PERIODS

OUTCOMES:
CO1: Choose different machine tools to manufacture gears.
CO2: Determine the tools required for finishing operations
CO3: Design cutter grinder with appropriate tools
CO4: Design and perform slot and keyway cutting with precision
CO5: Perform holes using drilling operations

MT17413 SENSORS AND INSTRUMENTATION LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To acquire knowledge about LabVIEW programming.
- Study the interfacing of different sensors with LabVIEW.
- To design a LabView program to obtain a required measurement data for temperature
- To generate appropriate design procedure to obtain a required measurement data for force
- To create appropriate design procedure to obtain a required measurement data for displacement.
- To develop an appropriate design procedure, suitable for signal conversion to interface with computer.

LIST OF EXPERIMENTS
1. Design and testing of Digital Comparator
2. Design and testing of Voltage to frequency converter and frequency to voltage converter
3. Design and testing of sample and hold circuit.
4. Design and testing of Flash type Analog to Digital Converters.
5. Design and testing of instrumentation amplifier using OP-AMP.
6. Displacement measurement using potentiometer and LVDT and plotting the characteristic curves.
7. Study of Characteristics and calibration of strain gauge and Load Cell

a. Measurement of strain using resistive type strain gauges with temperature compensation and various bridge configurations.
8. Temperature measurement using Thermocouple, Thermistor and RTD and comparing the characteristics.
9. Comparison of capacitive and resistive type transducer for humidity measurement with their characteristics.
10. Measurement of sound using microphones and sound level meter.
11. Conversation of time domain audio signal into frequency domain signal (FFT).
12. Measurements of 3 phase power and power factor.

TOTAL: 60 PERIODS

OUTCOMES:
CO1: Design a LabView program to obtain a required measurement data for temperature
CO2: Generate appropriate design procedure to obtain a required measurement data for force
CO3: Develop appropriate design procedure to obtain a required measurement data for displacement.
CO4: Develop an appropriate design procedure, suitable for signal conversion to interface with computer.
CO5: Develop the LabView program to control the speed and position of servomotor

HS17361 INTERPERSONAL SKILLS- LISTENING AND SPEAKING L T P C
(Common to B.E - CSE, ECE, MECH, AUTO, CIVIL, MCT, BME and B.Tech – FT, IT & BT) 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

CO1: Identify the different types of listening and speaking for effective interpersonal communication.

CO2: Discuss and respond to content of a listening passage.

CO3: Understand facts and directions and convince the listeners.

CO4: Understand different genres of communication and comprehend the materials to improve their vocabulary and get familiarized with new words, phrases, sentence structures and ideas.

CO5: Make inferences and predictions about spoken discourse.

REFERENCES

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

SEMESTER V

MT17501 CNC TECHNOLOGY AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

- Understand evolution and principle of CNC machine tools
- Describe constructional features of CNC machine tools
- Explain drives and positional transducers used in CNC machine tools
- Write simple programs for CNC turning and machining centres
- Describe tooling and work holding devices for CNC machine tools

UNIT I INTRODUCTION TO CNC MACHINE TOOLS 9

Evolution of CNC Technology, principles, features, advantages, applications - CNC and DNC concept, classification of CNC Machines turning centre, machining centre, grinding machine, EDM - Types of control systems - CNC controllers, characteristics, interpolators - Computer Aided Inspection

UNIT II STRUCTURE OF CNC MACHINE TOOL 9

CNC Machine building, structural details, configuration and design - Guide ways Friction – Anti friction and other types of guide ways - Elements used to convert the rotary motion to a linear motion Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion -spindle assembly - torque transmission elements gears, timing belts, flexible couplings - Bearings.

UNIT III DRIVES AND CONTROLS 9

Spindle drives - DC shunt motor, 3 phase - AC induction motor - Feed drives - Stepper motor – Servo principle - DC and AC servomotors - Open loop and closed loop control - Axis measuring system -synchro, synchro-resolver, gratings, moiré fringe gratings, encoders, inductosysn, laser interferometer

UNIT IV CNC PROGRAMMING 9

Coordinate system - Structure of a part program - G & M Codes - Tool length compensation – Cutter radius and tool nose radius compensation - Do loops, subroutines, canned cycles, mirror image, parametric programming - Machining cycles and programming for machining - Generation of CNC codes from CAM packages

UNIT V TOOLING AND WORK HOLDING DEVICES 9

Introduction to cutting tool materials: Carbides, Ceramics, CBN, PCD inserts classification - PMK, NSH, qualified, semi qualified and preset tooling - Tooling system for machining centre and turning centre - Work holding devices for rotating and fixed work parts - Economics of CNC – maintenance of CNC machines

TOTAL: 45 PERIODS

OUTCOMES:

Upon the completion of the course the student should be able to

CO1: Recall the evolution, principles, classification and applications of CNC machine tools
CO2: Realise the basic structure, construction, working and control of CNC machines
CO3: Identify the fundamentals of drive system and control modules of CNC technology
CO4: Develop program for CNC machines
CO5: Compare and select suitable tooling and working holding devices of CNC

TEXT BOOKS:

1. HMT, "Mechatronics", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017
2. Warren S.Seamers, "Computer Numeric Control", Fourth Edition, Cengage Learning, 2007.

REFERENCES:

1. Berry Leathan – Jones, "Introduction to Computer Numerical Control", Pitman, London, 1987.
2. Ken Evans, John Polywka & Stanley Gabrel, "Programming of CNC Machines", Second Edition – Industrial Press Inc, New York, 2002
3. Mike Mattson, "CNC Programming: Principles and Applications", Delmar; First edition, 2013.
4. Peter Smid, "CNC Programming Hand book", Industrial Press Inc., 2000
5. Radhakrishnan P "Computer Numerical Control Machines", New Central Book Agency, 2013.
6. Rao P.N., "CAD/CAM", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2002.

MT17502 PROGRAMMING FOR AUTOMATION USING C/C++ L T P C
3 0 0 3

OBJECTIVES:

- To introduce the C++ programming and its use in object oriented environment.
- Learn the basics of OO analysis and design skills.
- Learn the UML design diagrams.
- Learn to map design to code.
- Be exposed to the various testing techniques.

UNIT I INTRODUCTION TO C 9

Basics- Constants, Variables & Keywords- C Instructions- Declaration Instruction- Arithmetic Instruction- Integers & Float Conversion- Control Instruction- Control Structures- Decision Control Structures- Loop Control Structures-Case Control Structure.

UNIT II FUNCTIONS POINTERS & ARRAY 9

Basics- Functions & Pointers-Data types-Storage Classes in C-Arrays- Arrays & Pointers-Two Dimensional & Three Dimensional Array-Strings-Structures-I/O Functions- Operations on Bits-Miscellaneous Features.

UNIT III INTRODUCTION TO C++ 9

Overview-Syntax, Comments, Data types – Symbolic constants – Declaration of variables – Dynamic initialization of variables – Reference variables – Operators in C++ – Scope resolution operator – Manipulators– Type cast operator – Expressions and their types – Special assignment expressions – Control structures - The main function – Function prototyping – Call by reference – Return by reference – Inline functions – Default arguments – Function overloading.

UNIT IV CLASSES AND OBJECTS 9

Object Oriented Programming features – Class - Object - Encapsulation and Data Abstraction - constructors – Types of Constructors - Destructor – Friend functions- Static Data and Member functions – Function overloading. Operator overloading: Binary operator overloading – Generic Programming - Function Template – Class Template - Inheritance – Virtual functions.

UNIT V APPLICATIONS 9

Develop simple programs for Programming Line follower robot- Pick & place Robot- Automatic Washing Machine- Traffic light control- Automatic Guided Vehicles-Engine Management system etc..

TOTAL : 45 PERIODS

OUTCOMES:

Upon the completion of the course the student should be able to

CO1. Write simple programs using C
CO2. Implement functions, pointers and structures.
CO3. Design and implement projects using OO concepts.
CO4. Use the concept of classes and objects using C++.
CO5. Develop programs for mechatronic systems using C/C++

TEXT BOOKS:

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Bjarne Stroustrup, "The C++ Programming Language", Third Edition, Pearson Education, 2007

REFERENCES:

1. Baarkakati. N., "Object Oriented Programming in C++", Prentice Hall of India, 1997.
2. Balagurusamy. E., "Object Oriented Programing with C++", Tata McGraw Hill,1997
3. Herbert Schildt,"C++ The Complete Reference", Tata Mc Graw Hill Edition, 2003
4. Stanley, B.Lippman,JoveLagrie,"C++Primer",3rd Edition, Addison Wesley,1998

MT17503 THERMODYNAMICS AND HEAT TRANSFER L T P C
3 0 0 3

OBJECTIVES:

- To have an introduction on laws of thermodynamics.
- To have knowledge on types of I.C engines, air conditioning and refrigeration techniques and heat transfer methods.
- To familiarize the students to understand and perform thermal analysis and their behavior and performance.
- To be familiarized to Use the Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychrometric Chart.

UNIT I FIRST LAW OF THERMODYNAMICS 9

Thermodynamics – microscopic and macroscopic point of view – systems, properties, process, path, cycle. Units – pressure, temperature – Zeroth law. First law – application to closed and open systems, internal energy, specific heat capacities C_V and C_P – enthalpy

UNIT II SECOND LAW OF THERMODYNAMICS 9

Second Law of thermodynamics – statements – equivalents of Kelvin Plank and Clausius statements. Reversibility – Irreversibility, reversible cycle – Carnot cycle and theorem

UNIT III INTERNAL COMBUSTION ENGINES 9

Classification of IC engine - IC engine components and functions. Valve timing diagram and port timing diagram - Comparison of two stroke and four stroke engines, Comparison of petrol & diesel engine, Fuel supply systems, total fuel consumption, specific fuel consumption, mechanical efficiency, BHP, IHP, FP - Ignition Systems, Lubrication system, Cooling system, MPFI, DTSI, CRDI.

UNIT IV REFRIGERATION AND AIR-CONDITIONING 9

Principles of refrigeration, refrigerator& heat pump cycle, refrigerants, refrigerant properties, refrigerant selection, vapour compression refrigeration cycle, vapour absorption cycle, dry bulb temperature, wet bulb temperature, relative humidity, comfort air-conditioning, Psychrometric chart, humidification, de-humidification, air coolers, cooling towers.

UNIT V HEAT TRANSFER (Qualitative Treatment Only) 9

Heat transfer through conduction and convection, Fourier's law of conduction - Problems on one dimensional heat conduction through plain walls, composite walls, cylinder walls, spheres. Extended surfaces: Fins. Problems on heat transfer through rectangular fin, triangular fin, circumferential fin, pin fin, fin efficiency, fin effectiveness. Heat transfer through radiation, Stefan Boltzman Law, black body, grey body, shape factor. Types of Heat Exchangers.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Apply the Thermodynamic Principles to Mechanical Engineering Applications.

CO2: Apply second law of thermodynamics for thermal systems.

CO3: Describe the working of I.C engines and to determine its performance parameters

CO4: Use the thermodynamics laws to design air conditioning and refrigeration equipment.

CO5: To distinguish various modes of heat transfer and the applications.

TEXT BOOKS:

1. Nag P. K, 'Engineering Thermodynamics', 4th edition Tata McGraw-Hill, 2008.
2. Natarajan E., "Engineering Thermodynamics: Fundamentals and Applications", Anuragam Publications, 2012.

REFERENCES:

1. Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 2000.
2. Kothandaraman. C.P., Domkundwar. S. & Domkundwar. A.V., "A course in Thermal Engineering" Dhanpatrai & Co (P) Ltd, Fifth edition, 2000.
3. Kothandaraman. C.P., "Heat and Mass Transfer", New Age International (P) Publishers, 2002.
4. Michael A. Boles, Yunus A. Cengel, Yunus Cengel, "Thermodynamics", 2nd Edition, Mc Graw-Hill India, 2006.

MT17504 THEORY OF MACHINES AND MECHANISMS L T P C
3 2 0 4

OBJECTIVES:

- To understand the basic components and layout of linkages in the assembly of a system/ machine and to draw velocity acceleration diagrams for mechanisms.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and cam mechanisms for specified output motions.
- To understand the basic concepts and the effects of friction in motion transmission and in machine components.
- To study the inertia forces on machine elements.
- To understand static and dynamic balancing techniques and vibration in machine elements

UNIT I MECHANISMS 15

Machine Structure – Kinematic link, pair and chain – Mobility- Kutzbach criterion- Grashoff's law – 4bar, Slider crank mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Displacement, velocity and acceleration- Graphical Method (Relative velocity method)

UNIT II GEARS AND CAMS 15

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicylic gear trains - Determination of speed and torque

Cams – Types of cams – Design of profiles – Knife edged and roller ended followers with and without offsets for various types of follower motions – Tangent cams

UNIT III FRICTION 15

Friction in screw and nut – Plate and disc clutches – Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

UNIT IV INERTIA FORCES 15

Inertia force and Inertia torque – D' Alemberts principle - Dynamic Analysis of slider crank mechanism. Force analysis in Reciprocating engines (Analytical method) - Turning moment diagrams and Fly wheels. Basics of Governors.

UNIT V BALANCING and VIBRATION 15

Static and dynamic balancing – Single and several masses in different planes –Balancing of reciprocating masses. Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft – Critical speed of shaft.

TOTAL: 75 PERIODS

OUTCOMES:

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

CO1: Develop the design concepts of different types of mechanism with lower pairs and higher pairs. Analyze the velocity and acceleration of links of different mechanisms.

CO2: Design a gear transmission drive and draw gear profiles.

CO3: Design clutches and belt drives.

CO4: Perform static and dynamic balancing of unbalanced machine elements.

CO5: Compute natural frequency in free vibration and vibration response in forced vibrations.

TEXT BOOKS:

1. Rattan, S.S, “Theory of Machines”, 4th Edition, Tata McGraw-Hill, 2014.
2. Uicker, J.J., Pennock G.R and Shigley, J.E. “Theory of Machines and Mechanisms”, 4th Edition, Oxford University Press, 2014.

REFERENCES:

1. Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines", 3rd Edition, Affiliated East-West Pvt.Ltd., New Delhi, 2006.
2. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 2002.
3. Rao.J.S. and Dukkipati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
4. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
5. Thomas Bevan, "Theory of Machines", 3rd Edition, Pearson Education India, 2009.

MT17505 INDUSTRIAL ELECTRONICS AND APPLICATIONS L T P C 3 0 0 3

OBJECTIVES:

- To get an overview of different types of power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers
- To study the operation, switching techniques and basics topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and various configurations.

UNIT I POWER SEMI-CONDUCTOR DEVICES 9

Study of switching devices, SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGCT- Static characteristics: SCR, MOSFET and IGBT - Triggering and commutation circuit for SCR- Introduction to Driver and snubber circuits – di/dt and dv/dt protection.

UNIT II PHASE-CONTROLLED CONVERTERS 9

Single phase half and full converters, 3 phase half converters and 3 phase full converter – inverter operation – input power factor – effect of source inductance- use of flywheel diode in controlled rectifier configurations– Thyristor triggering circuits.

UNIT III INVERTERS AND CHOPPERS 9

Classification of inverters - Single phase and three phase voltage source inverters (both120° mode and 180°mode, buck- boost converter, Voltage and Current Commutated choppers, PWM inverters, Principle of Chopper, Chopper classification – step up and step-down Chopper - Types of regulators.

UNIT IV AC TO AC CONVERTERS 9

Single phase AC voltage controller – multistage sequence control – step up and step down cycloconverters – single phase and three phase cycloconverters.

UNIT V INDUSTRIAL APPLICATIONS 9

Solid-state switching circuits, Relays, Electronic Timer, Saw tooth generator, applications in Industrial process control, Motor drive applications, Electronic regulator, Induction heating, Dielectric Heating.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Relate the basic semiconductor physics to the properties of real power semiconductor devices and differentiate from low power devices.

CO2: Describe the operation, switching techniques and basics topologies of DC-DC switching regulators.

CO3: Compare different modulation techniques of pulse width modulated inverters and harmonic reduction methods.

CO4: Recognise the operation of AC voltage controller and various configurations.

CO5: Use power electronic devices in industrial applications.

TEXT BOOKS:

1. Bimbhra P.S. “Power Electronics” Khanna Publishers, Fifth Edition, 2012.
2. Rashid M.H., ‘Power Electronics: Circuits, Devices and Applications’, Pearson Education, PHI Fourth Edition, New Delhi, 2013.

REFERENCES:

1. Daniel.W.Hart, “Power Electronics”, Indian Edition, Mc Graw Hill, 3rd Print, 2013.
2. Dubey, G.K., Doradia, S.R., Joshi, A. and Singh, R.M., “Thyristorised Power Controllers”, Wiley Eastern Limited, 2 nd Edition, 2010.
3. Joseph Vithayathil, “Power Electronics, Principles and Applications”, McGraw Hill Series, 6th Reprint, 2013.
4. Ned Mohan, Tore. M. Undel and, William. P. Robbins,‘ Power Electronics: Converters, Applications and Design’, John Wiley and sons, third edition,2003.
5. Philip T. Krein, “Elements of Power Electronics” Oxford University Press, 2004 Edition.
6. Singh M.D and K.B. Khanchandani, “Power Electronics,” Mc Graw Hill India, 2013.

MT17511 POWER ELECTRONICS LABORATORY L T P C

0 0 4 2

OBJECTIVES:

- To introduce the students different power electronic components and usage of them in electronic circuits.
- To study characteristic of different power electronics and its components.
- To study the practical applications of all the experiments.
- To perform characteristic study on the electronics components
- To know how to use bread board, chips and other components that are present in electronic circuit.

LIST OF EXPERIMENTS

1. Study of SCR, MOSFET & IGBT characteristics
2. UJT, R, RC firing circuits for SCR

3. Voltage & current commutated chopper
4. SCR phase control circuit
5. TRIAC phase control circuit
6. Study of half controlled & fully controller converters
7. Study of three phase AC regulator
8. Speed control of DC shunt motor using three phase fully controlled converter.
9. SCR single-phase cyclo converter
10. SCR series and parallel inverters
11. IGBT Chopper
12. IGBT based PWM inverter (single phase)

TOTAL : 60 PERIODS

OUTCOMES:

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

CO1: Use SCR, MOSFET, TRIAC in electronic circuit

CO2: Determine characteristic study on the electronics components.

CO3: Recognise different power electronics components and use them in electronic circuits.

CO4: Compare the characteristics of different electron devices

CO5: Develop simple circuits using electronic devices for real time applications

MT17512	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.
- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To understand the principles in mechanisms used for speed control and stability control.

LIST OF EXPERIMENTS

1) Study of gear parameters. Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.

2) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms. Kinematics of single and double universal joints.

3) Determination of Mass moment of inertia of Fly wheel and Axle system.

Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus. Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum. Motorized gyroscope – Study of gyroscopic effect and couple.

Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors. Cams – Cam profile drawing, Motion curves and study of jump phenomenon

4) Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination. Multi degree freedom suspension system – Determination of influence coefficient.

5) Determination of torsional natural frequency of single and Double Rotor systems.- Undamped and Damped

Natural frequencies. Vibration Absorber – Tuned vibration absorber.
Vibration of Equivalent Spring mass system – undamped and damped vibration. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
6) Balancing of rotating masses. (b) Balancing of reciprocating masses.
7) Transverse vibration of Free-Free beam – with and without concentrated masses. Forced Vibration of Cantilever beam – Mode shapes and natural frequencies. Determination of transmissibility ratio using vibrating table.

TOTAL : 60 PERIODS

OUTCOMES:

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

CO1. Demonstrate the principles of kinematics and dynamics of machinery
CO2. Use the measuring devices for dynamic testing.
CO3. Derive force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
CO4. Distinguish all the control mechanisms of machines
CO5. Enumerate the undesirable effects of unbalances resulting from prescribed motions in mechanism.

MT17513	COMPUTING TECHNIQUES LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To understand the concepts of Object Oriented Programming.
- To study the concepts of objects and classes.
- To familiarize the types of constructors.

LIST OF EXPERIMENTS

1. Program using functions. Functions with default arguments. Implementation of call by value, address, reference
2. Simple classes for understanding objects, member functions & constructors Classes with primitive data members, Classes with arrays as data members Classes with pointers as data members Classes with constant data members Classes with static member functions
3. Compile time polymorphism Operator overloading & Function overloading
4. Run time polymorphism Inheritance Virtual functions Virtual base classes Templates
5. File handling Sequential access & Random access
6. Write down simple programs for mechatronic applications such as line follower robot, automatic washing machine, Pick and Place Robot etc.
7. Mini Project.

TOTAL : 60 PERIODS

OUTCOMES:

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

CO1: Write simple programs using C language.
CO2: Implement the OOP concepts using Objects and Classes in C++ language
CO3: Develop efficient programs using operator overloading
CO4: Develop the concepts of polymorphism to large scale software
CO5: Apply the concepts of files streams to real world problems

MT17514 **MINI PROJECT** **L T P C**
0 0 2 1

OBJECTIVES:

- The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

GUIDELINE 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 fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report has to be submitted by the group and the fabricated model, which will be reviewed and evaluated 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.

The project report shall carry a maximum of 30 marks. The project report shall be submitted as per the approved guidelines as given by Dean-Academics. Same mark shall be awarded to every student within the project group for the project report. The viva-voce examination shall carry 50 marks. Marks are awarded to each student of the project group based on the individual performance in the viva-voce examination.

Review I	Review II	Review III	End semester Examinations				
			Project Report Submission (30)		Viva-Voce(50)		
			Internal	External	Supervisor	Internal	External
5	7.5	7.5	15	15	15	20	15

TOTAL : 30 PERIODS

OUTCOMES:

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

CO1: Fabricate any components using appropriate manufacturing techniques

CO2: Use design principles and develop conceptual and engineering design of any mechatronics component.

CO3: Demonstrate the function of the fabricated model

CO4: Prepare the project as a technical report and deliver it in oral presentation

CO5: Show their team work and technical Skills

SEMESTER VI

MT17601 FUNDAMENTALS OF MACHINE DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To familiarize with various steps involved in the Design Process
- To understand the principles 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
- To learn to use catalogues and standard machine components (Use of P S G Design Data Book is permitted)

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9

Introduction to the design process - factors influencing machine design, 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 – Factor of safety - theories of failure - Design for variable loading.

UNIT II CURVED BEAMS, SHAFTS AND COUPLINGS 9

Curved beams – crane hook and 'C' frame - Design of solid and hollow shafts based on strength, rigidity and critical speed – Rigid and flexible couplings

UNIT III JOINTS and SPRINGS 9

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints –theory of bonded joints. Various types of springs, design of helical springs - leaf springs.

UNIT IV GEARS 9

Gear Speed ratios and number of teeth-Force analysis -Tooth stresses- Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations. Introduction to design of micro gears, timing belts

UNIT V BEARINGS and SURFACE MOUNTING METHODS 9

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, -- Selection of Rolling Contact bearings. Selection of ball screw, and guide rail systems. Mechanisms for securing materials – Clamps, T-Slots, Vises

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students will be able to
CO1: Design machine components for various types of loading
CO2: Carry out shaft design for different applications.
CO3: Design threaded fasteners and riveted joints based on the requirements.
CO4: Design spur and helical gears based on strength
CO5: Select suitable bearing based on application

TEXT BOOKS:

1. Bhandari V.B, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2017.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical

Engineering Design", 10th Edition, Tata McGraw-Hill, 2014.

REFERENCES:

1. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw- Hill Book Co.(Schaum's Outline), 2010
2. Ansel Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw- HillBook Co, 2003.
3. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8th Edition, Prentice Hall, 2003.
4. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
5. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design",4thEdition,Wiley, 2005
6. Sundararajamoorthy T. V. Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

MT17602 DESIGN OF MECHATRONICS SYSTEM L T P C
3 0 0 3

OBJECTIVES:

- To provide the mechatronic system design and their structure, ergonomic and safety.
- To provide an exposure on modeling and design of mechatronic system.
- The students will be exposed to design mechatronic system in Labview & Vim –Sim Simulation Software's.
- To develop the knowledge about the MEMS.

UNIT I INTRODUCTION TO MECHATRONICS SYSTEM 9

Key elements – Mechatronics Design process –Design Parameters – Traditional and Mechatronics designs – Advanced approaches in Mechatronics - Industrial design and ergonomics, safety.

UNIT II SYSTEM MODELLING 9

Introduction-model categories-fields of application-model development-model verification-model validation-model simulation-design of mixed systems-electro mechanics design-model transformation-domain-independent description forms-simulator coupling.

UNIT III REAL TIME INTERFACING 9

Introduction-selection of interfacing standards Elements of Data Acquisition & control Systems- Over view of I/O process, General purpose I/O card and its installation, Data conversion process, Application Software- Lab view Environment and its applications, Vim-Sim Environment & its applications -Man machine interface.

UNIT IV CASE STUDIES ON MECHATRONIC SYSTEM 9

Introduction – semi-active suspension system Fuzzy based Washing machine – pH control system – Autofocus Camera, exposure control– Motion control using D.C.Motor & Solenoids – Engine management systems.– Controlling temperature of a hot/cold reservoir using PID- Control of pick and place robot – Part identification and tracking using RFID – Online surface measurement using image processing

UNIT V MICRO MECHATRONIC SYSTEM 9

Introduction- System principle - Component design – System design – Scaling laws – Micro actuation

Micro robot – Micro pump – Applications of micro mechatronic components

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1: Design systems in mechatronics approach using modern software packages.
CO2: Will be able to model real time physical systems
CO3: Perform data acquisition and interfacing between the physical system and software
CO4: Develop mechatronic systems for real time applications.
CO5: Design micro mechatronic system.

TEXT BOOKS:

1. Devdas shetty, Richard A. Kolk, “Mechatronics System Design”, 2nd Edition, Cengage Learning 2011.
2. Georg pelz, "Mechatronic Systems: Modeling and simulation" with HDL’s, John wiley and sons Ltd, 2003
3. Tai-Ran Hsu, “MEMS & Microsystems Design and Manufacture”, Tata McGraw-Hill, 2007.

REFERENCES:

1. Bishop, Robert H, "Mechatronics Hand book", CRC Press, 2002.
2. Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes", CRC Press 1991 , First Indian print 2010.
3. De Silva, "Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint, 2013

MT17603 APPLIED HYDRAULICS AND PNEUMATICS L T P C
3 0 0 3

OBJECTIVES:

- Graduates will demonstrate and understand the principle and working of Fluid power system.
- Graduates will have the basic Knowledge about hydraulic control valve .
- Graduates will be broadly educated and will have an understanding of the impact of Pneumatic system.
- Graduates will be able to effectively differentiate between both hydraulic and Pneumatic troubleshoot with application.

UNIT I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS 9

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 – Friction loss- Work, Power and Torque. Problems Sources of Hydraulic power: Pumping Theory – Pump Classification- Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criterion of Linear, Rotary- Fixed and Variable displacement pumps-Problems

UNIT II HYDRAULIC ACTUATORS AND VALVES 9

Hydraulic Actuators: Cylinders– Types and construction, Application, Hydraulic cushioning - Hydraulic motors Control Components: Direction control, Flow control and Pressure control valves- Types, Construction and Operation- Servo and Proportional valves - Applications – Types of actuation. Accessories:

Reservoirs, Pressure Switches- Applications- Fluid Power ANSI Symbols - Problems

UNIT III HYDRAULIC SYSTEMS 9

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

UNIT IV PNEUMATIC SYSTEMS 9

Properties of air– Perfect Gas Laws- Compressors- Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Design of pneumatic circuit cascade method- Electro pneumatic circuits, Introduction to Fluidics, Pneumatic logic circuits.

UNIT V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems. Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for a Pick and Place application and tool handling in a CNC machine. - Low cost Automation – Hydraulic and Pneumatic power packs- case studies.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Recall operating principles and constructional features of hydraulic and pneumatic systems.

CO2: Select suitable hydraulic valve and actuator based on requirements.

CO3: Design the layout of Hydraulic Power package

CO4: Design pneumatic and electro pneumatic circuits.

CO5: Troubleshoot hydraulic and pneumatic systems in industrial Application.

TEXT BOOKS:

1. Anthony Esposito, “Fluid Power with Applications”, Prentice Hall, 2013.
2. Majumdar.S.R ” oil hydraulic system-Principle and Maintenance” Tata McGraw Hill, 2012

REFERENCES:

1. Dudelyt, A Pease and John J Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.
2. Joji.P, “Pneumatic Controls”, Wiley India, 2008
3. Majumdar, S.R., “Oil Hydraulics Systems- Principles and Maintenance”, Tata McGraw Hill, 2001
4. Majumdar, S.R., “Pneumatic Systems – Principles and Maintenance”, Tata McGraw Hill, 2007.
5. Shanmugasundaram.K, “Hydraulic and Pneumatic Controls”, Chand & Co, 2006.
6. Srinivasan.R, “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints, 2008.

MT17604 INDUSTRIAL AUTOMATION L T P C

3 0 0 3

OBJECTIVES

- To understand the various types of Automation processes.
- To study about the hardware and software involved in a PLC.
- To provide the control functions involved in DCS and SCADA.
- To give adequate information in the interfaces used in HMI.

UNIT I INTRODUCTION TO INDUSTRIAL AUTOMATION 9

Introduction to Industrial Automation, Requirements of Industrial Automation, Types of Automation – Localized Process-Distributed process-supervisory and data acquisition, Components of Industrial Automation, Advantages of industrial automation.

UNIT II PROGRAMMABLE LOGIC CONTROLLER 9

PLC architecture, Parts of PLC, CPU and Memory, Input/output modules, power supplies, relays, switches, Relay logic, PLC programming languages, Ladder logic, Timers and Counters, selection of PLC based on input and output.

UNIT III DISTRIBUTED CONTROL SYSTEM 9

Introduction to DCS - Distributed Control System (DCS) architecture, Database organization in DCS, System elements of DCS - Field station - Intermediate station - Central computer station, Reliability parameters of DCS, Classifications of Alarms in DCS.

UNIT IV SCADA SYSTEM & ARCHITECTURE 9

Introduction, Application areas of SCADA, Major elements of SCADA systems, Comparison of SCADA, DCS and PLC, Considerations and benefits of SCADA system. Introduction to field- programmable gate array (FPGA).

UNIT V HUMAN MACHINE INTERFACE 9

HMI –Automation system structure, Instrumentation subsystem, control subsystem, Human interface subsystem-operator panel-construction of the panel-Interfacing with control sub system-Types of Mimic panels, Advance HMI system-Intelligent operator panel-operator station- Data logging station.
Case studies: Loading and unloading, Material Transfer application.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to

CO1. Relate the significance of control in automation.
CO2. Choose appropriate PLC and explain the architecture, installation procedures and trouble shooting.
CO3. Connect the PLC peripherals with the ladder programming.
CO4. Summarize the working of various elements of DCS and SCADA.
CO5. Identify and interpret the processes in HMI.

TEXT BOOKS:

1. Dobrivoje Popovic and Vijay Bhatkar, “Distributed control for Industrial Automation”, Marcel Dekker Inc, 2012.
2. Frank D Petruzella, “Programmable Logic Controllers”, Tata McGraw Hill Publications, 2016

REFERENCES:

1. Michael P.Lukas, “Distributed Control system”, Van Nostrand Reinhold co, Canada, 2012.
2. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015.
3. Stuart A Boyer, “SCADA-supervisory control and data acquisition”, International Society of automation, 3rd edition,2011.
4. William T. Shaw, Cybersecurity for SCADA systems, Penn Well Books, 2006

MT17611 APPLIED HYDRAULICS AND PNEUMATICS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To introduce and provide hand on experience to students to design and test hydraulic circuit to control press, flow etc.,
- To provide hands on experience to design and test the pneumatic circuit to perform basic operations
- To introduce the MATLAB / LABVIEW software to simulate hydraulic, pneumatic and electrical circuit.

LIST OF EXPERIMENTS

1. Design and testing of hydraulic circuits such as
   - Pressure control
   - Flow control
   - Direction control
2. Design of circuit with programmed logic sequence, using an optional PLC in hydraulic Electro hydraulic Trainer.
3. Design and testing of pneumatic circuits such as
   - Pressure control
   - Flow control
   - Direction control
   - Circuits with logic controls
   - Circuits with timers
   - Circuits with multiple cylinder sequences in Pneumatic Electro pneumatic Trainer.
4. Modeling and analysis of basic electrical, hydraulic, and pneumatic systems using MATLAB/LABVIEW software.
5. Simulation of basic hydraulic, pneumatic and electrical circuits using Automation studio software.

TOTAL : 60 PERIODS

OUTCOMES:

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

CO1: Develop simple hydraulic circuits

CO2: Develop simple pneumatic circuits

CO3: Analyse the different controllers in pneumatic circuits

CO4: Develop automation circuits using MATLAB

CO5: Develop automation circuits using Automation studio

MT17612 INDUSTRIAL AUTOMATION LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To be able to do PLC programming for automation.
- To be Familiar with HMI

- To be familiar with SCADA

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.

TOTAL : 60 PERIODS

OUTCOMES:

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

CO1: Analyze the working of PLC

CO2: Analyze the programming logics in PLC

CO3: Design control circuits using HMI

CO4: Develop interfacing circuits with PLC

CO5: Design and develop PLC programs for real time applications

MT17613	COMPREHENSION	L	T	P	C
		0	0	4	2

OBJECTIVE:

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

GUIDELINE FOR REVIEW AND EVALUATION

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

TOTAL : 60 PERIODS

OUTCOMES:

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

CO1: Will be able to understand and comprehend any given problem related to mechatronics engineering field.

CO2: Will be able to recall basic concepts from various domains such as mechanical, electrical, electronics and programming.

SEMESTER VII

GE17451	TOTAL QUALITY MANAGEMENT	L	T	P	C
	(Common to all branches of B.E/B.Tech)	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:

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

CO1: Have Ability to explain the importance of quality in engineering.

CO2: Have Ability to explain various principles in TQM.

CO3: Can explore the knowledge of implementing various TQM tools.

CO4: Have Ability to create rapport among workers to form a quality team.

CO5: Have 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 Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.

MT17701 COMPUTER AIDED DESIGN AND MANUFACTURING L T P C 3 0 0 3

OBJECTIVES:

- To introduce the student to the basic tools of computer-aided design (CAD) and computer- aided manufacturing (CAM).
- To expose the student to contemporary computer design tools for aerospace and mechanical engineers.
- To expose the construction of solid models and usage of FEM.
- To expose the adequate knowledge in CNC System.
- To prepare the student to be an effective user of a CAD/CAM system.

UNIT I INTRODUCTION TO CAD/CAM 9

Fundamentals of CAD / CAM, product cycle and CAD/CAM, Basic components of CIM, Distributed communication system, Computer networks for manufacturing, Role of computer in CAD/CAM. Benefits of CAD/CAM. Concurrent Engineering, Design for Manufacturability

UNIT II INTERACTIVE COMPUTER GRAPHICS 9

Introduction of Hardware and Software - Input and Output devices - Creation of Graphics primitives - Graphical Input techniques - Display transformation in 2D and 3D - viewing transformation - clipping - hidden line elimination – Model storage and data structure - Data structure organization, Hierarchical data structure. Network data structure - Relational data structure. Data storage and search methods.

UNIT III SOLID MODELING AND GRAPHICS SYSTEM 9

Geometric modeling - wire frame, Surface and Solid models - CSG and B-Rep techniques – Wire frame versus Solid modeling - Introduction the software Configuration of Graphics System, Functions of Graphics Packages, Graphic standards - Introduction to Finite Element Analysis.

UNIT IV CNC MACHINES 9

Basic principles of numerical control; Methods of coding, Computer Numerical Control (CNC) System, Machine Structure, drive system, CNC programming, Machining centre, CNC Tooling. Direct Numerical control (DNC), Adaptive control machining systems: Adaptive control optimization, Adaptive control

constraints.

UNIT V COMPUTER AIDED PROCESS PLANNING SYSTEMS 9

Principle of computer integrated manufacturing, Approaches to Computer aided Process Planning (CAPP) - Generative and Retrieval CAPP systems, benefits of CAPP, Material Requirement Planning(MRP), mechanism of MRP, Capacity Planning, Computer integrated production planning and control, Shop floor control.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Explain the 2D and 3D transformations, clipping algorithm, Manufacturing models and Metrics

CO2: Explain the fundamentals of parametric curves, surfaces and Solids

CO3: Summarize the different types of Standard systems used in CAD

CO4: Apply NC & CNC programming concepts to develop part programme for Lathe & Milling Machines

CO5: Summarize the different types of techniques used in Cellular Manufacturing and FMS

TEXT BOOKS

1. Groover.M.P, "Automation Production systems and Computer Integrated Manufacturing, Pearson Education" - New Delhi, 2016.
2. Ibrahim Zeid, R Sivasubramanian CAD/CAM, "Theory and Practice", Tata McGraw Hill Ed, 2009.

REFERENCES

1. David F. Rogers and Alan Adams. J, "Mathematical Elements for Computer Graphics", McGraw - Hill Education, New York, 2017.
2. Groover and Zimmers, CAD/CAM; "Computer Aided Design and Manufacturing, Pearson Education" , New Delhi, 2006.
3. Paul G. Ranky, "Computer Integrated Manufacture, Prentice" – Hall International, UK,1986.
4. Radha Krishnan.P and Kothandaraman.C.P, "Comuter Graphics and Design", Dhanpat Rai and sons, New Delhi, 1991.
5. William M. Newman, Robert F.Sproull, "Principles of Interactive ComputerGraphics", McGraw-Hill International Book Company, second edition (reprint), 2010.

MT17702 ROBOTICS AND MACHINE VISION SYSTEM L T P C

3 0 0 3

OBJECTIVES:

- Students will learn about basics of robots laws and transmission systems
- The student will be exposed to the knowledge in different types end effectors based on their usage.
- To familiarize students with the concepts and techniques of robot manipulator, its kinematics
- The student will learn Programming and Machine vision applications in robots.

UNIT I BASICS OF ROBOTICS 9

Introduction- Basic components of robot-Laws of robotics- classification of robot-work space-accuracy-resolution –repeatability of robot. Power transmission system: Rotary to rotary motion, Rotary to linear motion, Harmonics drives

UNIT II ROBOT END EFFECTORS 9

Robot End effectors: Introduction- types of End effectors- Mechanical gripper- types of gripper mechanism- gripper force analysis- other types of gripper- special purpose grippers.

UNIT III ROBOT MECHANICS 9

Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- forward & inverse kinematics- trajectory planning. Robot Dynamics: Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation

UNIT IV MACHINE VISION FUNDAMENTALS 9

Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction-windowing technique- segmentation- Thresholding- edge detection- binary morphology - grey morphology

UNIT V ROBOT PROGRAMMING 9

Robot programming: Robot Languages- Classification of robot language-Computer control and robot software-Val system and Languages- concepts of Artificial Intelligence - application of robots.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Apply the basic engineering knowledge and laws for the design of robotics

CO2: Select suitable end effectors & grippers and tools' and sensors used in robots according to the requirements.

CO3: Develop kinematics, degeneracy, dexterity and trajectory planning.

CO4: Perform image processing and image analysis techniques by machine vision system

CO5: Analyze the concept of Artificial intelligence in robots, various types of robot programming and its applications.

TEXT BOOKS:

1. Groover MP, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Second Edition, Tata McGraw-Hill Education Pvt Limited, 2012

REFERENCES:

1. Jazar, "Theory of Applied Robotics:Kinematics, Dynamics and Control", Springer, Indian Reprint, 2010
2. John.J.Craig, " Introduction to Robotics: Mechanics & control" Pearson Publication, Fourth edition, 2018.
3. Ralph Gonzale, C.S.G. Lee K. S. Fu, "Robotics: Sensing, Vision & Intelligence", Tata McGraw- Hill Publication, 2008.
4. Sathya Ranjan Deb, "Robotics Technology & flexible Automation" Second edition, Tata McGraw-Hill Publication, 2009.

MT17711 COMPUTER AIDED ENGINEERING LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To impart the fundamental knowledge on using various CAD tools for Engineering Simulation. To know various fields of engineering where these tools can be effectively used to improve the output of a product.

LIST OF EXPERIMENTS:

1. Modelling of a part using any CAD package.
2. Modelling and assembling of the mechanical assembly using any CAD package.
3. Structural analysis using FEA software – any analysis package.
4. Beam deflection analysis using FEA software – any analysis package.
5. Modelling and tool path simulation – turning using any CAM package.
6. Modelling and tool path simulation – milling using any CAM package.
7. NC code generation for milling using any CAM package.
8. NC code generation for turning using any CAM package.

TOTAL : 60 PERIODS

OUTCOMES:

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

CO1: Develop a model using CAD Package for real time applications

CO2: Model and assemble a given three dimensional engineering components

CO3: Perform various analyses on simple structures for the application of different loads.

CO4: Generate CNC programs for a given components to work with CNC machines

CO5: Develop CNC programs for real time applications

MT17712 ROBOTICS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To understand the different robotic configurations and their subsystems
- To introduce different types of robotics and demonstrate them to identify different parts and components and to write programming for simple operations like pick and place, rotoxim etc.,

LIST OF EXPERIMENTS:

1. Study of different types of robots based on configuration, Links, Joints and application.
2. Study of components of robots with drive system and end effectors.
3. Determination of maximum and minimum position of links.
4. Modeling the Forward and inverse kinematics for 3 and 4 axis robotic arm.
5. Perform the machine tending operation of a six axis robot using Teach pendant.
6. Perform the palletizing operation of a six axis robot using Teach pendant.
7. Offline programming of a six axis robot using Robotics simulation Software.
8. Identify a simple part using machine vision technology

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Visualize the configurations of various types of robots.

CO2: Recognise the components of robots like arms, linkages, drive systems and end effectors.

CO3: Use of Adam's software and MAT Lab software to model the different types of robots and calculate work volume for different robots.
CO4: Ability to create programs to perform industrial tasks.
CO5: Develop simple arm control program

MT17713 PROJECT WORK PHASE - I L T P C
0 0 4 2

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.

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. 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.

Each batch is required to select any new component or an integrated mechatronics system that involves various sub components which are to be designed in Project Work Phase - I

The project report shall carry a maximum of 30 marks. The project report shall be submitted as per the approved guidelines as given by Dean-Academics. Same mark shall be awarded to every student within the project group for the project report. The viva-voce examination shall carry 50 marks. Marks are awarded to each student of the project group based on the individual performance in the viva-voce examination.

Review I	Review II	Review III	End semester Examinations				
			Project Report Submission (30)		Viva-Voce(50)		
			Internal	External	Supervisor	Internal	External
5	7.5	7.5	15	15	15	20	15

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of this course, the students will be able to
CO1: Ability to fabricate any components using appropriate manufacturing techniques
CO2: Use of design principles and develop conceptual and engineering design of any mechatronics component.
CO3: Demonstrating the function of the fabricated model
CO4: Ability to prepare the project as a technical report and deliver it in oral presentation
CO5: Ability to show their team work and technical Skills

SEMESTER VIII

MT17811 PROJECT WORK PHASE II L T P C
0 0 16 8

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.

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. 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.

The Mechatronics system designed in Phase-I need to be fabricated/ implemented in Phase II of the project.

The project report shall carry a maximum of 30 marks. The project report shall be submitted as per the approved guidelines as given by Dean-Academics. Same mark shall be awarded to every student within the project group for the project report. The viva-voce examination shall carry 50 marks. Marks are awarded to each student of the project group based on the individual performance in the viva-voce examination.

Review I	Review II	Review III	End semester Examinations				
			Project Report Submission (30)		Viva-Voce(50)		
			Internal	External	Supervisor	Internal	External
5	7.5	7.5	15	15	15	20	15

TOTAL: 240 PERIODS

OUTCOMES:

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

CO1: Ability to fabricate any components using appropriate manufacturing techniques

CO2: Use of design principles and develop conceptual and engineering design of any mechatronics component.

CO3: Demonstrating the function of the fabricated model

CO4: Ability to prepare the project as a technical report and deliver it in oral presentation

CO5: Ability to show their team work and technical Skills

ELECTIVES

GE17551	PRINCIPLES OF MANAGEMENT	L T P C
	(Common to all branches of B.E./B.Tech)	**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:

On the successful completion of the course, students will be

CO1: Able to know the basic aspects of management thought, its evolution and various approaches.

CO2: Able to provide policies and objectives for the organisation, and recommend appropriate tools and techniques.

CO3: Able to carry out structuring and restructuring of organisations and to effectively manage the human resources of the organization.

CO4: Able to carry out directing and controlling activities in organisations.

CO5: 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 of Management", Prentice Hall of India, New Delhi,2003.

ME17601	AUTOMOBILE ENGINEERING (Common to Mech and MCT)	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

CO1: Demonstrate a basic understanding of engine functions, performance, and design methodology for frame, chassis etc.

CO2: Understand the various fuel supply, ignition and performance improvement methods in IC engines and environmental issues.

CO3: Demonstrate the knowledge of various parts of transmission systems and its mechanism.

CO4: Understand the working of steering, brake and suspension systems.

CO5: 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

MT17E61 MEDICAL MECHATRONICS L T P C

3 0 0 3

OBJECTIVES:

- To understand how to measure biochemical parameters and various physiological information.
- To study the need and technique of electrical safety in Hospitals.
- To study the use of radiation for diagnostic and therapy.
- To study about recorders and advanced equipment in medicine

UNIT I INTRODUCTION 9

Cell structure – electrode – electrolyte interface, electrode potential, resting and action potential – electrodes for their measurement, ECG, EEG, EMG – machine description – methods of measurement – three equipment failures and trouble shooting

UNIT II TRANSDUCERS FOR BIO-MEDICAL INSTRUMENTATION 9

Basic transducer principles Types – source of bioelectric potentials – resistive, inductive, capacitive, fiber-optic, photoelectric and chemical transducers – their description and feature applicable for biomedical instrumentation – Bio & Nano sensors & application

UNIT III SIGNAL CONDITIONING, RECORDING AND DISPLAY 9

Input isolation, DC amplifier, power amplifier, and differential amplifier – feedback, op-Amp-electrometer amplifier, carrier Amplifier – instrument power supply. Oscillagraphic – galvanometric - X-Y, magnetic recorder, storage oscilloscopes – electron microscope – PMMC writing systems – Telemetry principles – Bio telemetry.

UNIT IV MEDICAL SUPPORT 9

Electrocardiograph measurements – blood pressure measurement: by ultrasonic method – plethysonography – blood flow measurement by electromagnetic flow meter cardiac output measurement by dilution method – phonocardiography – vector cardiography. Heart lung machine – artificial ventilator – Anesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – Bio-telemetry – laser equipment and application – cardiac pacemaker – DC– defibrillator patient safety - electrical shock hazards. Centralized patent monitoring system.

UNIT V BIO-MEDICAL DIAGNOSTIC INSTRUMENTATION 9

Introduction – computers in medicine – basis of signal conversion and digital filtering data reduction technique – time and frequency domain technique – ECG Analysis.

TOTAL: 45 PERIODS

OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Explain different measurement techniques used in physiological parameters measurement.

CO2: Describe the sensors and signal conditioning circuits used in biomedical engineering.

CO3: Exemplify various amplifiers, recording and display devices.

CO4: Differentiate the working of recorders and explain the advanced systems used in medicine

CO5: Explain various Bio- medical diagnostics instrumentation.

TEXT BOOKS:

1. Arumugam M., “Bio Medical Instrumentation”, Anuradha agencies Pub., 2003
2. Cromwell, Weibell and Pfeiffer, “Biomedical Instrumentation and Measurements”, 2nd Edition, Printice Hall of india , 2012.
3. Siamak Najarian “ Mechatronics in Medicine – A Bio medical engg approach", McGraw – Hill Education, 2011.

REFERENCES:

1. Geddes L.A., and Baker, L.E., “Principles of Applied Bio-medical Instrumentation”, 3rd Edition, John Wiley and Sons, 2010
2. Khandpur, R.S., “Handbook of Biomedical Instrumentation”, TMH, 2009.
3. Tompkins W.J., “Biomedical Digital Signal Processing”, Prentice Hall of India, 1998

MT17E62 ADVANCED MANUFACTURING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To understand the concepts of forming and sheet metal working of metals with its different types of operations and simultaneously to know about various non-traditional machining processes, surface finishing and surface hardening processes with its types and various applications.
- To understand the work and tool holding devices with its principles and its industrial applications

UNIT I SHEET METAL WORKING OF METALS 9

Hot and Cold Working- rolling, forging, wire drawing, extrusion-types-forward, backward & tube extrusion. Blanking-blank size calculation, draw ratio, drawing force, piercing, punching, trimming, stretch forming, tube bending, tube forming -embossing & coining-explosive forming electro hydraulic forming-electromagnetic forming

UNIT II NON TRADITIONAL MACHINING 9

Ultrasonic machining (USM) – process and description of USM-applications and limitations- Electron Beam Machining (EBM)-Process principles of EBM-applications-process principles- Laser Beam Machining (LBM)-Laser beam production-applications-laser beam welding-Plasma Arc Machining (PAM)-Generation of plasma arc-process parameters-applications

UNIT III SURFACE FINISHING AND SURFACE HARDENING PROCESS 9

Grinding process, various types of grinding machine-grinding wheel-types-selection of grinding wheel for different applications-selection of cutting speed and work speed- mounting of grinding wheel-galvanizing, electroplating, anodising. Surface hardening- carburizing, carbonitriding, cyaniding, nitriding, ion nitriding, boronizing, laser hardening, thin film coating (PVD, CVD).

UNIT IV EDM AND ECM 9

Electrical Discharge Machining (EDM) - Description of EDM equipment-electrical circuits - electrolyte-metal removal rate-applications-EDWC - process principles – equipments - applications. Electro Chemical Machining (ECM) - Description of the equipment-electrolyte-metal removal rate -accuracy and surface finish obtained. Electro Chemical grinding (ECG) – Chemical machining-electro chemical grinding equipment-application-electro chemical deburring - honing applications.

UNIT V JIGS AND FIXTURES 8

Jigs-Locating and Clamping devices-principles-elements-mechanical-pneumatic and hydraulic actuation-types of Jigs-general consideration in Jig design-jig bushing, types- methods of construction. Fixtures-types of fixtures- fixture for machine tools –lathe, milling, boring, broaching, grinding-assembly inspection of welding fixture design.

TOTAL :45 PERIODS

OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Recall the basics and working principles of various sheet metal working and forming processes

CO2: Recognise various non-traditional machining processes with its applications

CO3: Identify suitable surface finishing and surface hardening process.

CO4: Compare the concept of EDM and ECM with its characteristics and application

CO5: Select suitable work and tool holding devices used for different machine tools

TEXT BOOKS:

1. Rao P.N., "Manufacturing Technology, Metal cutting and Machine Tools", Tata McGraw Hill, 2013
2. Sharma .P.C., "A text book of Production Technology- vol I &II ", S.Chand & Company Ltd, New Delhi, 2014

REFERENCES:

1. Donaldson. C. "Tool design", Tata McGraw Hill Co. Ltd.,2003
2. HajraChoudhary.S.K. and Hajra Choudhary.A.K, "workshop Technology", Vol-I&Vol-II", Media Publishers 2008
3. H.M.T Bangalore "Production Technology" Tata McGraw Hill, 2016.

MT17E63 INTRODUCTION TO FINITE ELEMENT ANALYSIS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

UNIT I INTRODUCTION 9

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

UNIT II ONE-DIMENSIONAL PROBLEMS 9

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics 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 9

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.

UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 9

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

UNIT V ISOPARAMETRIC FORMULATION 9

Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques - Introduction to Analysis Software.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1: Derive Governing Differential Equation for any engineering problem.
CO2: Use 1-D bar, beam elements to solve one dimensional thermal, solid mechanics problems.
CO3: Use 2D elements to solve heat transfer, torsion problems.
CO4: Use Triangular elements to solve plane stress, plane strain problems
CO5: Perform isoparametric element formulation to solve problems.

TEXT BOOKS:

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

AE17701 AVIONICS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the basic of avionics and its need for civil and military aircrafts
- To impart knowledge about the avionic architecture and various avionics data buses
- To gain more knowledge on various avionics subsystems

UNIT I INTRODUCTION TO AVIONICS 9

Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – Introduction to Microprocessor and memories.

UNIT II DIGITAL AVIONICS ARCHITECTURE 8

Avionics system architecture – data buses – MIL-STD-1553B – ARINC – 420 – ARINC – 629

UNIT III FLIGHT DECKS AND COCKPITS 9

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS

UNIT IV INTRODUCTION TO NAVIGATION SYSTEMS 10

Radio navigation – VOR/DME, Hyperbolic navigation-LORAN and OMEGA, Landing system-ILS, MLS,Inertial Navigation Systems (INS)- INS block diagram – Satellite navigation systems – GPS.

UNIT V SOFTWARE ASSESSMENT AND AUTO PILOT 9

Fault tolerant systems -Software Assessment and Validation -Civil and Military standards - Certification of Civil Avionics. Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

TOTAL: 45 PERIODS

OUTCOMES:

After successful completion of this course, the students should be able to

CO1. Understand the concept of designing avionics systems

CO2. Understand the principle of digital avionics systems

CO3. Know the practical and working of flight deck equipments

CO4. Understand the principle and working of navigation system

CO5. Understand the air data systems and auto pilot

TEXTBOOKS:

1. Collinson.R.P.G. "Introduction to Avionics", Chapman and Hall, 1996.
2. Spitzer, C.R. "Digital Avionics Systems", Prentice-Hall, Englewood Cliffs, N.J.,U.S.A. 1993.

REFERENCES:

1. Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., 2004
2. Middleton, D.H., Ed., "Avionics systems, Longman Scientific and Technical", Longman Group UK Ltd., England, 1989.
3. Spitzer. C.R. "The Avionics Hand Book", CRC Press, 2000
4. Pallet.E.H.J., "Aircraft Instruments and Integrated Systems", Longman Scientific
5. Jim Curren, “Trend in Advanced Avionics”, IOWA State University, 1992.

EC17E65 DIGITAL IMAGE PROCESSING L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn digital image fundamentals, be exposed to simple image processing techniques.
- Learn image segmentation techniques.
- Be familiar with image compression concepts.
- Learn to represent image in the form of features.

UNIT I DIGITAL IMAGE FUNDAMENTALS 8

Introduction – Origin – Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels – color models.

UNIT II IMAGE ENHANCEMENT 10

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering – Frequency Domain: Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters. Matlab programs for image enhancement -zooming, histogram equalization and High pass filter

UNIT III IMAGE RESTORATION AND SEGMENTATION 9

Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering Segmentation: Detection of Discontinuities–Edge Linking via Hough Transform and Boundary detection – Region based segmentation-

Morphological processing- erosion and dilation. Matlab programs for Mean, Median and Contra Harmonic filters.

UNIT IV WAVELETS AND IMAGE COMPRESSION 9

Wavelets – Subband coding – Multiresolution expansions – Compression: Fundamentals – Image Compression models – Error Free Compression – Variable Length Coding – Bit-Plane Coding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding – Compression Standards.

UNIT V IMAGE REPRESENTATION AND RECOGNITION 9

Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier Descriptor, moments- Regional Descriptors –Topological feature, Texture – Patterns and Pattern classes – Recognition based on matching- Neural network -perceptron for two pattern classes.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Describe digital image fundamentals.

CO2: Apply image enhancement techniques.

CO3: Analyse Image Restoration and Segmentation Techniques.

CO4: Use image compression Techniques.

CO5: Demonstrate Image in the form of features.

TEXT BOOKS:

1. Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2010.

REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
2. Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt. Ltd., 2011.
3. Willliam K Pratt, “Digital Image Processing”, John Willey, 2002.
4. Malay K. Pakhira, “Digital Image Processing and Pattern Recognition”, First Edition, PHI Learning Pvt. Ltd., 2011.
5. http://eeweb.poly.edu/~onur/lectures/lectures.html.
6. http://www.caen.uiowa.edu/~dip/LECTURE/lecture.html

ME17E64 QUALITY CONTROL AND RELIABILITY ENGINEERING L T P C

(Common to Mech and MCT) 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

CO1: To apply the concept of SQC in process control for component production

CO2: To draw the process control charts for attributes

CO3: To understand the concepts of acceptance sampling for AQL and LTPD

CO4: To understand the concept of reliability , maintainability, availability and OC curves

CO5: 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.

MT17E71 AUTONOMOUS MOBILE ROBOTS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the fundamentals of mobile robotics.
- To expose the student to kinematics of mobile robots.
- To expose the sensors used in mobile robots.
- To study the methods used for planning and navigation of mobile robots..

UNIT I LOCOMOTION 9

Introduction , Key issues for locomotion, Legged Mobile Robots, Leg configurations and stability, Examples of legged robot locomotion, Wheeled Mobile Robots , Wheeled locomotion: the design space,Wheeled locomotion: case studies

UNIT II MOBILE ROBOT KINEMATICS 9

Kinematic Models and Constraints , Representing robot position, Forward kinematic models , Wheel kinematic constraints, Robot kinematic constraints, Examples: robot kinematic models and constraints ,Mobile Robot Maneuverability , Degree of mobility, Degree of steerability, Robot maneuverability , Mobile Robot Workspace, Degrees of freedom, Motion Control- Open loop control (trajectory-following) , Feedback control.

UNIT III SENSORS FOR MOBILE ROBOTS 9

Sensor classification, Characterizing sensor performance , Wheel/motor sensors, Heading sensors, Ground-based beacons, Active ranging, Motion/speed sensors, Vision-based sensors, Representing Uncertainty,Statistical representation, Error propagation: combining uncertain measurements .

UNIT IV MOBILE ROBOT LOCALIZATION 9

The Challenge of Localization: Noise and Aliasing ,1 Sensor noise, Sensor aliasing, Effector noise, An error model for odometric position estimation, Localization-Based Navigation versus Programmed Solutions, Belief Representation, Map Representation, Probabilistic Map-Based Localization, ,Autonomous Map Building –the stochastic map technique.

UNIT V PLANNING AND NAVIGATION 9

Competences for Navigation: Planning and Reacting, Path planning, Obstacle avoidance, Navigation Architectures, Modularity for code reuse and sharing, Control localization, Techniques for decomposition, Case studies: tiered robot architectures.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Design wheeled robots.

CO2: Control mobile robots of different geometry.

CO3: Select and device suitable sensors for any mobile robots.
CO4: Identify and map the location of mobile robots.
CO5: Navigate mobile robots by avoiding obstacles.

TEXT BOOKS

1. Jared Kroff," Modern Perspectives of Mobile Robot Systems", Clanrye International,USA,2015.
2. Todd, D.J, Walking Machines, an Introduction to Legged Robots. Springer ,2012.

REFERENCES

1. Borenstein, J., Everet,t H.R., Feng, L., Navigating Mobile Robots, Systems and Techniques. A.K. Peters, Ltd.,USA, 1996.
2. Cox, I.J., Wilfong, G.T. (editors), Autonomous Robot Vehicles. New York, SpingerVerlag, 1990.
3. Craig, J.J., "Introduction to Robotics: Mechanics and Control", Pearson Education India,2008.
4. Mason, M., Mechanics of Robotics Manipulation. Cambridge, MA, MIT Press, 2001.
5. Roland Siegwart, Illah Reza Nourbakhsh and Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", MIT Press Cambridge, England,2004.

MT17E72 PRODUCT DESIGN AND DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:

- To introduce the ideas of process management and product development.
- To study product architecture and Cad/CAM tool integration.
- To impart knowledge on design process.
- To create awareness on design for manufacturing.

UNIT I INTRODUCTION 9

Need for IPPD – Strategic importance of Product development – integration of customer, designer,material supplier and process planner, Competitor and customer – Behaviour analysis. Understandingcustomer – prompting customer understanding – involve customer in development and managingrequirements – Organization – process management and improvement – Plan and establish productspecifications.

UNIT II CONCEPT GENERATION AND SELECTION 9

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT III PRODUCT ARCHITECTURE 9

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation –clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

UNIT IV INDUSTRIAL DESIGN 9

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools –Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process –investigation of customer

needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 9

Definition – Estimation of manufacturing cost – reducing the component costs and assembly costs –Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes –Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Comprehend product design development process

CO2: Generate and select suitable concepts for developing various products.

CO3: Recognise product architecture.

CO4: Reduce the cost of industrial product design.

CO5: Control and accelerate industrial design projects.

TEXT BOOK:

1. Karl T.Ulrich and Steven D.Eppinger, ”Product Design and Development”, McGraw-Hill International Edns. 2009.
2. Staurt Pugh, ”Tool Design –Integrated Methods for Successful Product Engineering”, Addison Wesley Publishing, New york,1991.

REFERENCES:

1. Anil Mital, Anoop Desai, Anand Subramanian, AashiMital,”Product Development: A Structured Approach to Consumer Product Development, Design, and Manufacture”,Elsevier, 2014.
2. Geoffrey Boothroyd, “Product design for manufacture and assembly”, CRC Press; 3 edition , 2010.
3. Kemnneth Crow, "Concurrent Engg./Integrated Product Development”, DRM Associates,26/3, Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
4. Stephen Rosenthal, “Effective Product Design and Development”, Irwin Publishing house, 1999.

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 work holding 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

CO1: Construct the various charts / diagrams regarding movements and delays.

CO2: Compute standard time for completing a job

CO3: Make a standard and detailed process planning for a new product.

CO4: Differentiate between cost estimation and cost accounting.

CO5: 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

ME17E86 ADDITIVE MANUFACTURING L T P C
(Common to Mech ,Auto and MCT)
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

CO1: To understand the need of prototypes and its role in product development

CO2: To understand the importance of CAD model , reverse engineering and digitization techniques

CO3: To compare different method and discuss the effects of the liquid and solid based Additive Manufacturing technologies and analyze their characteristics

CO4: To understand the different methods , process and applications of the powder based Additive Manufacturing technologies and analyze its characteristics

CO5: 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.

MT17E73 SMART SENSORS AND MICRO ELECTRO MECHANICAL SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study about the internal composition of smart sensors
- To study about the working of smart sensors
- To gain knowledge on MEMS

UNIT I ACOUSTIC, MAGNETIC AND MECHANICAL SENSORS 9

Acoustic waves, piezoelectric materials Acoustic sensing, saw sensors Sensor applications and future trends Magnetic sensors: effects and materials Integrated Hall sensors Magnetotransistors, other magnetics transistor and future trends Mechanical sensors: piezoresistivity Piezoresistive sensors Capacitive sensors

UNIT II RADIATION, THERMAL AND CHEMICAL SENSORS 9

Radiation basics HgCdTe infrared sensors Visible-light color sensors, high-energy photodiodes Heat transfer, thermal structures Thermal-sensing elements Thermal and temperature sensors Thin-film sensors

UNIT III BIOSENSORS, ELECTRONIC INTERFACE AND INTEGRATED SENSORS 9

Immobilization of biological elements Transduction principles Lab-on-chip sensors Integrated sensors: system organization and functions Interface electronics Universal transducer interface Micro technologies: methods and tools, constructive and connective techniques

UNIT IV MICRO-AND NANOTECHNOLOGIES OR SENSORS 9

MEMS fabrication technologies: bulk micromachining Surface micromachining High-aspect-ratio (LIGA and LIGA-Like) technology microfluitics microsystem components Microfluidics Nanotechnology: product prospects - application trends Procedures and techniques:

UNIT V APPLICATIONS 9

The making of ultrathin films Creation of lateral nanostructures, nanocrystalline materials and principles of self-organization and Future trends

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can be able to
CO1: Compare the characteristics of Acoustic magnetic and Mechanical Sensors
CO2: Analyze the different thermal, chemical and Radiation sensors
CO3: Understand the working of Biosensors and its interfaces
CO4: Explain the Micro and Nano technologies in the field of smart sensors
CO5: Understand the applications of sensors in industries

TEXT BOOKS:

1. Gerard Meijer, "Smart Sensor Systems: Emerging Technologies and Applications", Wiley, 2014
2. Jacob Fraden, "Handbook of Modern Sensors: Physics, Designs, and Applications", Springer; 5th ed. 2016

REFERENCES:

1. Gopel W, J. Hesse, J. N. Zemel, "Sensors A Comprehensive Survey" Vol. 9, Wiley-VCH, 1995
2. Sze S. M., "Semiconductor Sensors", Wiley-Interscience,1994

MT17E74 AUTOMATED MATERIAL HANDLING SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the concepts of material handling equipment.
- To expose the student automated assembly and storage systems.

UNIT I MATERIAL HANDLING 9

Overview of material handling equipment – Considerations in material handling system design – 10 principles of material handling , Mechanism of part handling - Industrial trucks, Cost Criteria for Equipment Decisions.

UNIT II CONVEYOR SYSTEM 9

Conveyors systems – Cranes and Hoists – Analysis of Material transport systems. Storage system performance – storage location strategies – Conventional storage methods and equipment's – Automated storage systems.

UNIT III AUTOMATED STORAGE AND ASSEMBLYSYSTEMS 9

Engineering Analysis of Automated storage systems - AS/RS – Quantitative analysis- Carousel storage system. Fundamentals of Automated Assembly systems – Design for Automated Assembly – Bar-code techniques – Robotics in material handling system.

UNIT IV OVERHEAD AND SURFACE TRANSPORTATION EQUIPMENT 9

Overhead Trolley Conveyors, Cableways ,Aerial Tramways, Trackless Equipment , Narrow Gauge Equipment, Cross Handling Equipment .

UNIT V MODERN MATERIALS HANDLING EQUIPMENT 9

AGV systems – mobile Robots – Mono Rails, manipulators, storage systems, elevators, racks, bins, and other Rail Guided Vehicles.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Select appropriate of material handling equipment.

CO2: Design and develop conveyor system.

CO3: Implement suitable storage system.

CO4: Select appropriate of overhead material handling equipment.

CO5: Select modern material handling equipment.

TEXT BOOKS

1. Charles D Reese, "Material Handling Systems", Taylor And Francis, 2011.
2. Edward H. Frazelle, "World-Class Warehousing and Material Handling",McGraw-Hill Education, 2016.

REFERENCES

1. Agarwal,G.K "Plant Layout and material handling", Jain Brothers, Delhi, 2011.
2. Kant. Vajpayee, "Principles of Computer Integrated Manufacturing", Prentice Hall of India Pvt. Ltd., 2016.
3. Kulwiec R.A." Material Handling Hand book" 2nd Edition, JohnWiely& Sons Inc., New York, 2012.
4. Mikell.P.Groover,"Automation, Production System and Computer integrated manufacturing", Prentice Hall of India Pvt. Ltd., New Delhi, 2013.
5. Mulcahy.D.E. "Material handling hand book", McGraw Hill, New York, 2013.

MT17E75 AUTOMOTIVE MECHATRONICS L T P C

3 0 0 3

OBJECTIVES:

- To study about the basic Architecture and different systems in Automotive system
- To observe the characteristics of the sensors used in Automotive Applications
- To study about the working of different Control System in Automobiles
- To find the fault occurrences and safety measures in Automobiles
- To study about Hybrid Vehicles

UNIT I INTRODUCTION 9

Vehicle System Architecture - Electronic Control Unit: Operation, Design, Control Unit Software Motronic Engine Management System – Electronic Diesel Control

UNIT II SENSORS AND ACTUATORS IN AUTOMOTIVE SYSTEMS 9

Measuring Variables –Crank Shaft Sensor - Air Flow Rate Sensor – Throttle Angle Sensor – Coolant Sensor – Exhaust Gas Oxygen Sensor – Knock Sensor – Flex Fuel Sensor – Automotive Engine Control Actuators – Exhaust Gas Recirculation Actuator – Electric Motor Actuators.

UNIT III AUTOMOTIVE CONTROL SYSTEM 9

Digital Engine Control and Features – Control Modes for Fuel Control – Discrete Time Idle Speed Control – EGR Control – Electronic Ignition Control – Digital Cruise Control – Antilock Braking System – Digital Braking System – Electronic Suspension Control System

UNIT IV DIAGNOSTICS AND SAFETY IN AUTOMOTIVE SYSTEMS 9

Electronic Engine Control Diagnostics – Service Bay Diagnostic Tool – Onboard Diagnostics – Model Based Sensor Failure Detection – Misfire Detection – Expert systems in Automotive Diagnostics – Airbag Safety – Blind Spot Detection – Automatic Collision Avoidance System – Tire Pressure Monitoring System – Enhanced Vehicle Stability

UNIT V HYBRID DRIVES AND VEHICLES 9

Drive Concepts – Operating Strategies for Electric Hybrid Vehicle – Recuperative Brake System – Electrical Energy Accumulators – Tesla Roadster – Toyota Mirai - Volkswagen Golf GTE.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Recognize the different system architecture of Automotive systems

CO2: Compare the sensor characteristics and Determine its suitability in Real time Environment

CO3: Determine the control system characteristics in Automotive Systems

CO4: Analyze the Fault Occurrences and Recognize the safety measures in Automobiles

CO5: Compare the system of the Hybrid Vehicles with other Vehicles

TEXT BOOKS:

1. Konrad Reif, "Automotive Mechatronics", Springer, 2016
2. Robert Bosch GmbH, "Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, Springer, 2016
3. Tom Denton , "Electric and Hybrid Vehicles", IMI, 2016

REFERENCES:

1. Mandy Concepsion, Automotive Electronic Diagnostics, Automotve Diagnostics and Publishing, 2009
2. William Ribbens, "Understanding Automotive Electronics: An Engineering Perspective" Elseveir, 2017

GE17E51 HUMAN VALUES AND PROFESSIONAL ETHICS L T P C

(Common to all branches of B.E and B.Tech) 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

CO1: Comprehend morals and human values.

CO2: Explain engineering ethics.

CO3: Describe social responsibility as engineer

CO4: Discuss professional rights.

CO5: 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

MT17E81 INTELLIGENT CONTROL SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

- To introduce the ideas of artificial neural network, fuzzy sets and fuzzy logic
- To study basics of control-theoretic foundations such as stability and robustness in the frame work of intelligent control.
- To impart knowledge on various control techniques
- To create awareness of the application areas of intelligent technique

UNIT I INTRODUCTION TO NEURAL NETWORKS 9

History of neural network research, characteristics of neural networksterminology, models of neuron Mc Culloch – Pitts model, Perceptron, Adalinemodel, Basic learning laws, Topology of neural network architecture.

UNIT II ANN TECHNIQUES 9

Architecture of feed forward network, single layer ANN, multilayerperceptron, back propagation learning, input - hidden and output layercomputation, backpropagation algorithm, applications, selection of tuningparameters in BPN, Numbers of hidden nodes, learning.Radial basis function networks, and recurrent networks, Self-organized maps.

UNIT III INTRODUCTION TO FUZZY LOGIC 9

Fuzzy sets, Membership functions, linguistic variables,Fuzzy Logic operators,Fuzzy rule-based systems Fuzzification, defuzzification.

UNIT IV GENETIC ALGORITHM 9

Introduction to Genetic Algorithms,Search Operators: Crossover, mutation, Crossover for real-valued representations, mutation for real-valued representations, combinatorial GA, Selection Schemes: Fitness proportional selection and fitness scaling, ranking, tournament selection, selection pressure and its impact on evolutionary search.

UNIT V FUZZY LOGIC CONTROLLER 9

Parametric optimization of fuzzy logic controller using genetic algorithm - System identification using neural and fuzzy neural networks - Lyapunov stability theory.Adaptive control using neural and fuzzy neural networks, Direct and Indirect adaptive control, and Self-tuning PID Controllers- Applications to pH reactor control, robot manipulator dynamic control, under actuated systems such as inverted pendulum and inertia wheel pendulum control

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1: Select appropriate neural network.

CO2: Apply supervised and unsupervised ANN system.

CO3: Implement fuzzy logic technique.

CO4: Implement genetic algorithm for optimization problem.

CO5: Control using fuzzy logic.

TEXT BOOKS:

1. Kevin M. Passino and Stephen Yurkovich, Fuzzy Control, Addison Wesley Longman, Menlo Park,1998.
2. Poznyak A.S., E. N. Sanchez and Wen Yu, Differential Neural Networks for Robust Nonlinear Control, World Scientific, 2001.
3. Sivanandam, S.N.and Deepa, “Principles of soft computing”, John Willey & sons, 2013.

4. Stanislaw H. Zak, Systems and Control, Oxford University Press, 2003 .

REFERENCES:

1. ErdalKayacan, MojtabaAhmadiehKhaneswar, " Fuzzy neural networks for Real time control applications", Elsevier, 2015
2. LaureneFauseett, "Fundamentals of Neural Networks", Prentice Hall India, New Delhi, 2012
3. Timothy J. Ross, "Fuzzy Logic with Engineering Applications",Wiley; Fourth edition,2016.

MT17E82 VIRTUAL INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVE:

- The principle and applications of virtual instruments are introduced in mechatronics systems.

UNIT I REVIEW OF VIRTUAL INSTRUMENTATION 9

Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data -flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II VI PROGRAMMING TECHNIQUES 9

VIS and sub-VIS loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.

UNIT III DATA ACQUISTION BASICS 9

AOC.OAC. 010. Counters & timers. PC Hardware structure, timing. Interrupts OMA, software and hardware installation.

UNIT IV COMMON INSTRUMENT INTERFACES 9

Current loop, RS.232C/RS.485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, networking basics for office &.Industrial applications, Visa and IVI, image acquisition and processing, Motion control.

UNIT V USE OF ANALYSIS TOOLS 9

Fourier transforms, power spectrum correlation methods, windowing & filtering, VI application in various fields.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1: Recall the basic concepts of Virtual Instruments.
CO2: Implement various bus interfaces
CO3: Program and simulate systems using LabVIEW.
CO4: Acquire data using DAQ and implement various interfaces.
CO5: Use LabVIEW for various application

TEXT BOOKS:

1. Gupta," Virtual Instrumentation Using Lab view" 2ndEdition, Tata McGraw-Hill Education, 2010

REFERENCES:

1. Gary Jonson, "Labview Graphical Programming", Second Edition, McGraw Hill, New York, 1997.

2. Gupta.S., Gupta.J.P., "PC interfacing for Data Acquisition & Process Control", Second Edition, Instrument Society of America, 1994.
3. Sokoloff; "Basic concepts of Labview 4", Prentice Hall Inc., New Jersey 1998.

MT17E83 PROGRAMMING FOR ROBOT OPERATING SYSTEM L T P C
3 0 0 3

OBJECTIVES:

- To be familiar with robot operating system programming

UNIT I UBUNTU LINUX FOR ROBOTICS 9

GNU/Linux – Installing Ubuntu - Installing VirtualBox - Playing with the Ubuntu – Useful Ubuntu Applications - Shell Commands.

UNITII C++ FOR ROBOTICS PROGRAMMING 9

Started with C++ C/C++ in Ubuntu Linux – Learning OOP Concepts - Building a C++ Project.

UNIT III PYTHON FOR ROBOTICS PROGRAMMING 9

Python - Timeline: The Python Language – Python in Ubuntu Linux – Introduction to Python Interpreter – Installing Python on Ubuntu 16.04 LTS – Verifying Python Installation - Writing First Code – Understanding Python Basics

UNIT IV KICK-STARTING ROBOT PROGRAMMING USING ROS 9

Robot Programming - The ROS Equation - Robot Programming Before and After ROS Installing ROS - Robots and Sensors Supporting ROS – Popular ROS Computing Platforms – ROS Architecture and Concepts

UNIT V PROGRAMMING WITH ROS 9

Programming Using ROS – Creating a ROS Workspace and Package - Using ROS Client Libraries – Programming Embedded Boards

TOTAL PERIODS: 45

OUTCOMES:

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

CO1: Work with Ubuntu and Linux operating systems
CO2: Use C++ for programming Robot Operating System
CO3: Use Python for programming Robot Operating System
CO4: Program ROS Libraries.
CO5: Create ROS workspace and package

TEXT BOOKS:

1. Lentin Joseph, “Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy”, Apress, 2018.

REFERENCES:

1. Aaron Martinez, Enrique Fernández, "Learning ROS for Robotics Programming", Packt Publishing Ltd, 2013.
2. Anis Koubaa, "Robot Operating System (ROS): The Complete Reference", Volume 3, Springer, 2018.
3. Morgan Quigley, "Programming Robots With Ros:: A Practical Introduction To The Robot Operating System", Shroff Publishers & Distributors Pvt Ltd, 2016

MT17E84 MAINTENANCE ENGINEERING AND CONDITION MONITORING L T P C 3 0 0 3

OBJECTIVES:

- To understand various types of maintenance, their procedure and defects analysis commonly adopted in manufacturing industries.
- To know about usage of computers for maintenance management and various condition monitoring techniques.

UNIT I DEFECTS AND FAILURE ANALYSIS 9

Defect generation-types of failures-Defects reporting and recording-Defect analysis-Failure analysis-Equipment down time analysis-Breakdown analysis-FTA, FMEA.

UNIT II MAINTENANCE SYSTEMS 9

Planned and un-planned maintenance - Breakdown maintenance - Corrective maintenance - Opportunistic maintenance - Routine maintenance - Preventive maintenance, Predictive maintenance - Condition based maintenance system selection of maintenance system.

UNIT III SYSTEMATIC MAINTENANCE 9

Codification and Cataloguing-Instruction manual and operating manual-Maintenance manual and Departmental manual-Maintenance time standard-Maintenance work order and work permit - Feedback and control-Maintenance records and documentation.

UNIT IV COMPUTERIZED MAINTENANCE SYSTEM 9

Selection and scope of computerization-Equipment classification-Codification of breakdown, material and facilities- - Material management module-Captive Engineering module.

UNIT V CONDITION MONITORING 9

Condition monitoring techniques-Visual monitoring-Temperature monitoring-vibration monitoring- Lubricant monitoring-Cracks monitoring-Thickness monitoring-Noise and sound monitoring- condition monitoring of hydraulic system. Machine diagnostics-Objectives-Monitoring strategies- Examples of monitoring and Diagnosis

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Analyze the defects and failures encountered in manufacturing system

CO2: Classify the maintenance system and select suitable one based on requirement.

CO3: Explain the documentation and record updation involved in maintenance systems

CO4: Explain the scope of computers in maintenance system

CO5: Establish monitoring strategies according to system characteristics

TEXT BOOKS:

1. Don Nyman and Joel Levitt, Maintenance Planning, Scheduling and Coordination, Industrial Press Inc., New York, 2010.
2. Sushil Kumar Srivastava, Industrial Maintenance Management, S. Chand and Company Ltd, New Delhi, 2006.
3. Venkataraman, Maintenance Engineering and Management, Prentic-Hall of India Pvt. Ltd., New Delhi, 2007.

REFERENCES:

1. Davies, Handbook of Condition Monitoring, Chapman & Hall, 1996.
2. Garg M. R., Industrial Maintenance, S. Chand & Co., 1986.
3. Higgins L. R., Maintenance Engineering Hand book, McGraw Hill, 5th Edition, 1988.
4. Mishra R. C. and Pathak K., Maintenance Engineering and Management, PHI Learning Pvt.Ltd., New Delhi, 2009.

GE17E52	ENTREPRENEURSHIP DEVELOPMENT (Common to all branches of B.E and B.Tech)	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

CO1: Explain the meaning of Entrepreneur

CO2: Comprehend different motivation techniques

CO3: Describe various business opportunities

CO4: Identify sources of finance and to analyse

CO5: 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.

GE17E54	INTELLECTUAL PROPERTY RIGHTS (Common to all branches of B.E and B.Tech)	L T P C 3 0 0 3

OBJECTIVE:

- To give an idea about IPR, registration and its enforcement.

UNIT I INTRODUCTION 9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs 10

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III AGREEMENTS AND LEGISLATIONS 10

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW 9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies

UNIT V ENFORCEMENT OF IPRs **7**

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:

The students have the:

CO1: Ability to understand the basics of Intellectual Property right.

CO2: Able to understand the registration procedures of IPRs.

CO3: Able to know the different agreements and legislation related to IPRs.

CO4: Able to know the digital IP laws.

CO5: Able to understand the Violation and enforcement measures of IPRs

TEXT BOOKS

1. S.V. Satarkar, ―Intellectual Property Rights and Copy Rights‖, EssEss Publications, New Delhi,2002.
2. V. Scople Vinod, ―Managing Intellectual Property‖, Prentice Hall of India pvt Ltd, 2012

REFERENCES

1. Deborah E. Bouchoux, ―Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets‖, Cengage Learning, Third Edition, 2012.
2. PrabuddhaGanguli, Intellectual Property Rights: Unleashing the Knowledge Economy, McGrawHill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

MT17E85 INTERNET OF THINGS FOR MECHATRONICS **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the basics of Internet of Things
- To understand different applications of Internet of Things
- To understand the fundamental aspects of IoT.

UNIT I INTRODUCTION **9**

Definitions and Functional Requirements –Motivation – Architecture - IoT architecture and platforms - IoT Devices vs. Computers - Trends in the Adoption of IoT - Societal Benefits of IoT – IoT Information Security.

UNIT II EMBEDDED AND SENSORS SYSTEMS **9**

Embedded Systems. Sensing methods - Sensors types – Active, Passive sensors – Environmental sensing methods.Sensor Fusion.

UNIT III IOT SENSORS **9**

Evolving Sensor Technologies - Leveraging Sensor Fusion for the IoT - IoT Sensor Manufacturers - IoT Sensor Data Platforms.

UNIT IV CONTROLLERS **9**

Basics of Controllers - Interfacing methodologies - Controllers selection – GPIO interfaces – SPI interfaces – I2C interfaces – RTC interfaces – IDE usage – Bootloader – Memory utilization (EEPROM /Flash).

UNIT V PROGRAMMING 9

Basic programing of controllers – Controllers Expansion boards (breakouts). Hardware Platforms - Intel Galileo, Edison, Arduino, Beaglebone Black & Raspberry Pi. Software Platforms - Intel XDK, Node-RED, VISUINO, Fritzing, 123d Circuits, Scratch.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students shall have ability to

CO1: Explain the basic architecture and platform of IoT.
CO2: Explain the working principle of IoT
CO3: Develop, test & analyse a new IoT system.
CO4: Design systems for Real-Time Processing.
CO5: Program for IoT applications

TEXT BOOKS:

1. MaciejKranz, "Building Internet of Things", John Wiley and Sons, 2016
2. Peter Waher, "Learning Internet of Things", Packt Publishing, 2015.

REFERENCES:

1. Michael Miller, "The Internet of Things", Que Publishing, 2015
2. Samuel Greengard, "The Internet of Things", Second Edition, MIT Press, 2015.

MT17E86 OPTIMIZATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To introduce the concepts of linear modeling of optimization problems.
- To expose the student to network models of optimization problems.
- To expose the inventory, queuing and non-linear models.

UNIT I LINEAR MODELS 9

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.

UNIT II TRANSPORTATION MODELS AND NETWORK MODELS 9

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

UNIT III INVENTORY MODELS 9

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

UNIT IV QUEUEING MODELS 9

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

UNIT V NON LINEAR MODELS 9

Elimination methods-Fibonacci Method and Golden Section Method, interpolation methods-Quadratic Interpolation Method and Cubical Interpolation Method, Unconstrained Minimization Method-Univariate method and Constrained Optimization Techniques- Zoutendijk's method.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students shall have ability to

CO1: Formulate and solve the linear model optimization problems

CO2: Able to control the projects and manage the resources

CO3: Implement suitable inventory models to various factories

CO4: Formulate optimum service stations for different queuing systems

CO5: Solve all non linear optimization models

TEXT BOOKS

1. Hillier and Libeberman, "Operations Research", McGraw-Hill Higher Education, New York, 2010
2. Taha H.A., "Operations Research", Sixth Edition, Pearson, India, 2016.

REFERENCES:

1. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 2009.
2. Budnick F.S., "Principles of Operations Research for Management", McGraw-Hill Inc.,US, 1998.
3. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 2007.
4. Shennoy G.V. and Srivastava U.K.,"Operation Research for Management", New Age International Publishers; India, 2018.
5. Singiresu S.Rao, "Engineering Optimization: Theory and Practice", New Age International Publishers,India, 2013.

ME17E79 NON-DESTRUCTIVE TESTING AND EVALUATION L T P C
(Common to Mech and MCT) 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

CO1: Understand different NDT methods, characterization techniques, and defect detection.

CO2: Explain about various surface NDT methods such as liquid penetrate test and magnetic particle testing.

CO3: Get the knowledge regarding thermography and Eddy current testing.

CO4: Understand the concept of Ultrasonic Testing and Acoustic Emission testing.

CO5: 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. 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