CURRICULUM AND SYLLABUS

FOR

B.E. DEGREE (MECHANICAL ENGINEERING) PROGRAMME

REGULATIONS 2020

CHOICE BASED CREDIT SYSTEM

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2020-2021 ONWARDS

Sri Ramakrishna Institute of Technology
(An Autonomous Institution)
Pachapalayam, PerurChettipalayam, Coimbatore – 641 010
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SRI RAMAKRISHNA INSTITUTE OF TECHNOLOGY, COIMBATORE – 641010

DEPARTMENT OF MECHANICAL ENGINEERING

I) VISION

The Vision of the Department is to develop world class Engineers, who are creative, expert in the contemporary technologies of Mechanical Engineering to meet the challenges in industries and society and promote Entrepreneurship through Value-based teaching – learning process.

II) MISSION

- To impart quality education to the students and enhance their technical domain knowledge through value based teaching learning process.
- To foster better environment to encourage and support innovative research and development through best Mechanical Engineering practices and to engage in lifelong learning.
- To develop Industry institute interactions for promoting team work and to instil entrepreneurial skills and ethical values among the students to serve the society.

III) PROGRAMME EDUCATIONAL OBJECTIVES (PEO) FOR B.E. MECHANICAL PROGRAMME

PEO1. Graduates who effectively demonstrate Mechanical Engineering knowledge and entrepreneurial skills by providing practical solutions.

PEO2. Graduates who effectively demonstrate professionalism in multi-disciplinary engineering environment, leadership quality and teamwork.

PEO3. Graduates who make contributions to knowledge and establish best engineering practice through research and development.

PEO4. Graduates who demonstrate an ethical commitment to the community and the profession through involvement with professional organizations and society.

PEO5. Graduates who engage in life-long learning as demonstrated through career advancement.

CONSISTENCY OF PEO WITH MISSION OF THE DEPARTMENT

PEOs	ELEMENTS OF MISSION STATEMENT OF THE PROGRAMME		
	Promote Quality Education	**Enhancement of Skills to aid in industrial development**	**Excellence in research & development and collaborate with others**
PEO1	✓	✓	✓
PEO2	✓	✓	
PEO3	✓		✓
PEO4		✓	✓
PEO5	✓	✓	✓

IV) PROGRAM SPECIFIC OUTCOMES (PSO) FOR B.E. MECHANICAL PROGRAMME

PSO 1: Analyze design and evaluate mechanical components and systems using state of art mechanical tools.

PSO 2: Apply modern and relevant professional engineering practices as an individual or as a member of team to manufacture components and systems for sustainable development.

V) PROGRAM OUTCOMES (POs)

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, 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 t h e specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. 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 t h e 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.

CONSISTENCY OF PEOs WITH POs OF THE PROGRAMME

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	✓	✓		✓							✓	
PEO2									✓	✓		
PEO3			✓		✓		✓					
PEO4						✓		✓				
PEO5												✓

CURRICULUM STRUCTURE

SEMESTER – I

S.No	Course Code	Course Name	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	20HSG01	Technical English	HS	2	0	2	4	3
2	20PHG01	Engineering Physics	BS	3	1	0	4	4
3	20CHG01	Engineering Chemistry	BS	3	1	0	4	4
4	20MHG01	Calculus and Linear Algebra	BS	3	1	0	4	4
5	20ITG01	Programming for problem solving using C	ES	3	0	0	3	3
PRACTICALS								
6	20PHG02	Engineering Physics Lab	BS	0	0	3	3	1.5
7	20MEG02	Engineering Workshop	ES	0	0	4	4	2
8	20ITG02	Programming in C Laboratory	ES	0	0	4	4	2
Total				**14**	**3**	**13**	**30**	**23.5**

SEMESTER – II

S.No	Course Code	Course Name	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	20HSG02	Universal Human Values – II : Understanding Harmony	HS	3	0	0	3	3
2	20MHG02	Differential Equation and Complex Variables	BS	3	1	0	4	4
3	20CSG01	Object Oriented Programming using C++	ES	3	0	0	3	3
4	20CEG01	Engineering Mechanics	ES	3	0	0	3	3
5	20ME001	Manufacturing Processes I	PC	3	0	0	3	3
PRACTICALS								
6	20CHG02	Engineering Chemistry Lab	BS	0	0	3	3	1.5
7	20MEG01	Engineering Graphics	ES	0	0	4	4	2
8	20CSG02	Programming in C++ Laboratory	ES	0	0	4	4	2
9	20AC001	Environmental Science (AC-1)	AC	3	0	0	3	0
Total				**18**	**1**	**11**	**30**	**21.5**

SEMESTER – III

S.No.	Course Code	Course Name	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	20MHG03	Transforms and Partial Differential Equations	BS	3	1	0	4	4
2	20ME002	Manufacturing Processes II	PC	3	0	0	3	3
3	20ME003	Mechanics of Materials	PC	3	0	0	3	3
4	20ME004	Fluid Mechanics and Machinery	PC	3	0	0	3	3
5	20ME005	Engineering Thermodynamics	PC	3	0	0	3	3
6	20XXEXX	Open Elective – I	OE	3	0	0	3	3
PRACTICALS								
7	20ME006	Manufacturing Technology Laboratory	PC	0	0	3	3	1.5
8	20ME007	Mechanics of Materials and Fluid Machinery Laboratory	PC	0	0	3	3	1.5
Total				**18**	**1**	**6**	**25**	**22**

SEMESTER – IV

S.No.	Course Code	Course Name	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	20EEG03	Electrical and Electronics Engineering	ES	3	0	0	3	3
2	20ME008	Theory of Machines	PC	3	0	0	3	3
3	20ME009	Thermal Engineering	PC	3	0	0	3	3
4	20ME010	Engineering Materials and Metallurgy	PC	3	0	0	3	3
5	20MEPXX	Elective I (Professional)	PE	3	0	0	3	3
6	20XXEXX	Open Elective – II	OE	3	0	0	3	3
PRACTICALS								
7	20EEG04	Electrical Engineering Laboratory	ES	0	0	3	3	1.5
8	20ME011	Thermal Engineering Laboratory	PC	0	0	3	3	1.5
9	20ME012	Dynamics Laboratory	PC	0	0	3	3	1.5
Total				**18**	**0**	**9**	**27**	**22.5**

SEMESTER – V

S.No	Course Code	Course Name	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	20ME013	CAD/CAM	PC	3	0	0	3	3
2	20ME014	Heat and Mass Transfer	PC	3	0	0	3	3
3	20ME015	Design of Machine Elements	PC	3	0	0	3	3
4	20ME016	Engineering Metrology and Quality Control	PC	3	0	0	3	3
5	20MEPXX	Elective II (Professional)	PE	3	0	0	3	3
6	20XXEXX	Open Elective – III	OE	3	0	0	3	3
PRACTICALS								
7	20ME017	CAD/CAM Laboratory	PC	0	0	3	3	1.5
8	20ME018	Heat and Mass Transfer Laboratory	PC	0	0	3	3	1.5
9	20ME019	Metrology Laboratory	PC	0	0	3	3	1.5
Total				**18**	**0**	**9**	**27**	**22.5**

SEMESTER – VI

S.No	Course Code	Course Name	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	20ME020	Mechatronics	PC	3	0	0	3	3
2	20ME021	Design of Transmission Systems	PC	3	0	0	3	3
3	20ME022	Finite Element Analysis	PC	3	0	0	3	3
4	20MEPXX	Elective III (Professional)	PE	3	0	0	3	3
5	20XXEXX	Open Elective VI	OE	3	0	0	3	3
PRACTICALS								
6	20ME023	Mechatronics Laboratory	PC	0	0	3	3	1.5
7	20ME024	Simulation and Analysis Laboratory	PC	0	0	3	3	1.5
8	20ME901	Design Project	EC	0	0	8	8	4
9	20AC002	Constitution of India (AC-2)	AC	3	0	0	3	0
Total				18	0	14	32	22

SEMESTER – VII

S.No	Course Code	Course Name	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	20HMG06	Professional Ethics in Engineering	HS	3	0	0	3	3
2	20ME025	Computer Integrated Manufacturing	PC	3	0	0	3	3
3	20MEPXX	Elective – IV (Professional)	PE	3	0	0	3	3
4	20MEPXX	Elective –V (Professional)	PE	3	0	0	3	3
PRACTICALS								
5	20ME902	Final Year Project Phase I	EC	0	0	6	6	3
Total				**12**	**0**	**6**	**18**	**15**

SEMESTER – VIII

S.No	Course Code	Course Name	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	20MEPXX	Elective – VI (Professional)	PE	3	0	0	3	3
PRACTICALS								
2	20ME903	Final Year Project Phase II	EC	0	0	16	16	8
Total				**3**	**0**	**16**	**19**	**11**

TOTAL NUMBER OF CREDITS:160

PROFESSIONAL ELECTIVES

ELECTIVE – I [MATERIALS]

S.No	Course Code	Course Name	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	20MEP01	Composite Materials	PE	3	0	0	3	3
2	20MEP02	Non-destructive Evaluation of Materials	PE	3	0	0	3	3
3	20MEP03	Materials Characterization Techniques	PE	3	0	0	3	3
4	20MEP04	Nano Materials and Applications	PE	3	0	0	3	3
5	20MEP05	Metal Forming Technology	PE	3	0	0	3	3
6	20MEP06	Emerging Materials	PE	3	0	0	3	3

ELECTIVE – II [MANUFACTURING]

S.No	Course Code	Course Name	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	20MEP11	Unconventional Machining Processes	PE	3	0	0	3	3
2	20MEP12	Production Planning and Control	PE	3	0	0	3	3
3	20MEP13	Maintenance Engineering	PE	3	0	0	3	3
4	20MEP14	Additive Manufacturing	PE	3	0	0	3	3
5	20MEP15	Casting and Welding Processes	PE	3	0	0	3	3
6	20MEP16	Process Planning and Cost Estimation	PE	3	0	0	3	3

ELECTIVE – III [THERMAL]

S.No	Course Code	Course Name	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	20MEP21	Advanced Internal Combustion Engines	PE	3	0	0	3	3
2	20MEP22	New and Renewable Sources of Energy	PE	3	0	0	3	3
3	20MEP23	Gas Dynamics and Jet Propulsion	PE	3	0	0	3	3
4	20MEP24	Energy Conservation in Industries	PE	3	0	0	3	3
5	20MEP25	Refrigeration and Air Conditioning	PE	3	0	0	3	3
6	20MEP26	Automobile Engineering	PE	3	0	0	3	3

ELECTIVE – IV [DESIGN]

S.No	Course Code	Course Name	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	20MEP31	Product Design and Development	PE	3	0	0	3	3
2	20MEP32	Design for Manufacture & Assembly	PE	3	0	0	3	3
3	20MEP33	Piping System Design	PE	3	0	0	3	3
4	20MEP34	Computational Techniques For Fluid Dynamics	PE	3	0	0	3	3
5	20MEP35	Design Concepts in Engineering	PE	3	0	0	3	3
6	20MEP36	Design of Jigs, Fixtures and Press Tools	PE	3	0	0	3	3

ELECTIVE – V [MANAGEMENT]

S.No	Course Code	Course Name	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	20MEP41	Entrepreneurship Development	PE	3	0	0	3	3
2	20MEP42	Engineering Economics	PE	3	0	0	3	3
3	20MEP43	Lean Manufacturing	PE	3	0	0	3	3
4	20MEP44	Total Quality Management	PE	3	0	0	3	3
5	20MEP45	Operations Research	PE	3	0	0	3	3
6	20MEP46	Intellectual Property Rights	PE	3	0	0	3	3

ELECTIVE – VI [AUTOMATION]

S.No	Course Code	Course Name	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	20MEP51	Machine Vision	PE	3	0	0	3	3
2	20MEP52	Industrial Robotics Technology	PE	3	0	0	3	3
3	20MEP53	MEMS and Microsystems	PE	3	0	0	3	3
4	20MEP54	Applied Hydraulics and Pneumatics	PE	3	0	0	3	3
5	20MEP55	Industry 4.0	PE	3	0	0	3	3
6	20MEP56	Industrial Automation	PE	3	0	0	3	3

OPEN ELECTIVES

S.No	Course Code	Course Name	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
OFFERED BY COMPUTER SCIENCE ENGINEERING PROGRAMME								
1	20CSE01	Basics of Python Programming	OE	3	0	0	3	3
2	20CSE02	Introduction to AI	OE	3	0	0	3	3
3	20CSE03	Fundamentals of Data Science	OE	3	0	0	3	3
4	20CSE04	Basics of Internet Programming	OE	3	0	0	3	3
5	20CSE05	Introduction to Soft Computing	OE	3	0	0	3	3
OFFERED BY ELECTRONICS AND COMMUNICATION ENGINEERING PROGRAMME								
1	20ECE01	Electronic Measurements and Instrumentation	OE	3	0	0	3	3
2	20ECE02	Microcontrollers and its Applications	OE	3	0	0	3	3
3	20ECE03	Introduction to Embedded Systems	OE	3	0	0	3	3
4	20ECE04	Nano Electronics and Sensors	OE	3	0	0	3	3
5	20ECE05	Principles of VLSI Systems	OE	3	0	0	3	3
OFFERED BY INFORMATION TECHNOLOGY PROGRAMME								
1	20ITE01	Big Data Analytics and its Applications	OE	3	0	0	3	3
2	20ITE02	Cloud Computing Fundamentals	OE	3	0	0	3	3
3	20ITE03	Fundamentals of Internet of Things	OE	3	0	0	3	3
4	20ITE04	Introduction to Database Management Systems	OE	3	0	0	3	3
5	20ITE05	Web Interface Design and Development	OE	3	0	0	3	3
6	20ITE06	Introduction to Data Structures	OE	3	0	0	3	3

7	20ITE07	Principles of Software Engineering	OE	3	0	0	3	3
OFFERED BY ELECTRICAL AND ELECTRONICS ENGINEERING PROGRAMME								
1	20EEE01	Energy Management Systems	OE	3	0	0	3	3
2	20EEE02	Medical Instrumentation	OE	3	0	0	3	3
3	20EEE03	PLC Programming	OE	3	0	0	3	3
4	20EEE04	Renewable Energy Systems	OE	3	0	0	3	3
5	20EEE05	Virtual Instrumentation & Data Acquisition	OE	3	0	0	3	3
6	20EEE06	Electric Vehicles	OE	3	0	0	3	3

OPEN ELECTIVES OFFERED BY DEPARTMENT OF MECHANICAL ENGINEERING

Sl. No.	Course Code	Course Title	Category	Credit			Total Contact Periods	Credits
				L	T	P		
1	20MEE01	Automotive Fundamentals	GE	3	0	0	3	3
2	20MEE02	Computer Aided Design	GE	3	0	0	3	3
3	20MEE03	Introduction to Power Plant Engineering	GE	3	0	0	3	3
4	20MEE04	Introduction to Robotics	GE	3	0	0	3	3
5	20MEE005	3D Printing	GE	3	0	0	3	3

CREDIT DISTRIBUTION

S.No.	Course Work - Subject Area	Credits/Semester								Credits Total
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences including Management Courses (HSMC)	3	3					3		9
2	Basic Sciences Courses (BS)	13.5	5.5	4						23
3	Engineering Science Courses (ES)	7	10	4.5						21.5
4	Professional Core Courses (PC)		3	10.5	16.5	16.5	12	3		61.5
5	Professional Elective Courses (PE)				3	3	3	6	3	18
6	Open Electives (OE)			3	3	3	3			12
7	Employability Enhancement Courses (EC)						4	3	8	15
	Total	23.5	21.5	22	22.5	22.5	22	15	11	160

20HSG01	TECHNICAL ENGLISH	L	T	P	C
		2	0	1	3

COURSE OBJECTIVE:

The primary objective of this course is enhancement of listening, speaking, reading, writing skills of students. It further enables them to develop corporate test-taking strategies as well as employability skills through various grammar exercises for academic and workplace context.

COURSE CONTENT:

Importance of Communication
Listening: Importance of listening in the corporate world. Exposure to structured talks
Speaking: Self-introduction, Peer introduction, Extempore
Reading: Skimming and Scanning, Note-Making
Writing: Parts of Speech, Tense, Subject-Verb Agreement, Prepositions, Instructions Formal Letters (Quotations, Clarification, Placing orders & Complaint letter)

Formal Communication
Listening: Listening to motivational talks / TED talks, Note-taking practice.
Speaking: Describing a product/place, Conversation practice, Telephonic Conversation.
Reading: Reading Comprehension, Reading for specific information.
Writing: Voices, Compound Nouns, Paragraph Writing, Recommendations, Email writing, Analytical and issue based essays.

Writing Strategies
Listening: Listening to Announcements, Listening to Product description and Process Speaking: Role-Play, Picture description.
Reading: Cloze reading, Introduction to Blogs, Social media etiquette.
Writing: Cause and Effect, Gerunds and Infinitives, Tag Questions, Modal Verbs, Checklist.

Presentation Skills
Listening: Listening to Group Discussion and Interview Skills.
Speaking: Presentation on the technical topic, Sales talk.
Reading: Interpreting pictures of visual graphics.
Writing: If Conditional Clause, Use of sequence words, Process Description.

Technical Communication
Listening: Listening to talks of scientific nature, Listening for specific information.
Speaking: Giving impromptu talks, Giving a summary of an article.
Reading: Journals, Articles both general and technical.

Writing: Purpose and Function, extended definitions Wh- questions, Resume Writing, Report (Industrial visit reports, Accident report, Feasibility Reports) Proposals.

LIST OF LABORATORY EXERCISES:

1. Speaking - Self and Peer Introduction
2. Speaking - General Conversation on Business Context
3. Listening to short recordings
4. Listening to conversation
5. Technical Presentation (PPT)

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: make use of listening skills in business and workplace environment

CO2: relate in oral communication confidently

CO3: infer reading skills in different genres of texts and graphics through extensive reading.

CO4: utilize appropriate writing strategies in technical and business context.

REFERENCES:

1. Ian wood, Anne Williams with Anna Cowper, "Pass Cambridge BEC Preliminary", Second Edition, Cengage Learning, 2015.
2. Whitby, Norman, "Business Benchmark Pre-intermediate to Intermediate Business preliminary", First Edition Cambridge University Press, 2014.
3. Rizvi M.Ashraf, "Effective Technical Communication", Tata McGraw-Hill Publishing Company Limited, Fourth Edition, 2010.
4. Gerson Sharon J, Steven M.Gerson, "Technical Writing-Process and Product", Pearson Education Pvt. Ltd. Third Edition, 2009.
5. Sanborn Pfeiffer, Padmaja, "Technical Communication, A Practical Approach" Pearson Publication, Sixth Edition, 2007.

20PHG01	ENGINEERING PHYSICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

This course imparts knowledge in basic concepts and advances in Acoustics, Mechanics, Optics and Electromagnetic waves and develops an intuitive understanding of Physics by emphasizing Quantum computing for engineering applications.

COURSE CONTENT:

Acoustics, Ultrasonics and Thermal Insulation

Classification of Sound - decibel - Weber - Fechner law - Sabine's formula - derivation using growth and decay method - Absorption Co efficient and its determination - factors affecting acoustics of buildings and their remedies - Production of ultrasonic– Piezoelectric generator – Detection of ultrasonic waves – Applications – NDT – pulse echo system through transmission and reflection mode - thermal insulation of buildings.

Introduction to Mechanics and applications

Moment of inertia (M.I) - Radius of gyration - M.I of circular disc, solid cylinder, diatomic molecule - K.E of a rotating body — centre of mass – conservation of linear momentum – Relation between Torque and angular momentum - Torsional pendulum - The concept of gravity – Law of universal gravitation –weigh and weightlessness – Projectile motion – range – height – time.

Quantum Mechanics

Photons and light waves - Electrons and matter waves - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization - particle in an infinite potential well - Introduction to quantum computing - History of quantum computation and quantum information - Quantum bits - Quantum Physics and Computation Global perspectives - Future directions.

Oscillations, Optics and Lasers

Simple harmonic motion - resonance - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect - reflection and refraction of light waves - total internal reflection - interference – Michelson interferometer - air wedge experiment. Laser - characteristics - Spontaneous and stimulated emission - population inversion - CO_2 laser, semiconductor laser - applications - holography.

Electromagnetic Waves

Gauss's law – Faraday's law - Ampere's law - The Maxwell's equations (qualitative only) - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of

electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the basic concepts of physics and their relevant applications in acoustics, non-destructive testing and thermal insulation

CO2: illustrate the fundamental concepts in rigid bodies and gravitation

CO3: apply the concepts of quantum computations

CO4: understand the working principle of lasers and its applications.

CO5: apply the knowledge of oscillations and propagation of electromagnetic waves in solving engineering problems

REFERENCES:

1. D. Halliday, R. Resnick and J. Walker. Principles of Physics. John Wiley & Sons, 10th Edition, 2015.
2. D. Kleppner, R. J. Kolenkow, An Introduction to Mechanics, Tata Mc Graw Hill, 10th Edition, 2005.
3. D. J. Griffiths. Introduction to Electrodynamics. Pearson Education, 3rd Edition 2015.
4. S. Mani Naidu, Engineering Physics, Pearson Publications, 2014.
5. A. Marikani, Engineering Physics, PHI Publications, 2nd Edition, 2014.
6. Larry .D Kirkpatrick, Gregory E. Francis, Physics: A Conceptual World View, 7th Edition, Cengage Learning, 2010.
7. Paul G. Hewitt, John Suchocki, Leslie A. Hewitt, Conceptual Physical Science Pearson, 6th Edition, 2017.
8. Michael Nielsen, Isaac Chuang, Quantum Computation and Quantum Information, Cambridge, 10th Anniversary Edition, 2010.

20CHG01	ENGINEERING CHEMISTRY	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

The objective of the course is to provide knowledge on Electrochemistry, Battery Technology, Photochemistry, Spectroscopy, Water chemistry and Nanochemistry in the practice of engineering.

COURSE CONTENT:

Electrochemistry

Electrochemical cells – Nernst Equation (Problems), Electrode potential – Representation of a cell -Galvanic cell-Construction and working - Electrodes – Standard Hydrogen Electrode (SHE), Saturated Calomel Electrode (SCE) and Glass Electrode –Electrochemical Series and its applications - Conductometric titrations (Acid -Base Titration).

Batteries

Batteries – Characteristics – Current, Power, Capacity, Classification of batteries – Primary (Dry and Alkaline battery) – Secondary batteries (Lead acid and Nickel – Cadmium) and Flow batteries (Hydrogen – Oxygen and Methanol – Oxygen fuel cells) – Modern batteries – Lithium Ion batteries – Applications.

Photochemistry and Spectroscopy

Photochemistry: Laws of photochemistry - Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law. Photo physical processes – Jablonski diagram. Chemiluminescence, photo-sensitization and photo quenching– mechanism and examples. Spectroscopy: Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions. Atomic absorption spectroscopy, UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

Water Treatment

Importance of water – Water sources – Impurities – Carbonate and Non Carbonate Hardness (simple problems) – Potable water and its specifications, Steps involved in treatment of potable water – Disinfection methods – Internal Conditioning (Phosphate, Calgon, Carbonate and Colloidal conditioning method) - External Conditioning – Demineralization process -Zeolite process– Desalination (Reverse Osmosis).

Nanochemistry

Basics-distinction between molecules, nanomaterial and bulk materials; size-dependent properties. Types –nanoparticle, nano cluster, nano rod, nanowire and nanotube. Preparation of nanomaterial: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Characterization - Scanning Electron Microscope and Transmission Electron

Microscope - Principle and instrumentation (block diagram). Properties (optical, electrical, mechanical and magnetic) and Applications of nanomaterial - medicine, agriculture, electronics and catalysis.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: discuss the concepts of electrochemistry

CO2: compare the materials best suited for construction of battery

CO3: understand the concepts of photo chemistry and spectroscopy techniques

CO4: understand the basic properties of water and its quality improvement for domestic and industrial purposes

CO5: apply basic concepts of Nanoscience and Nanotechnology as a key component for applications involving batteries, fuel cells and water treatment

REFERENCES:

1. Jain P. C. & Monica Jain., "Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 6th Edition, 2012.
3. Dara S. S, "A text book of Engineering Chemistry", Chand Publications, 2nd Edition, 2014.
4. Vairam.S, Kalyani.P, Suba Ramesh, "Engineering Chemistry", John Wiley & Sons, 1st Edition, 2016.
5. Palanna O G, "Engineering Chemistry", Tata McGraw – Hill Education, 1st Edition, 2009.
6. Shikha Agarwal, "Engineering Chemistry – Fundamentals and applications", Cambridge university press, 2nd Edition, 2019.

20MHG01	CALCULUS AND LINEAR ALGEBRA	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

This course provides an understanding on various concepts of matrices, differential calculus, integral calculus and apply them in various Engineering fields.

COURSE CONTENT:

Matrices

Introduction – 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 – Stretching of an Elastic Membrane – Vibrating System of two masses on two springs.

Differential Calculus

Limit of function – One sided limit – Limit Laws – Continuity – left and right continuity – types of discontinuities – Intermediate Value Theorem – Derivatives of a function - Differentiation rules – Chain rule – Implicit differentiation – logarithmic differentiation – Maxima and minima – Mean value theorem

Functions of Several Variables

Partial derivatives – Total derivative – Differentiation of implicit functions – Change of variables – Jacobian – 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.

Integral Calculus

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

Multiple Integrals

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.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: solve practical problems that can be expressed as matrix algebra

CO2: classify the theorems in differential calculus

CO3: apply differential calculus on several variable functions

CO4: apply integral calculus including multiple integrals to solve problems on area and volume

REFERENCES:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2016.
2. Grewal. B.S, "Higher Engineering Mathematics", 44rd Edition, Khanna Publications, Delhi, 2017
3. James Stewart, "Calculus, Early Transcendental", 7th Edition, Cengage learning, New Delhi, 2018.
4. Joel Hass, Christopher Heil and Maurice D.Weir, Thomas "Calculus", Pearson, 14th Edition, New Delhi, 2018.
5. Srimanta Paul and Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, 1st Edition, 2015.

20ITG01	PROGRAMMING FOR PROBLEM SOLVING USING C	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course provides an introduction to computer hardware. The course further deals with problem solving techniques and their implementations through syntax and semantics of C language.

COURSE CONTENT:

Fundamentals of Computing

Basic concepts of computer organizations, Generation and classification of computers, Number System Representation, Fundamentals of algorithms, Pseudo code, Flow charts.

C Language Fundamentals

Introduction to C programming, Structure of a C program, Compilation and Linking Processes, Character Set, Identifiers, Keywords, Data Types, Constant and Variables, Statements, Expressions, Operators, Precedence of operators, Input-Output Operations, Control Structures, Decision Making, Branching & Looping. Application: Solving Simple Scientific and Mathematical Problems.

Arrays and Strings

Introduction to Arrays, One Dimensional Array, Multidimensional Array. Application: Matrix Operations, Sorting, Searching, Sum of Series and Statistical Problems. String Manipulation, String Arrays. Application: Solving problems using String Functions.

Functions and Pointers

User Defined and Standard Functions, Formal and Actual arguments, Function Prototypes, Parameter Passing, Call-by-Value, Call-by-Reference, Recursion. Application: Math Functions, Computation of Sine Series, Random Number Generation, Tower of Hanoi and Factorial using Recursive Functions. Pointers, Pointer Variables, Pointer Arithmetic, Passing Parameters by Reference, Pointer to Pointer, Pointers to Functions, Dynamic Memory Allocation. Application: Card shuffling and Dealing Simulation using Pointers.

Structures, Unions and File Handling

Declaration of Structures, Nested Structure, Pointer to Structure, Declaration of Unions, Pointer to Union, Application: Student Records. Storage Classes, Pre-Processor Directives. Files -Types of File Processing: Sequential Access, Random Access. Application: Transaction Processing Program.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: apply the concepts of algorithm, pseudo code and flow chart to solve problems
CO2: build control structures to solve problems
CO3: choose data structures for managing user data
CO4: apply memory and I/O management constructs of C

REFERENCES:

1. Behrouz A. Forouzan, Richard F. Gilberg, "Computer Science: A Structured Programming Approach Using C", 3rd Edition, Course Technology Inc, 2005.
2. Byron Gottfried S. "Programming in C", Third Edition, (Indian Edition), Tata McGraw Hill, 2010.
3. Balagurusamy E. "Programming in ANSI C", first Edition, Tata McGraw Hill Education, 2014.
4. Paul Deitel, Harvey Deitel "C How to Program", Seventh Edition, Pearson Education Asia, 2012.
5. Brian Kernighan, Dennis Ritchie "The 'C' programming language", Second Edition Prentice Hall Software Series
6. Greg Perry, Dean Miller, "C Programming Absolute Beginner's Guide", 3rd Edition, Pearson Education, 2014.

20PHG02	ENGINEERING PHYSICS LABORATORY	L	T	P	C
		0	0	1.5	1.5

COURSE OBJECTIVE:

The students will be provided with an insight to handle optical instruments like microscope, spectrometer, laser and fibre optic kit. The course also provides an outline of modern instruments such as Ultrasonic interferometer, band gap instruments and CRO.

LIST OF EXPERIMENTS:

1. Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
2. Determination of thermal conductivity of a bad conductor using Lee's Disc method.
3. Determination of Young's modulus by non - uniform bending method.
4. Determination of Young's modulus by uniform bending method.
5. Determination of rigidity modulus of a wire and moment inertia of a disc – Torsional pendulum.
6. Determination of dispersive power of prism using spectrometer.
7. Determination of wavelength of a spectral lines using spectrometer grating.
8. Determination of thickness of thin sheet / wire – Air wedge.
9. Determination angle of divergence and wavelength using laser.
10. Determination of Particle size using laser.
11. Determination of acceptance angle and numerical aperture of an optical fiber.
12. Determination of energy band gap of a semiconductor by using p-n junction diode.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: select appropriate materials for the thermal insulation of structures using Lee's disc experiment.

CO2: use Interferometer to measure compressibility of the liquid and velocity of ultrasonic waves.

CO3: analyze the elastic nature of materials and compute elastic moduli of different materials.

CO4: distinguish silicon and germanium semiconducting materials using forbidden energy gap experiment.

CO5: apply the principle of interference, diffraction and refraction to calculate the thickness of an insulation of a wire, micro-particle size and wavelength of spectral lines.

REFERENCES:

1. Dr. S. Vijayakumar, Engineering Physics I, John Wiley Publications, 2014.
2. Dr. S. Vijayakumar, Engineering Physics II, John Wiley Publications, 2015.

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20MEG02	ENGINEERING WORKSHOP	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

This course aims to make the students understand about various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering by providing practical experience

COURSE CONTENT:

CIVIL ENGINEERING PRACTICE LAB

Buildings: Study of plumbing and carpentry components of residential and industrial buildings.

Plumbing Works

a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and 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.

Hands-on-exercise:

a) Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

b) Demonstration of plumbing requirements of high-rise buildings.

Wood Work

Study of the joints in roofs, doors, windows and furniture.

Studying common industrial trusses using models.

Hands-on-exercise:

Wood work, joints by sawing, planning and cutting.

MECHANICAL ENGINEERING PRACTICE LAB

Welding & Sheet metal

1. Preparation of arc welding of butt joints, lap joints, tee joints and corner joints.
2. Sign board fabrication by the application of knowledge gained through welding process
3. Forming of simple objects using sheet metal – Trays.

Machining practices

Metal Hammer fabrication using Simple turning, taper turning, drilling taping practice.

Study

Assembling a centrifugal pump

Assembling a blower

Assembling an air conditioner

Demonstration

1. Demonstration on foundry operations.

ELECTRICAL ENGINEERING PRACTICE LAB

1. Familiarization of wiring tools, lighting accessories of CFL and incandescent lamps, types and selection of Fuse and MCB.
2. Study of various types of wiring systems
   a. Wiring of one lamp controlled by one switch.
   b. Wiring of one lamp controlled by two SPDT Switch and one 3 pin plug socket independently.
   c. Wiring of fluorescent lamp controlled by one switch from panel with MCB.
3. Study of wiring of different household appliances
   a. Iron-Box wiring.
   b. Fan Regulator wiring.
   c. Emergency Lamp wiring.
4. Familiarization with measuring instruments to measure current, voltage and power in AC/DC circuits.

ELECTRONICS ENGINEERING PRACTICE LAB

1. Study of Electronic Components and instruments– Resistors, Capacitors, Inductors, Diodes and multimeter.
2. Measurement of AC signal parameters (voltage, period, frequency) using CRO.
3. Measurement of ripple factor of half wave rectifier and full wave rectifier.
4. Study of logic gates –AND, OR, XOR and NOT.

Soldering practice using general purpose PCB – Components, Devices and Circuits.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: Identify the hand tools and instruments carpentry, plumbing, machining, metal joining and sheet metal processes

CO2: Fabricate products by selecting suitable tools for carpentry, plumbing, machining, metal joining and sheet metal processes.

CO3: Demonstrate the basic principles of electronic components and apply the concepts to design simple electronic circuits on PCB

REFERENCES:

1. Bawa H.S., “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited, New Delhi, 2009.
2. Chapman, William. Workshop Technology Part 1, Part 2. Routledge, 2019.
3. Uppal S. L., Electrical Wiring & Estimating, Khanna Publishers---fifth edition, 2003.
4. John H. Watt, Terrell Croft: American Electricians' Handbook: A Reference Book for the Practical Electrical Man - McGraw-Hill, 2002.
5. Thomas L. Floyd and Steve Wetterling, “Laboratory Exercises for Electronic Devices”, Pearson Education Limited, Tenth Edition, 2017.

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20ITG02	PROGRAMMING IN C LABORATORY	L	T	P	C
		0	0	2	2

COURSE OBJECTIVE:

This course provides guidance to find solutions for engineering problems by developing computer applications using C language.

LIST OF EXPERIMENTS:

1. Problem Solving Techniques (Algorithm, Pseudo code, Flowcharts).
2. Program using Simple Statements and Expressions.
3. Scientific Problem Solving using Decision Making and Looping.
4. Program using Single and Multidimensional Array.
5. Program using String, Math Inbuilt Functions.
6. Program using User Defined Functions (string & array manipulation) and Storage Classes.
7. Program using Recursive Function.
8. Program using Dynamic Memory Allocation.
9. Program using Structures and Unions.
10. Program using Files.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: find solution methodology using different problem solving techniques
CO2: use appropriate data types and control structures for solving a given problem
CO3: apply the various concepts of C programming for solving engineering problems
CO4: analyse the problem solving techniques which is appropriate for solving real world problems

REFERENCES:

1. Behrouz A. Forouzan, Richard F. Gilberg, "Computer Science: A Structured Programming Approach Using C", 3rd Edition, Course Technology Inc, 2005.
2. Byron Gottfried S. "Programming in C", Third Edition, (Indian Edition), Tata McGraw Hill, 2010.
3. Balagurusamy E. "Programming in ANSI C", Eighth Edition, Tata McGraw Hill Education.
4. Paul Deitel, Harvey Deitel "C How to Program", Seventh Edition, Pearson Education Asia, 2012.

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20HSG02	UNIVERSAL HUMAN VALUES – II : UNDERSTANDING HARMONY	L	T	P	C
		2	1	0	3

COURSE OBJECTIVE:

Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence Strengthening of self-reflection. Development of commitment and courage to act.

COURSE CONTENT:

Introduction - Need, Basic Guidelines, Content and Process for Value Education

Purpose and motivation for the course, recapitulation from Universal Human Values-I, Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation as the process for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority,5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order,

Competence in professional ethics:

a. Ability to utilize the professional competence for augmenting universal human order

b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems,

c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order:

a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers

b. At the level of society: as mutually enriching institutions and organizations , Sum up.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: become more aware of themselves, and their surroundings (family, society, nature)

CO2: become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

CO3: have better critical ability.

CO4: become sensitive to their commitment towards what they have understood (human values, human relationship and human society).

CO5: apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction

Readings:

1. R R Gaur, R Asthana A Foundation Course in Human Values and Professional Ethics, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

REFERENCES:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Relevant CDs, Movies, Documentaries & Other Literature:

1. Value Education website, http://www.uptu.ac.in
2. Story of Stuff, http://www.storyofstuff.com
3. Al Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charlie Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology – the Untold Story

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20MHG02	DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

This course provides knowledge on various concepts of differential equations, vector calculus, complex differentiation, complex integration, Laplace transforms and apply them in various engineering problems.

COURSE CONTENT:

Second and Higher Order Linear Differential Equations

Linear equations of second and higher order with constant coefficients – Homogenous equations of Euler's and Legendre's type – Method of variation of parameters – First order Simultaneous linear equations with constant coefficients – Simple Applications.

Vector Calculus

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

Analytic Function

Analytic functions – Necessary and sufficient conditions for analyticity– Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by functions $w = c + z,\ az,\ \frac{1}{z},\ z^2$ – Bilinear transformation – Temperatures in a Quarter-plane metallic sheet.

Complex Integration

Line integral – Cauchy's Integral theorem– Cauchy's Integral formula – Taylor's and Laurent's series – Singularities – Residues – Cauchy Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

Laplace Transform

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions – Derivatives and integrals of transforms – Transforms of unit step function and impulse function – Transform of periodic functions. Inverse Laplace transform – Convolution theorem – Initial and final value theorems – Application to solution of linear ordinary differential equations with constant coefficients.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: apply higher order linear differential equations in simple applications

CO2: solve problems in the domain of fluid dynamics using vector calculus

CO3: construct analytic functions and use their conformal mapping property in application problems.

CO4: apply the Cauchy's integral formula and residue theorem to evaluate real and complex integrals.

CO5: apply Laplace transform for solving linear differential equations.

REFERENCES:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2016.
2. Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2016.
3. Ravish R Singh and Mukul Bhatt, "Engineering Mathematics", 1st Edition, Tata McGraw Hill Education, New Delhi, 2016.
4. Srimanta Paul and Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, 1st Edition, 2015.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.

20CSG01	OBJECT ORIENTED PROGRAMMING WITH C++	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course provides an insight on the basic principles of Object Oriented Programming using C++ and its applications in real world scenarios.

COURSE CONTENT:

Fundamentals of OOP and C++

Structural versus object-oriented Programming - Elements of object oriented programming- benefits of OOP – Structure of C++ program - Variables - Tokens - Keywords – Identifiers -Type modifiers - Type casting - Input and Output - Data Types and Expressions - Operators - Flow of control - Arrays, Strings and Pointers.

Classes and Objects

Classes and Objects - Class specification: Class Members, Access Specifier, Scope resolution operator- Class Instantiation - Accessing class members- Passing and returning objects - Array of objects – Constructors: Parameterized constructors - Default arguments – Copy Constructor - Constructor overloading, Destructors - new, delete operators - "this" pointer - Friend classes and friend functions.

Overloading and Inheritance

Function overloading - Operator overloading: Overloadable operators - Unary operator overloading - Binary operator overloading, Overloading the Operator Using Friend Function - Inheritance: Base class and derived class relationship - Derived class declaration - Types of inheritance - Member accessibility - Constructors in derived class.

Virtual functions and Generic Programming

Virtual Functions: Need for virtual function - Pointer to derived class objects - Pure virtual functions - Abstract classes – Virtual Destructors, Generic programming with templates: Function templates - class templates

I/O Streams and Exception handling

Streams: Formatted and unformatted data – Manipulators - Files: Opening and Closing a file - File modes - File pointers and their manipulation, Sequential access to a file - Random access to a file - Reading and Writing files, Exception handling: Exception handling constructs - Handling exceptions.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the concepts of Object Oriented Programming

CO2: choose appropriate Object Oriented features for solving various problems

CO3: develop C++ application for real world scenarios

CO4: apply the concepts of Exception handling, generic programming and file handling in programmes using C++.

REFERENCES:

1. Herbert Schildt, "C++ The Complete Reference", 5th Edition, Tata McGraw Hill, New Delhi,
2. Bjarne Stroustrup, "The C++ Programming Language", 4th Edition, Addison-Wesley, 2013.
3. Deitel and Deitel, "C++ How to Program", 10th Edition, Prentice Hall India Learning Private Limited, 2018.
4. Robert Lafore, "Object Oriented Programming in C++", 4th edition, Pearson India, 2002.
5. Stanley B. Lippman and Josee Lajoie, "C++ Primer", 5th Edition, Pearson Education, New Delhi, 2013.
6. E.Balagurusamy, "Object Oriented Programming with C++", 6th Edition, Tata McGraw Hill, 2013.

20CEG01	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The objective of this course is to predict the effect of force and motion while carrying out the creative design functions of engineering.

COURSE CONTENT:

Basics and Statics of Particles

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.

Equilibrium of Rigid Bodies

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 dimension.

Properties of Surfaces and Solids

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.

Friction

The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction. Rolling Resistance, Ladder friction.

Dynamics of Particles

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions , Dynamic Equilibrium, Energy and Momentum Methods -

Work of a Force , Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact, Method of Virtual Work - Work of a Force, Potential Energy, Potential Energy and Equilibrium.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: describe position, forces, and moments in terms of vector components in two and three dimensions

CO2: select suitable reference coordinate axes, construct free body diagrams, and understand the relation between constraints imposed by supports and support forces

CO3: formulate static equilibrium equations for a rigid body and evaluate forces and moments in 2D and 3D structures

CO4: calculate centroid and moment of inertia to analyse engineering problems

CO5: apply friction laws to solve engineering problems and to determine kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces by using various methods

REFERENCES:

1. Beer, F. P., and Johnson Jr. E. R., "Vector Mechanics for Engineers", McGraw Hill, Year of publication: 2014.
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", Pearson Education , 12th Edition , 2010.
3. Antony M. Bedford and Wellace Flower, "Engineering Mechanics: Statics and Dynamics", Pearson, 5th Edition, 2007.
4. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", Vikas Publishing House Pvt. Ltd., 2011.
5. Kumar, K.L., "Engineering Mechanics", Tata McGraw–Hill Publishing Company, New Delhi 2011.

20ME001	MANUFACTURING PROCESSES I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course objectives are to introduce various forming processes available in manufacturing products, impart knowledge on various fabrication techniques used in industries and develop competence to select suitable manufacturing processes for manufacturing the products optimally.

COURSE CONTENT:

Metal Casting Processes

Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Gating and Riser - Moulding sand Properties and testing – Cores –Types and applications – Moulding machines – Types and applications– Melting furnaces – Principle of special casting processes- Shell, investment –Pressure die casting – Centrifugal Casting - Defects in Sand casting process – Stir casting.

Metal Fabrication Processes

Fusion welding processes – Type of Gas welding – Flame characteristics – Filler, Flux and Electrode materials –Arc welding, Principles and types of Resistance welding – Gas metal arc welding – Thermo chemical welding and radiant energy welding. Submerged arc welding — Electro slag welding - Tungsten arc welding – Principle and application of special welding processes – Plasma arc welding – Thermit Welding – Electron beam welding – Friction stir welding – Diffusion welding – Weld defects – Brazing and soldering- Adhesive bonding.

Metal Forming Processes

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

Sheet Metal Processes

Sheet metal characteristics – Typical shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes – Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning. Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming – Incremental forming.

Manufacture of Plastic Components

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

Transfer Moulding – Blow Moulding – Rotational Moulding – Film blowing - Extrusion – Thermoforming – Bonding of Thermoplastics.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: identify and choose the appropriate moulding and core making process to manufacture the desired metal components**.**

CO2: apply the procedure for preparation of moulding sand with solid and split patterns

CO3: interpret the welding's along with their basic equipment's to make the similar and dissimilar components joint.

CO4: select suitable metal forming process to produce flat, rod, wire and sheet metal components.

CO5: categorize plastics manufacturing processes for thermo and thermo setting plastics.

REFERENCES:

1. Kalpak Jian. S, "Manufacturing Engineering and Technology", Pearson Education India, Seventh Edition, 2014.
2. Hajra Chouldhary S.K. and Hajra Choudhury. A. K., "Elements of Workshop Technology", Volume I and II, Media Promoters and Publishers Private Limited, Mumbai, Fourteenth edition, 2010.
3. Rao. P. N., "Manufacturing Technology Foundry, Forming and Welding", Fourth Edition, Tata McGraw Hill, 2018.
4. Sharma, P.C., "A Textbook of Production Technology", S. Chand and Co. Ltd., 2014.
5. M. P. Groover, "Fundamentals of Modern Manufacturing Materials, Processes and Systems", John Wiley & Sons, Seventh edition, 2019.

20CHG02	ENGINEERING CHEMISTRY LABORATORY	L	T	P	C
		0	0	1.5	1.5

COURSE OBJECTIVE:

The objective of the course is to enable the students to gain exposure in various experimental skills based on corrosion studies, waste water treatment, electrochemistry, battery and fuel cells that are essential for engineering applications. Further, the students are exposed to various tools and instruments like conductivity meter, potentiometer, pH meter, colorimeter, spectrophoto meter and flame photometer to demonstrate their practical applications.

LIST OF EXPERIMENTS:

1. Estimation of acidity of industrial effluent by conduct metric titration.
2. Determination of corrosion rate by weight loss method.
3. Determinationn of water of crystallization of $CuSO_4.5H_2O$
4. Estimation of hardness of water by complex metric method.
5. Determination of DO content of water sample by Winkler's method.
6. Determination of molecular weight of polyvinyl alcohol using Ostwald Viscometer.
7. Determination of strength of Hydrochloric acid using pH meter.
8. Determination of Alkalinity in the given water sample.
9. Estimation of iron content of the given solution using potentiometer.
10. Conduct metric precipitation titration using Barium chloride and Sodium Sulphate
11. Determination of strength of acids in a mixture using conductivity meter.
12. Determination of Chloride content in the given water sample by Argentometric method.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: apply analytical techniques for the quality assessment of domestic and industrial waste water.

CO2: apply experimental chemistry for the investigation of corrosion related problems in industrial field.

CO3: measure the molecular weight of polymeric materials so as to use them for various engineering applications.

CO4: estimate the amount of metal ions present in unknown substances using titrimetric and instrumental methods.

REFERENCES:

1. Beran J.A, "Laboratory Manual for Principles of General Chemistry", Wiley publications,10th Edition, 2014.
2. Manoj Kumar Solanki, "Engineering Chemistry Laboratory Manual", Educreation publishing, 2019.
3. Jeffery G. H, and Basset J., "Vogel's text book of quantitative chemical analysis", Prentice Hall, 5th Edition, 2012.

20MEG01	ENGINEERING GRAPHICS	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

The objectives of this course are to impart knowledge to interpret engineering drawings and to enable the students to communicate the concepts, ideas, and basic designs through graphical representations as per related engineering conventions and standards.

COURSE CONTENT:

Curve Constructions and Orthographic Projection

Lettering – Types of lines – Dimensioning – 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 these curves. Principles of Orthographic projection – Layout of views Orthographic projection of simple Engineering components using first angle Projection. Drawing of multiple views from pictorial views of objects

Projection of Points, Lines and Plane Surfaces

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 trapezoidal method and traces – Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method

Projection of Solids

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 and auxiliary plane method.

Projection of Sectioned Solids and Development of Surfaces

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, cylinder and cone. Development of lateral surfaces of solids with cut-outs and holes.

Isometric and Perspective Projections

Principles of isometric projection – isometric scale – isometric projections of simple solids and truncated solids – Prisms, pyramids, cylinders, cones – Perspective projection of simple solids prisms, pyramids and cylinder by visual ray method and vanishing point method.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the concepts and conventions of engineering graphics to apply for engineering applications.

CO2: understand the concept of projection and construct orthographic views of points, planes, straight lines and solids.

CO3: build orthographic projection of solids and develop the lateral surfaces.

CO4: develop multi-aspect technical sketches, perspective, sectional views for simple objects.

REFERENCES:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2014.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Publications, Bangalore, 2017.
3. Jolhe, D. A., Engineering drawing, Tata McGraw Hill, 2017.
4. Shah, M. B. and Rana, B. C., Engineering Drawing, Pearson Education, 2009
5. K.V. Natarajan, A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2016.
6. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2018.
7. 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, 2015.
8. Sekkilar.S.M., "Engineering Graphics" Alpha Science International Ltd, 2018.

20CSG02	OBJECT ORIENTED PROGRAMMING WITH C++ LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

This course provides a practical experience on the concepts of Object Oriented Programming using C++ programming language.

LIST OF EXPERIMENTS:

1. Programs using Objects and Classes
2. Programs using Constructors and Destructors
3. Programs using friend function & friend class.
4. Programs using Function Overloading
5. Programs to overload unary & binary operators as member function & non-member function
6. Programs using types of inheritance
7. Programs using virtual functions
8. Programs using Function and class templates
9. Programs using Files and Streams
10. Programs using Exception handling

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: apply the concept related to Classes and Objects in simple programs

CO2: apply the concepts of polymorphism to achieve enhanced functionalities of functions and operator.

CO3: deploy inheritance in simple C++ programs

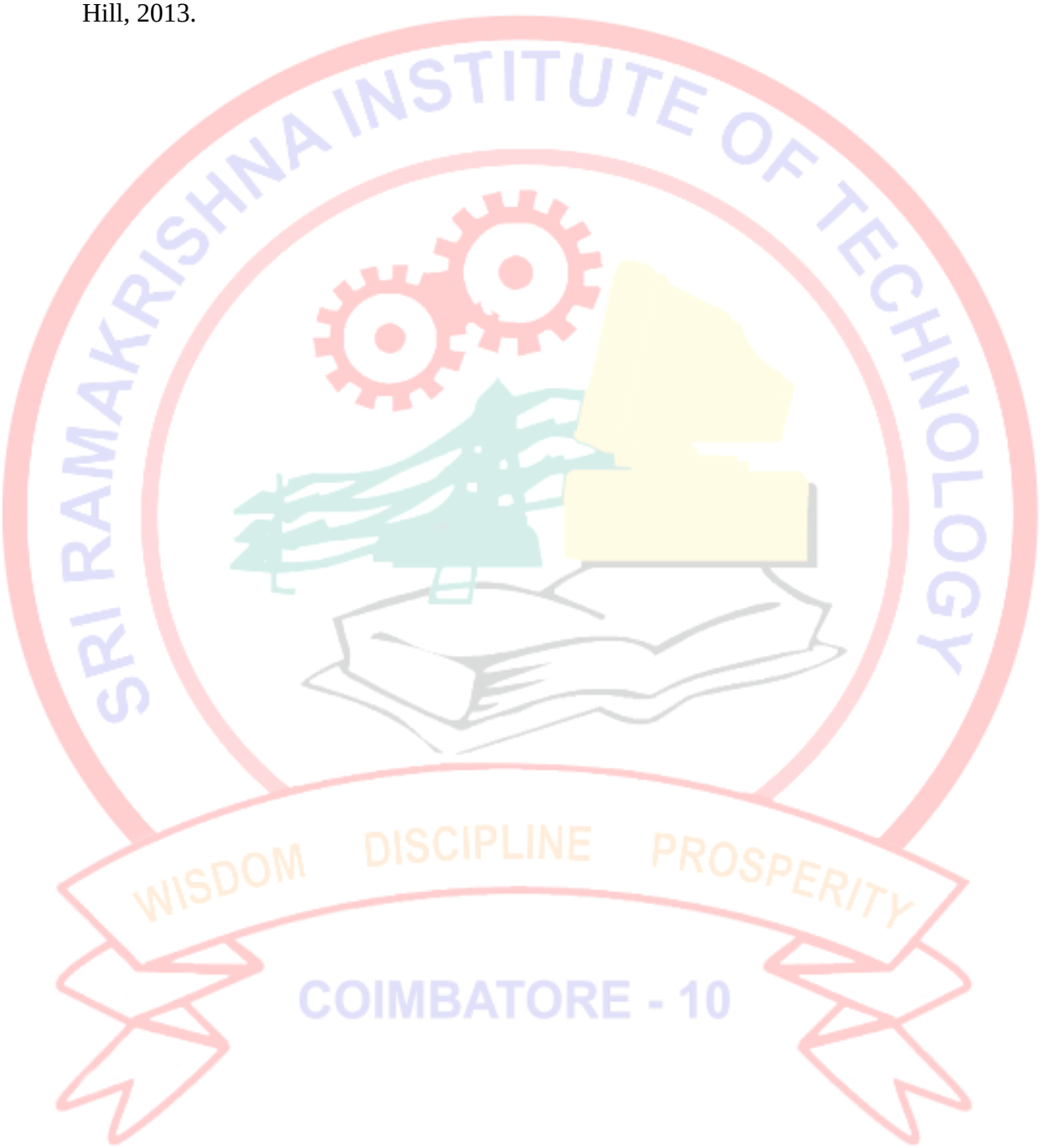
CO4: design simple applications that support File Processing

CO5: develop programs that are capable of handling Exceptions

REFERENCES:

1. Herbert Schildt, "C++ The Complete Reference", 5th Edition, Tata McGraw Hill, New Delhi,
2. Bjarne Stroustrup, "The C++ Programming Language", 4th Edition, Addison-Wesley, 2013.
3. Deitel and Deitel, "C++ How to Program", 10th Edition, Prentice Hall India Learning Private Limited, 2018.

4. Robert Lafore, “Object Oriented Programming in C++”, 4th edition, Pearson India, 2002.
5. Stanley B. Lippman and Josee Lajoie, “C++ Primer”, 5th Edition, Pearson Education, New Delhi, 2013.
6. E.Balagurusamy, “Object Oriented Programming with C++”, 6th Edition, Tata McGraw Hill, 2013.



20CHG02	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		AC			

COURSE OBJECTIVE:

To understand the basic knowledge about environment and their chemistry, to apply the knowledge in environmental pollution control and management, to create awareness about various technologies to control/ reduce all environmental related problems.

COURSE CONTENT:

Fundamentals of Environmental Science

Introduction- Definition-environment, Environmental science, Environmental engineering- Components of environment - Atmosphere, lithosphere, hydrosphere and biosphere - types of environment – Natural – man – made - Environmental education- objectives, importance and scope - Need for public awareness.

Chemistry of the Environment

Hydrological cycle- concept of DO, BOD and COD - chemical and photochemical reactions in the atmosphere - ozone chemistry - formation and depletion of ozone layer - acid rain mechanism of formation and effects - Photochemical smog and sulfurous smog. Greenhouse effect, global warming- causes, effects and control measures.

Renewable energy and environment

Introduction - Renewable and non - renewable energy sources - Principles of generation of hydro - power, tidal energy, ocean thermal energy conversion, wind power - wind mill - wind farm geothermal energy and solar energy (solar collectors, photovoltaic modules, solar ponds) - Bioenergy: methods to produce energy from biomass - impact of renewable and non - renewable energy sources on the environment.

Environmental Pollution and control

Introduction - Air pollution – sources - major air pollutants – effects and control - Air Pollution control technologies - cyclone separator and electrostatic precipitator –water pollution – sources - major water pollutants - effects and control of water pollution - waste water treatment - Noise pollution –sources- effects and control- Solid waste management – sources, classification, causes and effects -management and control measures of solid wastes - Hazardous waste management - role of an individual in prevention of pollution.

Human population and the Environment

Population growth - variation among nations - Population explosion – Family Welfare Programme -Environment and human health - Human Rights - Value Education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the basic knowledge about environment and their chemistry.

CO2: select suitable renewable resources for domestic and industrial applications to meet the growing energy demand.

CO3: apply the knowledge in environmental pollution control and management

REFERENCES:

1. George Tchobanoglous, Howard S. Peavy, Donald R. Rowe., "Environmental Engineering", McGraw Hill Education, 1st Edition, 2013.
2. Henry J.G. and Heinke G.W., "Environmental Science and Engineering", Prentice Hall, 2nd Edition, 2007.
3. Masters G.B., "Introduction to Environmental Engineering and Science", Pearson Education, 3rd Edition, 2008.
4. Tyler Miller G., "Environmental Science", Cengage Learning, 11th Edition, 2015
5. Smriti Srivastava., "Energy Environment & Ecology", S.K.Kataria & Sons, 2nd Edition, 2013.

20MHG03	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To impart knowledge in solving first and higher order partial differential equations.
- To construct full range and half range Fourier series expansion including Harmonic analysis.
- To develop methods to solve PDE using Fourier series solutions.
- To understand different types of Fourier transform and apply them to solve complex engineering problems.
- To familiarize Z transforms techniques to solve engineering problems.

COURSE CONTENT:

Partial Differential Equations

Formation of PDE by elimination of arbitrary constants and functions – Solutions of first order equations – Standard types and Equations reducible to standard types – Singular solutions – Lagrange's linear equation – Solution of second and higher order homogeneous and non-homogeneous linear equations with constant coefficients – Non linear equations of first order – Charpit's method.

Fourier Series

Dirichlet's conditions – Expansion of periodic functions into Fourier series – Change of interval – Fourier series for even and odd functions – Half-range expansions – RMS value of a function – Parseval's identity – Harmonic analysis.

Applications to Partial Differential Equations

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

Fourier Transform

Statement of Fourier integral theorem (without proof) – Fourier transform pairs – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity – Finite Fourier Sine and Cosine transform.

Z - Transform

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.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: Apply the concepts of partial differential equations to solve real time problems.
CO2: Construct Fourier series for discrete and continuous functions.
CO3: Utilize Fourier series to solve boundary value problems.
CO4: Solve complex engineering problems using Fourier transforms.
CO5: Apply Z-transform technique to solve difference equation.

REFERENCES:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2016.
2. Bali N., Goyal M, "Transforms and Partial differential equations" University Science Press, New Delhi, 2010.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 10th Edition, 2016.
4. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 3rd Edition, 2012.
5. Dennis G. Zill, "Advanced Engineering Mathematics", Jones and Bartlett Learning, LLC, an Ascend Learning Company, 6th Edition, 2016.
6. Peter V. O'Neil, "Advanced Engineering Mathematics", Cengage Learning, Boston, USA, 8th Edition, 2016.
7. Donald. A. McQuarrie, "Mathematical Methods for Scientists and Engineers", Viva Books Pvt. Ltd, New Delhi, 1st Edition, Reprint 2015.

20ME002	MANUFACTURING PROCESSES II	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will make the students understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaper and allied machines. Also to make the students understand the basic concepts of Computer Numerical Control (CNC) of machine tools.

COURSE CONTENT:

Theory of Metal Cutting

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

Turning Machines

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle:

Shaper, Milling and Gear Cutting Machines

Shaper - Types of operations. Drilling, reaming, boring, and Tapping. Milling operations-types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling, hobbing and gear shaping processes –finishing of gears.

Abrasive Process and Broaching

Abrasive processes: grinding wheel – specifications and selection, types of grinding process– cylindrical grinding, surface grinding, centreless grinding and internal grinding- Typical applications – concepts of surface integrity, broaching machines: broach construction – push, pull, surface and continuous broaching machines

CNC Machining

Numerical Control (NC) machine tools – CNC types, constructional details, special features, Machining centre, part programming fundamentals CNC – manual part programming – micromachining – wafer machining.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: identify the mechanics of chip formation, constructional features of turning machines, abrasive processes with their operations.

CO2: classify the types of lathes based on constructions and operations and select the appropriate cutting tool for the required machining processes.

CO3: Infer the various machining operations carried out in shaper, milling, drilling and gear cutting machines along with wafer and micro machining.

CO4: choose the surface finishing and broaching operations based on required tolerance of components.

CO5: estimate machining time and power factor for milling operations and select suitable milling cutter for the required operations.

CO6: select the appropriate machines and perform the desired operations based on the given materials and required profiles.

REFERENCES:

1. Serope Kalpakjian, Steven Schmid, "Manufacturing Engineering & Technology", Pearson, Seventh Edition, 2018.
2. M.P.Groover, "Fundamentals of Modern Manufacturing Materials, Processes and Systems", John Wiley & Sons, 2010.
3. Hajra Choudhury, "Elements of Workshop Technology", Vol.II, Media Promoters, 2004.
4. Milton C Shaw, "Metal Cutting Principles", Oxford University Press, 2012.
5. Singh D K "Manufacturing Technology", Pearson Education, 2nd Edition 2008.

20ME003	MECHANICS OF MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the student to classify and apply the principle concepts behind stress, strain deformation of solids, beams, shafts, springs, shells and deflection of beams for various engineering applications.

COURSE CONTENT:

Stress, Strain and Deformation of Solids

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumertric strains.

Transverse Loading on Beams and Stresses in Beam

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.

Torsion

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts – Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

Deflection of Beams

Double Integration method – Macaulay's method – Area moment method, Theorems for computation of slopes and deflections in beams.

Thick & Thin Shells

Stresses in thin cylindrical shell due to internal pressure, circumferential and longitudinal stresses and deformation in thin cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: describe the principle concepts of stress, strain and deformation of various structures.

CO2: interpret the transverse loading and stresses on beams for various engineering applications.

CO3: calculate the torsion on shafts and springs for different loading conditions.

CO4: classify the types of beams and calculate slope and deflection for different sections of the beam.

REFERENCES:

1. Bansal, R.K., Strength of Materials, Laxmi Publications (P) Ltd., 2007.
2. Jindal U.C., Strength of Materials, Asian Books Pvt. Ltd., New Delhi, 2007.
3. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2001.
4. Ferdinand P. Beer, Russell Johnson, J.r. and John J. Dewole Mechanics of Materials, Tata McGraw Hill publishing 'co. Ltd., New Delhi.
5. Hibbeler, R.C., Mechanics of Materials, Pearson Education, Low Price Edition, 2007.
6. Subramanian R., Strength of Materials, oxford University Press, Oxford Higher Education Series, 2007.

20ME004	FLUID MECHANICS AND MACHINERY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the conservation of mass, momentum and energy for fluid flow. It also provide insights to the hydraulic machines and introduces dimensional analysis for fluid flow problems in hydraulic engineering.

COURSE CONTENT:

Fluid Properties and Flow Characteristics

Properties of fluids - Classification of fluids - Types of fluid flow, Continuity equation- Bernoulli's equation and its applications - momentum equation.

Flow through Circular Conduits

Flow through pipes -Hagen Poiseuille equation - Boundary layer concepts - Losses in pipes - Major losses - Darcy-Weisbach equation and Chezy's equation - friction factor - Moody's diagram, Minor losses - pipes in series and parallel - equivalent length.

Dimensional Analysis

Methods of dimensional analysis -Similitude and model studies, dimensionless numbers, model laws and their applications.

Turbine

Turbines, Classification of Turbines - components, working and velocity triangles, draft tubes – Performance of turbines - Specific speed and their significance.

Pump

Classification of pumps, working principles – priming – head, power and efficiency - characteristic curves - Indicator diagram -Air vessel - work done against friction with and without air vessels – Rotary pumps and classification.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: describe the fundamental units and dimensions of fluid properties and flow characteristics.

CO2: apply the fluid flow equations and boundary layer concepts to determine head loss occurs in flow through pipes.

CO3: employ the concept of dimensional analysis to relate the variables involved in physical phenomena.

CO4: classify the types of pumps and turbines and calculate their performance of characteristics

REFERENCES:

1. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics, 19th edition, Standard Book House, New Delhi, 2015.
2. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, 9th edition, Laxmi Publications Pvt. Ltd, New Delhi, 2015.
3. Streeter V L and Wylie B.E, Fluid Mechanics, 6th edition McGraw Hill International Book Co., 2011.
4. L.Victor, Streeter and E, Benjamin Wylie, Fluid Mechanics, 9/e, 9th edition Tata McGraw Hill, 2013.
5. Roberson J.A and Crowe C.T., Engineering Fluid Mechanics. Jaico Books Mumbai, 2010.

20ME005	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	0	3

(Use of standard steam table data book and psychrometry chart permitted)

COURSE OBJECTIVE:

The course will enable the students to understand the thermodynamics laws and their interactions with the world, the concepts and properties of pure substances, gas mixtures and psychometric processes in various system.

COURSE CONTENT:

First law of Thermodynamics

Basic Concepts- Thermodynamic systems - closed, open and isolated, Thermodynamic equilibrium, Zeroth law of thermodynamics and First law of thermodynamics – application to closed and open systems, steady and unsteady flow processes with reference to various thermal equipments.

Second law of Thermodynamics

Second law of thermodynamics, Heat Engine, Refrigerator and Heat pump. Reversibility and irreversibility, Carnot theorem, Carnot cycle, reversed Carnot cycle, Clausius in-equality, Concept of entropy, entropy of ideal gas, Principle of increase of entropy.

Properties of Pure Substance and Vapour Cycle

Properties of pure substances in solid, liquid and vapor phases, PVT surfaces, P-V, P-T, T-V, T-S, H-S diagrams, Thermodynamic properties of steam, Calculations of work done and heat transfer in non-flow and flow processes, Standard Rankine cycle

Gas Mixtures and Thermodynamics Relations

Gas mixtures – properties ideal and real gases, equation state, Avogadro's Law, Dalton's law of partial pressure, Vander Waal's equation of state,Tds equations, Maxwell's relations, Joule – Thomson coefficient. Properties of gas mixtures.

Psychrometry

Psychometric properties, air vapor mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the fundamental laws of thermodynamics and interpret the concepts of energy transfer, flow and non-flow processes.

CO2: understand the basic concept of entropy and availability also calculate the efficiency and COP of the thermal systems.

CO3: calculate the thermodynamics properties of steam to determine the performances of various cycles of steam power plant.

CO4: identify the relationship between various thermodynamic properties of ideal and real gases.

CO5: understand the psychometric processes and evaluate the properties of gas mixtures for various thermodynamic applications.

REFERENCES:

1. Yunus. N.J, Cengel. A and Michael Boles. A, "Thermodynamics- An Engineering Approach" 8th Edition, McGraw Hill Education, New Delhi, 2016
2. Mahesh M. Rathore, "Thermal Engineering", Mc Graw Hill Education private limited, Reprint 2016.
3. Michael Moran.J, and Howard Shapiro.N, "Fundamentals of Engineering Thermodynamics", 4th Edition, John Wiley & Sons, New York, 2014.
4. Nag. P. K, "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, Fifth edition, 2014.
5. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, Twelfth reprint, 2007.

20ME006	MANUFACTURING TECHNOLOGY LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

The course will enable the students to learn and practice the techniques available in generation of patterns using sand molding, welding of two parts and provides practice in other machine tools, so as to equip the students with the practical knowledge required in mechanical industries.

LIST OF EXPERIMENTS:

1. Preparation of Mould with solid patterns
2. Preparation of Mould with split patterns
3. Preparation of Mould with core
4. Arc welding of two similar metals
5. Sheet metal fabrication
6. Step turning and knurling using capstan and turret lathes
7. Drilling, reaming and tapping for a given dimension
8. Spur gear cutting using milling machine
9. Helical gear cutting using milling machine
10. Gear generation using gear hobbing machine
11. Gear generation using gear shaping machine
12. Plain Surface and cylindrical grinding

COURSE OUTCOME:

Upon completion of the course, the student's will have the ability to

CO1: identify the different types of tools and machine tools to manufacture components.

CO2: illustrate the manufacturing processes such as casting, milling, welding, Gear generation and grinding.

CO3: apply the acquired knowledge to develop the product in industries.

REFERENCES:

1. Serope Kalpakjian, Steven Schmid, "Manufacturing Engineering & Technology", Pearson, Seventh Edition, 2018.
2. M.P.Groover, "Fundamentals of Modern Manufacturing Materials, Processes and Systems", John Wiley & Sons, 2010.
3. Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters, 2004.
4. Milton C Shaw, "Metal Cutting Principles", Oxford University Press, 2012.
5. Singh D K "Manufacturing Technology", Pearson Education, 2nd Edition 2008.

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WISDOM DISCIPLINE PROSPERITY
COIMBATORE - 10

20ME007	MECHANICS OF MATERIALS AND FLUID MACHINERY LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

The course will enable the students to understand the mechanical properties of materials when subjected to different types of loading and provides a platform to apply the principles studied in fluid Mechanics by performing experiments.

COURSE CONTENT:

MECHANICS OF MATERIALS

1. Tension test on mild steel
2. Torsion test on mild steel rod
3. Impact test
4. Test on springs
5. Deflection test on simply supported beam steel and aluminium
6. Hardness test

FLUID MACHINERY

1. Flow through pipes
2. Major losses and minor losses
3. Characteristics curves of centrifugal Pump
4. Characteristics curves of Pelton wheel Turbine

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: identify the different types of testing techniques for mechanical properties and measure the fluid flow properties.

CO2: illustrate the destructive testing methods and performance of the pumps and turbines.

CO3: apply the acquired knowledge to select materials and hydraulic machines.

REFERENCES:

1. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2015.
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Book House. New Delhi, 2017.
3. Subramanya K, Fluid Mechanics and Hydraulic Machines, Tata McGraw Hill Edu. Pvt. Ltd. 2011.

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COIMBATORE - 10

20EEG03	ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To enhance the knowledge in the field of electrical circuits and electronic circuits with their characteristics.
- To emphasize the DC motor, AC motor and transformer construction, working and characteristics for drive applications

COURSE CONTENT:

Basic Electrical and Electronics

Ohm's law, Kirchhoff's law, Series and parallel circuits. Introduction to electronic components – Diode, Transistor, half and full wave rectifier, Zener diode, voltage regulator.

Introduction to Electric Drives

History of electrical drive system, Block diagram, Classification and Selection of electric drives, Heating and cooling curves, loading conditions, Classes of duty, Multi-quadrant operation of Drive

DC Machines

Construction and Working principle of DC motor, Characteristics, Introduction to DC drive, Speed control of DC Drives: Conventional- Field Flux, Rheostatic control and applied voltage method, Solid State control- single phase and three phase fully controlled and half controlled rectifiers, Chopper controlled drives.

AC Machines

Construction and working principle of 1Φ transformer, OC, SC and load test on 1Φ transformer. Construction and working principle of Induction and Synchronous motor, Characteristics of AC Motors, Speed control of Induction Motors: Conventional- Stator & Rotor Side Control, Slip Power Recovery Scheme; Solid State control using Inverters

Starting and Braking of Drives

DC Drive: Need and Classification of starters, 2 point Starter, 3 point Starter, 4 point Starter, Braking of DC Drives (Plugging, Regenerative, Rheostatic)

AC Drive: Need and Classification of starters, DOL, Star─ Delta, Auto transformer, Braking of AC Drives (Plugging, Regenerative, Rheostatic)

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: visualize the operation of electrical drives.

CO2: analyze the characteristics, starting and braking of drive motors and to adopt different methods for speed control of DC and AC drives.

CO3: identify the need and choice of electric drives in real time applications.

REFERENCES

1. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", Tata Mc Graw Hill, 2007.
2. Dubey, G.K., "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2nd Ed. 2002
3. VedamSubramanyam, "Electric Drives Concepts & Applications" Tata McGraw Hill 2nd Edition 2010.
4. R.Krishnan, "Electric motor Drives: Modelling, Analysis and control", Prentice Hall, 2001.
5. Pillai S.K., "A First Course on Electrical Drives", Wiley Eastern Ltd., Bombay, 2nd Ed 2007.

20ME008	THEORY OF MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to illustrate and apply the basic components of mechanisms, toothed gearing and kinematics of gear trains and effects of friction in machine elements. Also the students will have an understanding on the importance of balancing and vibrations in machine elements.

COURSE CONTENT:

Kinematics of Mechanisms

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons– Analytical methods – cams – classifications – displacement diagrams - layout of plate cam profiles – cam with different follower motion - circular arc and tangent cams.

Gears and Gear trains

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – contact ratio – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains – Ferguson's paradox.

Friction in Machine Elements

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction aspects in brakes– Friction in vehicle propulsion and braking.

Force Analysis

Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members – Flywheels – Applications.

Balancing and vibration

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing – Vibration isolation.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: describe the kinematics mechanisms, gear trains, forces and vibrations in machine elements.

CO2: classify mechanisms, transmission elements and friction drives.

CO3: apply the laws of kinematics to solve problems on simple machine elements.

CO4: examine the force-motion relationship and vibrations in components subjected to external forces.

REFERENCES:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.
2. Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 2014.
3. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 2002.
4. AmitabhaGhosh and Asok Kumar Mallik, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., 1988.
5. Rao.J.S. AndDukkipati.R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2006.
6. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
7. Wilson and Sadler, Kinematics and Dynamics of Machinery, Pearson, 2008.

20ME009	THERMAL ENGINEERING	L	T	P	C
		3	0	0	3

(Use of standard steam table data book and Refrigeration table data book permitted)

COURSE OBJECTIVE:

The course will enable the students to understand and classify the various thermodynamic cycles, acquire knowledge on working of internal combustion engines,steam nozzle, turbines compressors, refrigeration and air conditioning systems.

COURSE CONTENT:

Power Cycles

Basic considerations in the analysis of power cycles - Otto cycle, diesel cycle, dual cycle, Brayton cycle- air standard efficiency- comparison of cycles.

Internal Combustion Engines

Classification - Components. Valve timing diagram and port timing diagram - Principles of Combustion and knocking in SI and CI Engines. Lubrication and Cooling systems. Engine performance calculations.

Steam Nozzles and Turbines

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and Reaction principles

Compressors

Classification and working principle of various types of compressors, performance and calculations of reciprocating compressors, Multistage air compressor and inter cooling.

Refrigeration and Air-Conditioning systems

Refrigeration system - Classification of Refrigerants and properties - ammonia - water and lithium bromide vapour absorption systems - vapour compression system. Air conditioning systems- Types and performance evaluation - Cooling Tower

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: interpret the working principle of Gas power cycles, Thermal systems, refrigeration and Air Conditioning systems and identify the engine components with their functions.

CO2: classify and determine the Gas power cycles, Thermal systems, and Refrigeration and Air Conditioning systems and interpret the valve -port timings of IC Engines.

CO3: apply the thermodynamic concepts in various thermal applications.

CO4: compare the performance of the Gas power cycles and analyze methods of energy conservation and energy efficiency for Thermal and Refrigeration systems.

CO5: evaluate the performance of IC engines, Compressors and Refrigeration systems and determine the thermodynamics properties of various thermal applications**.**

REFERENCES:

1. Mahesh M. Rathore, "Thermal Engineering", Tata McGraw-Hill Education, Reprint 2010.
2. Cengel. Y and M. Boles, "Thermodynamics - An Engineering Approach", Mcgraw Higher Ed, Eight Edition, 2015.
3. Ganesan V, Internal Combustion Engine; Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2013.
4. Arora C.P. "Refrigeration and Air Conditioning" Tata McGraw Hill, 3rd Edition 2008.
5. Frank Kreith "The CRC Handbook of Thermal Engineering"Springer; Softcover reprint of the original 1st ed. 2000 edition (26 November 2013)

20ME010	ENGINEERING MATERIALS AND METALLURGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the different engineering materials,construct phase diagrams, interpret heat treatment processes and their influence in microstructure formations indifferent materials.

COURSE CONTENT:

Constitution of Alloys and Phase Diagrams

Constitution of alloys, phase diagrams, Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application.

Heat Treatment

Full annealing, stress relief, recrystallisation and spheroidising –normalizing, hardening and Tempering of steel. Isothermal transformation diagrams – TTT diagram - continuous cooling Transformation diagram – Austempering, Martempering – Hardenability, Jominy end quench test -case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening.

Ferrous and Non-Ferrous Metals

Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) – stainless and tool steels – HSLA - Maraging steels – Grey, white, malleable, spheroidal – alloy cast irons, Copper and its alloys – Brass, Bronze and Cupronickel – Aluminium and its alloys; Al-Cu – precipitation strengthening treatment – Titanium alloys, Mg-alloys, Ni-based super alloys – shape memory alloys- Properties and Applications.

Non-Metallic Materials

Polymers – types of polymer – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS,PAI, PPO, PPS, PEEK, PTFE, Thermo set polymers – Urea and Phenol formaldehydes - Engineering Ceramics – Properties and applications of Al_2O_3, SiC, Si_3N_4, PSZ and SIALON – intermetallics- Composites- Nano composites - applications.

Mechanical Properties and Deformation Mechanisms

Mechanisms of plastic deformation, slip and twinning – Fracture mechanics- Griffith's theory- Testing of materials under tension, compression and shear loads – Hardness tests, Micro and nano-hardness tests, Impact test lzod and charpy, fatigue and creep failure mechanisms.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: describe the properties of various materials, phase diagrams, heat treatment techniques and deformation methods.

CO2: classify the heat treatment methods for ferrous & non- ferrous alloys.

CO3: apply the testing methods and deformation mechanics for various materials.

REFERENCES:

1. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint 2002.
2. Sydney H.Avner, "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1994
3. A. Alavudeen, N. Venkateshwaran, and J. T.WinowlinJappes, A Textbook of Engineering Materials and Metallurgy, Laxmi Publications, 2006.
4. Amandeep Singh Wadhwa, andHarvinder Singh Dhaliwal, A Textbook of Engineering Material and Metallurgy, University Sciences Press, 2008.
5. G.S. Upadhyay and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt.Ltd, New Delhi, 2006.
6. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt.Ltd. 1999.
7. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian edition 2007.

20EEG04	ELECTRICAL ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

- To study the performance of Electrical Machines.

LIST OF EXPERIMENT:

1. a) Simulation and experimental verification of electrical circuit problems using Ohm's law.
   b) Simulation and experimental verification of electrical circuit problems using Kirchhoff's voltage and current laws.
2. Characteristics of Semiconductor diode and Zener diode.
3. Characteristics of a NPN Transistor under common emitter, common collector and Common base configurations.
4. Load test on DC Shunt & DC Series motor.
5. Speed control of DC shunt motor (Armature, Field control)
6. a) Load test on single phase transformer
7. O.C & S.C Test on a single phase transformer
8. Load test on Single Phase and three phase squirrel cage Induction motor
9. Speed control of three phase slip ring Induction Motor
10. Study of DC & AC Starters

COURSE OUTCOME:

Upon completion of the course, the student's will have the ability to

CO1: understand the performance characteristics of electrical machines.

REFERENCES:

1. Dubey, G.K., "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2nd Ed. 2002.
2. VedamSubramanyam, "Electric Drives Concepts & Applications" Tata McGraw Hill 2nd Edition 2010.
3. Kothari D. P, and Nagrath I. J., "Electric Machines", Tata McGraw Hill Publishing Company Limited, New Delhi, 5th edition 2004.
4. Dr. P.S. Bhimbra, "Electrical Machinery", Khanna Publishers, 7th edition, 2017.
5. Gupta J B, "Theory and Performance of Electrical Machines", S K Kataria& Sons, 14th edition, 2015.

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20ME011	THERMAL ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1.5

(Use of standard steam table data book permitted)

COURSE OBJECTIVE:

The course will enable the students to understand and interpret proper valve and port timing in IC engines and analyze the performance characteristics of various engines.

LIST OF EXPERIMENTS:

1. Study of IC Engines and actual p-v diagrams of IC engines
2. Determination of valve timing diagram of single cylinder four stroke diesel engine
3. Determination of port Timing diagram of single cylinder two stroke petrol engine
4. Determination of Flash Point, Fire Point and viscosity of various fuels / lubricants
5. Performance Test on four – stroke Diesel Engine.
6. Determination of Heat Balance Test on four – stroke Diesel Engine.
7. Performance on Morse Test in Multi-Cylinder Petrol Engine.
8. Performance on Retardation Test in four stroke Diesel Engine.
9. Performance test on a two stage Reciprocating Air compressor
10. Study of Steam Generators and Turbines

COURSE OUTCOME:

Upon completion of the course, the student's will have the ability to

CO1: understand the various components and mechanisms of IC engines

CO2: determine the valve timing and port timing diagram of internal combustion engines

CO3: identify the various fuel/lubricants characterizations through experimental testing

CO4: evaluating the performance characteristics petrol and diesel engines

CO5: .analyze the air compressor characteristics and understand the steam generators / turbines.

REFERENCES:

1. Mahesh M. Rathore, "Thermal Engineering", Tata McGraw-Hill Education, Reprint 2010.
2. Cengel. Y and M. Boles, "Thermodynamics - An Engineering Approach", Mcgraw Higher Ed, Eight Edition, 2015.
3. Ganesan V, Internal Combustion Engine; Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2013.
4. Arora C.P. "Refrigeration and Air Conditioning" Tata McGraw Hill, 3rd Edition 2008.
5. Frank Kreith "The CRC Handbook of Thermal Engineering" Springer; Softcover reprint of the original 1st ed. 2000 edition (26 November 2013)

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20ME012	DYNAMICS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students to gain knowledge on experimenting with machines that involves dynamic forces

COURSE CONTENT:

1. Study of gear parameter.
2. Epicycle gear Train.
3. Determination of moment of inertia of flywheel and axle system.
4. Determination of mass moment of inertia of a body about its axis of symmetry.
5. Watt Governor.
6. Porter Governor.
7. Experiment of Proell Governor.
8. Experiment of motorized gyroscope.
9. Determination of critical speed of shaft

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: Apply the measurement of various kinematic parameters and understand the kinematics of various mechanisms.

CO2: Determine the cause and effects of various undesirable forces acting upon a machine.

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20ME013	CAD/CAM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course enables the students to apply the fundamental concepts of 2D and 3D transformations and apply NC & CNC programming concepts to part programmes. Also to summarize the different types of techniques used in Cellular and FMS Manufacturing

COURSE CONTENT:

Introduction

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations- homogeneous coordinates - Line drawing -Clipping- viewing transformation-Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- CAD/CAM concepts.

Geometric Modeling

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

CAD Standards

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

Fundamental of CNC

Introduction to NC systems and CNC - Machine axis and Co-ordinate system - CNC machine tools- Principle of operation CNC - Construction features including structure- Drives and CNC controllers- 2D and 3D machining on CNC

Part Programming

Introduction of Part Programming, types - Detailed Manual part programming (FANUC) on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the basics of computer aided design and computer integrated manufacturing concepts in Manufacturing Automation and Control.

CO2: Interpret surface modeling techniques for curves and surfaces with various case studies

CO3: construct the G codes and M codes used in part programming for manufacturing of components through NC Programming through CAD/CAM

CO4: determine the Fundamentals of CIM, Group Technology and Computer Aided Process Planning, Automated Storage and Retrieval Systems (ASRS), Computer Aided Inspection

CO5: apply the concepts of CAD/CAM/CIM and CNC in real time case studies in design manufacturing and assembly.

CO6: analyze and develop various Intelligent Manufacturing Systems, Rapid Prototyping and Tooling

REFERENCES:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill PublishingCo.2014
2. Mikell. P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2016.
3. Chris McMahon and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing management "Second Edition, Pearson Education, 2000.
4. William M Neumann and Robert F. Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.
5. Donald Hearn and M. Pauline Baker "Computer Graphics"'. Prentice Hall, Inc, 2nd edition (1997).

20ME014	HEAT AND MASS TRANSFER	L	T	P	C
		3	0	0	3

(Use of standard HMT data book and steam table data book permitted)

COURSE OBJECTIVE:

The course will enable the students to learn the conduction and convective heat transfer under steady state and transient conditions. Also to understand the theory of phase change in heat transfer, radiations and design of heat exchangers.

COURSE CONTENT:

Conduction

General Differential equation – Cartesian, Cylindrical Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids.

Convection

Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Plate, Cylinders and Spheres.

Phase Change Heat Transfer and Heat Exchangers

Nusselt's theory of condensation- Regimes of Pool boiling and Flow boiling, correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficients. LMTD and NTU methods..

Radiation

Radiation laws, Black Body and Gray body Radiation. Shape Factor. Electrical Analogy. Radiation Shields.

Mass Transfer

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

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the mechanism of various modes in heat and mass transfer, boiling and condensation.

CO2: Apply the concepts of conduction, convection and radiation to solve real time heat transfer problems.

CO3: Determine the performance of heat exchangers using LMTD and NTU methods.

CO4: Apply the concepts of molecular diffusion and convection to solve the real time mass transfer problems.

REFERENCES:

1. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2015
2. Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, 5thEdition – 2013
3. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 7th Edition, 2014.
4. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010
5. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012
6. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.
7. S.P. Venkateshan, "Heat Transfer", Ane Books, New Delhi, 2014
8. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2014

20ME015	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	0	0	3

(Use of Approved P S G Design Data Book is permitted)

COURSE OBJECTIVE:

The course will enable the students to design machine members subjected to static and variable loads for various engineering applications.

COURSE CONTENT:

Fundamental Concepts in Design

Introduction to the design process - Direct, Bending and torsional equation- Factor of safety – Eccentric Loading – Impact and Shock Loading – Calculation of Principle Stresses for Various Load Combinations – Theories of Failure – Design of curved beams – crane hook and 'C' frame- theories of failure –Stress concentration – Design for Variable Loading, Soderberg, Goodman and Gerber Relations.

Shafts and Couplings

Design of Solid and Hollow Shafts –Critical speed- Design of Knuckle Joint – Design of Keys and Couplings –Rigid -Muff, Split muff and flexible couplings

Temporary and Permanent Joints

Threaded fasteners - Bolted joints – Simple and eccentrically loaded bolted joints- Welded joints – Butt, Fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentric loads.

Energy Storing Elements

Types of springs, design of helical and concentric springs–surge in springs, Design of laminated springs - Flywheels considering stresses in rims and arms for engines and presses - Solid and Rimmed flywheels

Bearings

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs, -- Selection of Rolling Contact bearings.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the design process for designing of various machine components based on strength, stiffness, static and variable loading conditions.

CO2: Select the materials based on mechanical properties, joints, springs, flywheel and bearings.

CO3: calculate the principle stresses for various load conditions and determine the size of the components with specifications.

CO4: determine the parameters of springs and bearings, analyze the factors influencing machine design for various machine elements.

CO5: evaluate the design specifications of various machine elements based on coded specifications and able to select bearings based on Sommerfeld number, Raimondi and boyd graphs.

CO6: design solid and hollow shafts, flywheels, connecting rods and crankshafts for various machines.

REFERENCES:

1. Bhandari V B, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2017

2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill , 2015.

3. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine component Design",6th Edition, Wiley, 2017.

4. Bernard Hamrock, Steven Schmid,Bo Jacobson, "Fundamentals of Machine elements",3rd Edition, Tata McGraw-Hill Book Co., 2014.

5. Ugural A. C, "Mechanical Design an Integral Approach", McGraw-Hill Book Co, 2004.

6. Spotts M. F., Shoup T. E, "Design and Machine Elements", 8th Edition, Pearson education, 2004.

7. "Design Data" – P.S.G. College of Technology, KalaikathirAchchagam, 2013.

20ME016	ENGINEERING METROLOGY AND QUALITY CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to impart knowledge on basic principles and errors in measurements and to make the students acquire knowledge on various measuring instruments

COURSE CONTENT:

Basics of Metrology

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

Linear and Angular Measurements

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design –terminology – procedure – concepts of interchange ability and selective assembly – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar –Angle alignment telescope – Autocollimator – Applications.

Advances in Metrology

Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications.

Form Measurement

Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, and surface finish measurement, Roundness measurement – Applications.

Measurement of Power, Flow and Temperature

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

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the significance and need for metrology and measurements in manufacturing of components.

CO2: interpret the basics of standards of measurement, limits, fits & tolerances in industrial applications.

CO3: classify the various methods of linear and angular measurement tools used for industrial applications.

CO4: select the type of instruments required for error calculation in various types of component geometry.

CO5: Choose and illustrate the type of geometrical forms, torque and power measurements based on industrial requirement.

CO6: apply the procedure to carry out the measurement process using coordinate measuring machine, laser and temperature measuring instruments for industrial components.

REFERENCES:

1. Richard S. Figliola, Donald E. Beasley, "Theory and Design for Mechanical Measurements, 3rd Edition International Student Version", Wiley India Private Limited, Third edition, 2008.
2. Bucher, Jay L "The Metrology handbook ", Second Edition, Quality press, 2012.
3. R.K.Rajput, "Engineering Metrology and Instrumentation", S.K. Kataria& Sons Publications, 2014.
4. Bewoor and Vinay Kulkarni, "Metrology & Measurement", Tata Mc Graw Hill Publishing Company Pvt Ltd, New Delhi, 2017.
5. Raghavendra, Krishnamurthy, "Engineering Metrology and Measurements" Oxford University Press, 2013.

20ME017	CAD/CAM LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

The course will enable the students to understand and apply the concepts of computer aided design softwarewidely used in industries.

COURSE CONTENT:

1. CAD Introduction – Drafting
2. Drafting: Layouts, Standard & Sectional Views, Detailing & Plotting.
3. Feature manipulation: Copy, Edit, Pattern, Suppress, History operations
4. Solid modeling: Extrude, Revolve, Sweep, Variational sweep and Loft.
5. Surface modeling: Extrude, Sweep, Trim, Mesh of curves and Free form.
6. Assembly: Constraints, Exploded Views, Interference check
7. Flange coupling
8. Knuckle joint
9. Screw jack
10. Plummer block
11. Universal coupling

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: Construct 3 Dimensional geometric model of parts, sub-assemblies, assemblies.
CO2: interpret isometric views of a 3D object and dimensioning of part models as per the ISO standards.
CO3: Ability to evaluate the 2D diagrams as per the ISO standards.

REFERENCES:

1.M. Groover"CAD/CAM" Pearson Education; 1st edition (1 January 2003).
2.Ibrahim Zeid, R.Sivasubramanian "CAD/CAM : Theory and Practice",McGraw Hill Education; 2nd edition (25 June 2009).
3.R K Dhawan "A Text Book of Engineering Drawing"S Chand; 3rd Rev. Edition 2006
4. Cecil H. Jensen "Interpreting Engineering Drawings" S.Chand (G/L) & Company Ltd; 6th edition (2001).
5. N.D.Bhatt"Engineering Drawing"Charotar Publishing House Pvt Ltd; Fifty Third Edition 2014.

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20ME018	HEAT AND MASS TRANSFER LABORATORY	L	T	P	C
		0	0	3	1.5

(Use of standard Heat and Mass transfer data book, Refrigeration data book and steam table data book permitted)

COURSE OBJECTIVE:

The course will enable the students to study the heat transfer phenomena and predict the relevant coefficient using heat transfer equipments along with performance of refrigeration cycle anditscomponents.

LIST OF EXPERIMENTS:

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

COURSE OUTCOME:

Upon completion of the course, the student's will have the ability to

CO1: determine the thermal conductivity in various heat transfer apparatus, composite walls and insulating powders
CO2: understand and interpret the thermal coefficient in natural and forced convections
CO3: apply the fundamental concept and principles of radiations
CO4: analyze the COP in refrigeration system.

REFERENCES:

1. R.C. Sachdeva, “Fundamentals of Engineering Heat & Mass transfer”, New Age International Publishers, 2015
2. Yunus A. Cengel, “Heat Transfer A Practical Approach” – Tata McGraw Hill, 5thEdition – 2013
3. Frank P. Incropera and David P. Dewitt, “Fundamentals of Heat and Mass Transfer”, John Wiley & Sons, 7th Edition, 2014.
4. Holman, J.P., “Heat and Mass Transfer”, Tata McGraw Hill, 2010
5. Kothandaraman, C.P., “Fundamentals of Heat and Mass Transfer”, New Age International, New Delhi, 2012

20ME019	METROLOGY LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

The course provides the students with knowledge on dynamic forces and the ability to measure the dimensions of any given component precisely.

COURSE CONTENT:

1. Calibration and use of linear measuring instruments – Vernier caliper, micrometer, Vernier height gauge, depth micrometer, bore gauge, telescopic gauge, Comparators.
2. Measurement of angles using bevel protractor, sine bar, autocollimator, precision level.
3. Measurement of assembly and transmission elements - screw thread parameters – Screw thread Micrometers, Three wire method, Toolmaker's microscope.
4. Measurement of gear parameters – Micrometers, Vernier caliper, Gear tester.
5. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM)
6. Non-contact (Optical) measurement using Measuring microscope / Profile projector and Video measurement system.
7. Surface metrology - Measurement of form parameters – Straightness, Flatness, Roundness, Cylindricity, Perpendicularity, Run out, Concentricity – in the given component using Roundness tester.
8. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: analyze the dimensional anomalies in given component or calibrated measurement device.

CO2: identify the errors caused while using linear measuring instruments

CO3: demonstrate the necessary skills to collect data, perform analysis and interpret results to draw valid conclusions through standard test procedures using various metrology instruments.

REFERENCES:

1. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.
2. Jain R.K. "Engineering Metrology", Khanna Publishers, 2009.
3. F. B. Sayyad, "Dynamics of Machinery", McMillan Publishers India Ltd., Tech-Max Educational resources, 2011.
4. Rattan, S.S, "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2014.
5. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014.

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20ME020	MECHATRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course aims to impart knowledge about the elements and techniques involved in mechatronics systems which are very much essential to understand the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical and Electronic Systems. The students will able to understand the basic concepts of microprocessor, microcontroller, PLC and also learn about the programming methods and integration of peripherals to the microcontroller.

COURSE CONTENT:

Introduction

Introduction to Mechatronics – Systems – Basic elements in Mechatronics - Need for Mechatronics – Emerging areas of Mechatronics –. Sensors and Transducers: Static and dynamic Characteristics of Sensor, LVDT - Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensor – Vision sensor – Laser Range sensor (LIDAR) – Selection of sensors**.**

Drives and Actuators

Need for automation, Classification of drives -Introduction to Actuators - Types Actuation -Fluid Power Actuation Systems - Electrical Actuation Systems – Mechanical Switches –Solenoids - Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages

8085 Microprocessor and 8051 Microcontroller

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set – Concepts of 8051 microcontroller – Block diagram – CISC and RISC - Stepper Motor Control – Traffic Control interface.

Programmable Logic Controller

Fundamentals of programmable logic controller – Functions of PLCs – PLC operations – Evaluation of the modern PLC –Selection of PLC – Features of PLC – Architecture – Basics of PLC programming – Developing Fundamental wiring diagrams – Programming Timers – Programming counters – Data Handling.

Mechatronics System Design and Case Studies

Key Elements of Mechatronics Design process - stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier – Washing Machine - Wireless surveillance balloon

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: identify the basic elements of Mechatronics system and choose suitable sensors for appropriate applications.
CO2: understand the basic working principles of fluid power, electrical actuation systems and MEMS.
CO3: apply the peripheral interfacing techniques to control real time applications by using microprocessor and microcontroller.
CO4: apply the Programmable Logic Controller instructions to develop a mechatronics system.
CO5: design real time mechatronic systems for various industrial applications.

REFERENCES:

1. Michael B. Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2012.
2. Musa Jouaneh, "Fundamentals of Mechatronics," Cengage Learning, 2011.
3. Lawrence J. Kamm, "Understanding Electro Mechanical Engineering", An Introduction to Mechatronics, Prentice –Hall of India Pvt., Ltd., 2013.
4. De Silva, "Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint, 2013.
5. Bolton W, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 4th Edition, Pearson Publisher, 2010.

20ME021	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

(Use of standard P S G Design Data Book is permitted)

COURSE OBJECTIVE:

The course will enable the students to learn and design flexible elements and other gear drives for power transmissions for engineering applications.

COURSE CONTENT:

Design of Flexible Elements

Motor power capacity for various applications - Design of Flat belts and pulleys - Selection of V belts and sheaves – Selection of wire ropes and pulleys – Design of Transmission Chains and Sprocket.

Spur and Helical Gears

Gear materials - Design of straight tooth spur & helical gears based on speed ratios, number of teeth, Fatigue strength, Factor of safety, strength and wear considerations. Force analysis –Tooth stresses - Dynamic effects - Helical gears – Module - normal and transverse, Equivalent number of teeth – forces.

Bevel and Worm Gears

Straight bevel gear: Gear materials - Tooth terminology, tooth forces and stresses, equivalent number of teeth, estimation of dimensions of straight bevel gears. Worm Gear: Gear materials - Tooth terminology, Thermal capacity, forces and stresses, efficiency, estimation of dimensions of worm gear pair.

Gear Boxes

Need - Design of sliding and constant mesh gear boxes: Speed selection - Geometric progression - Standard step ratio - Ray diagram, kinematic layout – Determination of number of teeth. Design of multi speed gear box for machine tool applications, Variable speed gear box.

Clutches and Brakes

Design of single and multi-plate clutches, cone clutches, internal expanding rim clutches and Electromagnetic clutches. Design of brakes: External shoe brakes - Single and Double Shoe, Internal expanding shoe brakes and Band brakes.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: interpret the design parameters of flexible transmission elements for given condition along with gear tooth terminologies for various gears.
CO2: design the various gears using standard procedure /catalogues and construct ray diagram and kinematics layout for gear boxes for machine tool applications.
CO3: estimate the speed ratio and number of teeth requirement based on power transmission and factor of safety for various gears.
CO4: design fluid couplings, torque converter and cams for automotive applications.
CO5: design clutches and brakes for industrial applications.
CO6: design rigid and flexible power transmission systems for real world applications.

REFERENCES:

1. Bhandari V, "Design of Machine Elements", 15th Reprint, Tata McGraw-Hill Book Co,2014.
2. C.S.Sharma, KamleshPurohit, "Design of Machine Elements", Prentice Hall ofIndia,Pvt. Ltd., 2003.
3. Design Data Hand Book, PSG College of Technology, 2013- Coimbatore.
4. GitinMaitra,L. Prasad "Handbook of Mechanical Design", 2nd Edition, Tata McGraw-Hill, 2001.
5. Bernard Hamrock, Steven Schmid, Bo Jacobson, "Fundamentals of MachineElements",2nd Edition, Tata McGraw Hill, 2006.
6. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine componentDesign", 5th Edition, Wiley, 2011.

20ME022	FINITE ELEMENT ANALYSIS	L	T	P	C

		3	**0**	**0**	**3**

COURSE OBJECTIVE:

The course will enable the students to solve mathematical models for Boundary Value problem, one dimensional problem, two dimensional scalar and vector problems. Also the ability to interpret Isoperimetric transformation and the use of numerical integration.

COURSE CONTENT:

Introduction

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

One-Dimensional Problems

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors-Assembly of Matrices - Natural coordinates- Solution of problems from solid mechanics, bar, springs, trusses, bending of beams including thermal stresses-heat transfer.

Two Dimensional Scalar Variable Problems

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

Two Dimensional Vector Variable Problems

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

Isoparametric Formulation and Advanced Topics

Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions – Serendipity elements – Numerical integration - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software- Introduction to Non Linearity.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand and summarize the basics of finite element formulation**.**

CO2: develop mathematical models for Boundary Value Problems and one dimensional problems.

CO3: determine field variables for two dimensional scalar and vector variable problems

CO4: apply the need for Isoparametric transformation and the use of numerical integration

REFERENCES:

1. David Hutton, "Fundamentals of Finite Element Analysis", Tata McGrawHill, 2005
2. Dhanaraj. R and Prabhakaran Nair. K, "Finite Element Analysis", Oxford Publications, 2015.
3. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2004.
4. Seshu.P, "Text Book of Finite Element Analysis", PHI Learning Pvt. Ltd., New Delhi, 2012.
5. TirupathiR.Chandrupatla and Ashok D.Belegundu, "Introduction to Finite Elements in Engineering", International Edition,
6. Rao, S.S., "The Finite Element Method in Engineering", 6th Edition, Butterworth-Heinemann, 2018.
7. Reddy,J.N. "Introduction to the Finite Element Method", 4thEdition, Tata McGrawHill,2018.

		L	T	P	C

20ME023	MECHATRONICS LABORATORY	0	0	3	1.5

COURSE OBJECTIVE:

To know the method of programming the microprocessor and also the design, modeling& analysis of basic electrical, hydraulic & pneumatic Systems which enable the students to understand the concept of mechatronics.

LIST OF EXPERIMENTS:

1. Assembly language programming of 8085 - 8-bit Addition & Subtraction
2. Assembly language programming of 8085 - 8-bit Multiplication & Division
3. Assembly language programming of 8085 - Sorting in ascending & descending order
4. Study of Hydraulic, Pneumatic and Electro-pneumatic circuits.
5. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Software.
6. Actuation of single acting cylinder with PLC using AND & OR gate
7. Actuation of single acting cylinder using a two way pressure valve and 3/2 single solenoid valve
8. Design and testing of logical control of double acting cylinder using 'OR' gate and 5/2 single pilot valve
9. Actuation of double acting cylinder using electrical push button switch in meter-in and meter-out circuit
10. Stepper motor interface with 8051– Microcontroller
11. Traffic light interface
12. Study of PLC and its applications.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: apply the fundamentals of mechatronics key elements, various sensors principles and actuation systems.

CO2: understand the basic concepts of microprocessor, microcontroller and PLC.

CO3: use mechatronic system design for commercial applications.

20ME024		**L**	**T**	**P**	**C**

	SIMULATION AND ANALYSIS LABORATORY	0	0	3	1.5

COURSE OBJECTIVES:

The course will enable the students to understand the computer aided finite element analysis and recognize the skills to make real time simulation of various machine elements under controlled environment.

COURSE CONTENT:

1. Force and Stress analysis using link elements in Trusses.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates.
4. Stress analysis of axis–symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Modal analysis of Beams.
9. Harmonic analysis of simple systems.
10. Transient and spectrum analysis of simple systems.
11. Stress analysis of Universal coupling.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: analyze various structural elements with various loading conditions using finite element method.

CO2: determine the effects of thermal loads in machine elements.

CO3: apply finite element method to solve problems on iso parametric element and dynamic Problems.

CO4: analyze non-linear responses of a mechanical system.

REFERENCES:

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.
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.

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20ME901	DESIGN PROJECT	L	T	P	C
		0	0	8	4

COURSE OBJECTIVE:

- The objective of this course is to impart and improvise the designing and manufacturing capability of the student using various designing and analyzing software tools along with the concept of simulation.

COURSE CONTENT:

This course comprehends purely a problem in any one of the disciplines of Mechanical Engineering; e.g., Design of jigs and Fixtures, Design of intricate shapes and Design of Cast able products etc., The project can be allotted to either an individual student or a group of students comprising of not more than three. At the end of the course the group should submit a complete report on the design problem consisting of the data given, the design calculations, specifications if any and complete set of drawings which follow the design.

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COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1	identify improvisations in design and manufacturing of mechanical components.
CO2	compare the strategies, methodologies and interpret several existing solutions .
CO3	apply the principles and new tools for designing and analyzing the component.
CO4	simulate and examine the solutions for cost effectiveness and ease of manufacturing
CO5	analyze and comprehend the findings as a team .
CO6	build the report and present the findings of the work conducted

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20AC002	CONSTITUTION OF INDIA (AC-2)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understand the historical background of Indian constitution.
- Interpret the the importance and limits of fundamental rights and its legal status.
- Understand the federal structure, power and functions.
- Infer constitutional amendments, and constitutional scheme in India.
- Understand fundamental right to equality.

COURSE CONTENT

Historical perspective of the Constitution of India

Meaning of the constitution law and constitutionalism – Historical perspective of the Constitution of India – Salient features and characteristics of the Constitution of India.

Fundamental rights and legal status

Scheme of the fundamental rights – The scheme of the Fundamental Duties and its legal status – The Directive Principles of State Policy – Its importance and implementation.

The constitution powers

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India – The constitution powers and status of the President of India - Amendment of the Constitutional Powers and Procedure.

Constitutional amendments

The historical perspectives of the constitutional amendments in India - Emergency Provisions: National Emergency, President Rule, Financial Emergency - Local Self Government – Constitutional Scheme in India.

Right to Life and Personal Liberty

Scheme of the Fundamental Right to Equality - Scheme of the Fundamental Right to certain Freedom under Article 19 – Scope of the Right to Life and Personal Liberty under Article 21.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1	understand and abide by the rules of the Indian constitution.
CO2	comprehend the constitutional rights & fundamental rights.
CO3	understand the form of government in India.
CO4	comprehend the parliamentary system and the constitutional scheme in India.
CO5	interpret scheme of the fundamental right.

REFERENCES:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, First Edition, 2015.
3. Granville Austin, Working Democratic Constitution: The Indian Experience, Oxford Publication. 2003.
4. Jain M P, Indian Constitution Law, Seventh Edition, Lexis Nexis, 2014.
5. The Constitution of India (Bare Act), Government Publication, 1950.

20HMG06	PROFESSIONAL ETHICS IN ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The course will enable the students to create an awareness on Engineering Ethics and Human Values. In addition, the course creates awareness on the use of ethical and moral principles along with code of conduct in engineering experimentation.

COURSE CONTENT:

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

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

Engineering for Safety
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk –The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal.

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

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

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand and apply the core values toward the ethical behavior of an engineer.
CO2: apply the ethical and moral principles in engineering experimentation.
CO3: analyze the ethical and moral principles in engineering for safety.

CO4: understand and interpret the standard codes of moral conduct toward the ethical behavior of an engineer.

CO5: exhibit ethical and moral principles for engineers as managers, consultants, expert witness and resolve global issues of ethics concerning weapon development and multinational companies.

REFERENCES:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.
2. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, 2003.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003.
5. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, 2004.
6.Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thompson Learning, 2000.
7. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, 2005.

20ME025	COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The course will enable the students to understand the concept of group technology, Cellular manufacturing, Flexible Manufacturing Systems and AGVs

Introduction

CIM concepts and elements – Types of production – Manufacturing Metrics and Economics – Production Performance Metrics –Basic Elements of an Automated system – Advanced Automation Functions - Levels of Automation

Computer Aided Process Planning

Introduction to Material Requirement Planning (MRP I) Manufacturing Resource Planning (MRP II) & Enterprise Resource Planning (ERP) - Process planning – Manual Process Planning and case studies Computer Aided Process Planning (CAPP)

Group Technology and Cellular Manufacturing

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

Flexible Manufacturing System (FMS) and Automated Guided Vehicle System (AGVs)

Types of FMS & Flexibility – FMS Components – FMS Application & Benefits – FMS Planning and Implementation Issues –Bottleneck in FMS - Alternative Approach in Flexible Manufacturing - Automated Guided Vehicle System (AGVS) – Types of AGVS - Applications – Vehicle Guidance technologies –Vehicle Management & Safety.

Industrial Robotics

Robot Anatomy – Control systems – End Effectors –Sensors – Applications – Basics of Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: Understand the concepts and elements of computer integrated manufacturing system.

CO2: Apply the Manufacturing knowledge in Process Planning and improve the production rate.

CO3: Apply the concept of group technology and cellular manufacturing in industry to improve the production.

CO4: Analyze abilities of AGVs and FMS for improving the lead time.

CO5: Interpret the basics of robot anatomy, control systems and their various applications.

REFERENCES:

1. Mikell .P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", PEARSON, 2018.
2. Kant Vajpayee S., "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.
3. Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman& Hall, London, 1995.
4. GrooverMikell P. & ZIMMERS E., "CAD/CAM – Computer Aided Design and Manufacturing", PEARSON, 2018.
5. Radhakrishnan P., Subramanyan S. and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

20ME902	FINAL YEAR PROJECT -PHASE I	L	T	P	C
		0	0	6	3

COURSE OBJECTIVE:

- To allow students to complete a research and / or development project via an individual work or team work.
- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To enhance students skills pertaining to scientific and technical report writing and presentation.

COURSE CONTENT:

The student individually or in a group of 2 to 3 works on a specific topic approved by the project review committee constituted by the head of the department under the guidance of a faculty member who is familiar in this area of interest. The students can select any topic which is relevant to the area of Mechanical Engineering. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The progress of the project is evaluated based on a minimum of three reviews by the project review committee. 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.

COURSE OUTCOMES:

CO1: Identify real world problems and develop design solutions based on various literature reviews.

CO2: compare the strategies and methodologies to meet the objectives with concern for society, environment and ethics.

CO3: examine various solutions and cost effectiveness for the research work under consideration.

CO4: apply the principles and new tools for development of competent mechanical systems.

CO5: apply the management skills to achieve the project goal by working as a team and also improve communication and technical writing skills during presentation.

CO6: develop the report and present the findings of the work conducted as a team.

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20ME903	FINAL YEAR PROJECT -PHASE II	L	T	P	C
		0	0	16	8

COURSE OBJECTIVE:

- To solve the identified problem based on the formulated methodology.
- To further develop students' skills to analyze and discuss the test results, and make conclusions.
- To enhance students skills pertaining to scientific and technical report writing and presentation.

COURSE CONTENT:

The student should continue the Final Year Project -Phase I work on the selected topic as per the formulated methodology under the same supervisor. The progress of the project be evaluated based on the report as well as by conducting a minimum of three reviews by the project review committee. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: identify and understand the requirements and develop design solutions for a real-world problem.

CO2: demonstrate a depth of knowledge in Mechanical Engineering for the development of solutions.

CO3: apply various tools and techniques to find the solutions for problems pertaining in the field of mechanical engineering.

CO4: analyze data to produce useful information and to draw conclusions by systematic deduction and complete the finding of solutions successfully.

CO5: choose an appropriate hardware and software to investigate or development project as a team

CO6: invent a new innovative research project, resulting in publications in conference proceedings and journals.

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20MEP01	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the importance of different composite materials along with their various applications and manufacturing methods.

COURSE CONTENT

Introduction to Composites

Fundamentals of composites - need for composites – Enhancement of properties- composite interphases - Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) Particle reinforced composites, Fibre reinforced composites. Applications of various types of composites.

Polymer Matrix Composites

Polymer matrix resins – Thermosetting resins, thermoplastic resins – Reinforcement fibres – Rovings – Woven fabrics – Non woven random mats – various types of fibres - PMC processes - Hand lay up processes – Spray up processes – Compression moulding – Reinforced reaction injection moulding - Resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), Glass fibre reinforced plastics (GRP).

Metal Matrix Composites

Characteristics of MMC, Various types of Metal matrix composites Alloy vs. MMC, Advantages of MMC, Limitations of MMC, Metal Matrix - Reinforcements – particles – fibres. Effect of reinforcement - Volume fraction – Rule of mixtures. Processing of MMC - Powder metallurgy process – diffusion bonding – stir casting – squeeze casting.

Ceramic Matrix Composites

Engineering ceramic materials – properties – advantages – limitations – Monolithic ceramics - Need for Ceramic Matrix composites (CMC) – Ceramic matrix - Various types of Ceramic Matrix composites- Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing).

Special Composites

Carbon / carbon composites – Advantages of carbon matrix – limitations of carbon matrix Carbon fibre – chemical vapour deposition of carbon on carbon fibre perform preform. Sol gel technique. Composites for aerospace applications.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the fundamentals of different types of composites with their various properties and applications.

CO2: interpret the different manufacturing methods for polymer, ceramic and metal matrix composites along with their advantages and limitations

CO3: select the various special composites based on the method of manufacturing and applications.

CO4: identify the real time applications of composite materials

REFERENCES:

1. Mathews F. L. and Rawlings R.D., "Composite materials: Engineering and Science", Chapman and Hall, London, England, Fifth edition, 2012.
2. Chawla K. K., "Composite materials", Springer – Verlag, 2012
3. Clyne T. W. and Withers P.J., "Introduction to Metal Matrix Composites", Cambridge University Press, 2011.
4. Strong A. B., "Fundamentals of Composite Manufacturing", SME, 2013.
5. Sharma S. C., "Composite materials", Narosa Publications, 2010.

20MEP02	NON-DESTRUCTIVE EVALUATION OF MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to understand the importance of NDT, principles and it's applications in quality assurance.

COURSE CONTENT:

Introduction & Visual Inspection Methods

NDT versus Mechanical testing, Need for NDT, Relative merits and limitations, various physical sensors, Microscopes & replication Microscopy Technique and applications, Holography, Case study.

Liquid Penetrant Testing& Magnetic Particle Testing

LPT – Principle – Procedures – Types – Equipments – Advantages – Applications – Case studies. MPT-Principle, Theory of Magnetism - Principle – Procedures – Types – Equipments – Advantages – Applications – Case studies.

Thermography & Eddy Current Testing

Thermography – Introduction, Principle, inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods and applications, Case study. Eddy current Testing – Principle, elements, Instrumentation, Case study.

Ultrasonic Testing

Ultrasonic Testing-Principle, Basic Equipment, Transducers, couplants, Ultrasonic wave, Variables in UT, Transmission and Pulse-echo method, Straight beam and angle beam, A-Scan, B-Scan & C-Scan, Phased Array Ultrasound& Time of Flight Diffraction, Advantages & Limitations, Interpretation of Results& Applications, Case study.

Radiography

Introduction, Principle, X-ray Production, Gamma ray sources, tubing materials, X-ray tubing characteristics, Interaction of X-ray with matter, Imaging, Film techniques, Filmless techniques, Types and uses of filters and screens, Fluoroscopy- Xero-Radiography, Digital Radiography – Film Digitisation, Direct Radiography &Computed Radiography, Computed Tomography, Case study.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: Compare the differences between the various visual inspection techniques and apply the same to the components to be inspected.
CO2: recognize the importance of penetrant testing in NDT with the understanding of the procedures involved in the Penetration methods.
CO3: interpret the images and the results obtained from the Thermo graphic technique and the Eddy current testing.
CO4: evaluate and interpret the results obtained in the Ultrasonic inspection and Acoustic Emission technique.
CO5: summarize the techniques involved in the Radiographic testing and the various advancements in Radiography.

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. 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
4. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
5. Charles, J. Hellier," Handbook of Non-destructive evaluation", McGraw Hill, New York 2001.
6. Ravi Prakash, "Non-Destructive Testing Techniques", New Age International Publishers, 1st revised edition, 2010.

20MEP03	MATERIALS CHARACTERIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to have a precise knowledge on the Interpretation of various materials characterization using microscopic and other related techniques.

COURSE CONTENT:

Optical Microscopy and Scanning Electron Microscopy (SEM)

Optical Microscopy - Introduction, Optical principles, Instrumentation, Specimen preparation-metallographic principles, Imaging Modes, Applications, Limitations; Scanning Electron Microscopy (SEM) - Introduction, Instrumentation, Contrast formation, Operational variables, Specimen preparation, imaging modes, Applications, Limitations

Transmission Electron Microscopy (TEM) and X- Ray Diffraction (XRD)

Transmission Electron Microscopy (TEM) - Introduction, Instrumentation, Specimen preparation-pre thinning, final thinning, Image modes- mass density contrast, diffraction contrast, phase contrast, Applications, Limitations; X- Ray Diffraction (XRD) - Introduction, Basic principles of diffraction, X - ray generation, Instrumentation, Types of analysis, Data collection for analysis, Applications, Limitations.

Scanning Probe Microscopy (SPM)

Scanning Probe Microscopy (SPM) & Atomic Force Microscopy (AFM) - Introduction, Instrumentation, Scanning Tunneling Microscopy-Basics, probe tips, working environment, operational modes, Applications, Limitations; Electron Probe Micro Analyzer (EPMA) - Introduction, Sample preparation, Working procedure, Applications, Limitations.

X- Ray Spectroscopy

X- Ray Spectroscopy for Elemental Analysis - Introduction, Characteristics of X-rays, X-ray Fluorescence Spectrometry, Wavelength Dispersive Spectroscopy-Instrumentation, Working procedure, Applications, Limitations.

Energy Dispersive Spectroscopy

Energy Dispersive Spectroscopy - Instrumentation, Working procedure, Applications, Limitations; Thermal Analysis - Instrumentation, experimental parameters, Basic principles, Instrumentation, working principles, Applications, Limitations.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: interpret various materials characterization techniques.

CO2: understand the principle and operation of characterization equipments and the adjustment of operation variables to obtain good images / results.

CO3: select the characterization tool for specific application.

CO4: compare the principle and operation of different characterization tools such as optical microscope, Scanning electron microscopes and transmission electron microscope.

CO5: analyze the characterization results by various equipment.

REFERENCES:

1. ASM Handbook: Materials Characterization, ASM International, 2008.

2. Yang Leng: Materials Characterization-Introduction to Microscopic and Spectroscopic Methods, John Wiley & Sons (Asia) Pte Ltd., 2008.

3. Robert F. Speyer: Thermal Analysis of Materials, Marcel Dekker Inc., New York, 1994.

4. V. T. Cherapin and A. K. Mallik: Experimental Techniques in Physical Metallurgy, Asia Publishing House, 1967.

20MEP04	NANO MATERIALS AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to have a precise knowledge on the different nanomaterial's available, their properties and methods of synthesis along with applications.

COURSE CONTENT:

Nanostructures

Zero-, One- Two- and Three- dimensional structure, Size control of metal Nanoparticles and their properties: Optical, Electronic, Magnetic properties; Surface plasmon Resonance, Change of bandgap- Application: catalysis, electronic devices

Nanocomposites and Biomaterials

Organic / inorganic materials – Polymer nanocomposites – Ceramic nanocomposities – Metal nanocomposites – Synthesis – Properties – Characterizations – Applications of nanocomposites. Types of biomaterials – compatibility issues- biopolymers and their properties in vitro and in vivo- metals and ceramics as biological implants.

Medicinal Applications

Therapeutic applications of Nanoparticles / nanoparticulate Delivery systems – Cancer therapy – Intracellar targeting – treatment of respiratory diseases – per oral absorption – ocular delivery – Gene delivery – Brain delivery – prolonged systemic circulation.

Thermo Electric Materials (TEM)

Concept of phonon, Thermal conductivity, Specific heat, Exothermic & Endothermic processes. Bulk TEM Properties, Different types of TEM; One dimensional TEM; Composite TEM; Applications.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand and describe the various structures and properties of nano materials.

CO2: Interpret the different types of nano-composites and biomaterials along with their properties, characterization techniques and applications.

CO3: enumerate the medicinal applications of nano particles with their advantages and limitations.

CO4: Identify and enumerate the concept, processes, properties and applications of thermo electric materials.

REFERENCES:

1. C. N. R. Rao, A.Müller, A.K.Cheetham, "Nanomaterials Chemistry", Wiley-VCH, Weinheim, 2007.

2.FernandoLanga De La Puente, Jean-Francois Nierengarten "Fullerenes: Principles and Applications"RSC publications, 2007.

3. Wilson M., Kannangara K., Smith G., Simmons M., and Raguse B., "Nanotechnology: basic science and emerging technologies", Overseas Press, 2005.

4. Rao, C.N.R, "Nanotubes and Nanowires", RSC publications, 2005.

5. Thomas Twardowski, "Introduction to Nanocomposite Materials: Properties, Processing", DES Tech Publications 2007

6. Buddy D. Ratner, Biomaterials science : an introduction to materials in medicine, Academic Press, 1996.

7. Robert W. Kelsall, Mark. Geoghegan, Ian W. Hamley, "Nanoscale Science and Technology", John Wiley and Sons, 2005.

8. J.B.Park and R.S. Lakes Biomaterials, Plenum, 1992.

20MEP05	METAL FORMING TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to understand the importance of metal forming processes in a manufacturing industry.

COURSE CONTENT:

Stress - Strain Tensor

State of stress, components of stress, symmetry of stress tensor, principle stresses, stress deviator, Von Mises, Tresca Yield criteria, comparison of yield criteria, Octahedral shear stress and shear strain, Slip, twinning, Forming load calculations, Strain Rate Tensor.

Fundamentals of Metal Forming

Classification of forming process- Mechanics of metal working, Flow stress determination, Effect of temperature, strain rate and metallurgical structure on metal working, Friction and lubrication. Deformation zone geometry, Workability, Residual stresses.

Forging and Rolling

Forging-Hot, Cold and Warm Forging – types of presses and hammers. Classification, die design, forging in plane strain, calculation of forging loads, forging defects – causes and remedies, residual stresses in forging. Rolling: Classification of rolling processes, types of rolling, forces and geometrical relationship in rolling, rolling defects- causes and remedies.

Extrusion and Drawing

Direct and indirect extrusion, variables affecting extrusion, deformation pattern, equipment's, port – hole extrusion die, hydrostatic extrusion, defects and remedies, simple analysis of extrusion ,tube extrusion and production of seamless pipe and tube. Drawing of road, wires and tubes.

Sheet Metal Forming and Other Processes

Forming methods – Shearing, blanking, bending, stretch forming, deep drawing, defects, sheet metal formability, forming limit diagram. High velocity forming, Explosive forming, Electro hydraulic, Electro Magnetic forming, Dynapak and petroforge forming.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: explain the stress-strain concepts of materials during plastic deformation.

CO2: apply the theory of plasticity and its application for analyzing various metal forming processes.

CO3: apply the principle of forging and rolling for load calculation and its applications.

CO4: apply the principle of extrusion and drawing for load calculations and its applications.

CO5: enumerate the various sheet metal forming methods and its applications.

REFERENCES:

1. Dieter.G.E., "Mechanical Metallurgy", McGraw – Hill Co., SI Edition, 2007.
2. Surender Kumar, "Technology of Metal Forming Processes", PHI, New Delhi, 2008.
3. Avitzur, "Metal Forming – Process and Analysis", Tata McGraw – Hill Co., New Delhi, 1977.
4. Kurt Lange, "Handbook of Metal Forming", Society of Manufacturing Engineers, Michigan, USA, 1998
5. Nagpal G. R., "Metal Forming Processes", Khanna Pub., New Delhi, 2000
6. ShiroKobayshi, Altan. T, Metal Forming and Finite Element Method, Oxford University Press, 1987.
7. Sadhu Singh, "Theory of plasticity and Metal Forming Processes", Khanna Publishers, 2005.

20MEP06	EMERGING MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To introduce the students about metallurgy and materials science. To study the information on new, exotic materials for high-tech applications. To emphasize the physical properties of the materials.

COURSE CONTENT:

Smart Materials

Types and characteristics of Smart materials-Fundamental characteristics. Solid materials-Introduction of advanced materials and its manufacturing processes for engineering applications- smart materials- Classification of smart materials.

Hydrogen Storage Materials

Storage of Hydrogen in pure form-Joule Thompson coefficient, Gaseous storage. Liquid storage. Hybrid and super critical storage, Hydrogen slush.Physisorption in Porous Materials-Carbon Materials, Organic Polymers, Zeolites, Coordination Polymers.

Thermo Electric Materials

Thermo Electric Materials (TEM)-Concept of phonon.Thermal conductivity. Specific heat.Exothermic -endothermic processes. Different types of TEM -Bulk TEM Properties. Composite TEM-Applications.

Importance of Nano-Technology

Properties of Nano materials, Molecular building blocks for nanostructure systems. Influence of Nano structure on mechanical, optical, electronic, magnetic and chemicalproperties. Carbon Nano Structures-Introduction- Fullerenes. Types of Nano-tubes- assemblies-synthesis of carbon nanotube - Applications

High Temperature Materials

Characteristics of high-temperature materials, The super alloys - applications, Nickel as a high-temperature material -composition–microstructure relationships in nickel alloys. Defects in nickel and its alloys. Coatings - Processes for the deposition of coatings on the superalloys, Thermal barrier coatings, Overlay coatings, Diffusion coatings.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the fundamental characteristics, properties, structure and classification of different materials.

CO2: Interpret the various processes and concepts related to emerging materials

CO3: Classify the emerging materials based on the type of applications.

CO4: Emphasize the physical properties of the materials and to understand the concepts of hydrogen storage materials, thermo electric materials, high temperature materials and other smart materials

REFERENCES:

1. Smart Materials and New Technologies- D. Michelle Addington Daniel L. Schodek, Elsevier, 2005.
2. Handbook of advanced materials enabling new designs , Ed.James K. Wessel, Wiley Eastern , 2004.
3. Handbook of Hydrogen Storage: New Materials for Future Energy Storage- Ed.MichaelHirscher,Wiley VCH ,2010.
4. Nano: The Essentials - T.Pradeep - Tata McGraw Hill, New Delhi, 2007 .
5. Introduction to Nanotechnology- Charles P.Poole, Jr. and Frank J.Owens ,Wiley, 2003 .
6. Piezoelectricity -W.Taylor George Gorden and Breach Sc. Pub., 1985
7. Smart materials and Structures- M.V. Gandhi, B.S Thompson, Chapman and Hall, 1992.
8. The Superalloys -Fundamentals and Applications-Roger C. Reed, Cambridge university press Cambridge, 2006.

20MEP11	UNCONVENTIONAL MACHINING PROCESS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications

COURSE CONTENT:

Introduction

Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes

Mechanical Energy Based Processes

Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations.

Thermo-Electric Energy Based Processes

Principles, equipments, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining.

Chemical and Electro Chemical Energy Based Processes

Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring - Principles, equipment, effect of process parameters, applications, advantages and limitations

Nano Finishing Processes

Principles, equipments, effect of process parameters, applications, advantages and limitations of Abrasive flow machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magnetorheological finishing, Magneto rheological abrasive flow finishing.

Hybrid Non-Traditional Machining Processes

Introduction - Various hybrid non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Selection and comparison of different non-traditional machining processes.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: Summarize the needs and classification of unconventional machining process

CO2: Understand the various input and output parameters that influence the process performance

CO3: interpret the working principle of mechanical, thermo-electric, chemical and electro chemical energy based machining process

CO4: Select the material and tools with respect to the required machining processes.

REFERENCES:

1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007.
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi,2007
3. Benedict. G.F. "Nontraditional Manufacturing Processes", Marcel Dekker Inc., New York,1987
4. McGeough, "Advanced Methods of Machining", Chapman and Hall, London, 1998
5. Paul De Garmo, J.T.Black, and Ronald.A.Kohser,"Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., 8thEdition, New Delhi , 2001

20MEP12	PRODUCTION PLANNING AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.

COURSE CONTENT:

Introduction

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

Work Study

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

Product Planning and Process Planning

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

Productivity

Importance, Productivity patterns, productivity measurements & ratios, improvement-maintenance process. 3 Human Factors & Ergonomics: Human abilities, Training & motivation safety programs, workplace design & working conditions.

Inventory Control and Recent Trends InPpc

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

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand and prepare production planning and control activities such as work study, product planning, production scheduling, Inventory Control.

CO2: apply work study and time study tools for organization effective to improve productivity

CO3: plan manufacturing requirements using manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

CO4: interpret manufacturing requirements using Just in Time and Ordering procedures considering human and environmental factors

REFERENCES:

1. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition, John Wiley and Sons, 2000.
3. KanishkaBedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007.
4. Melynk, Denzler, "Operations management – A value driven approach" Irwin Mcgraw hill.
5. Norman Gaither, G. Frazier, "Operations Management", 9th edition, Thomson learning IE, 2007
6. UpendraKachru, "Production and Operations Management – Text and cases", 1st Edition, Excel books 2007.

20MEP13	MAINTENANCE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.

COURSE CONTENT:

Principles and Practices of Maintenance Planning

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.

Maintenance Policies – Preventive Maintenance

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM.

Condition Monitoring

Condition Monitoring – Cost comparison with and without CM – On-load testing and offload testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis

Repair Methods for Basic Machine Elements

Repair methods for beds, slideways, spindles, gears, lead screws and bearings – Failure analysis – Fault tree analysis and Root cause analysis, Failures and their development – Logical fault location methods – Sequential fault location.

Repair Methods for Material Handling Equipment

Repair methods for Material handling equipment - Equipment records –Job order systems - Use of computers in maintenance.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand maintenance objectives and evaluate various maintenance strategies for a manufacturing industry,

CO2: understand the maintenance policies and classify the various types of maintenance employed in industry.

CO3: Interpret the repair methods for basic machine elements and material handling equipments.

CO4: enumerate the importance of Total Productive maintenance and its implementation in in manufacturing industry.

CO5: apply the condition monitoring techniques to monitor various process parameters and to analyze the obtained mechanical data.

REFERENCES:

1.JMaiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.

2.R. Keith Mobley, Maintenance Fundamentals, Elsevier, 2011. 5. W. E. Vesely, F. F. Goldberg, Fault Tree Handbook, Create space Independent Pub, 2014

3.Alakesh Manna ," A Textbook of Reliability and Maintenance Engineering" I K International Publishing House Pvt. Ltd; First Edition 2013

4.Keith Mobley, Lindley Higgins, Darrin Wikoff "Maintenance Engineering Handbook" (McGraw-Hill Handbooks) McGraw-Hill Education; 7 edition (16 May 2008)

20MEP14	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To enable the student to understand the processes, techniques and methods of fabrication in additive manufacturing.

COURSE CONTENT:

Introduction

Introduction to AM – Classification of AM-Need for AM - Development of Additive Manufacturing (AM) Technology: - Rapid Prototyping Rapid Tooling – Rapid Manufacturing – Additive Manufacturing. AM Process Chain- Classification – Benefits Applications: Building Printing-Bio Printing- Food Printing-Printing Electronics – Post Processing of AM - Business Opportunities and Future Directions - Intellectual Property

Design For Additive Manufacturing (DFAM)

Concepts and Objectives- Generative Design – Defining Generative setup - AM Unique Capabilities: Part Consolidation-Topology Optimization- Data Processing - CAD Model Preparation - Part Orientation and Support Structure Generation -Model Slicing - Tool Path Generation Customized Design and Fabrication for Medical Applications-Post Processing of generative design - Case Studies.

VAT Polymerization and Material Extrusion

Photo polymerization: Stereo lithography Apparatus (SLA) - Materials -Process -Advantages Limitations- Applications. Digital Light Processing (DLP) - Materials – Process - Advantages - Applications. Extrusion Based System: Fused Deposition Modeling (FDM) - Process- Materials - Applications and Limitations.

Powder Bed Fusion and Direct Energy Deposition

Powder Bed Fusion: Selective Laser Sintering (SLS): Process – Powder Fusion Mechanism – Process Parameters – Typical Materials and Application. Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Materials – Process - Advantages and Applications. Beam Deposition Process: Laser Engineered Net Shaping (LENS)- Process -Material Delivery - Process Parameters -Materials -Benefits -Applications.

Other Additive Manufacturing Processes

Binder Jetting: Three Dimensional Printing - Materials -Process - Benefits and Limitations. Material Jetting: Multijet Modeling- Materials - Process - Benefits. Sheet Lamination Process: Laminated Object Manufacturing (LOM) - Basic Principle- Mechanism: Gluing or Adhesive Bonding – Thermal Bonding- Materials-Application and Limitation.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: Ability to understand the different process of Additive Manufacturing. Using Polymer, Powder and Nano materials manufacturing.

CO2: interpret various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM

CO3: describe the various NC, CNC machine programing and Automation techniques.

CO4: develop different AM tools to produce new components with intricate geometry.

REFERENCES:

1. Ian Gibson, David W. Rosen and Brent Stucker "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", 2nd edition, Springer., United States, 2015, ISBN13: 978-1493921126.
2. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1- 56990-582-1.
3. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092.
4. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Wood head Publishing., United Kingdom, 2016, ISBN: 9780081004333.
5. L. Jyothish Kumar, Pulak M. Pandey, David Ian Wimpenny "3D Printing and Additive Manufacturing Technologies" Springer, 2018 ISBN 9811303053, 9789811303050

20MEP15	CASTING AND WELDING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To enable the student to understand the various casting and processes along with their process techniques.

COURSE CONTENT:

Patterns, Core and Moulding

Moulding sands - Types and Properties, Patterns - types of patterns, selection of materials for patterns - pattern allowances, Gating and Risering, Sand moulding processes, Moulding machines, Core requirements, Core making processes.

Types of casting

Melting furnaces ,Die Casting, Investment Casting, Centrifugal Casting, Shell Moulding, Gravity die/ permanent mold, casting, Continuous Casting, pressure die casting, Slush Casting,Non-metal Molding /Ceramic Molding, squeeze casting. Solidification time. Modernization and Mechanization of Foundry, Pollution Control in Foundry, Casting defects and remedies

Aluminum Casting

Aluminum castings – Advantages, limitations, melting of aluminum using lift-out type crucible furnace. Hardeners used, drossing, gas absorption, fluxing and flushing, grain refining, pouring temperature. Stir casting set up, procedure, uses, advantages and limitations

Arc and Gas Welding Processes

Definition, Principles, Classification, Application, Advantages & limitations of welding. Arc welding: Principle, Metal arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW) and Atomic Hydrogen Welding (AHW).

Resistance and Special Welding Processes

Resistance welding principles, Seam welding, Butt welding, Spot welding and Projection welding. Friction welding, Explosive welding, Thermit welding, Laser welding and electron beam welding. Welding defect and remedies, Brazing and soldering.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: To understand the sand casting processes, special casting processes, melting and modernization and mechanization of foundries.

CO2: To analyze the casting defects and remedies as well as to understand nonferrous foundry practices.

CO3: To understand the various welding processes, soldering, brazing and welding defects and remedies.

REFERENCES:

1. SeropeKalpakjian StevenSchmid, "Manufacturing Engineering & Technology", Pearson, SeventhEdition, 2014
2. M.P.Groover, "Fundamentals of Modern Manufacturing Materials, Processes and Systems", John Wiley& Sons, 2010
3. P N Rao, "Manufacturing Technology Volume 1: Foundry, Forming and Welding", Tata McGraw Hill, Fourth Edition, 2013
4. Richard L. Little, "Welding and Welding Technology", McGraw Hill Education, 2001, Processes, and Equipment", CRC Press, 2011

20MEP16	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To introduce the process planning concepts to make cost estimation for various products after process planning

COURSE CONTENT:

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

Process Planning Activities
Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods – Set of documents for process planning-Economics of process planning- case studies

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

Production Cost Estimation
Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

Machining Time Calculation
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

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the concepts of different elements involved in process planning techniques.
CO2: select the suitable production processes and tools required for the manufacturing of components.

CO3: apply the principles of process planning and cost estimation to optimize the process parameters through different process planning and estimation techniques.
CO4: estimate the elements of cost and document the quality assurance methods.
CO5: calculate the machining time for various machining operations involved in the production processes.

REFERENCES:

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

20MEP21	ADVANCED INTERNAL COMBUSTION ENGINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To familiarize with the terminology associated with IC engines and understand the basics of IC engines.

COURSE CONTENT:

Spark Ignition Engines

Mixture requirements – Fuel injection systems – stoichiometric combustion-combustion with excess air-equivalence ratio. Stages of combustion – Normal and Abnormal combustion-Knock. Combustion chambers.

Compression Ignition Engines

Nature of combustion in IC engines-Types of fuel injection systems, Stages of combustion – Knocking, Air motion- Combustion Chambers Fuel spray behavior -Spray penetration and evaporation, waste gate in turbocharger - different arrangements of turbochargers.

Emission Formation And Control

Pollutant - Sources and types, formation of NOx - Hydrocarbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions. Emission control devices, automotive catalytic converters and Particulate Traps - Selective Catalytic Reduction (SCR) - Diesel Oxidation Catalyst (DOC). Emission standards: Bharat stage and Europe standards

Alternative Fuels

Alcohol Fuels, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel -Properties, Suitability– Engine Modifications for alternate fuels (liquid and gaseous fuels). Merits and Demerits as fuels

Alternate Combustion and Power Train System

Learn burn Engines - Homogeneous charge compression ignition (HCCI) – Reactivity Controlled Compression Ignition (RCCI) – Spark Assisted HCCI - Hybrid Electric and its types. Electric Vehicles –Fuel Cells.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: Analyze thermo-chemistry of combustion by applying thermodynamic laws in engine cycles

CO2: Determine performance and combustion characteristics of SI and CI engines.

CO3: Understand emission control techniques in engines, based on emission standards/norms

CO4: Identify and critically evaluate different types of alternate fuels for automobiles.

CO5: Demonstrate the developments to enhance the efficiency and performance of IC engines.

REFERENCES:

1. V. Ganesan, "Internal Combustion Engines", V Edition, Tata McGraw Hill, 2012.
2. John B. Heywood, "Internal Combustion Engines Fundamentals", McGraw-Hill, 1988.
3. Richard Stone, Introduction to Internal Combustion Engines, 4thedition, Palgrave Macmillan, 2012
4. John B.Heywood, Internal Combustion Engine Fundamentals, 2nd Edition, Tata McGraw Hill

20MEP22	NEW AND RENEWABLE SOURCES OF ENERGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the current energy scenario in terms of conventional renewable energy and future Plan. And also apply the principle of various solar, wind, bio energy, ocean and geothermal energy devices.

COURSE CONTENT:

Introduction

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy statusPotential of various renewable energy sources-Global energy status-Per capita energy consumption in various countries - Future energy plans

Solar Energy

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

Wind Energy

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

Bio Energy

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

Tidal Energy

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

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: describe the current energy scenario in terms of conventional renewable energy and to plan for the future

CO2: understand and apply the principles of various solar, wind energy generating devices.

CO3: classify and implement ocean and geothermal energy devices

REFERENCES:

1. G.D. Rai, "Non-Conventional Energy Sources", Standard Publishers Distributors, 1992.
2. John Twidell, Tony Weir, and Anthony D. Weir, Renewable Energy Resources, Taylor & Francis, 2006.
3. B.H. Khan, "Non-Conventional Energy Resources", McGraw Hill, 2009.
4. G.N. Tiwari, "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science, 2015.
5. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, 2012.

20MEP23	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
		3	0	0	3

(Use of standard Gas tables Data Book is permitted)

COURSE OBJECTIVE:

The course will enable the students to understand the fundamental knowledge on compressible and incompressible flows and effect of frictions and imparts knowledge on flow through the ducts, diffuser, nozzle and different shock waves, aircraft propulsions.

COURSE CONTENT:

Fundamentals of Isentropic Flows
Introduction to compressible flow – continuity, momentum and energy equations for compressible flow – wave propagation in incompressible, subsonic, sonic and supersonic flows.

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

Flow through Ducts and flow properties
Flow in constant area ducts with friction (Fanno flow), variation of flow properties, variation of Mach number with duct length. Isothermal flow with friction in constant area ducts. Flow in constant area ducts with heat transfer (Rayleigh flow).

Normal and Oblique Shocks
Governing equations, variation of flow parameters across the normal shock, Flow with normal shock waves – Prandtl-Mayer relation - impossibility of shock in subsonic flows - Applications.

Jet and Space Propulsion
Aircraft propulsion – types of jet engines, Propulsive Devices: turbo jet, turbo prop engine, turbo shaft engine, Ram jet, pulse jet, Rocket Propulsion, Principle of rocket propulsion, solid and liquid propellants - space flights.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: interpret energy and momentum equations of various compressible fluid flows and their applications.

CO2: compare the techniques used, benefits and drawbacks of various propellants feeding, ignition and combustion systems.

CO3: apply the governing equations and prandtl– meyer relations in various compressible fluid flows as well as the thrust equation in jet propulsion.

CO4: conclude the effect of mach number on various compressible fluid flows and correlate the staging, terminal and characteristic velocity.

CO5: determine the variation in flow parameters across the shock waves through the nozzle, diffuser and the performance of aerospace engines.

REFERENCES:

1. Anderson, J.D., "Modern Compressible flow", McGraw Hill, 2013.
2. S.M. Yahya, Fundamentals of Compressible Flow with Aircraft and Rocket propulsion, New Age International (P) Limited, 4th Edition, 2010.
3. Sutton, G.P. Rocket Propulsion Elements, John wiley, 2010, New York.
4. Radhakrishnan, E., Gas Dynamics, Printice Hall of India, 8th edition, 2010.
5. Shapiro, Dynamics and Thermodynamics of Compressible Fluid Flow, prentice hall, 6th edition, 2009.
6. Yahya. S. M., "Fundamental of compressible flow", New Age International (p) Ltd., New Delhi, Seventh Edition (2007).
7. Patrich.H. Oosthvizen, William E. Carscallen, "Compressible fluid flow", McGraw-Hill, Second edition 2013.
8. Ahmed F. El-Sayed "Aircraft Propulsion and Gas Turbine Engines", CRC Press, 2008.

20MEP24	ENERGY CONSERVATION IN INDUSTRIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the basic knowledge about current energy scenario, energy conservation, audit and management.

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COURSE CONTENT:

Basics of Energy

Classification of energy- primary and secondary energy, commercial and noncommercial energy, non-renewable and renewable energy - Global fuel reserve - Energy scenario in India and state of Tamilnadu Sector-wise energy consumption (domestic, industrial, agricultural and other sectors).

Energy Conservation and EC Act 2001

Analysis of scope and potential for energy conservation - Good housekeeping practice - Need of energy conservation in India - energy conservation act 2001 - national role of IRDEA (Indian renewable energy development agency) in energy conservation.

Electrical Supply System and Motors

Types of electrical supply system - Single line diagram - Losses in electrical power distribution system - Understanding Electricity Bill – Transformers - Electric Motors

Energy Efficiency in Electrical Utilities

Pumps - Compressed Air System - Energy Conservation in HVAC and Refrigeration System – Introduction - Concept of Energy Efficiency Ratio (EER) - Energy saving opportunities in Heating, Ventilation and Air Conditioning (HVAC) and Refrigeration Systems.

Energy Efficiency in Thermal Utilities

Thermal Basics - Energy Conservation in boilers and furnaces - Cooling Towers - heat exchangers, lighting system, Motors belts and drives, refrigeration system - Efficient Steam Utilization.

Heat Recovery and Co-Generation

Heat recovery from ventilation, air co-generation of heat and electricity, heat recovery and bottoming cycles

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: Design suitable energy monitoring system to analyze and optimize the energy consumption in an organization and Guide the employees of the organization about the need and the methods of energy conservation.

CO2: interpret the cost- benefit analysis of various investment alternatives for meeting the energy needs of the organization.

CO3: improve the thermal efficiency by designing suitable systems for heat recovery and co-generation.

REFERENCES:

1. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, Guide to energy management, The Fairmont Press (2008).
2. Nagabhushan Raju, K., Industrial Energy Conservation Techniques: Concepts, Applications and Case Studies, Atlantic Publishers & Distributors (2007).
3. Kenney, W.F., Energy Conservation in the Process Industries, Academic Press, (1984).
4. Reay, D.A., Industrial Energy Conservation, Pergamon Press (1979).
5. Giovanni Petrecca, Industrial energy management: principles and applications, Springer (1993).
6. Tripathy S C, "Electrical Energy Utilization and Conservation", Tata McGraw-Hill, New Delhi, 1991.

20MEP25	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

(Use of standard Refrigeration table and Steam tables Data Book are permitted)

COURSE OBJECTIVE:

The course will enable the students to understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components.

COURSE CONTENT:

Introduction

Introduction to refrigeration - unit of refrigeration and C.O.P.– ideal cycles- refrigerants desirable properties – classification - nomenclature - ODP & GWP.

Vapour Compression Refrigeration System

Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multi pressure system – low temperature refrigeration. Equipment's: Type of Compressors, Condensers, Expansion devices, Evaporators.

Other Refrigeration Systems

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

Psychrometric Properties and Processes

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

Air Conditioning Systems and Load Estimation

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load

COURSEOUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: understand the refrigeration system, classification, properties and nomenclature along with vapor compression cycles.

CO2: classify the different types of compressors used in refrigeration system

CO3: interpret the various psychometric properties and processes effectively.

CO4: analyze the air conditioning systems with various loads.

CO5: enumerate the design aspects of Refrigeration & Air conditioning systems

REFERENCES:

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010.
2. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.
3. Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.
4. ASHRAE Hand book, Fundamentals, 2010
5. Jones W.P., "Air conditioning engineering", 5th edition,Elsevier Butterworth-Heinemann, 2001

20MEP26	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the structure and components of the automobile vehicles and familiarise with the working Principle of IC engines and their auxiliary system.

COURSE CONTENT:

Vehicle structure, Engine

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, IC engines –components, Trends in automobile design. Types of wheels, construction, Tyres- construction, Tyre retreading cold & hot, Tubeless tyres. Tyres wear and causes.

Transmission Systems

Clutch: diaphragm clutch, single and multi-plate clutch, centrifugal clutch and construction, Gear box: Types - gear selector and shifting mechanism, over drive, transfer box, torque converter, propeller shaft, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

Steering, Brakes and Suspension Systems

Steering system: Steering geometry, wheel Alignment and balancing and types of steering, Power Steering. Suspension system: Types of Suspension Systems-front and rear suspension, Braking system: Types of brakes, anti-lock braking system (ABS).

Engine auxiliary systems

Electronic Engine Management systems for SI and CI engines. Turbo chargers, Safety systems - seat belts, air-bag. Modern electronic features in vehicles like tyre pressure monitoring, Electronic stability control,Electronicbrakeforce distribution, Automatic headlamp ON, Rain sensing wipers, speed sensing auto locking, On-Board Diagnostic.

Alternative Energy Sources and Emission Control

Liquid and gaseous alternate fuels - Alcohol, LPG, CNG, and Hydrogen in Automobiles. Hybrid Vehicles, Fuel Cell. Engine emission: Automotive air pollution, emission control, Engine emission control by three-way catalytic converter system, Introduction to MV Act, Emission norms (Euro and BS).

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: identity the various components and structures of automobiles.

CO2: select the suitable type of tires for on and off road vehicles.

CO3: classify the components of I.C engines, engine auxiliary systems, drive shafts, suspension and braking systems of various automobiles

CO4: select the suitable alternate energy sources, emission control techniques and interpret the environmental implications of automobile emission norms.

CO5: apply vehicle structures, auxiliary systems, transmission systems, suspension systems and brakes for automobile applications.

REFERENCES:

1. Kirpal Singh, "Automobile Engineering", Standard Publishers, Vol-I & II. Thirteenth Edition. New Delhi, 2014.

2. R. K. Rajput, "A Text book of Automobile Engineering", Lakshmi publication, Second Edition. 2014

3. Jack Erjavek, "Automotive Technology – A Systems Approach", Thomson Learning, 7th Edition, 2018. 4. Gill P.S., "A Textbook of Automobile Engineering – Vol. I , II and III", S.K.Kataria and Sons, 2nd Edition, 2012.

4. Gupta R B, "Automobile Engineering", SatyaPrakashan, 2015.

5. C.R. Ferguson, A. T. Kirkpatrick, Internal Combustion Engines, 2nd Edition, John Wiley & Sons, 2016.

20MEP31	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- The course will enable the students to understand the set of tools and methods used for product design and development.

COURSE CONTENT:

Introduction to Product Development

Introduction – Need for new product developing - A Generic Development Process – Adapting the Generic Product Development Process - Product Development Process Flows – Product life cycle - Product Specifications: Establishing Target and final Specifications; Identifying market opportunities.

Concept Generation and Selection

Concept Generations – concept screening – concept scoring – external and internal searches – concept exploration -concept testing methods - Task – Structured approaches – clarification – concept selection – methodology –benefits – Competitive benchmarking

Product Architecture and Industrial Design

Product Architecture – Implications - Establishing the Architecture platform planning - geometric layout development – fundamental and incidental interactions - Level Design Issues – Industrial Design - Need for Industrial Design; Impact of Industrial Design; The Industrial Design Process; Management of the Industrial Design Process.

DFM and Prototyping

Overview of Design for Manufacturing – steps in DFM - Estimate the Manufacturing Costs; Reduce the Costs of Components and Assembly; Reduce the Costs of Supporting Production; Impact of DFMA– Prototyping: Type; Uses; Principles; Technologies; Planning for Prototypes.

Product Development Economics and IPR

Product Development Economics: Elements of Economic Analysis; Economic Analysis Process - Managing Projects: Understanding and Representing Tasks; Overview of patents – utility patents – steps in preparing disclosure.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1:apply the principles of generic development process and also generate, select, screen, and test concepts for new product design and development.

CO2: analyze and interpret the principles of product architecture, industrial design and DFMA to design and develop new products.

CO3: enumerate the concepts of economics principles and IPR basics.

REFERENCES:

1. Jamnia, A., Introduction to Product Design and Development for Engineers, CRC Press, 2018.
2. Kari T.Ulrich and Steven D.Eppinger, Product Design and Development, McGraw-Hill International Edns. 1999.
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, Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
5. Staurt Pugh, Tool Design -Integrated Methods for Successful Product Engineering, Addison Wesley Publishing, New york, NY.

20MEP32	DESIGN FOR MANUFACTURE AND ASSEMBLY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- The course will enable the students to understand significance of design for manufacturing and assembly and to make the students learn about tolerance analysis, allocation and geometrical tolerances. Guidelines for design for manufacturing and assembly with examples

COURSE CONTENT:

Introduction for Manufacturing and Assembly

General design principles for manufacturability - Design for assembly - Geometric tolerances – Worst case method - Assembly limits –Design and Manufacturing Datum – Conversion of design datum into manufacturing datum -Tolerance stacks- Process capability.

Material Selection

Principal materials - Selection of materials and processes - Mechanisms selection - Possible solutions - Evaluation method - Influence of materials on form design - form design of grey iron, malleable iron, steel and aluminum castings, welded members and forgings.

Machining Processes

Design features to facilitate machining – Single point and multipoint cutting tools - Doweling procedures - Reduction of machined area- Simplification by separation - Simplification by amalgamation - Design for machinability - Design for economy - Design for accessibility.

Casting Design

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes – Design rules for sand castings – The die casting cycle, Determination of number of cavities and appropriate machine size in die casting- Modifying the design - Computer applications in DFMA

Environment Apects

Environmental objectives – Basic DFE methods – Lifecycle assessment –AT&T‟s environmentally responsible product assessment - Weighted sum assessment method – Design to minimize material usage – Design for recyclability – Design for remanufacture – Design for energy efficiency – Design to regulations and standards.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: understand the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications.

CO2: interpret the various design consideration principles of forming, machining and casting.

CO3: apply design consideration principles to minimize material usage, recyclability, remanufacture and energy efficiency.

REFERENCES:

1. Peck, Harry., "Design For Manufacture", Pitman Publications, London 1983.
2. Boothroyd, G, "Product Design for Manufacture and Assembly", New York, CRC Press, London, 2002.
3. Otto, Kevien and Wood, Kristin, "Product Design". Pearson Publication, New Delhi, 2004.
4. Matousek, "Engineering Design: A Systematic Approach", Blackie & Son Ltd., Glasgow, 1974.
5. Bralla, "Design for Manufacture Handbook", McGraw Hill, New York, 1999.

20MEP33	PIPING SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To understand the functional fundamentals of piping engineering, pipe hydraulics, piping supports.

COURSE CONTENT:

Introduction to Piping System

Fundamentals of piping engineering -Definitions, Piping Components their introduction, applications. Piping MOC, Budget Codes and Standards, Fabrication and Installations of piping.

Piping Drawing

Pipe hydraulics and sizing -Pipe sizing based on velocity and pressure drop consideration cost, least annual cost approach, pipe drawing basics, development of piping general arrangement drawing, dimensions and drawing of piping.

Layout and Analysis

Plot plan-Development of plot plan for different types of fluid storage, equipment layout, process piping layout, utility piping layout. Stress analysis -Different types of stresses and its impact on piping, methods of calculation, dynamic analysis, and flexibility analysis.

Piping design

Piping support-Different types of support based on requirement and its calculation. Design of liquid handling piping system, sizing for equal velocity, sizing for equal areas, optimal sizing, water hammer, Steam piping design, stream traps

Measuring Methods

Instrumentation Final Control Elements; measuring devices, instrumentation symbols introduction to process flow diagram (PFD) and piping & instrumentation diagram (P&ID)

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: apply concepts of mechanical engineering to understand the mechanism of piping systems and its core design.

CO2: analyze the flow elements and optimization of piping systems.

CO3: Construct piping system for robust environments using electromechanical elements.

REFERENCES:

1. Luyben, W. L.," Process Modeling Simulation and Control for Chemical Engineers,McGraw Hill, 1990.
2. Piping Design Handbook edited by Johan J McKetta, CRC Press, 1992.
3. Piping Handbook, 6 th edition, M.L. Nayyar, P.E., Mc Graw-Hill, Inc.
4. Sahu G.K., “Hand Book of Piping Design”, New Age International (P) Ltd. 1998
5. Peter Smith “The Fundamentals of Piping Design” Gulf Publishers 2007.

20MEP34	COMPUTATIONAL TECHNIQUES FOR FLUID DYNAMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the various aspects of computational techniques

COURSE CONTENT:

Governing Equations and Boundary Conditions

Introduction to CFD – Conservation and Nonconservation form - Governing equations– Continuity, Momentum and Energy equations – Physical boundary conditions – Time-averaged equations for Turbulent Flow Characteristics of PDE's - Elliptic, Parabolic and Hyperbolic equations.

Discretization and Finite Difference Methods

Basic aspects of discretization – Comparison of finite difference, finite volume and finite element techniques - Derivation of finite difference equations– General Methods for first and second order accuracy – Finite difference methods: Forward, backward and central difference schemes – Transient one and two dimensional conduction – Explicit, Implicit schemes and ADI methods.

Finite Volume Method for Convection Diffusion

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes, Hybrid, Power-law, exponential, quick schemes, False diffusion - Conservativeness, Boundedness, Transportiveness.

Flow Field Analysis

Stream function and vorticity, Representation of the pressure gradient term, Staggered grid – Momentum equations, Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

Turbulence Models and Mesh Generation

Introduction – Types of Turbulence modeling, mixing length model, Boussinesq approach - Two equation (k-Є) models – Reynolds time average conservation equations - Mesh Generation and refinement Techniques-software tools.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: apply the fundamentals of CFD to develop case specific governing equations and perform finite difference and finite volume based analysis

CO2: analyze numerical modeling and its role in the field of fluid flow and heat transfer

CO3: utilize the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems.

REFERENCES:

1. Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2014.
2. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill, 1998. John. F. Wendt, "Computational Fluid Dynamics – An Introduction", Springer, 2013.
3. K.Muralidhar&T.Sundararajan, Computational Fluid Flow and Heat Transfer, Narora Publishing House, 1994.
4. Suhas V, Patankar, "Numerical Heat transfer and Fluid flow", Taylor & Francis, 2009.
5. Uriel Frisch, Turbulence, Cambridge University Press, 1999.
6. YogeshJaluria& Kenneth E. Torrance, "Computational Heat Transfer", CRC press, 2002.

20MEP35	DESIGN CONCEPTS IN ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the various design requirements and get acquainted with the processes involved in product development.

COURSE CONTENT:

Design Terminology

Definition-various methods and forms of design-importance of product design-static and dynamic products-various design projects-morphology of design-requirements of a good design-concurrent engineering-computer aided engineering-codes and standards-product and process cycles-bench marking.

Introduction to Design Processes

Basic modules in design process-scientific method and design method-Need identification, importance of problem definition-structured problem, real life problem- information gathering -customer requirements- Quality Function Deployment (QFD)- product design specifications-generation of alternative solutions- Analysis and selection-Detail design and drawings-Prototype, modeling, simulation, testing and evaluation

Creativity in Design

Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocks-Creativity methods-brainstorming, synectics, force fitting methods, mind map, concept map-Theory of innovative problem solving (TRIZ) - conceptual decomposition creating design concepts.

Human and Societal Aspects in Product Development

Human factors in design, ergonomics, user friendly design-Aesthetics and visual aspects environmental aspects-marketing aspects-team aspects-legal aspects-presentation aspects

Material and Processes in Design

Material selection for performance characteristics of materials-selection for new design substitution for existing design-economics of materials-selection methods-recycling and material selection-types of manufacturing process, process systems- Design for Manufacturability (DFM) - Design for Assembly (DFA).

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: analyze the various design requirements and get acquainted with the processes involved in product development.

CO2: apply the design processes to develop a successful product.

CO3: apply scientific approaches to provide design solutions.

CO4: design solution through relate the human needs and provide a solution.

CO5: apply the principles of material selection, costing and manufacturing in design.

REFERENCES:

1. Dieter. G. N., Linda C. Schmidt, "Engineering Design", McGraw Hill, 2013.
2. Horenstein, M. N., Design Concepts for Engineers, Prentice Hall, 2010.
3. Dhillon, B. S., Advanced Design Concepts for Engineers, Technomic Publishing Co.,1998.
4. Edward B. Magrab, Satyandra K. Gupta, F. Patrick McCluskey and Peter A. 5.Sandborn, "Integrated Product and Process Design and Development", CRC Press,2009.
5. James Garratt, "Design and Technology", Cambridge University Press, 1996.
6. Joseph E. Shigley, Charles R.Mische, and Richard G. Budynas, "Mechanical Engineering Design", McGraw Hill Professional, 2003.
7. Sumesh Krishnan and MukulSukla, Concepts in Engineering Design, Notion Press, 2016.

20MEP36	DESIGN OF JIGS, FIXTURES AND PRESS TOOLS	L	T	P	C
		3	0	0	3

(Use of standard P S G Design Data Book is permitted)

COURSE OBJECTIVE:

- The students will be taught various types of jigs, fixtures and design jigs and fixtures for given components.
- Students also will be able to estimate the tonnage requirements of various dies and learn various components of dies.
- Students will also learn cutting, bending, drawing and forming dies. The course will also impart knowledge on combination dies also.

COURSE CONTENT:

Introduction

Tool design objectives, Materials used in Jigs and Fixtures, Types of Jigs, Types of Fixtures, Mechanical actuation, pneumatic and hydraulic actuation. Analysis of clamping force, Tolerance and error analysis.

Types of Jigs and Fixtures

Types of jigs, plate, latch, channel, box, post, angle plate, angular post, turnover, pot jigs. Automatic drill jigs. General principles of boring, lathe, milling, broaching, grinding, planning, shaping, assembly, inspection, welding and modular fixtures. Design and development of jigs and fixtures for given components

Press Tools

Press working terminology, Presses and accessories. Computation tonnage requirements. Elements of progressive, combination and compound dies. Die block, die shoe, bolster plate, punch plate, punch holder guide pins and bushes. Strippers, knockouts, stops, pilots. Selection of standard die sets, strip lay out calculations.

Design of Press Tools

Design and development of progressive and compound dies for blanking and piercing operations. Design of combination dies. Design and development of bending, drawing and forming dies.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: understand the concepts of Tool design, Materials used in Jigs and Fixtures, Presses and accessories.

CO2: classify Types of Jigs, Fixtures, Mechanical actuation, pneumatic and hydraulic actuation

CO3: analyze the clamping force, tolerance and errors.

CO4: design progressive dies, compound dies and combination dies

CO5: design bending dies, drawing dies and forming dies.

CO6: select appropriate dies, jigs, fixtures and press tools for given components.

REFERENCES:

1. Joshi, P.H. "Jigs and Fixtures", Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.
2. Joshi P.H "Press tools - Design and Construction", S. Chand & Co Ltd. 2001.
3."ASTME – Fundamentals of tool design", Prentice Hall of India, 1984.
4. Donaldson, Lecain and Goold, "Tool Design", Tata McGraw Hill, 2000.
5. Hoffman "Jigs and Fixture Design" – Thomson Delmar Learning, Singapore, 2004.
6. Kempster, "Jigs and Fixture Design", Hoddes and Stoughton, 1974.
7. K. Venkataraman, "Design of Jigs Fixtures & Press Tools", Anne Publications, 2015.

20MEP41	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the various aspects of entrepreneurship development.

COURSE CONTENT:

Entrepreneurship

Entrepreneur – Characteristics – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Role of Entrepreneurship in Economic Development – Factors Affecting Entrepreneurial Growth – Economic, Non Economic, Government Actions.

Motivation

Entrepreneurial Motivation: Theories and Factors, Achievement Motivation – Entrepreneurial Competencies – Entrepreneurship Development Programs – Need, Objectives – Business Game, Thematic Apperception Test, Self Rating, Stress management.

Business

Small Enterprises – Definition, Characteristics, Project Identification and selection – Project Formulation: Significance, content, formulation of project report – Project Appraisal: Concept and method – Ownership Structures: Selection & Pattern.

Financing and Accounting

Finance: Need, Sources, Capital Structure, Term Loans – Accounting: Need, Objectives, Process, Journal, Ledger, Trial Balance, Final Accounts – Working Capital Management: Significance, Assessment, Factors, Sources, Management.

Support to Entrepreneurs

Sickness in small Business: Concept, Signals, Symptoms, Magnitude, Causes and Consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in Small Scale Enterprise – Institutional Support to Entrepreneurs: Need and Support – Taxation Benefits to Small Scale Industry: Need, Depreciation, Rehabilitation, Investment.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: understand characteristics of entrepreneurship and its role in economic development.

CO2: classify the theories of achievement, motivation and the principles of entrepreneurship development program.

CO3: select the appropriate form of business ownership in setting up an enterprise.

CO4: apply the fundamental concepts of finance and accounting to enterprise.

CO5: identify sickness in industry, select the appropriate corrective measures and the required growth strategies in enterprise.

REFERENCES:

1. S.S.Khanka, "Entrepreneurial Development" S.Chand& Co. Ltd. Ram Nagar New Delhi,1999.
2. Kurahko&Hodgetts, " Entrepreneurship – Theory, process and practices", Thomson learning 6th edition.
3. Charantimath, P. M., Entrepreneurship Development and Small Business Enterprises, Pearson, 2006.
4. Hisrich R D and Peters M P, "Entrepreneurship" 5th Edition Tata McGraw-Hill, 2002.
5. Mathew J Manimala," Entrepreneurship theory at cross roads: paradigms and praxis" Dream tech, 2nd edition 2006.
6. Rabindra N. Kanungo, "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998.
7. Singh, A. K., Entrepreneurship Development and Management, University Science Press, 2009.

20MEP42	ENGINEERING ECONOMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the fundamental economic concepts applicable to engineering. And apply the concepts of value, estimate cost of product / services and economic decision making.

COURSE CONTENT:

Introduction

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Production – factors affecting production – PPC curve.

Cost Estimation

Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis – P/V ratio, Elementary economic analysis – Material selection for product Design selection for a product, Process planning.

Value Engineering and Make/Buy Desion Making

Value engineering – Function, aims, Value engineering procedure. Interest formulae –Time value of money, Make or buy decision, Project decision making using Payback period method, NPV and IRR.

Replacement and Maintenance Analysis

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return.

Inflation, International Business and Globalisation

Economic policy -fiscal policy – monetary policy - Inflation – types – measures to control inflation – Globalization and international business

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: Understand the basics of economics.

CO2: Compare making or buying of components and selection of projects from alternatives.

CO3: Examine the various cost components and undertake basic economic analysis.

CO4: Analyze the maintenance and replacement of machines based on their economic life.

CO5: **U**nderstand economic policies, inflation, international business and globalization

REFERENCES:

1. Joel Dean, Managerial Economics , Prentice Hall India, 2014
2. John A. White, Kellie S. Grasman, Kenneth E. Case, Kim LaScola Needy, and David B. Pratt, Fundamentals of Engineering Economic Analysis first edition, Wiley, August 2013.
3. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2010.
4. Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2011.
5. Gupta, G.S. Managerial Economics , 2nd Edition, Tata McGraw Hill , 2013.

20MEP43	LEAN MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To understand and acquire Knowledge on important tools in lean Manufacturing system adopted in an Organization

COURSE CONTENT

Introduction

Introduction, background, and lean thinking. Importance of philosophy, strategy, culture, alignment, focuses and systems view.

Toyota Production System

Discussion of Toyota Production System. Lean production preparation – System assessment, process and value-stream mapping – Sources of waste.

Lean Production Processes

Lean production processes, approaches and techniques. Importance of focusing upon flow. Tools include: Workplace organization – 5S, Stability, Just-In-Time – One piece flow – Pull, Cellular systems, Quick change and set-up reduction methods, Total productive maintenance, Poka-Yoke – mistake proofing.

Lean Implementation

Employee involvement, communication, Start-up of lean processes and examples of applications. Sustaining improvement and change, auditing, follow-up actions.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: understand the concepts and approaches of lean production processes and techniques with sustaining improvement.

CO2: classify and categorize the different sources of waste and value stream mapping for manufacturing processes.

CO3: interpret lean thinking and employee involvement concepts in manufacturing industry.

CO4: determine the lean communication and auditing concepts followed in industry.

CO5: enumerate lean techniques such as 5S, Just-In-Time, Cellular systems, Quick change and set-up reduction methods.

CO6: implement Total productive maintenance, Poka-Yoke for a manufacturing sector.

REFERENCES:

1. Lonnie Wilson, How To Implement Lean Manufacturing, Second Edition, McGraw Hill Inc., New York, 2015.
2. Jon Miller , Mike Wroblewski , Jaime Villafuerte , "Creating a Kaizen Culture: Align the Organization, Achieve Breakthrough Results, and Sustain the Gains" (Mechanical Engineering), McGraw Hill Inc., New York, 1st Edition,2013.
3. Jacob Stoller, "The Lean CEO: Leading The Way To World-Class Excellence", McGraw Hill Inc., New York, First Edition, 2015.
4. Kimberly Watson-Hemphill and Kristine Nissen Bradley, "Innovating Lean Six Sigma: A Strategic Guide To Deploying The World's Most Effective Business Improvement Process", McGraw Hill Inc., New York, First Edition, 2016.
5. Ola Johansson, Martin Broman,Dan Blucher, HenricAlsterman Per Petersson , "Lean - Turn Deviations Into Success", (First Indian Edition, 2015).

20MEP44	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Understand the need for quality, its evolution, basic concepts, and contribution of quality gurus, TQM framework, Barriers and other benefits of TQM.

COURSE CONTENT:

Introduction

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM - Basic concepts of TQM – TQM Framework- Benefits and Barriers to TQM.

TQM Principles

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal--Continuous process improvement –Juran Trilogy, PDCA cycle, 5S and Kaizen.

TQM Tools & Techniques I

The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Pitfalls - FMEA - Design FMEA and Process FMEA.

TQM Tools & Techniques II

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.

Quality Management System

Introduction - Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation-Internal Audits-Registration-Environmental Management System: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: Understand TQM concepts and principles in a selected enterprise.

CO2: Comprehend the principles pertaining to TQM and the various spheres of TQM system

CO3: Apply Six Sigma and other traditional and new tools, benchmarking, FMEA, etc.

CO4: Apply Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ, BPR, QMS and EMS in any organization. And various quality systems and standards.

REFERENCES:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field, MaryB. Sacre, HemantUrdhwareshe and RashmiUrdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.
2. Joel.E. Ross, "Total Quality Management – Text and Cases",Routledge.,2017.
3. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
4. James R. Evans Total Quality: Management, Organization and Strategy, South-Western College Publications, 4th edition, 2004.
5. Kiran.D.R, "Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.

20MEP45	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand and acquire Knowledge on important tools in operations research adopted in an Organization

COURSE CONTENT:

Linear Programming Problems

OR-Definition - Phases - models, LP problem formulation – Graphical solution, GLPP, Standard and Canonical forms of LPP- simplex methods- Big M, Two phase methods, Alternate optimal solutions, Duality in LP.

Transportation

Transportation problems- Basic feasible solution, Optimal solution By MODI method, Balanced and Unbalanced TP, Degeneracy, Production problems. Assignment problems – Hungarian method Traveling salesman problems - Sequencing models- Johnson algorithm, n job 2 machines,n job 3 machines and n job m machines.

Inventory Control

Types of inventory- Inventory cost - EOQ - Deterministic inventory problems – Purchase and Production models with and without shortages-EOQ with price breaks - Stochastic inventory problems - Multi product problems - Systems of inventory control (P and Q Systems)-Determination of buffer stock and re-order levels -Selective inventory control techniques (ABC,VED, SDE, etc.)

Queuing Theory

Queuing system - Characteristics - symbols - Poisson process and exponential distribution – Single server queuing models - Multiserver queuing models, Simulation Monte Carlo technique- Inventory& Queuing problems.

Project Management and Replacement Models

Project management: Network logic – Ford-Fulkerson's rule - AON diagram - CPM and PERT techniques, Critical path and float calculations Replacement models -types of failures – Gradual failures-replacement of items: Efficiency deteriorates with time, sudden failures-individual and group replacement policies.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: select the constraints on the availability of resources, develop a model and render an optimal solution during the given circumstances.

CO2: appraise the challenges in the transportation and production problems and furnish a rational solution to maximize the benefits.

CO3: plan the purchase/ manufacturing policies, manage the spares/ stocks and meet the customer demands.

CO4: analyze the queue discipline and explore the avenues for better customer service.

CO5: investigate the nature of the project/ failure and offer methodical assistance towards decision making.

REFERENCES:

1. Wayne.L.Winston, "Operations research applications and algorithms", 4th edition, Cengage learning, 2004.
2. HamdyATaha, "Operations research an introduction", 10th edition, PHI/Pearson education, 2017.
3. Srinivasan G, "Operations research principles and applications", 3rd edition EEE PHI, 2017.
4. Pannerselvam R, "Operations research", 2nd edition, PHI, 2009.
5. Ravindran, Phillips and Solberg, "Operations research principles and practice", 2nd edition, Wiley India, 2007.
6. Sharma J K, "Operations research theory and applications",5th edition, Macmillan India, 2013.
7. Premkumar Gupta and D.S.Hira, "Problems in Operations research", S.Chand, 2009

20MEP46	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the various aspects of IPR, its registration and its enforcement.

COURSE CONTENT:

Introduction

Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.

Process

New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

Statutes

International Treaties and conventions on IPRs, The TRIPs Agreement, PCT Agreement, The Patent Act of India, Patent Amendment Act (2005), Design Act, Trademark Act, Geographical Indication Act, Bayh- Dole Act and Issues of Academic Entrepreneurship.

Strategies in Intellectual Property

Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

Models

The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: Understand intellectual property and appreciation of the need to protect it.
CO2: create awareness about the process of patenting.
CO3: Understand of the statutes related to IPR.
CO4: apply strategies to protect intellectual property.
CO5: apply models for making strategic decisions related to IPR.

REFERENCES:

1. V. Sople Vinod, Managing Intellectual Property by (Prentice hall of India Pvt.Ltd), 2006.
2. Intelluctual Property rights and copyrights, EssEss Publications
3. Primer, R. Anita Rao and Bhanoji Rao, Intelluctual Property Rights, Lastain Book company.
4. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intelluctual Property, Edward Elgar Publishing Ltd., 2006.
5. WIPO Intelluctual Property Hand book
6. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", PHI Learning, 2011.

20MEP51	MACHINE VISION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the various elements and techniques of machine vision.

COURSE CONTENT:

Introduction

Human Vision – Machine vision and Computer Vision – Benefits of Machine Vision – Block Diagram and Function of Machine Vision System Implementation of Industrial Machine Vision System – Physics of Light – Interactions of Light – Refraction at a Spherical Surface – Thin Lens Equation.

Image Acquisition

Scene Constraints – Lighting Parameters – Lighting Sources, Selection – Lighting Techniques – Types and Selection – Machine Vision Lenses and Optical Filters, Specifications and Selection – Imaging Sensors – CCD and CMOS, Specifications – Interface Architectures – Analog and Digital Cameras –Digital Camera Interfaces – Camera Computer Interfaces, Specifications and Selection – Geometrical Image Formation Models – Camera Calibration.

Image Processing

Machine Vision Software – Fundamentals of Digital Image – Image Acquisition Modes – Image Processing in Spatial and Frequency Domain – Point Operation, Thresholding, Grayscale Stretching – Neighborhood Operations, Image Smoothing and Sharpening – Edge Detection – Binary Morphology – Color image processing.

Image Analysis

Feature Extraction – Region Features, Shape and Size Features – Texture Analysis – Template Matching and Classification – 3D Machine Vision Techniques – Decision Making.

Machine Vision Applications

Machine Vision Applications in Manufacturing, Electronics, Printing, Pharmaceutical, Textile, Applications in Non-Visible Spectrum, Metrology, Vision Guided Robotics – Field and Service Applications – Agricultural, and Bio Medical Field, Augmented Reality, Surveillance, Bio-Metrics .

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: Explain the concepts of Physics behind Digital Image Processing.
CO2: Illustrate the Methods of Image Acquisition.
CO3: Apply the different knowledge in different types image Processing.
CO4: Develop knowledge of different types analyzing the Captured Image.
CO5: Implement at the idea about Machine Vision Applications.

REFERENCES:

1. AlexandaerHornberg, "Hand Book of Machine Vision", Wiley-VCH, 2006.
2. Davies E.R., "Machine Vision Theory, Algorithms and Practicalities", Elsevier, 2005.
3. NelloZuech, "Understanding and Applying Machine Vision", Marcel Decker, 2000.
4. Bruce Batchelor and Frederick Waltz, "Intelligent Machine Vision Techniques, Implementations and Applications", Springer-Verlag, 2001.
5. Rafael C. Gonzales, Richard. E. Woods and Steven L. Eddins, "Digital Image Processing Using MATLAB", McGraw Hill Education, 2014.
6. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis, and Machine Vision", Cengage Learning, 2014.
7. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", PHI Learning, 2011.
8. Chanda B. and Dutta Majumder D., "Digital Image Processing and Analysis", PHI Learning, 2011.

20MEP52	INDUSTRIAL ROBOTICS TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the importance of robot technology along with its various mechanical and sensory systems.

COURSE CONTENT:

Introduction

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

Types of Grippers

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic-Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

Sensors in Robots

Requirements of a sensor, Principles and Applications of the following types of sensors-Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors, Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors

Camera, Frame Grabber, Sensing and Digitizing Image Data Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications, Inspection, Identification, Visual Serving and Navigation

Kinematics

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

Applications of Robotics

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

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: understand the concepts of industrial robots with respect to its classification, specifications and coordinate systems along with application of robots in different engineering fields.

CO2: classify the different types of robot drive systems as well as robot end effectors.

CO3: apply the different sensors and image processing techniques in robotics to improve the ability of robots.

CO4: develop robotic programs for different tasks and analyze the kinematics motions of robot.

CO5: implement robots in various industrial sectors and interpolate the economic analysis of robots.

REFERENCES:

1. Fu. K.S, Gonzalez. R.C, Lee. C.S.G "Robotics – Control, Sensing, Vision, and Intelligence", McGraw Hill, 2015

2. GrooverMikell .P, "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2014.

3 Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2009.

4. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 2013.

5. Koren Y., "Robotics for Engineers", McGraw Hill Book Co., 1992

20MEP53	MEMS AND MICROSYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the different aspects of MEMS and Microsystems..

COURSE CONTENT:

Introduction

History of MEMS Development, Multidisciplinary Nature of Microsystems, Energy Domains, Scaling Laws in Miniaturization, Essential Electrical and Mechanical Concepts in MEMS, Materials for MEMS and Microsystems.

Sensors and Actuators-I

Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition, Physical Vapour Deposition-Sputtering, Deposition by Epitaxy, Etching, Bulk Micromanufacturing, Micromachining Processes, LIGA Process, Microsystem Assembly and Testing.

Sensors and Actuators-II

Introduction to Electrostatic Sensors and Actuators, Parallel-Plate Capacitor, Application of ParallelPlate Capacitors, Interdigitated Finger Capacitors, Applications of Comb-Drive Devices, Introduction to Thermal Sensors and Actuators, Sensors and Actuators Based on Thermal Expansion, Thermocouples, Thermal Resistors, Shape Memory Alloy, Applications of Thermal Sensors and Actuators.

Types of Sensors and Actuators

Introduction to Piezoresistive& Piezoelectric effects, Piezoresistive& Piezoelectric materials, Stress Analysis of Mechanical Elements, Applications of Piezoresistive& Piezoelectric Sensors and Actuators, Essential Concepts and Principles of Magnetic Sensors and Actuators, Fabrication of Micro Magnetic Components, Applications of Magnetic Sensors and Actuators.

Fluid Mechanics

Microfluidics - Fluid Mechanics Concepts, Design and Fabrication of Channels, Valves, Pumps, Case Studies - Accelerometer, Gyros, RF MEMS and MOEMS.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability

CO1: Select suitable material for MEMS and Microsystems, and explain the scaling laws involved in miniaturization.
CO2: Explain the various micro-manufacturing processes.
CO3: Apply the working principle of electrostatic and thermal based MEMS sensors and actuators in the design of MEMS devices.
CO4: Apply the working principle of piezo-resistive, piezo-electric and magnetic effect in the design of MEMS devices.
CO5: Design the elements of Micro-fluidic systems, and select suitable MEMS devices for Industrial applications.

REFERENCES:

1. Chang Liu, "Foundations of MEMS", Pearson Education, 2011.
2. Tai-Ran Hsu, "MEMS and Microsystems: Design and Manufacture", McGraw Hill Education, 2002.
3. Marc J. Madou, "Fundamentals of Microfabrication and Nanotechnology", CRC Press, 2011.
4. Mohamed Gad-el-Hak, "The MEMS handbook: MEMS Applications", CRC press, 2006.
5. NitaigourPremchandMahalik, "MEMS", McGraw Hill Education, 2007.

20MEP54	APPLIED HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The course will enable the students to understand the hydraulic and pneumatic systems in detail.

COURSE CONTENT:

Fluid Power Priniciples and Hydraulic Pumps

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque, Sources of Hydraulic power : Pumping Theory-– Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps

Hydraulic Actuators and Control Components

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary actuators-Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories : Reservoirs, Pressure Switches – Filters –types and selection- Applications – Fluid Power ANSI Symbols

Hydraulic Circuits and Systems

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits ,Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits,–Servo and Proportional valves – Applications-Mechanical ,hydraulic servo systems.

Pneumatic and Electro Pneumatic Systems

Properties of air –Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit –classification- single cylinder and multi cylinder circuits-Cascade method –Integration of fringe circuits ,Electro Pneumatic System – Elements – Ladder diagram – timer circuits-Introduction to fluidics and pneumatic logic circuits

Trouble Shooting and Applications

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for

Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low cost Automation – Hydraulic and Pneumatic power packs.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the working principles of fluid power systems and hydraulic pumps.
CO2: apply the working principles of hydraulic actuators and control components.
CO3: design and develop hydraulic circuits and systems.
CO4: apply the working principles of pneumatic power system and its components.
CO5: solve problems and troubles in fluid power systems.

REFERENCES:

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, Prentice Hall, 1997
3. Jagadeesha. T., "Pneumatics Concepts, Design and Applications ", Universities Press, 2015.
4. Joshi.P., Pneumatic Control", Wiley India, 2008.
5. Majumdar, S.R., "Oil Hydraulics Systems – Principles and Maintenance",TataMcGraw Hill, 2001.
6. Shanmugasundaram.K., "Hydraulic and Pneumatic Controls". Chand & Co, 2006.
7. Srinivasan.R., "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 2008.

20MEP55	INDUSTRY 4.0	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The objective of the course is to help the students to understand the constraints and opportunities involving around evolution of automation industry with help of modern day computers.

COURSE CONTENT:

Introduction

Introduction to industrial revolution-First Industrial revolution- Second Industrial revolution- Third industrial revolution-Fourth industrial revolution(4.0)-Definition of Industry 4.0- Revloving reality-work groups and design principles-benefits and challenges involved in implementation.

Principles of Industry 4.0

Introduction to Integration systems-Horizontal integration-Vertical Integration-levels of automation pyramids-sensors and actuators-systems and connectivity-Interoperability,interconnection, connectivity- Real-time capability- Modularity-Decentralization, autonomous decisions and autonomy

Cyber Physical Systems

Introduction to cyber physical systems-cyber physical system before industry 4.0-Building blocks-Maturity models-roadmaps-characteristics of cyber physical system-evolution of mechatronics systems-adaptronics-condition monitoring-case studies on real time applications of cyber physical systems-track and trace-structural health monitoring.

Internet of Things

IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Knowledge Management. Case studies-sensor body-area-network and control of a smart home.

Cloud Computing

Introduction to Cloud Computing including benefits, challenges, and risks-Cloud Computing Models including Infrastructure/Platform/Software – as-a-service-Public cloud, private cloud and hybrid clouds-characteristics of cloud computing-virtualization concepts-Hadoop.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the importance of Industry 4.0 and it's basic concepts.
CO2: classify the various sensors and other instruments used in system integration
CO3: interpret and understand cyber physical systems along with its building blocks
CO4: develop and implement Internet of things and Cloud Computing.

REFERENCES:

1. Computer networking: a top-down approach 5th ed., international ed.: Boston, Mass.: Pearson,cop. 2010
2. John Rhoton ,Cloud Computing Explained: Handbook for Enterprise Implementation 2013 edition, 2013, recursive press
3. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand,StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014
4. Bolton, "Mechatronics", Printice Hall, 2008

20MEP56	INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To introduce the need, evolution, and motivation for Industrial Automation. Familiarization with basic concepts and different automation strategies being used in practice worldwide.

COURSE CONTENT:

Introduction

Introduction to Factory Automation and Integration: Basic concepts and scope of industrial automation, socio-economic considerations, modern developments in automation in manufacturing and its effect on global competitiveness. Need and implications of automation in manufacturing. Different types of production systems and automation. Hard/fixed automation.

Hydraulic and Pneumatic Systems

Introduction to Hydraulics/Pneumatics: Basic elements of hydraulics/pneumatics, electro-pneumatic controls and devices, electro-pneumatic systems, fluid power control elements.Construction and performance of fluid power generators, hydraulic and pneumatic actuators. Applications in manufacturing. Hydraulic & pneumatic valves for pressure, flow & direction control, servo valves and simple servo systems with mechanical feedback, solenoid.

Programmable Logic Circuits (PLC)

Design of Pneumatic and Electro-pneumatic Logic Circuits: Logic circuits to be designedfor a given time displacement diagram or sequence of operation. Pneumatic safety and control circuits and their applications to clamping, traversing and releasing operations. Programmable Logic Controllers (PLC): PLC for design demonstration, programming and interface the hardware with software for modern manufacturing applications.

Automatic Transfer Machines:

Classifications, analysis of automated transfer lines, without and with buffer storage, group technology and flexible manufacturing system.

Assembly Line

Assembly Automation: Types of assembly systems, assembly line balancing, performance and economics of assembly system.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: measure the output of any physical system with the help of various sensors and transducers and able to evaluate the performance of any physical system.
CO2: understand the various components of Hydraulics/Pneumatics Electro-pneumatic systems and methods to design, construct and evaluate such systems.
CO3: interpret the design of pneumatic logic circuits for a given time displacement diagram for pneumatic safety and remote control circuits
CO4: develop automated transfer lines along with assembly line balancing for a manufacturing process.

REFERENCES:

1. Esposito, A., Fluid Power with Applications, Prentice Hal of India, New Delhi (2005).
2. Majumdar, S. R., Pneumatic Systems, Tata McGraw Hill, New Delhi (1995). 87th Senate approved Courses Scheme & Syllabus for B.E. Mechanical (Production) Engg. (2014)
3. Auslander, D. M. and Kempf, C. J., Mechatronics: Mechanical System Interfacing, Prentice Hall Inc., New Jersey (1996).
4. Deppert, W. and Stoll, K., Pneumatic Control, Vogel Verlag, Wurzburg, Germany (1987). 3 Herbert, E.M., Hydraulic Control System, John Wiley & Sons, New York (1991).
5. Hall, D.V., Microprocessors & Interfacing: Programming & Hardware, McGraw Hill, New York (2006).

OPEN ELECTIVES
(Offered by B.E. Computer Science and Engineering)

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	20CSE01	Basics Of Python Programming	OE	3	0	0	3	3
2	20CSE02	Introduction To AI	OE	3	0	0	3	3
3	20CSE03	Fundamentals of Data Science	OE	3	0	0	3	3
4	20CSE04	Basics of Internet Programming	OE	3	0	0	3	3
5	20CSE05	Introduction to Soft Computing	OE	3	0	0	3	3

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20CSE01	BASICS OF PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to learn the basics of algorithmic problem solving, read and write simple Python programs and to develop Python programs with Python data structures namely lists, tuples, and dictionaries.

COURSE CONTENT:

Introduction

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion).

Python Basics

Python interpreter and interactive mode; values and types: int, float, Boolean , string and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments.

Control Structures and Strings

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays.

Lists and Tuples

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension.

File Handling and Exceptions

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: develop algorithmic solutions to solve various computational problems
CO2: structure simple python programs for solving problems.
CO3: create applications written using simple Python programs.

REFERENCES:

1. Anita Goel and Ajay Mittal "Computer Fundamentals and Programming in C", Pearson Education, 2013(Unit 1)
2. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/) (Units 2,3,4 and 5)
3. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
4. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
5. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
6. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.

20CSE02	INTRODUCTION TO AI	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The objective of the course is to learn the concepts of Artificial Intelligence and to understand the various characteristics of intelligent agents, the different search strategies in AI and represent knowledge for solving AI problems.

COURSE CONTENT:

Introduction

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

Problem Solving Methods

Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems -Searching with Partial Observations – Constraint Satisfaction Problems.

Knowledge Representation

First Order Predicate Logic – Inference in FOL – Unification – Forward Chaining - Backward Chaining – Resolution.

Learning

Learning- Learning from Examples: Forms of Learning – Theory of Learning - Decision Trees - Explanation-Based Learning - Reinforcement Learning: Active - Passive.

AI Applications

Expert Systems: Architecture - DART - MYCIN- Robotics: Hardware – Robotic Perception – Planning - moving.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the basic concept of Artificial Intelligence.
CO2: apply appropriate search algorithms for any AI problem.
CO3: represent a problem using first order and predicate logic.
CO4: apply AI techniques in developing real world applications.

REFERENCES:

1. Stuart J. Russell, Peter Norvig, "Artificial Intelligence - A Modern Approach", Third Edition, Pearson Publishers, 2015.
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, "Artificial Intelligence", Third Edition, Tata McGraw-Hill Education, 2008.
3. Dr. S N Sivanandam, Dr. M Paulraj," Introduction to Artificial Networks",Vikas Publishing House, India-2014.
4. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", O'Reilly, 2009, https://www.nltk.org/book/.
5. Nils J. Nilsson, "Artificial Intelligence: A New Synthesis", Morgan Kaufmaan Publishers Inc; Second Edition, 2003.
6. David L. Poole and Alan K. Mackworth, ―Artificial Intelligence: Foundations of Computational Agents‖, Cambridge University Press, 2010.

ONLINE RESOURCES:

1. NPTEL, "Artificial Intelligence", http://nptel.ac.in/courses/106105079/2.
2. Udacity, "Introduction to Artificial Intelligence".
3. https://www.coursera.org/learn/introduction-to-ai#syllabus.

20CSE03	FUNDAMENTALS OF DATA SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will introduce the rapidly growing field of data science and equip the students with some of its basic principles and tools as well as its general applications.

COURSE CONTENT:

Introduction

What is Data Science? Big Data and Data Science – Datafication - Current landscape of perspectives - Skill sets needed; Matrices - Matrices to represent relations between data, and necessary linear algebraic operations on matrices - Intro to R/ Python.

Data preprocessing

Data cleaning - data integration - Data Reduction Data Transformation and Data Discretization- Evaluation of classification methods – Confusion matrix, Students T-tests and ROC curves - The Data Science Process.

Basic Machine Learning Algorithms

Association Rule mining - Linear Regression- Logistic Regression - Classifiers - k-Nearest Neighbors (k-NN), k-means -Decision tree - Naive Bayes. Feature Generation and Feature Selection algorithms - Filters; Wrappers; Decision Trees; Random Forests.

Clustering

Choosing distance metrics - Different clustering approaches - hierarchical agglomerative clustering, k-means (Lloyd's algorithm), - DBSCAN - Relative merits of each method - clustering tendency and quality.

Data Visualization

Basic principles, ideas and tools for data visualization.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: describe what Data Science is and the skill sets needed to be a data scientist.
CO2: explain in basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modeling Fit a model to data.
CO3: use R to carry out basic statistical modeling and analysis.
CO4: explain the significance of exploratory data analysis (EDA) in data science.

REFERENCES:

1. Cathy O'Neil and Rachel Schutt, " Doing Data Science, Straight Talk From The Frontline", O'Reilly, 2014.
2. Jiawei Han, Micheline Kamber and Jian Pei, " Data Mining: Concepts and Techniques", Third Edition. ISBN 0123814790, 2011.
3. Mohammed J. Zaki and Wagner Miera Jr, "Data Mining and Analysis: Fundamental Concepts and Algorithms", Cambridge University Press, 2014.
4. Matt Harrison, "Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization , O'Reilly, 2016.
5. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2015.
6. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.

20CSE04	BASICS OF INTERNET PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to learn the basics of HTML5, CSS3 and JavaScript essential for website development. Also, to learn the basics of PHP and XML essential for the development of dynamic websites.

COURSE CONTENT:

Introduction to World Wide Web and HTML5

Web Basics – Multitier Application Architecture – Client-Side Scripting versus Server-Side Scripting – **HTML5:** Introduction – Editing HTML5 – Headings – Linking – Images – Special Characters – Horizontal Rules – List - Tables – Forms – Form Input Types

Cascaded Style Sheets

Introduction – Inline styles – Embedded styles – linking external styles – Conflicting styles – Absolute and Relative Positional Elements – Backgrounds – Box Model – Text flow – linear gradient – radial gradient

Client-Side Programming: JavaScript

Displaying a line of Text – User input with prompt dialogs – Arithmetic – Control Statements – if, if-else, while – for – switch – do…while – break and Continue – logical operators – Function Definitions – Scope Rules – Global functions – Declaring and Allocating Arrays - Example Arrays - Modelling a Document: DOM Nodes and Trees – Traversing and Modifying DOM Tree - load Event – Event mousemove and the event Object – Form processing with Events.

Server-Side Programming: PHP

Introduction – Converting between data types – Operators – Arrays – String Comparison – Form Processing and Business Logic – Reading from a database – Using Cookies and Session

XML

XML Basics – Structuring Data – XML Namespaces – W3C XML Schema Documents - Ajax web Application – Ajax example using XMLHttpRequest Object.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: design and develop a static website with latest W3C standards

CO2: design and develop an interactive website with client-side programming

CO3: design and develop a dynamic web page / web application with database access and session management.

REFERENCES:

1. Deitel and Deitel and Nieto, "Internet and World Wide Web - How to Program", Prentice Hall, 5th Edition, 2012.
2. Jeffrey C. Jackson, Web Technologies A Computer Science Perspective, 1st edition, Pearson Education, 2011
3. Chris Bates, Web Programming: Building Internet Applications, 3rd Edition, Wiley India Pvt. Limited, 2007
4. Robert W. Sebesta, Programming the World Wide Web, 7th Edition, Pearson, 2013
5. Eric Freeman, Elisabeth Robson, Head First HTML5 Programming, Building Web Apps with JavaScript, 1st Edition, O'Reilly Media, Incorporated, 2011
6. Jason Hunter, William Crawford, Java Servlet Programming, 2nd Edition, O'Reilly Media, 2010.

20CSE05	INTRODUCTION TO SOFT COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course focuses on the various soft computing frame works and familiarize with the design of neural networks, fuzzy logic and fuzzy systems and also to learn the mathematical background for optimized genetic programming.

COURSE CONTENT:

Introduction

Introduction to Soft computing - Basic tools of Soft Computing - Soft Computing vs Hard Computing -Artificial Neural Networks -Classification of ANNs.

Artificial Neural Networks

Back propagation Neural Networks – Associative memory neural networks - Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks.

Fuzzy Systems

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets – Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification – Fuzzy Arithmetic.

Genetic Algorithms

Basic Concepts- Working Principles -Encoding- Fitness Function – Reproduction -Inheritance Operators – Cross Over – Inversion and Deletion -Mutation Operator – Bit-wise Operators - Convergence of Genetic Algorithm.

Optimization Techniques

Multi objective Evolutionary Algorithms (MOEA) - Particle swarm optimization (PSO)- Ant Colony Optimization - Fire fly Optimization.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: apply the various soft computing concepts for solving real time problems.
CO2: apply the fuzzy rules and reasoning to develop decision making and expert system.
CO3: improve solution by optimization techniques.

REFERENCES:

1. S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.
2. George J. Klir, Ute St. Clair, Bo Yuan, “Fuzzy Set Theory: Foundations and Applications” Prentice Hall, 1997.
3. David E. Goldberg, “Genetic Algorithm in Search Optimization and Machine Learning” Pearson Education India, 2013.
4. James A. Freeman, David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India, 1991.
5. Simon Haykin, “Neural Networks Comprehensive Foundation” Second Edition, Pearson Education, 2005.

OPEN ELECTIVES
(Offered by B.E. Electronics and Communication Engineering)

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	20ECE01	Electronic Measurements and Instrumentation	OE	3	0	0	3	3
2	20ECE02	Microcontrollers and its Applications	OE	3	0	0	3	3
3	20ECE03	Introduction to Embedded Systems	OE	3	0	0	3	3
4	20ECE04	Nano Electronics and Sensors	OE	3	0	0	3	3
5	20ECE05	Principles of VLSI Systems	OE	3	0	0	3	3

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20ECE01	ELECTRONIC MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the fundamentals of electrical and electronic instruments, measurement techniques, storage and display devices.

COURSE CONTENT:

Introduction

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – – Standards and calibration

Electrical and Electronic Instruments

Principle and types of analog and digital voltmeters, ammeters, multimeters – Single and three phase wattmeters and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss.

Comparative Methods of Measurements

D.C & A.C potentiometers, D.C & A.C bridges, transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops - Electrostatic and electromagnetic interference – Grounding techniques.

Storage and display Devices

Magnetic disk and tape –digital plotters and printers, CRT display, digital CRO, OLED,LED display systems, LCD –USB Data Loggers.

Transducers and Data Acquisition Systems

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – A/D, D/A converters – Smart sensors.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: find electrical parameters using appropriate Electronics Instruments.

CO2: interpret the characteristics and operation of Electrical and Electronic Instruments.

CO3: apply storage and display devices.

CO4: select appropriate sensors in various applications.

REFERENCES:

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2004.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria & Sons, Delhi, 2003.
3. J Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.
4. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, II Edition 2004.
5. D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2007.

20ECE02	MICROCONTROLLERS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the primary concept of microcontrollers, hardware usage for programming intelligence and get familiarized with the architecture, instruction set and applications of microcontroller.

COURSE CONTENT:

8051 Microcontroller

Architecture of 8051 – Register set - I/O Pins, Ports and Circuits - Instruction set - Addressing modes - Assembly language programs for arithmetic and Logical operations.

Interfacing 8051 Microcontroller

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - Stepper Motor Interfacing –ADC – DAC.

Application of 8051 Microcontroller

Temperature Controller using ADC – Square and Triangular waveform generation using DAC – Water level controller – Traffic Light Controller.

PIC Microcontroller

CPU Architecture – Register – I/O pins, Ports -Instruction set – addressing modes - Interrupts

Interfacing PIC Microcontroller

PIC: Timers- I2C Interfacing –UART- A/D Converter –Pulse Width Modulation

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: interpret the architecture of 8051 and PIC microcontrollers.

CO2: develop Assembly Language Programs (ALP) for arithmetic and Logical operations using microcontrollers.

CO3: build 8051 microcontroller-based systems using peripheral interfaces.

CO4: build PIC microcontroller-based systems using peripheral interfaces.

REFERENCES:

1. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson Education, 2011
2. Subrata Ghoshal, “8051 Microcontrollers: Internals, Instructions, Programming &Interfacing”, Second Edition, Pearson education, 2014.
3. John. B. Peatman, “Design with PIC Microcontroller”, Prentice Hall, 2011.
4. Gene .H.Miller, “Micro Computer Engineering”, Pearson Education, 2013.
5. Subrata Ghoshal, “8051 Microcontrollers: Internals, Instructions, Programming &Interfacing”, Second Edition, Pearson education, 2014.

20ECE03	INTRODUCTION TO EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the architecture of embedded systems, design and analysis of embedded computing, basic concepts of real time operating system, programming concepts for embedded systems, system design techniques of embedded hardware and its applications.

COURSE CONTENT:

Architecture of Embedded Systems

Categories of Embedded Systems – Specifications of Embedded systems – Recent trends in Embedded Systems – Detailed Hardware and Software Design – ARM Processor – CPU: programming input and output - supervisor mode, exceptions and traps – Co-processors – Memory system mechanisms – CPU performance – CPU power consumption.

Embedded Computing Platform Design

The CPU Bus-Memory devices and systems – Designing with computing platforms – Host and target machines – consumer electronics architecture – platform-level performance analysis - Components for embedded programs – Models of programs – Assembly, linking and loading – compilation techniques – Program level performance analysis

Processes and Operating Systems

Introduction – Multiple tasks and multiple processes – Multi rate systems – Preemptive real-time operating systems – Priority based scheduling – Inter process communication mechanisms – Semaphores and Shared Data – Message Queues – Mailboxes and Pipes – Interrupt Routines in RTOS Environment – Evaluating operating system performance – power optimization strategies for processes.

Hardware/Software Integration & Programming

Cross-Compilers – Cross-Assemblers – Linker/Locator – Debugger – Emulator – Simulators – Introduction to Integrated Development Environment (IDE) – Getting Embedded Software into Target System: In-Circuit Emulators –Serial Port Programming and Interrupts Programming.

Embedded System Applications

Applications of Embedded systems – Case study of Embedded systems like automatic chocolate vending machine, Adaptive Cruise Control Systems in a Car, Digital camera, Smart card and ATM.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the architecture of embedded systems.

CO2: understand the concepts of multiple processes and operating systems.

CO3: choose appropriate tools for developing real time embedded systems.

CO4: apply suitable hardware and software architectures to implement embedded system applications.

REFERENCES:

1. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", Third Edition, Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
2. Jonathan W. Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning, 2012.
3. Raj Kamal, "Embedded Systems Architecture Programming and Design", Pearson, 2011.
4. K.V.K.K.Prasad "Embedded /Real-Time Systems: Concepts, Design and Programming" Dream tech, Wiley 2012.
5. Daniel 5.W Lewis, "Fundamentals of Embedded Software" Pearson Education, 2013.

20ECE04	NANO ELECTRONICS AND SENSORS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the overview of nano electronics, basic components of electronic systems, memory devices, sensors and actuators.

COURSE CONTENT:

Overview of Nano-Electronics

Nano-scale electronics; Foundation of nano-electronics – low dimension transport, quantum confinement, Coulomb blockade and quantum dot; Ballistic transport and Quantum interferences; Landauer formula, quantization of conductance, example of Quantum point contact.

Two-Terminal Junction Transistors

Basic CMOS process flow; MOS scaling theory; Issues in scaling MOS transistors; Requirements for non-classical MOS transistor; PMOS versus NMOS; Design and construction of MOS capacitor; Integration issues of high-k MOS – interface states, bulk charge, band offset, stability, reliability; MOS transistor and capacitor characteristics.

Gate Transistors

Metal gate transistors – motivation, basics and requirements; quantum transport in nano MOSFET; Ultrathin body silicon on insulator (SOI) – double gate transistors; Vertical transistors – FinFET and surround gate FET; compound semiconductor MOSFET – Hetero-structures MOSFET.

Characteristics of Sensors and Actuators

Basics: types and working principles of sensors and actuators; Characteristic features: Range, Resolution, Sensitivity, Error, Repeatability, Linearity and Accuracy, Impedance, Nonlinearities, Static and Coulomb Friction, Eccentricity, Backlash, Saturation, Dead-band, System Response, First Order System Response, Under-damped Second Order System Response, Frequency Response.

Memory Devices and Sensors

Nano ferroelectrics – Ferroelectric random-access memory –Fe-RAM circuit design – ferroelectric thin film properties and integration – calorimetric -sensors – electrochemical cells – surface and bulk acoustic devices – gas sensitive FETs – resistive semiconductor gas sensors –electronic noses – identification of hazardous solvents and gases – semiconductor sensor array.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the concepts of Nano electronics

CO2: interpret the characteristics and operation of Gate transistors.

CO3: interpret the characteristics of sensors and actuators.

CO4: understand the operation of memory devices and sensors.

REFERENCES:

1. W. Ranier, 'Nano Electronics and Information Technology', Wiley, 2003.
2. K.E. Drexler, 'Nano systems', Wiley, 1992.
3. M.C. Petty, 'Introduction to Molecular Electronics', 1995.
4. Handbook of Nanoscience, Engineering and Technology", Kluwer publishers, 2002.
5. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications", Imperial College Press, 2004.

20ECE05	PRINCIPLES OF VLSI SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the principles of MOS transistors, realization of combinational and sequential logic circuits using MOS transistors, arithmetic building blocks and implementation strategies using FPGA.

COURSE CONTENT:

MOS Transistor Principle

NMOS and PMOS transistor operations, MOS DC Equations, Electrical properties of CMOS circuits and device modeling, scaling principles CMOS inverter, Second Order Effects, Stick diagram.

Combinational Logic Circuits

MOSFETs as switches, Basic Logic Gates in CMOS, Examples of Combinational Logic Design, RC Delay Model, Linear Delay Model, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design.

Sequential Logic Circuits

Static and Dynamic Latches and Registers, Timing issues, Memory architecture and memory control circuits.

Arithmetic Building Blocks

Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, Multipliers, speed and area tradeoff

Implementation Strategies

Full custom and Semi-custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures, Xilinx FPGA.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: interpret the characteristics and operation of MOS transistors.

CO2: interpret the operation of VLSI architecture using FPGA.

CO3: build CMOS based arithmetic and logic circuits.

CO4: build CMOS based sequential circuits.

REFERENCES:

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, “Digital Integrated Circuits: A Design Perspective”, Second Edition, Prentice Hall of India, 2013.
2. M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 2001.
3. A.Pucknell, Kamran Eshraghian, “BASIC VLSI Design”, Third Edition, Prentice Hall of India, 2009.
4. Weste and Harris: CMOS VLSI DESIGN: A Circuits and Systems Perspective (Fourth edition) Pearson Education, 2010.
5. N.Weste, K.Eshraghian, “Principles of CMOS VLSI Design”, Second Edition, Addison Wesley 2009.

OPEN ELECTIVES
(Offered by B.Tech Information Technology)

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	20ITE01	Big Data Analytics and its Applications	OE	3	0	0	3	3
2	20ITE02	Cloud Computing Fundamentals	OE	3	0	0	3	3
3	20ITE03	Fundamentals of Internet of Things	OE	3	0	0	3	3
4	20ITE04	Introduction to Database Management Systems	OE	3	0	0	3	3
5	20ITE05	Web Interface Design and Development	OE	3	0	0	3	3
6	20ITE06	Introduction to Data Structures	OE	3	0	0	3	3
7	20ITE07	Principles of Software Engineering	OE	3	0	0	3	3

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20ITE01	BIG DATA ANALYTICS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

This course will enable the students to understand the basics of big data analytics, Hadoop,and gain knowledge about the different data analytics techniques and its applications.

COURSE CONTENT

Introduction to Big Data

Introduction – distributed computing – Need of distributed computing for Big Data– Evolution of data management–Understanding the data – Defining big data –characteristics of Big Data – Big Data and its importance– Big Data analytics–Traditionaland advanced analytics. Big Data Types - Structured data - Unstructured data - Semi structured data.

Introduction to Hadoop

Big Data – Apache Hadoop & Hadoop Ecosystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of Map Reduce - Data Serialization.

Introduction to MongoDB

What is MongoDB? – Why Mongo DB? – Terms used in RDBMS and MongoDB – Data Types in MongoDB – MongoDB Query Language.

Big Data Trends

Data Curators – CDOs are stepping up – Dark data in the cloud – Streaming the IoT for machine learning - Edge Computing – Open Source – chatbots will get smarter – ContainerRevolution - Commoditization of visualization.

Big Data Applications

Big Data in Health care – Big Data contributions to Education - Big Data contributions toInsurance Services - Big Data Contributions to Industrial and Natural Resources - Big DataContributions to Transportation - Big Data Contributions to Banking Zones and Fraud Detection.

COURSE OUTCOMES

Upon completion of the course, the student's will have the ability to

CO1: Understand the fundamental concepts of Big Data

CO2: Demonstrate the deployment of Hadoop and Map reduce in a Big Data Environment

CO3: Understand the usage of Mongo DB in data analytics.

CO4: Compare the various data platforms with IoT and Cloud based on evaluation parameters.

CO5: Understand the application of big data analytics in real-time scenarios

REFERENCES

1. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", 2nd Edition, Wiley India Pvt Ltd, 2021.
2. Chris Eaton, Dirk deroos, "Understanding Big data", McGraw Hill, 2012.
3. Judith Hurwitz, Alan Nugent et al.," Big Data for Dummies", John Wiley & Sons, Inc, 2013
4. Vignesh Prajapati, "Big Data Analytics with R and Haoop", Packet Publishing, 2013.
5. Tom Plunkett, Brian Macdonald et al, "Oracle Big Data Handbook", Oracle Press, 2014.

20ITE02	CLOUD COMPUTING FUNDAMENTALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

The course will enable the students to understand the basic concepts, Cloud Models, architecture of cloud computing and techniques of virtualization and also get familiarized with the cloud platforms.

COURSE CONTENT

Cloud Computing and Cloud Services

Introduction to Cloud Computing - History of Cloud computing - Types of Clouds - Characteristics of Cloud Computing - Cloud Architecture - Cloud Storage - Cloud Services - Benefits from Cloud Computing - Pros and Cons of Cloud Computing - Applications of Cloud Computing. Web based applications - Advantages of cloud development - Disadvantages of cloud development - Types of Cloud Service Development: Software as a Service - Platform as a Service - On demand Computing - Discovering Cloud services development services and tools.

Virtualization Technology and Services

Introduction - Virtualization Defined - Virtualization benefits - Server Virtualization - Virtualization for x86Architecture - Hypervisor Management Software - Virtual Infrastructure Requirements. Exploring Online Calendar Applications: Google Calendar- Yahoo Calendar - Windows Live Calendar - Apple MobileMe calendar - Exploring Online Scheduling Applications - Exploring Online Planning.

Collaborating with Cloud

Evaluating Web mail services - Evaluating Instant Messaging Services - Evaluating Web Conferencing Tools – Collaborating via social networks and group ware - Collaborating on budgets.

Web Services

Introduction - Amazon Web Services - Google App Engine – Microsoft Azure – Cloud computing economics - AJAX and Mashups.

Security in Cloud Computing

Cloud Computing software security Fundamentals : Cloud Security Services, Cloud Security Design Principles - Security Challenges Concerns, Risk Issues, and Legal Aspects - Security Requirements for the Architecture

COURSE OUTCOME

Upon completion of the course, the student's will have the ability to

CO1: Apply cloud computing techniques to solve large scale scientific problems.
CO2: Implement virtualization for applications, desktops, servers,& network platforms.
CO3: Develop a cloud application with a user interface and understand data components.
CO4: Apply the various cloud platforms to develop and deployment for web application.
CO5: Understand the security aspects and architecture that are considering to protect cloud systems

REFERENCES

1.Rajkumar Buyya, Christian Vacchiola, S Thamarai Selvi, “Mastering Cloud Computing”, First Edition ,McGraw Hill Publications, 2013.

2.Michael Miller, “Cloud Computing: Web-Based Applications that Change the way you Work and collaborate Online’, Pearson publications Aug 2008.

3.Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra, “Distributed and Cloud Computing: From Parallel Processing to the Internet of Things”, First Edition Morgan Kaufmann Publisher, an imprint Elsevier 2012.

4.Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, Publisher: CRC Press, September 2013.

5.Graham Speake, Vic (J.R.) Winkler, “Securing the Cloud: Cloud Computer Security Techniques and Tactics”, Elsevier, USA, 2011.

20ITE03	FUNDAMENTALS OF INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

This Course will enable the students to understand the basic concepts of Internet of Things, Elements involved in Internet of Things, Physical Devices of IoT,Data Analytics in IoT and Explore the various real-time applications which can be automated using Internet of Things.

COURSE CONTENT

Fundamentals of IoT

Introduction - Definition and Characteristics of IoT - Physical design - IoT Protocols - Logical design - IoT communication models, IoT Communication APIs - Enabling technologies - Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates - Domain specific IoTs - IoT Architectural view - IoT and M2M- difference between IoT and M2M- IoT systems management – Needs - NETCONF, YANG - IoT design methodology

Elements of IoT

Sensors and actuators - Communication modules – Zigbee - LoRa - RFID - Wi-Fi - Power sources- IoT platforms - Cloud Computing in IoT - Cloud Connectivity - Big Data Analytics-Data Visualization.

IoT Physical Devices and Endpoints

Basic Building Blocks of IoT Device - Raspberry Pi – About the Board – Linux on Raspberry Pi - Raspberry Pi interfaces – Introduction Django framework – Designing a Web RESTful API - Other IoT devices – Introduction to Arduino.

Data Analytics for IoT

Introduction – Apache Hadoop – Using Hadoop MapReduce for Batch data analysis – Apache Spark – Apache Storm – using Apache Storm for Real time data analytics.

Challenges in IoT and Case Studies

Security Concerns and Challenges - Real time applications of IoT – Home automation Cities – Environment – Energy – Agriculture – Industry – Health and Lifestyle.

COURSE OUTCOMES

Upon completion of the course, the student's will have the ability to

CO1: Understand the fundamental concepts of Internet of Things.
CO2: Demonstrate the integration IoT elements with various technologies.
CO3: Understand the building blocks of Internet of Things and characteristics
CO4: Understand the relationship between IoT and Data analytics.
CO5: Understand the application of IoT in real-time scenarios.

REFERENCES

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things-A hands-on approach", Universities Press, 2015.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key applications and Protocols”, Wiley Publications 2nd Edition, 2013.
3. Raj Kamal, “Internet of Things – Architecture and Design Principles”, Mc Graw Hill Education Pvt. Ltd., 2017.
4. Internet of Things and Data Analytics, HwaiyuGeng, P.E, Wiley Publications, 2017.
5. Adrian McEwen, “Designing the Internet of Things”, Wiley Publishers, 2013,

20ITE04	INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

The course will enable the students to learn the basic concepts of DBMS, ER Diagrams, Relational model, transaction processing, and Familiarized with the various queries that can be used for data retrieval.

COURSE CONTENT

Introduction to DBMS

Overview - Purpose of Database System -– Views of data – Data Models – Database Languages —– Database System Architecture – Database users and Administrator - Data Models – Introduction to relational databases

Relational Model

Entity-Relationship Diagram-Design Issues- Weak Entity Sets- and Extended E-R features - Structure of relational Databases- Views- Modifications of the Database – Keys.

SQL Fundamentals

Concept of DDL- DML- TCL - DCL: Basic Structure- Set Operations- Aggregate Functions- Null Values- Domain Constraints- Referential Integrity Constraints- CODD's Rule - Functional Dependency- Different Anomalies in designing a Database - Normalization.

Data Storage, Querying and Transaction Management

RAID – Indexing – Query optimization and Processing – transaction Concept – ACID Properties – Serializability – Transactions as SQL statements.

Database Applications

Proprietary DBMS vs Open Source DBMS –NoSQL – Databases for Social Networks – Introduction to Multimedia Databases.

COURSE OUTCOMES

Upon completion of the course, the student's will have the ability to

CO1: Describe the most common designs for core database system components

CO2: Apply the modeling concepts and notation of the relational data model

CO3: Create a relational database schema in SQL that incorporates key, entity integrity, and referential integrity constraints.

CO4: Understand the various transaction processing, transaction models, storage management techniques and indexing techniques.

CO5: Understand the various types of databases that are used in social networks.

REFERENCES

1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, "Database System Concepts", Sixth Edition, McGraw Hill Education India Pvt. Ltd., 2016.
2. Atul Kahate, "Introduction to Database Management Systems", Pearson Education, New Delhi, 2006.
3. Alexis Leon and Mathews Leon, "Database Management Systems", Vikas Publishing House Private Limited, New Delhi, 2003.
4. Raghu Ramakrishnan, "Database Management Systems",McGraw-Hill, third Edition,2014.
5. Bipin C Desai, "An Introduction to Database Systems", Galgotia Publications Pvt Limited, Revised edition 2012.

20ITE05	WEB INTERFACE DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

The course will enable the students to understand the basic concepts of web designing, CSS, Java script, JQuery and familiarized with designing web pages.

COURSE CONTENT HTML5

Introduction, New Elements, Canvas, SVG, Drag/Drop, Geolocation, Video, Audio, Input Types, Form Elements, Attributes, Semantic, Web Storage, App Cache, Web Workers, SSE.

Cascading Style Sheets

Introduction, Syntax, Id & Class, Backgrounds, Text, Fonts, Links, Lists, Tables, Box Model, Border, Outline, Margin, Padding, Grouping/Nesting, Dimension, Display, Positioning, Floating, Align, Pseudo-class, Pseudo-element, Navigation Bar.

Radial Gradients of Cascading Style Sheets

Image Gallery, Image Opacity, Image Sprites, Media Types, Animations, Attribute Selectors, CSS3 Introduction, Gradients, Text Effects, Fonts, 2D Transforms, 3D Transforms, Transitions, Animations, Multiple Columns.

JavaScript

Introduction, Comment, Variable, Global Variable, Data Types, Operators, If Statement, Switch, Loop: for and while, Function, Objects, Array, Browser Object Model, Validation.

JQuery

Introduction, Selectors, Events, CSS Classes, Dimensions.

COURSE OUTCOMES

Upon completion of the course, the student's will have the ability to

CO1: Create and validate HTML/XHTML documents
CO2: Use Cascading Style Sheets as a presentation technologies.
CO3: Understand the radial gradients of CSS.
CO4: Design and implement a simple web pages using JavaScript and JQuery.
CO5: Construct a website to include Client-side programming with JavaScript.

REFERENCES

1. Harvey Deitel, Abbey Deitel, Internet and World Wide Web: How to Program 5th Edition, Pearson Education 2012.
2. DJ Editorial Services, "HTML5 Black Book", 2nd Edition, Dream tech Press 2016.
3. Thomas A.Powell, HTML & CSS: The Complete Reference, 5th Edition, Tata McGraw-Hill 2010.
4. Thomas A.Powell and Fritz Schneider, JavaScript: The Complete Reference, 3rd Edition, Tata McGraw-Hill, 2013.
5. Thomas A.Powell, Web Design: The Complete Reference, 2nd Edition, Tata McGraw- Hill, 2003.

20ITE06	INTRODUCTION TO DATA STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

The course will enable the student to learn basic and advanced concepts related to linear data structures such as lists, stack, queue and non-linear data structures like trees and graphs. It also provides an outline of various sorting, searching and storage techniques.

COURSE CONTENT

Preliminaries of Data Structures
Basic Terminology- Algorithms: Complexity, Time-Space tradeoff – Algorithmic Notations – Complexity of Algorithms

Arrays and Linked Lists
Linear Arrays – Traversing Linear Arrays – Inserting and Deleting – Linked Lists - Traversal - Search- Insertion, Deletion – Two-way Lists

Stacks, Queues and Recursion
Stacks: Array Representation, Linked Representation – Arithmetic Expressions – Applications: Recursion, Tower of Hanoi – Queues – Linked Representation of Queues – Priority Queues

Trees and Graphs
Tree Terminology - Binary Trees: Representation – Binary Search Trees: Search, Insertion, Deletion – AVL Search Trees: Insertion, Deletion – Heap – Heapsort – Graph Terminology – Graph Representations: Adjacency Matrix, Path Matrix –Shortest Paths (Dijkstra's Algorithm)- Topological Sort – Minimum Spanning Trees (Prim's Algorithm and Kruskal's Algorithm)

Sorting and Searching
Sorting – Insertion Sort – Selection Sort – Radix Sort – Searching and Data Modification - Hashing

COURSE OUTCOMES

Upon completion of the course, the student's will have the ability to

CO1: Apply appropriate data structures and abstract data types (ADT) such as lists, stacks, queues, trees and graphs in problem solving.
CO2: Analyze the performance of different implementations of data structures.
CO3: Determine appropriate ADTs and data structures for various sorting and searching algorithms.
CO4: Determine time and space requirements of common sorting and searching algorithms.
CO5: Describe a simple hash function

REFERENCES

1. Seymour Lipschutz, “Data Structures with C”, McGraw Hill, 1st Edition, 2017.
2. John Hubbard, “Data Structures with C++”, McGraw Hill, 1st Edition, 2017.
3. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Pearson Education, 2nd Edition, 2014.
4. Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, “Data Structures using C and C++”, Pearson, 2nd Edition, 2015.
5. Venkatesan R and Lovelyn Rose S, “Data Structures”, Wiley, 2nd Edition, 2019

20ITE07	PRINCIPLES OF SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

The course will enable the students with the understanding of software engineeringprocesses such as requirement modeling, design, testing etc. and experiential learning opportunities to apply that knowledge to solve real-world problems.

COURSE CONTENT

Software Process and Agile Development

Introduction to Software Engineering – Process Model: Perspective process models-Specialized process models- The unified process - Personal and Team Process Models- Agile Process- Other Agile Process Models.

Requirements Modeling

Functional and non-functional requirements – User Requirements – System requirements - Interface specification - The software requirements document - Requirements engineering processes

Design Concepts

Architectural design: Architectural design decisions - System organization - Modular decomposition styles - Control styles - Reference architectures.

Testing

Software Testing Fundamentals - System testing - Component testing - Test case design -Test automation.

Project management

Management activities - Project planning - Project scheduling - Risk management.

COURSE OUTCOMES

Upon completion of the course, the student's will have the ability to

CO1: Understand the various software process models.

CO2: Apply the requirement specifications and appropriate software design methodology for a given scenario.

CO3: Understand the various architectural styles of software.

CO4: Compare and contrast various testing measures.

CO5: Acquire the knowledge of managing, modern and future software projects.

REFERENCES

1. Ian Sommerville, "Software Engineering", Pearson Education Asia, 10th Edition, 2017.
2. Roger S Pressman, Bruce R Maxim, "Software Engineering - A Practitioner's Approach",McGraw-Hill Education, 8th Edition, 2019.
3. Rajib Mall, "Fundamentals of Software Engineering", PHI Learning, 4th Edition, 2014
4. Pankaj Jalote, "Software Engineering: A Precise Approach", Wiley India, 2010.
5. Shari Lawrence Pfleeger, "Software Engineering Theory and Practice", Pearson Education,4th Edition, New Delhi, 2009.

OPEN ELECTIVES
(Offered by B.E. Electrical and Electronics Engineering)

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDIT
			L	T	P		
1	20EEE01	Energy Management Systems	3	0	0	3	3
2	20EEE02	Medical Instrumentation	3	0	0	3	3
3	20EEE03	PLC Programming	3	0	0	3	3
4	20EEE04	Renewable Energy Systems	3	0	0	3	3
5	20EEE05	Virtual Instrumentation & Data Acquisition	3	0	0	3	3
6	20EEE06	Electric Vehicles	3	0	0	3	3

SRI RAMAKRISHNA INSTITUTE OF TECHNOLOGY
WISDOM DISCIPLINE PROSPERITY
COIMBATORE - 10

20EEE01	ENERGY MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to study the concepts behind energy management and auditing, economic analysis and Load management, the energy management on various electrical equipment and metering and to illustrate the concept of lighting systems and cogeneration.

COURSE CONTENT

INTRODUCTION

Definition for energy management - Need for energy management - energy basics - designing and starting an energy management program - energy accounting -energy monitoring, targeting and reporting - Definition for Energy Audit – Types of energy audit.

ENERGY COST AND LOAD MANAGEMENT

Important concepts in an economic analysis - Economic models-Time value of money - Utility rate structures - cost of electricity - Loss evaluation. Load management: Demand control techniques - Utility monitoring and control system - HVAC and energy management - Economic justification.

ENERGY EFFICIENCY IN ELECTRICAL UTILITIES

Electricity billing – power factor improvement and benefits – transformers – Distribution losses in industrial system – energy efficient motors and factors affecting motor efficiency – star operations of motor – soft starters with energy saver – standards and labelling for motors.

METERING FOR ENERGY MANAGEMENT

Relationships between parameters - Units of measure - Typical cost factors - Utility meters –Smart meters - Demand meters - Paralleling of current transformers – Instrument transformer burdens- Multitasking solid-state meters - Metering location vs. requirements- Metering techniques and practical examples - Power Balancing & Metering: from grid, Solar to gird

LIGHTING SYSTEMS & COGENERATION

Concept of lighting systems - The task and the working space -Light sources - Ballasts - luminaries - Lighting controls-Optimizing lighting energy - Power factor and effect of harmonics on power quality - Cost analysis techniques-Lighting and energy standards Cogeneration: Forms of cogeneration – feasibility of cogeneration- Electrical interconnection.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the basics of energy management with respect to economic and social maters.

CO2: apply the concepts of energy management in various electrical energy applications.

CO3: analyze the energy calculation and statistics for improving the efficiency in industries, commercial and domestic applications.

REFERENCES

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to EnergyManagement, Fifth Edition, The Fairmont Press, Inc., 2006
2. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 196.
3. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.
4. Book III - Energy efficiency in electrical utilities, Second Edition 2018, By Bureau of Energy Efficiency, Ministry of Power, India.
5. Reay D.A, Industrial Energy Conservation, 1stedition, Pergamon Press, 1977.

20EEE02	MEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objective:

This course will enable the students to impart knowledge about the basic concepts of bio medical engineering and about sensors, electrodes and their applications in medical fields.

Course Content

FUNDAMENTALS OF BIOMEDICAL ENGINEERING:

Introduction to biomedical Engineering - Development of Bio medical instrumentation – Biometrics – Introduction and Components of man vs Instrument system – physiological system of the body – problems in measuring living system – Sources of biomedical signal – Basic medical instrumentation system – Intelligent Medical Instrumentation system – Regulation of medical devices.

BIO ELECTRIC SIGNALS AND ELECTRODES

Origin of Bio electric signals – ECG – EEG – EMG – Electrodes for ECG - Electrodes for EEG - Electrodes for EMG – Electrical conductivity of Electrode jellies and creams – Micro electrodes – Electrode and Electrolyte interface – polarization.

PHYSIOLOGICAL TRANSDUCERS

Introduction to transducers – classifications of transducers – Performance characteristics of transducer – Displacement transducers – Motion transducers – Position transducers – Pressure transducer – temperature measurement transducer – Photoelectric transducer – Bio sensors – Smart sensors.

RECORDING MODERN IMAGING SYSTEM

ECG recorder – VCG recorder – PCG recorder – Digital Stethoscope – EEG – Electromyography – Central monitors – Heart and blood pressure measurement - Basis of Diagnostic Radiology – X-ray machine - Visualization of X-Rays - Portable and Mobile X-Ray Units – Digital X-ray System.

BIO AMPLIFIER AND PATIENT SAFETY

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference - Electric Shock Hazards - Leakage Currents - Safety Codes For Electro medical Equipment - Electrical Safety Analyser - Testing Of Biomedical Equipment

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: remember the basic concepts in bio medical engineering.

CO2: understand the concept of various sensors, meters and recording devices used in the medical fields.

CO3: apply this bio-electrical and bio-electronic device to identify the various diseases.

REFERENCES

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.
3. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
4. Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGrawHill Publisher, 2003.
5. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.

20EEE03	PLC PROGRAMMING	L	T	P	C
		3	0	0	3

Course Objective:

The course will enable the students to understand the operating and selection procedures of a PLC for industrial systems and possess knowledge levels to program a small, automated industrial production line.

Course Content:

INTRODUCTION

Programmable Logic Controller- History of PLC, Difference between PC & PLC, Architecture of PLC, Advantages and Disadvantages, Overall PLC system, PLC cycle Application.

PROGRAMMABLE LOGIC CONTROLLER

PLC as a computer, Programming format, PLC Modules - Input on/off Switching Devices, Input Analog Devices, Output on/off Switching Devices, Output Analog Devices.

PLC PROGRAMMING

Relay Logic, Coils and Indicators, Ladder Diagram, PLC Input Instructions, PLC Programming Examples, Industrial Process Example.

PLC FUNCTIONS

PLC Registers – Input, Output, Holding, Module Addressing, PLC Timer functions, PLC Counter Functions, PLC Arithmetic Functions, and Industrial Application Examples.

SELECTION, MAINTENANCE AND APPLICATION

Factors in Selecting a PLC, Electrical Connections, Troubleshooting malfunctions, Maintenance. Applications – Water Filling Station, Industrial Three-axis Robot Control, PID controller using PLC.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the electrical relay logic and ladder logic.
CO2: identify the correct PLC for an industrial system.
CO3: design ladder logic for small industrial applications.

REFERENCES:

1. John W Webb, Ronald A Reis, “Programmable logic controllers: Principles and Applications”, Prentice Hall India, 2003.
2. Frank D Petruzella, “Programmable Logic Controllers ", McGraw Hill Inc, 2005.
3. Kelvin T Erikson, “Programmable Logic Controllers”, Dogwood Valley Press, 2005.
4. Garry Duning, “Introduction to Programmable Logic Controller”, Cengage Learning, 3rd Edition, 2006.

20EEE04	RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to study about renewable Energy Sources and technologies, learn adequate inputs on a variety of issues in harnessing renewable Energy and to recognize current and possible future role of renewable energy sources.

COURSE CONTENT

RENEWABLE ENERGY (RE) SOURCES

Environmental consequences of fossil fuel use - Importance of renewable sources of energy - Sustainable Design and development - Types of RE sources - Limitations of RE sources - Present Indian and international energy scenario of conventional and non-conventional sources.

WIND ENERGY

Power in the Wind – Types of Wind Power Plants(WPPs)–Components of WPPs-Working of WPPs - Siting of WPPs - Grid integration issues of WPPs.

SOLAR PV AND THERMAL SYSTEMS

Solar Radiation - Radiation Measurement - Solar Thermal Power Plant - Central Receiver Power Plants - Solar Ponds.- Thermal Energy storage system with PCM - Solar Photovoltaic systems - Types of PV Systems - Types of Solar Cells - Cell, module - array - PV Module - I-V Characteristics - series and parallel connections, maximum power point tracking -Applications. Practical usage: Direct supply, Balance Supply Balance Supply needs temporary storage – Batteries fly wheel system (mechanical) based energy optimization

BIOMASS ENERGY

Introduction - Bio mass resources - Energy from Bio mass: conversion processes - Biomass Cogeneration - Environmental Benefits. Geothermal Energy: Basics - Direct Use - Geothermal Electricity - Mini/micro hydro power: Classification of hydropower schemes - Classification of water turbine - Turbine theory - Essential components of hydroelectric system.

OTHER ENERGY SOURCES

Tidal Energy: Energy from the tides - Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves - wave power devices. Ocean Thermal Energy Conversion (OTEC) - Hydrogen Production and Storage - Fuel cell: Principle of working - various types - construction and applications. Energy Storage System - Hybrid Energy Systems.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: Understand the concept of conventional, non-conventional energy sources and solar, wind, biomass, biogas power generation.

CO2: Understand the concept of energy conversion of solar, wind, biomass, biogas, hydrogen cell, fuel cell, Geo thermal, Ocean thermal, Tidal and Wave energy.

CO3: Apply the concept of energy conversion techniques for the betterment of power generation and power system.

REFERENCES

1. Joshua Earnest, Tore Wizeliu, 'Wind Power Plants and Project Development', PHI Learning Pvt.Ltd, New Delhi, 2011.
2. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, 2013.
3. A.K.Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi, 2011
4. Chetan Singh Solanki, " Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011
5. Shobh Nath Singh, 'Non-conventional Energy resources' Pearson Education, 2015.

20EEE05	VIRTUAL INSTRUMENTATION AND DATA ACQUISTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to impart the knowledge about software and programming structure of LabVIEW and to introduce various techniques of interfacing with external instruments of PC.

COURSE CONTENT

Introduction to Virtual Instrumentation

Introduction - Block diagram and architecture of a virtual instrument - Conventional Instruments versus Virtual Instruments – Data flow techniques, graphical programming in data flow, comparison with conventional programming.

Graphical Programming

Front panel - Block diagram - VIs - Sub-VIs - Simple examples - Looping: For loop, while loop - Shift registers - case and sequence; structures, formula nodes. Arrays - Clusters, charts and graphs - Local and global variables - Property node, string and file I/O.

Data Acquisition

DAQ – Components - Buffers - Triggering - Analog I/O - Digital I/O - Counters and timers - DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

Instrument Control

VI Chassis requirements. Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI. PXI system controllers - Ethernet control of PXI. Industrial applications- VISA and IVI.

Application of Virtual Instrumentation

Simulation of systems using VI: Development of Control system - Industrial Communication- Image acquisition and processing - Motion control.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the fundamental programming and dataflow in virtual Instrumentation using various data structures, program structures.

CO2: understand the fundamental programming and dataflow in virtual Instrumentation using various plotting the graphs and charts for system monitoring, processing and controlling.

CO3: apply the concept of network interface for data communication using Data Acquisition systems.

CO4: analyze the tools and to create graphical programming for automation, control applications, real time signal acquisition and analysis

REFERENCES:

1. Jane W. S. Liu," Real-time Systems", Pearson Education, 2001.
2. Jovitha Jerome, "Virtual Instrumentation using LabVIEW", Prentice Hall of India, New Delhi, 2011.
3. Gary Johnson, "LabVIEW Graphical Programming", McGraw Hill, 1997.
4. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement", Instrumentation and Control, Newnes, 2000.
5. Gupta S and Gupta J P, "PC Interfacing for data acquisition and Process control", Instrument Society of America.

20EEE06	ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to impart knowledge about the basic concepts and terminologies, energy storage devices used to drive and power the hybrid electric vehicles, different charging technologies and the control units available in the market area.

COURSE CONTENT

INTRODUCTION

History of EV – basics of EV - Components in EV – Hybrid Electric Vehicles - Fuel Cell Vehicles - Recent EVs and HEVs – efficiency comparison – pollution comparison – advantages of EV

VEHICLE MECHANICS and REGENRATIVE BRAKING

General Description of Vehicle Movement - Vehicle Resistance - Dynamic Equation - Tire–Ground Adhesion and Maximum Tractive Effort - Power Train Tractive Effort and Vehicle Speed - Vehicle Power Plant and Transmission Characteristics – EV Vehicle Performance - Tractive Effort in Normal Driving – Energy Consumption – fundamentals of regenerative braking.

ELECTRIC PROPULSION SYSTEMS AND DESIGN OF SERIES AND PARALLEL HEV

DC Motor Drives - Induction Motor Drives – PMBLDC motors – SRM drives – Series HEV: Operation Patterns - Control Strategies - Sizing of the Major Components – Parallel HEV: Control Strategies of Parallel Hybrid Drive Train - Design of Drive Train Parameters - Mild Hybrid Electric Drive Train Design

ENERGY STORAGE SYSTEM

Battery Basics – Li-ion Battery - Cell Discharge Operation - Cell Charge Operation – Construction - Alternative Batteries - Battery Parameters - Technical Characteristics - Practical Capacity - Battery Power - Ragone Plots - Targets and Properties of Batteries - Battery Modelling – Ultra capacitors - Ultrahigh-Speed Flywheels - Hybridization of Energy Storages.

CHARGING STATION AND BMS

EV charging standards - various methods of charging – battery swapping - V2G - G2V- V2B - V2H - integration of EVs in smart grid – Introduction to BMS

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: remember the basic concepts in Electric and hybrid electric vehicles.

CO2: understand the concept of vehicle dynamics, prime movers, energy storage device and various sensors Electric and hybrid electric vehicles.

CO3: apply control units concepts in Electric and hybrid electric vehicles to improve the vehicle efficiency.

REFERENCES

1. Emadi, A. (Ed.), Miller, J., Ehsani, M., “Vehicular Electric Power Systems” Boca Raton, CRC Press, 2003.
2. Husain, I. “Electric and Hybrid Vehicles” Boca Raton, CRC Press, 2010.
3. Larminie, James, and John Lowry, “Electric Vehicle Technology Explained” John Wiley and Sons, 2012.
4. Tariq Muneer and Irene Illescas García, “The automobile, In Electric Vehicles: Prospects and Challenges”, Elsevier, 2017.
5. Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Springer, 2013.

OPEN ELECTIVES
(Offered by B.E. Mechanical Engineering)

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CREDIT			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**20MEE01**	Automotive Fundamentals	GE	3	0	0	3	3
2	**20MEE02**	Computer Aided Design and Manufacturing	GE	3	0	0	3	3
3	**20MEE03**	Fundamentals of Power Plant Engineering	GE	3	0	0	3	3
4	**20MEE04**	Introduction to Robotics	GE	3	0	0	3	3
5	**20MEE005**	3D Printing	GE	3	0	0	3	3

SRI RAMAKRISHNA INSTITUTE OF TECHNOLOGY
WISDOM DISCIPLINE PROSPERITY
COIMBATORE - 10

20MEE01	AUTOMOTIVE FUNDAMENTALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide knowledge on IC Engines, braking, transmission, suspension, starting systems along with insights into new combustion techniques used for various fuels and alternative sources.

COURSE CONTENT

VEHICLE STRUCTURE, ENGINE

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics, IC engines –components function and materials

ENGINE AUXILIARY SYSTEMS

Electronically controlled gasoline injection system for SI engines and 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),

TRANSMISSION SYSTEMS

Clutch: Types diaphragm clutch, single and multi-plate clutch, centrifugal clutch and construction, Gear box: Types - gear selector and shifting mechanism, transfer box, propeller shaft, slip joints, universal joints, Differential and rear axle.

BRAKES AND SUSPENSION SYSTEMS

Braking system: Types of brakes, Mechanical, and Air brakes, Disc & Drum brakes, Engine brakes, anti-lock braking system (ABS).Suspension system: Types of Suspension Systems-front and rear suspension,

ALTERNATIVE ENERGY SOURCES AND EMISSION CONTROL

Use of Natural Gas, Liquefied Petroleum Gas, and Hydrogen in Automobiles. Electric and Hybrid Vehicles, Fuel Cell. Engine emission, Engine emission control system, Emission norms (Euro and BS).

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: identity the various components and structures of automobiles.
CO2: select the suitable type of tyres for on and off road vehicles.
CO3: classify the components of I.C engines, engine auxiliary systems, drive shafts, suspension and braking systems of various automobiles.
CO4: select the suitable alternate energy sources, emission control techniques and interpret the environmental implications of automobile emission norms

CO5: apply vehicle structures, auxiliary systems, transmission systems, suspension systems and brakes for automobile applications.

REFERENCES:

1. Kirpal Singh, "Automobile Engineering", Standard Publishers, Vol-I & II. Thirteenth Edition. New Delhi, 2014.
2. R. K. Rajput, "A Text book of Automobile Engineering", Lakshmi publication, Second Edition. 2014
3. HenizHeisler, "Vehicle and Engine Technology, SAE, Second Edition. 2009.
4. Julian Happian Smith, "An Introduction to Modern Vehicle Design", Butterworth-Heinemann, New Delhi, 2002.
5. Gupta R B, "Automobile Engineering", Satya Prakashan, 2015.
6. C.R. Ferguson, A. T. Kirkpatrick, Internal Combustion Engines, 2nd Edition, John Wiley & Sons, 2016.

20MEE02	COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To provide an overview of how computers are being used in engineering component designs and make the students understand different CAD standards used in Industries

COURSE CONTENT

FUNDAMENTALS OF COMPUTER GRAPHICS

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

GEOMETRIC MODELING

Geometry and topology -representation of curves- Hermite curve- Bezier curve- B-spline curves - Techniques for surface modeling –analytical and synthetic surfaces. Solid modeling techniques- CSG

CAD STANDARDS

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

BASIC CONCEPTS OF CIM

CIM Definition, Elements of CIM, Evolution of CIM, Benefits of CIM, Needs of CIM: Hardware and software. Product Development Cycle, Concurrent Engineering: Sequential Engineering versus Concurrent Engineering, Benefits of Concurrent Engineering.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the basics of computer aided design and in Manufacturing Automation and Control.
CO2: Interpret surface modeling techniques for curves and surfaces with various case studies.
CO3: classify the CAD standards and file formats in computer aided design.
CO4: understand the elements benefits and needs of computer integrated manufacturing.
CO5: describe the concept of concurrent engineering, product development cycle and sequential engineering.

REFERENCES:

1. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill Publishing Co.2007
2. Chris McMahon and Jimmie Browne “CAD/CAM Principles", "Practice and Manufacturing management “ Second Edition, Pearson Education, 1999.
3. William M Neumann and Robert F.Sproul “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore, 1989.
4. Donald Hearn and M. Pauline Baker “Computer Graphics”’. Prentice Hall, Inc, 1992.
5. Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Education - 2003.

20MEE03	FUNDAMENTALS OF POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To providing an overview of power plants and detailing the role of Engineers in their operation and maintenance of renewable power sources,

COURSE CONTENT

LAYOUT OF POWER PLANTS

Layout of Steam, Hydel, Diesel, Nuclear and Gas Turbine Power Plants - Combined Power Cycles – Comparison and Selection

NUCLEAR AND HYDRO POWER PLANTS

Nuclear Energy – Fission, Fusion Reaction, Types of Reactors, Waste Disposal and safety. Hydroelectric power plants – runoff storage and pumped storage type.

DIESEL AND GAS POWER PLANTS

Types of Diesel Plants, Components, Selection of Engine Type, Applications, environmental hazards-Gas Turbine Power Plant – Fuels - Gas Turbine Material – Regeneration and Intercooling.

SOLAR, TIDAL, WIND POWER PLANTS AND ECONOMIC ISSUES OF POWER PLANTS

Tidal - Solar thermal central receiver system – wind power plants -Cost of Electric Energy – Fixed and operating Costs – Energy Rates – Types of Tariffs.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: interpret the working principles of various power plants.
CO2: construct the layouts of various power plants and their equipment in accordance with economic principles, tariffs and safety precautions.
CO3: apply the concept of energy balance in various power plant operations.
CO4: choose the appropriate auxiliary systems to enhance the performance of power plants.
CO5: analyze the economics of various power plants and list factors affecting their performance.

REFERENCES:

1. EI- Wakil M. M, “Power Plant Technology”, McGraw-Hill, Second Edition, 2014.
2. Arora S. C and Domkundwar S, “A course in Power Plant Engineering”, Dhanpatrai, Third Edition, 2012.
3. Nag P.K, “Power Plant Engineering”, Tata McGraw-Hill, 2014.
4. G. D. Rai, “Introduction to Power Plant Technology”, Khanna Publishers, Third Edition, 2014.
5. T. Morse Frederick, “Power Plant Engineering”, Prentice Hall of India, Third Edition, 2014.
6. Culp A. W., “Principles of Energy Conversion”, McGraw Hill, Second Edition, 2014.

20MEE04	INTRODUCTION TO ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart knowledge about automation, various sensors and their applications in robots. Along with Robot Programming methods & Languages used by robots.

COURSE CONTENT

FUNDAMENTALS OF ROBOTICS

Robotics and programmable automation-History of robotics - Laws of robotics-Definition of a Robot - robotics systems and robot anatomy - Specifications of robots -human systems and robotics applications.

ROBOT DRIVE SYSTEMS

Functions of drive systems - Hydraulic drives - Pneumatic drives - Electrical drives - Drive mechanisms.

ROBOT CONTROL SYSTEM

Control loop- Principles of servo control in Robot - Servo control modes-Proportional control - Proportional and integral control - Proportional and derivative control - PID control

ROBOT END EFFECTORS

Introduction-Classification of End effectors - Drive system for grippers -Mechanical grippers-Vacuum gripper - Magnetic gripper - Adhesive gripper - Active and Passive gripper

ROBOT SENSORS

Need for sensing system - Sensing devices - Types of sensors - Contact and Non-contact sensors - Active and passive sensors - smart sensors - Tactile and touch sensors - Proximity and range sensors - Robot vision system.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the fundamentals of robotics and its components
CO2: interpret the various components and operations of robots.
CO3: enumerate the sensing and machine vision in robotics
CO4: describe the control systems and end effectors in robotics.
CO5: elucidate the various applications of robots.

REFERENCES:

1. S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2010
2. Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, “Industrial Robotics, Technology programming and Applications”, McGraw Hill, 2012
3. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin,”Robotics Engineering an Integrated Approach”, PHI Learning, 2011.
4. K.S. Fu., R.C.Gonalez, C.S.G.Lee, “Robotics Control Sensing ", Vision and Intelligence, McGraw Hill International Edition, 2000.
5. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.

20MEE05	3D PRINTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the various RPT processes adopted to produce parts and to impart knowledge on three dimensional printing, reverse engineering, current technologies and their influence in manufacturing.

COURSE CONTENT

FUNDAMENTALS OF RPT

Development of RP systems, Rapid Tooling, Rapid Manufacturing- Principle –Fundamental – File format – Other translators – medical applications of RP- Materials for Rapid Prototyping Systems

LIQUID BASED RAPID PROTOTYPING SYSTEMS

Liquid based system – Stereolitho graphy Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses.

SOLID BASED RAPID PROTOTYPING SYSTEMS

Solid based system - Fused Deposition Modeling, principle, process, products, advantages, applications and uses - Laminated Object Manufacturing

POWDER BASED RAPID PROTOTYPING SYSTEMS

Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses.

REVERSE ENGINEERING AND NEW TECHNOLOGIES

Reverse Engineering - Introduction, measuring device- contact type and non-contact type, CAD model creation, medical data processing - types of medical imaging, software for making medical models, medical materials, and other applications.

COURSE OUTCOMES:

Upon completion of the course, the student's will have the ability to

CO1: understand the fundamentals of rapid prototyping and it's medical applications.

CO2: interpret the various components of solid and liquid based rapid prototyping.

CO3: enumerate the principle and processes involved in selective laser sintering along with its advantages and limitations

CO4: apply reverse engineering concepts for various parts production.

REFERENCES:

1. Douglas Bryden ,"CAD and Rapid Prototyping for Product Design", Laurence King, 2014.
2. Kalani Kirk Hausman ,Richard Horne,"3D Printing For Dummies",Wiley Publications, 2014.
3. Chee Kai Chua, Kah Fai Leong, Chu Sing Lim "Rapid Prototyping: Principles and Applications" World Scientific Publication Pvt Ltd, 2011.
4. Chua C. K, Leong K. F and Lim C. S, "Rapid Prototyping: Principles and Applications", World Scientific, second edition, 2010.
5. Ian Gibson, "Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototyping", Wiley, 2006.