VINAYAKA MISSIONS RESEARCH FOUNDATION

SALEM, TAMILNADU

FACULTY OF ENGINEERING AND TECHNOLOGY

CURRICULAM AND SYLLABUS

(REGULATION - 2016)

B.E MECHANICAL ENGINEERING (FULLTIME) - CBCS

VINAYAKA MISSSION'S KIRUPANANDA VARIYAR ENGINEERNG COLLEGE
SALEM
AND
AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR, CHENNAI

SCHOOL OF MECHANICAL SCIENCES

BOARD : MECHANICAL ENGINEERING
REGULATION : 2016
PROGRAM : B.E – MECHANICAL ENGINEERING - FULL TIME

CURRICULUM & SYLLABUS

SEMESTER I

SL.NO.	COURSE CODE	COURSE TITLE	DEPT	L	T	P	C
THEORY							
1		CALCULUS FOR ENGINEERS	MATHS	3	1	0	**4**
2		ENGLISH FOR ENGINEERS	ENG	3	0	0	**3**
3		PHYSICS FOR ENGINEERS	PHY	3	0	0	**3**
4		ESSENTIALS OF COMPUTER SCIENCE AND ENGINEERING	CSE	3	0	0	**3**
5		ESSENTIALS OF ELECTRICAL AND ELECTRONICS ENGINEERING	EEE/ECE	3	0	0	**3**
PRACTICAL							
7		PHYSICS LAB	PHY	0	0	4	**2**
8		WORKSHOP PRACTICES	MECH	0	0	4	**2**
9		COMPUTER LAB	CSE	0	0	4	**2**
10		ELECTRICAL AND ELECTRONICS ENGINEERING LAB	EEE/ECE	0	0	4	**2**
TOTAL				**15**	**1**	**16**	**24**

SEMESTER II

SL.NO.	COURSE CODE	COURSE TITLE	DEPT	L	T	P	C
THEORY							
1		TRANSFORMS AND MATRICES	MATHS	3	1	0	**4**
2		BUSINESS ENGLISH	ENG	3	0	0	**3**
3		CHEMISTRY FOR ENGINEERS	CHEM	3	0	0	**3**
4		‘C’ PROGRAMMING	CSE	3	0	0	**3**
5		ENGINEERING MECHANICS	MECH	3	1	0	**4**
PRACTICAL							
7		YOGA AND MEDITATION	YOGA	0	0	2	**2**
8		ENGINEERING CHEMISTRY LAB	CHEM	0	0	4	**2**
9		‘C’ PROGRAMMING LAB	CSE	0	0	4	**2**
10		ENGINEERING GRAPHICS LAB	MECH	0	0	4	**2**
TOTAL				**15**	**2**	**14**	**25**

SEMESTER III

SL.NO.	COURSE CODE	COURSE TITLE	DEPT	L	T	P	C
THEORY							
1		MATHEMATICS FOR MECHANICAL SCIENCES	MATHS	3	1	0	**4**
2		ENGINEERING THERMODYNAMICS	MECH	3	1	0	**4**
3		MANUFACTURING TECHNOLOGY-I	MECH	3	0	0	**3**
4		FLUID MECHANICS AND MACHINERY	MECH	3	0	0	**3**
5		STRENGTH OF MATERIALS	MECH	3	1	0	**4**
6		KINEMATICS OF MACHINES	MECH	3	1	0	**4**
PRACTICAL							
7		MACHINE DRAWING LAB (Manual & CAD)	MECH	1	0	3	**2**
8		MANUFACTURING TECHNOLOGY LAB I	MECH	0	0	3	**2**
9		HYDRAULICS AND STRENGTH OF MATERIALS LAB	MECH	0	0	3	**2**
10		VALUE ADDED COURSE I	MECH	0	0	2	**1**
TOTAL				**19**	**4**	**11**	**29**

SEMESTER IV

SL.NO.	COURSE CODE	COURSE TITLE	DEPT	L	T	P	C
THEORY							
1		NUMERICAL METHODS	MATHS	3	1	0	**4**
2		DYNAMICS OF MACHINES	MECH	3	1	0	**4**
3		MANUFACTURING TECHNOLOGY-II	MECH	3	0	0	**3**
4		DISASTER MITIGATION AND MANAGEMENT	MECH	3	0	0	**3**
5		THERMAL ENGINEERING	MECH	3	1	0	**4**
6		ENVIRONMENTAL SCIENCE AND ENGINEERING	CHEM	3	0	0	**3**
PRACTICAL							
7		DYNAMICS LAB	MECH	0	0	3	**2**
8		MANUFACTURING TECHNOLOGY LAB - II	MECH	0	0	3	**2**
9		ENGINE TESTING LAB	MECH	0	0	3	**2**
10		VALUE ADDED COURSE II	MECH	0	0	2	**1**
TOTAL				**18**	**3**	**11**	**28**

SEMESTER V

SL.NO.	COURSE CODE	COURSE TITLE	DEPT	L	T	P	C
THEORY							
1		DESIGN OF MACHINE ELEMENTS	MECH	3	1	0	**4**
2		MECHANICAL BEHAVIOUR OF MATERIALS AND METALLURGY	MECH	3	0	0	**3**
3		ENGINEERING METROLOGY AND MEASUREMENTS	MECH	3	0	0	**3**
4		GAS DYNAMICS AND JET PROPULSION	MECH	3	1	0	**4**
5		ELECTRICAL MACHINES AND DRIVES	EEE	3	0	0	**3**
6		ELECTIVE – I	MECH	3	0	0	**3**
PRACTICAL							
7		METROLOGY AND MEASUREMENTS LAB	MECH	0	0	3	**2**
8		METALLURGY LAB	MECH	0	0	3	**2**
9		ELECTRICAL MACHINES AND DRIVES LAB	EEE	0	0	3	**2**
10		VALUE ADDED COURSE III	MECH	0	0	2	**1**
TOTAL				**18**	**2**	**11**	**27**

SEMESTER VI

SL.NO.	COURSE CODE	COURSE TITLE	DEPT	L	T	P	C
THEORY							
1		AUTOMOBILE ENGINEERING	MECH	3	0	0	**3**
2		HEAT AND MASS TRANSFER	MECH	3	1	0	**4**
3		DESIGN OF TRANSMISSION SYSTEMS	MECH	3	1	0	**4**
4		COMPUTER INTEGRATED MANUFACTURING	MECH	3	0	0	**3**
5		PROFESSIONAL ETHICS AND HUMAN VALUES	MGMT	3	0	0	**3**
6		ELECTIVE – II	MECH	3	0	0	**3**
PRACTICAL							
7		COMPUTER AIDED MANUFACTURING LAB	MECH	0	0	3	**2**
8		HEAT TRANSFER LAB	MECH	0	0	3	**2**
9		AUTOMOBILE ENGINEERING LAB	MECH	0	0	3	**2**
10		VALUE ADDED COURSE IV	MECH	0	0	2	**1**
TOTAL				**18**	**2**	**11**	**27**

SEMESTER VII

SL.NO.	COURSE CODE	COURSE TITLE	DEPT	L	T	P	C
THEORY							
1		HYDRAULICS AND PNEUMATIC SYSTEMS	MECH	3	0	0	**3**
2		FINITE ELEMENT ANALYSIS	MECH	3	1	0	**4**
3		RENEWABLE SOURCES OF ENERGY	MECH	3	0	0	**3**
4		MECHATRONICS	MECH	3	0	0	**3**
5		ELECTIVE – III	MECH	3	0	0	**3**
6		ELECTIVE – IV	MECH	3	0	0	**3**
PRACTICAL							
7		FINITE ELEMENT ANALYSIS LAB	MECH	0	0	3	**2**
8		AUTOMATION LAB	MECH	0	0	3	**2**
9		MINI PROJECT	MECH	0	0	3	**2**
TOTAL				**18**	**1**	**9**	**25**

SEMESTER VIII

SL.NO.	COURSE CODE	COURSE TITLE	DEPT	L	T	P	C
THEORY							
1		ELECTIVE – V	MECH	3	0	0	3
2		ELECTIVE – VI	MECH	3	0	0	3
3		ELECTIVE- VII	MECH	3	0	0	3
PRACTICAL							
3		PROJECT WORK AND VIVA VOCE	MECH	0	0	8	6
TOTAL				**9**	**0**	**8**	**15**
TOTAL CREDITS -							**200**

LIST OF ELECTIVES

SL. NO.	COURSE CODE	COURSE TITLE	DEPT	L	T	P	C
1		OPERATION RESEARCH	MECH	3	0	0	**3**
2		REFRIGERATION AND AIR CONDITIONING	MECH	3	0	0	**3**
3		UNCONVENTIONAL MANUFACTURING PROCESSES	MECH	3	0	0	**3**
4		INDUSTRIAL ROBOTICS	MECH	3	0	0	**3**
5		ADVANCED IC ENGINES	MECH	3	0	0	**3**
6		CRYOGENIC ENGINEERING	MECH	3	0	0	**3**
7		RAPID PROTOTYPING AND TOOLING	MECH	3	0	0	**3**
8		POWER PLANT ENGINEERING	MECH	3	0	0	**3**
9		LEAN MANUFACTURING SYSTEMS	MECH	3	0	0	**3**
10		TOTAL QUALITY MANAGEMENT	MECH	3	0	0	**3**
11		INDUSTRIAL TRIBOLOGY	MECH	3	0	0	**3**
12		COMBUSTION ENGINEERING	MECH	3	0	0	**3**
14		EMERGING MATERIALS	MECH	3	0	0	**3**
15		NANOTECHNOLOGY	MECH	3	0	0	**3**
16		AUTOMOTIVE INFOTRONICS	MECH	3	0	0	**3**
17		COMPUTATIONAL FLUID DYNAMICS	MECH	3	0	0	**3**
18		TURBO MACHINERY	MECH	3	0	0	**3**
19		ENTREPRENEURIAL SKILLS DEVELOPMENT FOR ENGINEERS	MECH	3	0	0	**3**
20		MARKETING TECHNIQUES FOR ENGINEERS	MECH	3	0	0	**3**
21		INDUSTRIAL ENGINEERING	MECH	3	0	0	**3**
22		INTRODUCTION TO AIRCRAFT INDUSTRY AND AIRCRAFT SYSTEMS	AERO	3	0	0	**3**
23		DESIGN OF AIRCRAFT STRUCTURES	AERO	3	0	0	**3**
24		FUNDAMENTALS OF PIPING ENGINEERING	MECH	3	0	0	**3**
25		ADVANCED CERAMIC TECHNOLOGY	MECH	3	0	0	**3**
26		VIBRATION AND NOISE CONTROL	MECH	3	0	0	**3**
27		CYBER SECURITY	CSE	3	0	0	**3**
28		PETROLEUM PRODUCTION ENGINEERING	MECH	3	0	0	**3**
29		COAL MINING AND MECHANIZATION	MECH	3	0	0	**3**
30		ENERGY CONSERVATION AND MANAGEMENT	MECH	3	0	0	**3**
31		NON DESTRUCTIVE TESTING	MECH	3	0	0	**3**
32		PROCESS PLANNING AND COST ESTIMATION	MECH	3	0	0	**3**

I	**CALCULUS FOR ENGINEERS** **(COMMON TO THE BRANCHES MECH, ECE, CSE, CSSE, EEE, EIE,CIVIL,IT,MECHTRONICS, AERONAUCTICAL ,ETC, AUTOMOBILE)**	**3**	**1**	**0**	**4**

Aim: To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.

Objectives:

To provide students with mathematical knowledge and skills needed to support their concurrent and subsequent engineering and science studies

- To improve their ability in solving geometrical applications of differential calculus problems
- To equip themselves familiar with the functions of several variables.
- To have knowledge in multiple calculus
- To improve their ability in Vector calculus

Outcome:

To impart analytical ability in solving Mathematical problems as applied as the respective branches of Engineering.

UNIT I APPLICATION OF DIFFERENTIAL CALCULUS

Curvature – Cartesian and Parametric Co-ordinates – Centre and radius of curvature – Circle of curvature – Evolute

UNIT II FUNCTIONS OF SEVERAL VARIABLES

Partial Derivatives – Total Differential - Maxima and Minima – constrained Maxima and Minima by Lagrangian Multiplier Method.

UNIT III INTEGRATION

Concept of integration-Integration of Rational andTrigonometric functions – Using Partial Fractions – Integration by parts.

UNIT IV MULTIPLE INTEGRAL

Double integration –change of order of integration- Cartesian and polar coordinates –Area as a double integral – Triple integration.

UNIT V VECTOR CALCULUS

Directional derivatives – Gradient, Divergence and Curl – Irrotational and solenoidal- vector fields – Vector integration – Green‟s theorem, Gauss divergence theorem and Stoke‟s theorem (excluding proof).

TEXT BOOK:

1. **"**Engineering Mathematics**"** by Department of Mathematics, VMU
2. Veerarajan, T., "Engineering Mathematics", Tata McGraw Hill Publishing Co., NewDelhi, 2006.
3. Dr.A .Singaravelu , Engineering Mathematics Volume I & Volume II by Meenakshi Publications.

REFERENCES:

1. Grewal, B.S., "Higher Engineering Mathematics" (36th Edition), Khanna Publishers, Delhi 2001.
2. Kreyszig, E., "Advanced Engineering Mathematics" (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
3. Kandasamy .P.,Thilagavathy. K., and Gunavathy. K., "Engineering Mathematics", Volumes I & II (4th edition), S.Chand& Co., New Delhi., 2001.
4. T. Veerarajan, "Engineering Mathematics" (for semester III), Third Edition Tata McGraw- Hill Publishing Company limited.

SEMESTER	SUBJECT	L	T	P	C
I	**ENGLISH FOR ENGINEERS** **(Common for all branches)**	3	0	0	3

Aim: To Strengthens the basic LSRW (Listening, Speaking, Reading and Writing) skills.

Objectives:

1. To enable students to develop LSRW skills in English.
2. To become effective communicators in English.
3. To ensure that learners use Electronic media materials for developing language skills.

Outcome:

Out come of the revised English for Engineers syllabus for the first semester UG engineering students for the academic year 2015- 2016.

1. By teaching this syllabus, our UG Engineering graduates will enable to enhance wide range vocabulary to use at right place in right time.
2. Students who undergo this syllabus will fulfill practice in professional writing and comprehension skill and meet the industry requirements.

Unit – I

Self introduction - Simulations using E Materials - Whatsapp, Face book, Hiker, Twitter- Effective Communication with Minimum Words - Interpretation of Images and Films - Identify the different parts of speech– Common Errors in English – Scientific Vocabulary, (definition and meaning) - Listening Skills- passive and active listening, Listening to native speakers, , guided note taking - Characteristics of a good listener– Telephonic conversation with dialogue.

Unit – II

Articles - Phonetics (Vowels, Consonants and Diphthongs) – Pronunciation Guidelines –Listening to Indian speakers from different regions, intrusion of mother tongue – Homophones – Homonyms, Note taking and Note making - Difference between Spoken and Written English- Use of appropriate language - Listening and Responding to Video Lectures (Green India, environment, social talks) - Extempore.

Unit – III

Tense forms- Verbal &Non verbal communication – Describing objects – Process Description- Speaking Practice – Paragraph Writing on any given topic (My favourite place, games / Hobbies / School life, etc.) – Types of paragraphs- Telephone Etiquettes.

Unit – IV

Impersonal Passive Voice- Conditional Sentences – Technical &Non technical Report Writing (Attend a technical seminar & submit a report) – News Letters & Editing –Skimming & Scanning - How to Improve Reading Speed – Designing Invitations & Poster Preparation.

Unit – V

Sentence Pattern (SVOCA) - Statement of Comparison - Transcoding – Informal letters - SWOT analysis– Resume Writing- Difference –Bio – data, Resume and CV.

References:

1. Practical English Usage- Michael Swan (III edition), Oxford University Press
2. Grammar Builder- I, II, III, and Cambridge University Press.

SEMESTER	SUBJECT	L	T	P	C

I	**PHYSICS FOR ENGINEERS (COMMON TO ALL BRANCHES)**	**3**	**0**	**0**	**3**

Aim: To Strengthens the fundamental knowledge in physics will improve the scientific thinking of students.

Objective: The fundamental knowledge in physics will improve the scientific thinking of students.

Outcome: To understand the elastic properties of materials.

To understand the properties of crystals.

To understand the significance of laser and its applications in technology.

To understand the basic principles of optical fibres and their applications.

To understand the Non-Destructive Testing techniques.

UNIT I –Properties of matter **9**

Elasticity – Hooke's law – Stress-strain diagram - Relationship between three moduli of elasticity (qualitative) - Poisson's ratio – Young's modulus by uniform bending and non-uniform bending – Experimental determination of rigidity modulus – I-shaped girders.

UNIT II – Crystal Physics **9**

Unit cell – Bravais lattice – Miller indices – Calculation of number of atoms per unit cell – atomic radius – coordination number – packing factor for SC, BCC, FCC, HCP structures – Crystal imperfections – point, line, surface and volume defects.

UNIT III – Lasers **9**

Laser characteristics - Stimulated Emission – Population Inversion - Einstein coefficients – Lasing action – Types of Laser – Nd:YAG laser, CO_2 laser, GaAs laser – Applications of Laser – Holography – construction and reconstruction of a hologram

UNIT IV – Fibre Optics **9**

Principle and propagation of light in optical fibres – numerical aperture and acceptance angle – types of optical fibres (material, refractive index, mode) – Applications: Fibre optic communication system – fibre optic displacement sensor and pressure sensor.

UNIT V - Non – Destructive Testing **9**

Introduction – Types of NDT - Liquid penetrant method – characteristics of penetrant and developer - ultrasonic flaw detector – Ultrasonic scanning methods - X-ray Radiography: displacement method – X-ray Fluoroscopy.

Total hours : 45

TEXT BOOK

"Engineering Physics", compiled by Department of Physics, Vinayaka Missions University, Salem.

REFERENCE BOOKS

1. Beiser, Arthur, "Concepts of Modern Physics", 5th Ed., McGraw-Hill, 2009.

2. Halliday.D, Resnick.R, Walker.J, Fundamentals of Physics, Wiley & sons, 2013.

3.Gaur R. K. and Gupta S. L., "Engineering Physics", DhanpatRai publishers, New Delhi, 2001.

4. Avanadhanulu.M.N., ArunMurthy.T.V.S, Engineering Physics Vol. I, S.Chand, 2014.

5. Rajendran. V, "Engineering Physics", Tata McGraw Hill Publication and Co., New Delhi, 2009.

SEMESTER	SUBJECT	L	T	P	C
I	**ESSENTIALS OF COMPUTER SCIENCE AND ENGINEERING (COMMON TO ALL BRANCHES)**	**3**	**0**	**0**	**3**

AIM: To study the basics of Computer, Hardware, Software Applications, Algorithms and Problem solving methodologies.

OBJECTIVES:

- To provide basic knowledge on hardware and software components of computers.
- To introduce and demonstrate various software applications
- To introduce Problem solving methodologies
- To learn about Implementation of Algorithms
- To learn about HTML

OUTCOME

At the end of this course, student shall be able to:

Do Problem Solving using Programming and algorithms, Describe working of Internet based applications, Document artifacts using common quality standards, Design simple data store using DBMS concepts and implement, Develop a working website with all above learning

UNIT I - Basics of Computer and Information Technology 10

Computer – Generations, Types of Computers, Block diagram of a computer- Components of a computer system - Hardware and software definitions - Categories of software – Booting - Installing and Uninstalling a Software - Software piracy - Software terminologies - Applications of Computer - Role of Information Technology - History of Internet - Internet Services.

UNIT II - Software Applications (Practical Learning) 7

Office Automation: Application Packages - Word processing (MS Word) - Spread sheet (MS Excel) – Presentation (MS PowerPoint).

UNIT III - Problem Solving Methodologies 10

Problems Solving Techniques - Program Development Cycle – Algorithm Development - Flow chart generation – Programming Constructs (Sequential, Decision-Making, Iteration) - Types and generation of programming languages

UNIT IV Implementation of Algorithms 9

Implementation of Algorithms-program verification-The efficiency of algorithms-The analysis of algorithms-Fundamental Algorithms

UNIT V HTML 9

Basics of HTML – Applications of HTML – HTML Fonts – anchor tag and its attributes – Using images in HTML programs – list tag - Table tag – HTML forms

TOTAL HOURS: 45

TEXT BOOKS

1. *Essentials of Computer Science and Engineering – by VMU*

SEMESTER	SUBJECT	L	T	P	C
I	**ESSENTIALS OF ELECTRICAL AND ELECTRONICS ENGINEERING (COMMON TO AERO, AUTO, CIVIL, MECH)**	**3**	**0**	**0**	**3**

AIM :

To study the basics of electrical and electronics engineering

OBJECTIVE: To provide the basic knowledge about EEE

To provide an understanding of fundamentals of Electrical and Electronics Engineering

OUTCOME:

The student will be able to identify and understand the operation of electrical and electronic components and design circuits.

A) ELECTRICAL ENGINEERING

UNIT I Electrical Circuits & Meters 9

Definition of electromotive force, current, power and energy-InternationalSystem of units-Ohm's law and Kirchhoff's laws-solution of series and parallel Circuits.

Generation of alternating voltage-average and RMS values-solution of simple R,RL,RC and RLC circuits- Calculation of power and power factor in ACcircuits.

Construction and principles of operation of moving coil,moving iron anddynamometer instruments.

UNIT II DC Machines (Qualitative Treatment Only) 8

Dc machines –parts-DC generator-EMF equation-Different types of DCgenerators and their applications-DC motors and their applications-different types-speed control-Starters.

UNIT III AC Machines (Qualitative Treatment Only) 6

Construction & principle of operation of transformers-Single phase & Three phasetransformers-Construction and operation of AC motors-Single phase and three phase Induction motors-applications-construction, principles of operation and application of synchronous motors.

B) BASIC ELECTRONICS ENGINEERING

UNIT I: SEMICONDUCTOR DEVICES 8

Passive and Active Components - Resistors, Inductors, Capacitors, Characteristics of PN Junction Diode - Zener Diode and its Characteristics - Half wave and Full waveRectifiers - Voltage Regulation. Bipolar Junction Transistor, FET, MOSFET & UJT.

UNIT II: DIGITAL FUNDAMENTALS 8

Number Systems – Binary, Octal, Decimal and Hexa-Decimal – Conversion from one to another – Logic Gates – AND, OR, NOT, XOR, Universal Gates – Adders, Multiplexer, De Multiplexer, Encoder, Decoder – Memories – PAL, PLA.

UNIT III: COMMUNICATION AND ADVANCED GADGETS 8

Modulation andDemodulation – AM, FM, PM – RADAR – Satellite Communication – Optical Fibre Communication, Mobile Communication, Digital TV, HD Video Camera, Smart Phones – Block diagrams Only.

TEXT BOOKS

1. “Basic Electrical and Electronics Engineering”, compiled by Department of EEE&ECE faculty of Engineering & technology, VMRFDU, Anuradha Agencies,2006.
2. Edward Hughes, “Electrical and Electronics Technology”, Pearson Education Limited, Ninth edition,2005.
3. “Basic Electrical and Electronics Engineering”, Compiled by Department of EEE & ECE, Faculty of Engineering and Technology, VMRFDU, Anuradha agencies,2006.
4. Edward Hughes, "Electrical and Electronics Technology",Pearson Education Limited, Ninth edition, 2005.
5. "Basic Electrical and Electronics Engineering", Compiled byDepartment of EEE & ECE, Faculty of Engineering and Technology, VMRFDU, Anuradha agencies,2006

REFERENCES

1. B.R. Guptha, “Principles of Electrical Engineering “ ,S.Chand& Co,2002.
2. I.J.Nagrath, “Elements of Electrical Engineering”, Tata McGraw Hill Publishing Co.,2002.
3. H.Cotton.” Advanced Electrical Technology”, Wheeler,1983.
4. Principles of Communication Engineering, S.Chand& Co, 1994.
5. John Kennedy "Electronics Communication System" TataMcGraw Hill, 2003
6. Millman and Halkias, "Electronic Devices and Circuits", TataMcGraw hill.

SEMESTER	SUBJECT	L	T	P	C
I	**PHYSICS LAB (REAL AND VIRTUAL) (COMMON TO ALL BRANCHES)**	**0**	**0**	**3**	**2**

Aim: To provide the knowledge about basics of physics

Objective: Students will have the knowledge of taking measurements precisely.

Outcome: To understand the experiments through online virtual demonstration followed by real hands-on experience.

List of Experiments

1. Young's modulus of a bar - Non-uniform bending
2. Rigidity modulus of a wire - Torsional Pendulum
3. Viscosity of a liquid - Poiseuille's method
4. Velocity of ultrasonic waves in liquids - Ultrasonic Interferometer
5. Particle size determination using Laser
6. Wavelength of spectral lines – grating - Spectrometer
7. Thickness of a wire - Air wedge Method
8. Thermal conductivity of a bad conductor - Lee's disc
9. Band gap determination of a thermistor - Post Office Box
10. Specific resistance of a wire – Potentiometer

SEMESTER	SUBJECT	L	T	P	C
I	**ELECTRICAL AND ELECTRONICS ENGINEERING LAB (COMMON TO CIVIL, AUTO , AERO, MECH)**	**3**	**0**	**0**	**2**

AIM:

To provide the basic skills of EEE

OBJECTIVE:

To provide exposure to the students with hands on experience on various basic Engineering practices in Electrical and Electronics Engineering.

OUTCOME:

Development of skills in electrical and electronic devices.

LIST OF EXPERIMENTS

A) ELECTRICAL ENGINEERING LAB

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

B) ELECTRONICS ENGINEERING LAB

1. Characteristics of PN junction Diode.
2. Characteristics of Zener diode.
3. Input, Output characteristics of BJT.
4. Transfer characteristics of JFET.
5. Amplitude Modulation
6. Frequency Modulation.

SEMESTER	SUBJECT	L	T	P	C
I	**COMPUTER SCIENCE LAB (COMMON TO ALL BRANCHES)**	**0**	**0**	**3**	**2**

AIM

To practice the basics of office automation application, SQL and basic HTML coding

OBJECTIVE

To familiarize students with the basic tools of computer and their application in engineering & technology

OUTCOME

At the end of the course, the students would have develop their skills for Office automation, SQL queries and Html

1. Implement Mail Merge in MS-Word and send letters to parents regarding the semester fee structure of the student.
2. Using MS-Word, create a leave letter addressed to your faculty advisor
3. A) Using MS-Word, create a table for a list of students with different font sizes and colours
   B) Using MS-Word, create a flow-chart using the basic shapes available. Use page border, a watermark, header and footer
4. Using MS-PowerPoint, create a presentation about the university
5. Using MS-PowerPoint, create a story line with various animations and transition effects.
6. Using MS-Excel, Analyze Students performance using MS-Excel and prepare a chart type report.
7. Using MS-Excel, create a pivot table
8. Using MS-Excel, create look-up tables
9. Using MS-Excel, create graphs for the weather condition in various cities of India
10. Create an HTML page Create an HTML page to
    a) Click on a link and go to the bottom of the page using <a href>
    b) Display an image.
11. Create an HTML page to
    a) Display ordered and unordered lists of your friends names and sports persons
    b) Display a table with 3 columns and 4 rows.

SEMESTER	SUBJECT	L	T	P	C
I	**WORKSHOP PRACTICES LAB (COMMON TO ALL BRANCHESEXCEPT BIO-TECH)**	**0**	**0**	**3**	**2**

AIM

The aim of the lab to learn basic skill in fitting, Carpentry and welding techniques

OBJECTIVE

To learn the experience of practice in basic sections of the workshop namely fitting, Carpentry and welding in order to know the various methods involved in making parts of the various machines.

OUTCOME

The students would have been completely exposed to the various basic methods that are going to play in the manufacture of even very heavy machines.

FITTING

1. Square Joint
2. Dove Tail Joint

CARPENTRY

1. Half Lap Joint
2. Dove Tail Joint

WELDING

1. Arc Welding of butt Joint.
2. Arc Welding of Lap Joint

CASTING

1. Foundry – Mould Preparation using single piece pattern

DEMONSTRATION

1. Sheet Metal – Fabrication of cone
2. Black Smithy – Round to square rod

Reference:

1.“Basic Workshop Practice”, Department of Mechanical Engineering, Vinayaka Missions University

SEMESTER	SUBJECT	L	T	P	C
II	**TRANSFORMS AND MATRICES** **(COMMON TO THE BRANCHES MECH, ECE, CSE, CSSE, EEE, EIE,CIVIL,IT,MECHTRONICS, AERONAUCTICAL ,ETC, AUTOMOBILE)**	3	1	0	4

Aim: To provide students with mathematical knowledge and skills needed to support their concurrent and subsequent engineering and science studies

Objectives:

The syllabus for the Engineering Mathematics I have been framed catering to the needs of the Engineering students. It is purely applications oriented. To mention a few

- To utilize the powerful features of MATLAB one has to be an expert in Matrix theory
- The matrix theory plays a vital role in simplifying large arrays of equation and in determining their solution.
- Partial differential equation frequently occurred in the theory of elasticity and Hydraulics.
- In circuit branches the current flow can be calculated by using Laplace transform when EMF, resistance and inductions are known.

Outcome:

- At the end of this course the students will be in a position to apply the knowledge of Mathematics in the respective Engineering branches.

UNIT I
MATRICES

Characteristic equation – Eigen values and eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors (Without proof) – Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a symmetric matrix to diagonal form.

UNIT II
LAPLACE TRANSFORMS

Laplace transform – transform of elementary functions – basic properties – derivatives and integrals of transforms – transforms of derivatives and integrals – initial and final value theorems – Transform of periodic functions.

UNIT III
INVERSE LAPLACE TRANSFORMS & APPLICATIONS

Inverse Laplace transform – Convolution theorem – Initial and Final value theorem-Solution of linear ODE of second order with constant coefficients and first order simultaneous equation with constant coefficients using Laplace transforms.

UNIT IV
FOURIER TRANSFORMS

Fourier transform pairs - Fourier Sine and Cosine transforms – Properties - Transforms of simple functions - Convolution theorem - Parseval's identity.

UNIT V

Z-TRANSFORMS

Z-Transform – Elementary Properties – Inverse Z-Transform – Convolution Theorem – Formation of Difference Equations – Solution of Difference Equations using Z-Transform.

TEXT BOOKS

1. **"**Engineering Mathematics**"** by Department of Mathematics, VMU
2. Veerarajan, T., "Engineering Mathematics", Tata McGraw Hill Publishing Co., NewDelhi, 2006.
3. Dr.A .Singaravelu , Engineering Mathematics Volume I & Volume II by Meenakshi Publications.
4. A.Singaravelu,"Transforms and Partial Differential Equations", MeenakshiAgencies,Chennai

REFERENCE BOOKS

1. Grewal, B.S., "Higher Engineering Mathematics" (36th Edition), KhannaPublishers,Delhi 2001.
2. Kreyszig, E., "Advanced Engineering Mathematics" (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
3. Kandasamy .P.,Thilagavathy. K., and Gunavathy. K., "Engineering Mathematics",Volumes I,II & III (4th edition), S.Chand& Co., New Delhi., 2001

SEMESTER	SUBJECT	L	T	P	C
II	**BUSINESS ENGLISH** **(Common for all branches)**	3	0	0	3

Aim: To provide the basic knowledge of business english

Objectives:

1. To impart and enhance corporate communication.
2. To enable learners to develop presentation skills.
3. To build confidence in learners to use English in Business contexts.

Outcome:

Out come of the revised Business English syllabus for the second semester UG engineering students for the academic year 2015-2016.

1. It is hoped that this syllabus will able to communicate with a range of formal and informal context.
2. This syllabus will enable the students to undergo in activities, demonstrating interaction skills and consider how own communication is adjusted in different scenario.

Unit – I

Subject and verb agreement (Concord) – Preposition and Relative Pronoun – Cause and effect- Phrasal Verbs – Idioms and Phrases – Listening comprehension - Listening to Audio Files and Answering Questions – Framing Questions – Negotiation skills, Persuasion Skills and Debating skills.

Unit – II

Stress (Word stress and Sentence stress) – Intonation – Difference between British and American English– Vocabulary – Indianism - Compound Words(including technical terminology).

Unit – III

Reading Skills – Understanding ideas and making inferences – Group Discussion – Types of Interviews, FAQs – e- mail Netiquette, Sample e-mails – Watching Documentary Films and responding to questions.

Unit – IV

Corporate communication – Recommendation - Instruction – Check List- circulars- Inter office memo – Minutes of meeting and Writing agenda – Discourse Markers- Rearranging the jumbled sentences – Technical Articles – Project Proposals, Making Presentations on given topics – Preparing Power Point Presentations.

Unit – V

Critical Reading – Book Review - Finding Key Information and Sifting Facts from Opinions – Business letters (Calling for Quotation, Placing orders and Complaint letters) – Expansion of an Idea. – Creative Writing.

References:

1. Grammar Builder- I, II, III -Cambridge University Press.
2. Technical English-Writing, Reading and Speaking- Pickett and Lester, Harper and Row publication

SEMESTER	SUBJECT	L	T	P	C
II	**CHEMISTRY FOR ENGINEERS** **(COMMON TO ALL BRANCHES)**	3	0	0	3

AIM

To impart in basic knowledge in chemistry so that the student will understand the engineering concept and they can face the competitive examinations effectively.

OBJECTIVE

With a solid foundation in basic scientific and engineering principles, while allowing specialization in Engineering chemistry and ability to assess the impact of engineering solutions in a global and societal context.

OUTCOME

The student will come out with the ability to assess the impact of engineering solutions.

UNIT I : ELECTROCHEMISTRY, BATTERIES AND FUEL CELLS 9 Hrs

Ostwald Law and Debye Huckle's law - Electrode potential - Nernst equation – Electrodes (SHE, Calomel and Glass)- cells - EMF measurement-emf and galvanic series.

Primary battery (Daniel and dry cell) – secondary battery (lead Acid storage battery and Nickel-Cadmium battery) – Fuel cell (H_2-O_2 fuel cell)

UNIT II : WATER TECHNOLOGY & CORROSION 9 Hrs

Sources of water – impurities – Hardness and its determination (problems to be avoided) – boiler troubles – water softening (zeolite &Demineralisation) – Domestic water treatment – Desalination (Electrodialysis& Reverse Osmosis).

Corrosion – Types – principles – corrosion control methods (Electroplating,Electroless plating, Sacrificial anode and Impressed current method).

UNIT III: CHEMISTRY OF ADVANCED MATERIALS 9 Hrs

Refractories – properties and uses, Portland cement –manufacturing, setting and hardening –Special cement, ceramics.

Organic electronic material, shape memory alloys, smart materials,polymers(PVC,Teflon, Bakelite)-fibers(optical fibre) & composites (FRP,MMC & PMC)

UNIT IV : PHASE EQUILIBRIA & NUCLEAR CHEMISTRY 9 Hrs

Phase rule: statement and explanation of terms involved – One component system (water) – Condensed phase rule – Two component system (Lead-silver) .

Nuclear Chemistry – Fission – Fusion – working of nuclear reactor – Radiations and harmful effects.

UNIT V : CHROMATOGRAPHY AND SPECTROSCOPY 9 Hrs

Chromatography — classification (Paper, Column, Thin Layer, Gas, HPLC). Principle and applications.

Spectroscopy – Electromagnetic radiation – Beer Lambert's law – UV – Visible – IR – Atomic absorption & flame emission spectroscopy (Principle,Instrumentation, block diagram).

TEXT BOOK: Engineering Chemistry by VMU.

References:

1. A text book of Engineering Chemistry by S.S. Dara, S.Chand& company Ltd., New Delhi
2. Engineering Chemistry by Jain & Jain, 15th edition Dhanpatrai Publishing Company (P) Ltd., New Delhi
3. A text book of Engineering Chemistry by ShashiChawla,Edition 2012 Dhanpatrai& Co., New Delhi.
4. Engineering Chemistry by Dr.A.Ravikrishnan,Sri Krishna Publications, Chennai.

SEMESTER	SUBJECT	L	T	P	C
II	**C - PROGRAMMING (COMMON TO ALL BRANCHES)**	3	0	0	3

AIM:

The aim is to introduce C programming to the students.

OBJECTIVES:

- To introduce Basics of C
- To understand Control Structures & Arrays
- To learn about String concept, Structure and Union in C
- To introduce the concepts of Functions and Pointers
- To introduce Memory and File management concepts in C

OUTCOME

At the end of this course, student shall be able to know the concepts of C programming techniques.

UNIT I - Basics of C **9**

Identifiers, variables, expression, keywords, data types, constants, Objective of variables. Operators: arithmetic, logical, relational, conditional and bitwise operators - Special operators: size of () & comma (,) operator - Precedence and associatively of operators - Type conversion in expressions.

UNIT II - Control Structures & Arrays **9**

Basic input/output and library functions: Single character input/output i.e. getch(), getchar(), getche(), putchar() - Formatted input/output: printf() and scanf() – Library functions (mathematical and character functions). Decision Making and Branching – Looping statements. Arrays – Initialization – Declaration – One dimensional and two dimensional arrays.

UNIT III String, Structure & Union **9**

Strings: Declaration-Initialization and string handling functions. Structure and Union: structure declaration and definition – Accessing a Structure variable – Structure within a structure – Union.

UNIT IV Functions and Pointers **9**

Function –Function Declaration–function definition- Pass by value – Pass by reference – Recursive function – Pointers - Definition – Initialization – & and * operators - Pointer to functions-Function returning pointers – Pointers and arrays

UNIT V Memory and File management **9**

Static and dynamic memory allocation - Storage class specifier - Preprocessor directives. File handling concepts – File read – write- Functions for file manipulation: fopen, fclose, gets, puts, fprintf, fscan, getw, putw, fputs, fgets, fread, fwrite - Random access to files: fseek, ftell, rewind - File name as Command Line Argument.

TOTAL HOURS: 45

TEXT BOOKS:

1. Balaguruswami.E, “Programming in C”, TMH Publications,1997

REFERENCE BOOKS:

1. Behrouz A. Forouzan& Richard F. Gilberg, “Computer Science A Structured Programming using C”, Cengage Learning, 3rd Edition, 2007
2. Gottfried , “Programming with C”, schaums outline series, TMH publications,1997
3. Mahapatra , “Thinking in C”, PHI publications, 2nd Edition, 1998.

SEMESTER	SUBJECT	L	T	P	C
II	ENGINEERING MECHANICS (COMMON TO AERO, AUTO, CIVIL, MECH)	3	0	0	3

AIM:

The aim is to introduce basics of solid mechanics to the students.

OBJECTIVES:

To create and understanding of statics and dynamics of bodies in rest or in motion.

OUTCOME

At the end of this course, student will be in a position to design mechanical systems independently.

UNIT 1. BASICS & STATICS OF PARTICLES 9

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

UNIT 2. EQUILIBRIUM OF RIGID BODIES 9

Free body diagram - Types of supports and their reactions - requirements of stable equilibrium - Moments and Couples - Moment of a force about a point and about an axis - Vectorialrepresentaion of moments and couples - Scalar components of a moment - Varignon's theorem - Equilibrium of Rigid bodies in two dimension - Equilibrium of Rigid bodies in three dimensions.

UNIT 3. PROPERTIES OF SURFACES AND SOLIDS 9

Determination of Areas and Volumes - First moment of area the Centroid of sections - Rectangle, circle, triangle from integration - T section, I section, Angle section, Hollow section by using standard formula - second and product moments of plane area - Rectangle, triangle, circle from integration - T section, I section, Angle section, Hollow section by using standard formula - Parallel axis theorem and perpendicular axis theorem - Polar moment of inertia - Principle moments of inertia of plane areas - Principle axes of inertia - Mass moment of inertia.

UNIT 4. FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 9

Frictional force - Laws of Coloumb friction - simple contact friction - Rolling resistance - Belt friction. Translation and Rotation of Rigid Bodies - Velocity and acceleration - General Plane motion.

UNIT 5. DYNAMICS OF PARTICLES 9

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

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Beer & Johnson, Vector Mechanics for Engineers. Vol.I Statics and Vol. II Dynamics, McGraw Hill International Edition, 1995.
2. KottiswaranN,Engineering Mechanics-Statics &Dynamics,SriBalaji Publications,2014.
3. Meriam, Engineering Mechanics, Vol. I Statics & Vol. II Dynamics 2/e, Wiley Intl., 1998.

REFERENCE BOOKS :

1. Rajasekaran.S, and Sankara Subramanian G, "Engineering Mechanics", Vikas Publishing Co. New Delhi.
2. Irving H. Sharma, Engineering Mechanics - Statics & Dynamics, III Edition, Prentice Hall of India Pvt. Ltd., 1993.
3. K.L.Kumar, Engineering Mechanics III Edition, Tata McGraw Hill Publishing Co. Ltd., 1998

SEMESTER	SUBJECT	L	T	P	C
II	**C – PROGRAMMING LAB (COMMON TO ALL BRANCHES)**	0	0	3	2

AIM

To practice and develop applications using C Programming languages.

OBJECTIVE

To make the students to develop program in C languages.

OUTCOME

At the end of the course, the students will be able to develop applications using C Programming languages.

List of exercises:

1. Write a C Program to Implementation of Sine and cosine series
2. Write a C Program to calculate Simple Interest
3. Write a C Program to generate Fibonacci Series using for loop
4. Write a C program to calculate factorial using while loop
5. Write a C Program to
   a) Find the greatest of three numbers using if condition.
   b) Find the greatest of three numbers using conditional operator.
6. Write a C program for finding the roots of a given quadratic equation using conditional control statements
7. Write a C program to
   a) Compute matrix multiplication using the concept of arrays.
   b) Illustrate the concept of string handling functions.
8. Write a C program to
   a) Find the largest element in an array using pointers.
   b) Convert a binary number to decimal or decimal to binary using functions.
9. Write a C program to read data from keyboard, write it to a file named student again read the same data from student file and write it into data file.
10. Write a C program to store employee details using the concept of structures.

SEMESTER	SUBJECT	L	T	P	C
II	**ENGINEERING GRAPHICS LAB (COMMON TO ALL BRANCHES EXCEPT BIO-TECH))**	3	0	0	2

AIM:

AN INTRODUCTION OF CAD SOFTWARE AND ITS UTILITIES IN ENGINEERING FIELDS.

OBJECTIVES:

1. To improve imagination skills.
2. Increase ability to communicate with people.
3. Learn to sketch and take field dimensions.
4. Learn to take data and transform it into graphic drawings.
5. Learn basic engineering drawing formats.
6. Prepare the student for future Engineering positions.

COURSE OUTCOMES:

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

1. Get acquainted with the knowledge of various lines, geometrical constructions and construction of various kinds of scales, and Ellipse.
2. Improve their imagination skills by gaining knowledge about points, lines and planes.
3. Become proficient in drawing the projections of various solids. 4. Gain knowledge about orthographic and isometric projections.

Concepts and conventions (Not for Examination)

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

UNIT I PLANE CURVES AND FREE HAND SKETCHING 9

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

UNIT II PROJECTION OF POINTS, LINES 9

Projection of points, Projection of straight lines located in the first quadrant: inclined to both planes – Determination of true lengths and true inclinations – rotating line method only.

UNIT III PROJECTION OF SOLIDS 9

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

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 9

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones

UNIT V ISOMETRIC VIEW AND PERSPECTIVE PROJECTION 9

Principles of isometric View – isometric scale – isometric view of simple solids- Introduction to Perspective projection

TEXT BOOKS:

1. N.D. Bhatt, "Engineering Drawing" Charotar Publishing House, 46th Edition, (2003).
2. K. V. Natarajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2006).

REFERENCES:

1. M.S. Kumar, "Engineering Graphics", D.D. Publications, (2007).
2. K. Venugopal& V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited.
3. M.B. Shah and B.C. Rana, "Engineering Drawing", Pearson Education (2005).
4. K. R. Gopalakrishnana, "Engineering Drawing" (Vol.I&II), Subhas Publications (1998).

SEMESTER	SUBJECT	L	T	P	C
II	ENGINEERING CHEMISTRY LAB (REAL & VIRTUAL) (COMMON TO ALL BRANCHES EXCEPT BIO-TECH)	0	0	3	2

AIM

To impart in basic knowledge in chemistry so that the student will understand the engineering concept.

OBJECTIVE

To learn the relevant experience using laboratory experiments

OUTCOME

The student will have the experience in handling the instruments relevant to his/her theory.

List of Experiments

1. Estimation of total hardness of water sample by EDTA method.
2. Estimation of dissolved oxygen by Winkler's method.
3. Estimation of ferrous ion by Potentiometry.
4. Precipitation reaction by Conductometry.
5. Acid base reaction by pH metry.
6. Estimation of copper from its ore.
7. Estimation of iron by spectrophotometer.
8. Estimation of sodium by flame photometer.
9. Separation of mixture of components using thin layer chromatography.
10. Corrosion experiment by weight loss methods.

SEMESTER	TITLE OF PAPER	L	T	P	C
III	MATHEMATICS FOR MECHANICAL SCIENCES (Common to BE-Mech, Aero, Auto)	3	1	0	4

Aim:

To provide students with mathematical knowledge and skills needed to support their concurrent and subsequent engineering and science studies

Objective:

- To provide the students with the concept and an understanding of Differential equations.
- To orient the students to know about the application of Harmonic analysis.
- To teach the students about the solutions of wave and heat equations.
- To motivate the students to know about the applications of Fourier Series
- To equip the students with the knowledge of descriptive and inferential statistics
- To Understand the various application design of experiments

Outcome:

- Analyze the spectral characteristics of continuous time periodic and periodic signals using Fourier series.
- Gain the knowledge in vibrations of stretched strings.
- Develop the fundamental ideas of D Alembert's solution of the wave equation
- Understand the concepts of Steady state conditions
- Use the applications of statistics in practical life
- Apply Probability Distributions logics to solve the problems
- Understand in collection, presentation and drawing conclusion about biological data
- Apply the subject knowledge in their engineering subjects

UNIT-I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation - Solutions of standard types f(p,q)=0, clairauts form, f(z,p,q)=0,f(p,x)=g(q,y) of first order equations - Lagrange's Linear equation - Linear partial differential equations of second and higher order with constant coefficients.

UNIT-II FOURIER SERIES 12

Dirichlet's conditions - General Fourier series - Half-range Sine and Cosine series - Parseval's identity – Harmonic Analysis.

UNIT-III BOUNDARY VALUE PROBLEMS 12

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 in Cartesian coordinates.

UNIT-IV STANDARD DISTRIBUTIONS 12

Binomial – Poisson- Geometric –Uniform-Exponential-Gamma and Normal Distributions,their MGF and Properties (Mean,Variance and Problems).

UNIT-V STATISTICS **12**

Measures of central tendency, Curve fitting-Straight line and Parabola by least square method, Correlation, Rankcorrelation andRegression.

Lecture Hours: 45;Tutorial Hours: 15;Total hours : 60

TEXT BOOKS:

1.A.Singaravelu,"Transforms and Partial Differential Equations", Meenakshi Agencies,Chennai.
2. A.Singaravelu, Probability and Statistics, Meenakshi Agencies,Chennai.
3. S.C.Gupta,V.K.Kapoor,"Fundamentals of mathematical statistics",Sultan Chand&Sons.

REFERENCES

1**.** T. Veerarajan, "Engineering Mathematics" (for semester III), Third Edition Tata McGraw- Hill Publishing Company limited.
2**.**Grewal, B.S., "Higher Engineering Mathematics" (35th Edition), Khanna Publishers,Delhi2000.
3. Kreyszig, E., "Advanced Engineering Mathematics" (8th Edition), John Wiley and Sons,(Asia) Pte Ltd.,Singapore, 2000.
4.T.Veerarajan, "Probability ,Statistics and Random processes" (Second Edition), Tata McGraw-Hill Publishing Company Ltd., New Delhi (2006).
5.Johnson. R.A., "Miller & Freund's Probability and Statistics for Engineers", Sixth Edition, Pearson education, Delhi, 2000. (Chapters 7,8,9,12)

SEMESTER	SUBJECT	L	T	P	C
III	**ENGINEERING THERMODYNAMICS** (Common to MECH,AUTO and AERO)	3	1	0	4

Aim	*The aim of the subject is to provide a fundamental knowledge of thermodynamics.*
Objective	*1. To achieve an understanding of fundamentals of thermodynamic systems and first law of thermodynamics.* *2. To provide an in-depth study of availability and second law of thermodynamics.* *3. To understand the concept of working fluid and its properties.* *4. To provide in-depth study of power cycles applying the different working fluids studied in the previous chapter.* *5. To understand the Thermodynamic Relations and also to understand combustion equations.*
Outcome	*The students would understand the basic fundamentals in thermodynamics and its applications.*

UNIT –I BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS 9

Definition of Thermodynamics, macroscopic and microscopic approach, thermodynamic systems and surroundings, thermodynamic properties, thermodynamic equilibrium, state, path, process and cycle, reversible and irreversible processes, work, energy, and heat, state postulate and Zeroth- law of thermodynamics, thermometer and thermometric property, temperature Scales.

Internal energy, First law of thermodynamics, perpetual motion machine of the first kind PMM I, application of first law to non-flow processes or closed system and related problems, application of first law to steady flow process, steady flow energy equation. Problems

UNIT –II SECOND LAW OF THERMODYNAMICS 9

Limitations of First law of thermodynamics, thermal reservoir, heat engine, refrigerator, and heat pump, statements of Second law of thermodynamics, perpetual motion machine of II Kind - PMM II, Carnot cycle, , Carnot theorem, corollary of Carnot's theroem, Clausius inequality. Problems on heat engine ,refrigerator and heat pump. Entropy, Temperature – entropy diagram, entropy changes for a closed system. Problems on entropy change calculations in different processes. Availability and irreversibility , available and unavailable energy, availability in non-flow and steady flow systems. Problems on irreversibility and avaialbility.

UNIT 3 PURE SUBSTANCES AND THERMODYNAMIC RELATIONS 9

Definition of pure substance, phase change of a pure substance, p-T diagram, p-V-T Surface, phase change terminology, property diagram in common use. Formation of steam, sensible heat, latent heat, dryness fraction, enthalpy, superheated steam, thermodynamic properties of steam and steam table, work, internal energy, entropy calculation, Mollier diagram, calorimeters for determination of dryness fraction. Problems determining thermodynamic properties of steam.

Thermodynamic relations : Thermodynamic potentials, thermodynamic gradients, general thermodynamics relations, entropy (Tds) equations, equations for internal energy and enthalpy, equation of state, coefficient of expansion and compressibility, specific heats, Joule Thomson coefficient, Clausius –Claperyon equation, Maxwell's relations.

UNIT 4 : GASES AND VAPOUR MIXTURES **9**

Ideal gas, equation of state for a perfect gas, Joules law, internal energy, enthalpy & specific heat capacities of an ideal gas, real gases, Van der waals equation – Amagats experiment , the cooling effect. Law of corresponding states, reduced properties, compressibility chart. Problem on calculation of properties ideal and real gases. Daltons law, Gibbs – Daltons law, volumetric analysis of a gas mixture, apparent molecular weight and gas constant, specific heats of a gas mixture, adiabatic mixing of perfect gases. Problems on gas mixture property values.

UNIT 5: FUELS AND COMBUSTION **9**

Characteristics of an ideal fuel, properties of fuel , flash point , fire point, cloud point, pour point, viscosity, combustion reaction and combustion analysis, theoretical air and excess air, stoichiometric air fuel ratio, analysis of combustion products, internal energy and enthalpy of formation, calorific value, determination of calorific value of fuels, Junkers gas calorimeter, Orsat apparatus, exhaust gas analyser, problem on calculation of air fuel ratio.

TUTORIAL : 15 PERIODS
TOTAL HOURS : 60 PERIODS

TEXTBOOKS :

1. Yunus. A.Cengel et al, Thermodynamics: An Engineering Approach, McGH, 8th Edn, 2015.
2. P.K.Nag, Engineering Thermodynamics, Mc Graw Hill, 5th edition,2013.
3. R.K.Rajput, A text book of Engineering Thermodynamics , Laxmi Publications, 5th Edn, 2016. 4.
D.S.Kumar, Engineering Thermodynamics : Principles and Practices, Laxmi Publications, Katsun Books 2012.

SEMESTER	SUBJECT	L	T	P	C
III	MANUFACTURING TECHNOLOGY – I	3	0	0	3

Aim	*The aim of the subject is to provide a fundamental knowledge in manufacturing sector.*
Objective	*1. To acquire the knowledge about mould making, metal melting and casting process.* *2. To acquire the knowledge about various metal joining processes.* *3. To acquire the knowledge about various hot and cold working processes.* *4. To acquire the knowledge about various sheet metal forming processes.* *5. To acquire the knowledge about various plastic processing.*
Outcome	*The students would understand the basic working principle of joining and cutting operations and can perform casting and welding process.*

UNIT– I METAL CASTING PROCESSES 9

Introduction: Concept of manufacturing process, Classification and its importance. Casting process: steps involved, advantages and limitations - Pattern: Definition, Functions, Materials used, allowances and their importance, core making process - Moulding sand: constituents, types, properties, testing - Moulding machines: Jolt type, Squeeze type and Sand slinger - Melting Furnaces: Cupola furnace, Pit furnace, Resistance furnace, Induction furnace and Electric Arc furnace - Sand casting processes: mould making, pouring, casting. Special casting processes - Shell and investment casting, Pressure die casting - Centrifugal casting - Casting defects and remedies.

UNIT– II METAL JOINING PROCESS 9

Welding processes – Types of welding –Gas welding, Arc welding, TIG, MIG, GMAW, Submerged arc welding-Electro slag welding–Resistance welding – Friction welding - seam welding – Percussion welding. - – Brazing and soldering process - Weld defects and control measures. Introduction to inspection methods – Introduction to friction stir welding.

UNIT – III BULK DEFORMATION PROCESSES 9

Hot and Cold working of materials - Forging: hot and cold forging, open and close forging, types forging machines, types of forging operations. Extrusion: hot and cold extrusion, forward and backward extrusion, types operations. Rolling: hot and cold rolling, types and operations, wire drawing and tube piercing. Drawing: Hot and cold drawing – sheet metal drawing, deep drawing, bar drawing, tube drawing, tube piercing, wire drawing, plastic drawing.

UNIT – IV SHEET METAL FORMING PROCESSES 9

Sheet metal processes: characteristics, Typical shearing, bending, curling, embossing, coining and drawing operations – Stretch forming operations : Formability of sheet metal – Working principle and application - special forming processes: Hydro forming – Rubber pad forming – Metal spinning – Explosive forming – Electro hydraulic forming – Electro magnetic pulse forming – Peen forming – Super plastic forming – Process characteristics

UNIT – V PROCESSING OF PLASTICS 9

Plastics: Types and characteristics of forming and shaping processes – Principle of operation and applications: Injection moulding, Blow moulding, Rotational moulding - Processing of Thermosets - Compression moulding – Transfer moulding – Bonding of Thermoplastics – Fusion and solvent methods – Induction and Ultrasonic methods.

TOTAL HOURS : 45 PERIODS

TEXT BOOKS

1. Elements of Workshop Technology- Vol. I and II- Hajra Choudhury - Media Promoters Pvt Ltd.- Mumbai- 2001
2. Manufacturing Engineering and Technology - Serope Kalpajian-Steven R.Schmid - Pearson Education- Inc. 2002(Second Indian Reprint).
3. Manufacturing Technology- P.N. Rao - Tata McGraw-Hill Publishing Limited- II Edition- 2002.

REFERENCES

1. Elements of Manufacturing Processes- B.S. Magendran Parashar & R.K. Mittal- Prentice Hall of India- 2003.
2. A text book of production technology- P.C. Sharma- S. Chand and Company- IV Edition- 2003.
3. Introduction to Manufacturing Processes – Amithab Gosh & Malik.

Contents beyond the syllabus:

1. Introduction about Friction stir process.
2. Stir casting process.

SEMESTER	SUBJECT	L	T	P	C
III	FLUID MECHANICS AND MACHINERY	3	0	0	3

Aim	*The aim of the subject is to provide a fundamental knowledge in fluid mechanics and machinery.*
Objective	1. *To learn the fundamentals in Fluid Mechanics* 2. *To understand the kinematics of the fluid flow.* 3. *To understand the fluid flow concepts* 4. *To learn the working principle, applications & design of various hydraulic turbines.* 5. *To learn the working principle, applications &, design of various hydraulic pumps.*
Outcome	*The students would be able to understand the basic fluid properties and could understand the working principle of pumps.*

UNIT –I - BASIC CONCEPTS AND PROPERTIES 9

Fluid – Definition - solid and fluid - Units and dimensions - Properties of fluids – Temperature - Viscosity - Compressibility - Vapour pressure - Capillary and surface tension - Fluid statics: concept of fluid static pressure - Pressure measurements by manometers and pressure gauges. Introduction to CFD, geophysical fluid dynamics. Velocity and density measurement methods.

UNIT –II - FLUID KINEMATICS AND SIMILARITIES 9

Fluid Kinematics - Flow visualization - Lines of flow - Types of flow - Velocity field and acceleration - Continuity equation (one and three dimensional differential forms)- Equation of streamline - Stream function - Velocity potential function - Circulation - Flow net – Fluid dynamics - Equations of motion - Euler's equation along a streamline - Bernoulli's equation – Applications - Venturi meter - Orifice meter - Pitot tube - Dimensional analysis - Buckingham's π theorem- Applications - Similarity laws and models.

UNIT –III - INCOMPRESSIBLE FLUID FLOW 9

Viscous flow - Navier-Stoke's equation - Shear stress - Pressure gradient relationship - Laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseulle's) - Hydraulic and energy gradient - Flow through pipes - Darcy - Weisbagh's equation - Pipe roughness -Friction factor- Moody's diagram - Minor losses - Flow through pipes in series and in parallel - Power transmission - Boundary layer flows - Boundary layer thickness - Boundary layer separation - Drag and lift coefficients. Major losses- design aspect in application of drags and lift coefficients. Piping Engineering-Introduction and Applications.

UNIT –IV - HYDRAULIC TURBINES 9

Fluid machines: definition and classification - Exchange of energy - Euler's equation for turbo machines - Construction of velocity vector diagrams - Head and specific work - Components of energy transfer - Degree of reaction. Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - propeller turbine - Kaplan turbine - Working principles - Velocity triangles - Work done - Specific speed - Efficiencies - Performance curve for turbines. Energy saving design requirements for turbine.

UNIT –V - HYDRAULIC PUMPS 9

Pumps: definition and classifications - Centrifugal pump: classifications - Working principle- velocity triangles - Specific speed - Efficiency and performance curves - Reciprocating pump: classification - Working principle - Indicator diagram -Work saved by air vessels and performance curves - Cavitations in pumps - Rotary pumps- Applications.

TOTAL HOURS : 45 PERIODS

TEXT BOOKS

1. Bansal- R.K. - "Fluid Mechanics and Hydraulics Machines"- (5^{th} edition) - Laxmi publications (P) Ltd- New Delhi- 2005.
2. Modi.P.N. & Seth.S.M., a Textbook on Fluid Mechanics, Standard Publishers Ltd.

REFERENCES

1. White- F.M. - "Fluid Mechanics"- Tata McGraw-Hill- 5^{th} Edition- New Delhi- 2003.
2. Ramamurtham. S- "Fluid Mechanics and Hydraulics & Fluid Machines"-Dhanpat Rai & Sons, Delhi-2003.

SEMESTER	SUBJECT	L	T	P	C
III	STRENGTH OF MATERIALS	3	1	0	4

Aim	*The aim of the subject is to provide a fundamental knowledge in strength of materials*
Objective	*1. To understand basic mechanical forces acting on rigid and deformable bodies.* *2. To learn to draw shear force and bending moment diagram for various types of beams.* *3. To learn the torsional effects on circular bars, shafts, helical spring.* *4. To learn the deflection equations of beams and columns for different end conditions.* *5. To learn the two dimensional stresses and deformation of cylinders and spherical shells.*
Outcome	*The students would understand the basic properties of materials and their testing methodologies.*

UNIT –I -STRESS- STRAIN AND DEFORMATION OF SOLIDS 9

Properties of material, Concept of Stress and Strain, Hook's Law, Stress Strain Diagram for structural steel and Non-ferrous materials. Poisson's Ratio & principles of superposition, Total elongation of tapering bars of circular and rectangular cross-sections. Elongation due to self-weight, volumetric strain. Expression for Volumetric strain, Elastic constants, relationship among elastic constants, compound bars Rigid and Deformable bodies – Strength- Stiffness and Stability – Stresses; Tensile- Compressive and Shear – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

UNIT –II -BEAMS - LOADS AND STRESSES 9

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever- Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Shear stresses in beams.

UNIT –III –TORSION 9

Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts – Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs.

UNIT –IV -DEFLECTION OF BEAMS 9

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method- Macaulay Method- and Moment-area Method –Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns – Introduction to curved beams.

UNIT –V -ANALYSIS OF STRESSES IN TWO DIMENSIONS 9

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress - Strain energy in bending and torsion.

TUTORIAL : 15
TOTAL HOURS : 60
TEXT BOOKS

1. Ramamrutham.S- Strength of Materials- S.Chand &B Co. - New Delhi-2007.

2. Beer F. P. and Johnston R- “Mechanics of Materials”- McGraw-Hill Book Co- Third Edition- 2008.

REFERENCES

1.Nash W.A- “Theory and problems in Strength of Materials”- Schaum Outline Series-, McGraw-Hill Book Co- New York- 2005
2. Ryder G.H- “Strength of Materials”- Macmillan India Ltd.- Third Edition- 2007
3. Ray Hulse- Keith Sherwin & Jack Cain- “Solid Mechanics”- Palgrave ANE Books- 2006.
4. Singh D.K “Mechanics of Solids” Pearson Education 2009.

SEMESTER	SUBJECT	L	T	P	C
III	KINEMATICS OF MACHINES (Common to MECH & MECHAT)	3	1	0	4

Aim	*The aim of the subject is to provide a fundamental knowledge in kinematics of machines*
Objective	1. *To learn the basic mechanisms of kinematics.* 2. *To learn to calculate the velocity and acceleration of links using graphical and vectorial approach.* 3. *To study about Cams and to draw their profiles.* 4. *To learn about Gear terminology and types of gear trains* 5. *To study about effect of friction in Transmission devices*
Outcome	*The students would understand the basic link mechanisms and would draw cam profiles*

UNIT –I -BASICS OF MECHANISMS **9**

Terminology and Definitions-Degree of Freedom -Mobility-Kutzbach criterion-Grashoff's law-Kinematic Inversions of 4-bar chain and slider crank chains-Mechanical Advantage-Transmission angle-Description of common Mechanisms-Single - Double and offset slider mechanisms - Quick return mechanisms - Ratchets and escapements - Indexing Mechanisms - Rocking Mechanisms - Straight line generators - Design of Crank-rocker Mechanisms.

UNIT –II -KINEMATICS OF LINKS **9**

Displacement- velocity and acceleration - analysis in simple mechanisms - Graphical Method- velocity and acceleration polygons - Vector Approach- Computer applications in the kinematic analysis of simple mechanisms-Coincident points- Coriolis Acceleration.

UNIT –III -KINEMATICS OF CAM **9**

Classifications - Displacement diagrams-parabolic- Simple harmonic and Cycloidal motions - Layout of plate cam profiles - Derivatives of Follower motion - High speed cams - circular arc and tangent cams - Standard cam motion - Pressure angle and undercutting.

UNIT –IV -GEARS **9**

Spur gear Terminology and definitions - Fundamental Law of toothed gearing and involute gearing-Interchangeable gears - Gear tooth action – Terminology - Interference and undercutting-Non standard gear teeth- Helical- Bevel- Worm- Rack and Pinion gears (Basics only)-Gear Trains: Simple gear trains, Compound gear trains, Epicyclic gear trains, Algebraic method & Tabular method, Problems on gear trains.

UNIT –V –FRICTION **9**

Surface contacts-Sliding and Rolling friction - Friction drives – Friction in screw threads - Friction clutches - Belt and rope drives- Friction aspects in Brakes – Friction in vehicle propulsion and braking

TOTAL HOURS: 45 PERIODS

TEXT BOOKS

1. Rattan S.S, “Theory of Machines”, Tata McGraw-Hill Publishing Company Ltd. New Delhi, 2009.
2. Khurmi.R.S. - Gupta, “Theory of Machines”.S.Chand & Co., 2011

REFERENCES

1. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 2005.
2. Ghosh A and A.K.Mallick, “Theory of Mechanisms and Machines”, Affiliated East-West Pvt. Ltd., New Delhi.
3 Shigley J.E and Vickes J.J, “Theory of Machines & Mechanism”, McGraw Hill, 2009.

STANDARDS

1. IS 2458: 2001- Vocabulary of Gear Terms – Definitions Related to Geometry.
2. IS 3756: 2002- Method of Gear correction – Addendum modifications for External Cylindrical Gears with Parallel Axes.
3. IS 5267 : 2002 Vocabulary of Gear Terms – Definitions Related to Worm Gear Geometry.
4. IS 12328 : Part 1: 1988 Bevel Gear Systems Part – 1 Straight Bevel Gears.
5. IS 12328 : Part 2: 1988 Bevel Gear Systems Part – 2 Spiral Bevel Gears.

SEMESTER	SUBJECT	L	T	P	C
III	MACHINE DRAWING LAB	1	0	3	2

Aim	*The aim of the subject is to provide a fundamental knowledge in Drawing Sotwares*
Objective	• *To study about fits and tolerances and enable students apply them in assembly of components.* • *To make students assemble simple machine components, measure and create assembly drawings on A2 Sheets using Mini Drafter or using Computer Aided Drafting software.*
Outcome	*The students would be enable to learn the basic drafting procedures, allowances, 2D and 3D drawings.*

INTRODUCTION TO MACHINE DRAWING

Limits and Tolerances - introduction, tolerances – Grades, Values and deviation. Selection of tolerance zones. Problems on computing fundamental deviations, methods of indicating tolerances on drawing.

Fits - Terminology, classification, basic systems, selection of fits, Methods of indicating fits on drawing. Geometrical Tolerances.

1. Assembly Drawing using Mini Drafter – Universal Coupling
2. Assembly Drawing using Mini Drafter – Footstep Bearing
3. Assembly Drawing using Mini Drafter – Plummer Block

INTRODUCTION TO CAD SOFTWARE

Orthographic Views, Isometric Views, 2-D Sectional Views, Part Drawing, Assembly Drawing, Broken views, Detailed Drawing. Dimensioning, Annotations, Symbols - Welding, Surface Finish, Threads. Text, Bill of Materials, Title Block.

4. 2D Drawing by using CAD software - Knuckle Joint
5. 2D Drawing by using CAD software – Gib and Cotter Joint
6. 2D Drawing by using CAD software - Screw Jack

INTRODUCTION TO 3D MODELING

Creation of 3D Models - Wire Frame, Surface, Solid modeling Techniques Using CAD Packages – CSG, B-Rep Approaches in Solid Modeling - Feature Based Modeling Technique – Assembly – Detailing - Exposure to Industrial Components – Application of GD&T

7. 3D Modeling by using CAD software – Press tool Assembly
8. 3D Modeling by using CAD software – Bushed Bearing
9. 3D Modeling by using CAD software – Machine Vice
10. 3D Modeling by using CAD software – Piston and Connecting Rod

TOTAL HOURS: 45

TEXT BOOKS

1.Bhatt-N.D.-"Machine Drawing"-Published by R.C.Patel-Chartstar Book Stall- Anand- India- 2003.
2. P.S.G. Design Data Book.

REFERENCES

Sidheswar- N. - Kanniah- P. and Sastry- V.V.S. - “Machine Drawing ". TMH.

SEMESTER	SUBJECT	L	T	P	C
III	MANUFACTURING TECHNOLOGY LAB -I	0	0	4	2

Aim	*The aim of the subject is to provide make the students to understand the basic operations of lathe machine and drilling machine*
Objective	*To practice the various operations in lathe and drilling machine*
Outcome	*The students can perform operations in lathe and drilling machine.*

LIST OF EXPERIMENTS

1. Exercise on plain turning and facing of given cylindrical MS specimen.
2. Exercise on step turning and chamfering.
3. Exercise on taper turning of given specification on a cylindrical specimen.
4. Manufacture of external or internal threads of given specification on a cylindrical Specimen.
5. Exercise on step turning with knurling of given specification on a cylindrical specimen
6. Exercise on drilling, boring and reaming on the given MS plate.
7. Exercise on eccentric turning in lathe on a given specimen.
8. Exercise on drilling with internal thread on a given specimen.

TOTAL : 30

SEMESTER	SUBJECT	L	T	P	C
III	HYDRAULICS AND STRENGTH OF MATERIALS LAB	0	0	4	2

Aim	*The aim of the subject is to provide make the students to understand the basic mechanism in hydraulics and strength of materials.*
Objective	*i)To understand the concepts of fluid mechanics and performances of various pumps* *ii)To get hands on experience to conduct testing of materials.*
Outcome	*The students can perform operations in hydraulic machineries and test various materials.*

LIST OF EXPERIMENTS:

1. A comparative analysis of Coefficient of discharge using Orifice meter & venturimeter.
2. Determination of pipe loses(major & minor).
3. Conducting experiments and draw the characteristic curves of centrifugal pump/submersible pump/jet pump/reciprocating pump/Gear pump (any 3 pump experiments must be done).
4. Study about the performance characteristics of Pelton wheel and Francis turbine.
5. Determination of Tensile strength and Compression strength on a given specimen.
6. Determination of shear strength of Mild steel and Aluminium rods
7. Determination of Torsional strength of mild steel rod
8. Determination of Impact strength
9. Conduct of Hardness test on metals - Brinell and Rockwell Hardness.
10. Conduct of Deflection test on beams

SEMESTER	SUBJECT	L	T	P	C
IV	NUMERICAL METHODS (COMMON TO MECH, AERO, AUTO, MECT, CIVIL, EIE & EEE)	3	1	0	4

AIM

- To provide students with mathematical knowledge and skills needed to support their concurrent and subsequent engineering and science studies

Objective:

- To provide the knowledge in solving different types of equations.
- To apply appropriate numerical methods to solve a linear system of equations
- To equip the students with interpolation, numerical differentiation and numerical integration techniques.

Outcome:

The students will be able to

- Relate their subject knowledge with their experiments during their course of study.
- Understand the use of numerical methods in modern scientific computing with finite precision computation.
- Solve an algebraic or transcendental equation using an appropriate numerical method.
- Solve their engineering problems using interpolation techniques.
- Understand the calculation and interpretation of errors in numerical methods.
- Identify the numerical techniques for their engineering problem

UNIT-I

SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 12

Method of false position, Newton-Raphson method for single variable, Solutions of a linear system by Gaussian, Gauss-Jordan, Jacobian and Gauss- Seidel methods. Inverse of a matrix by Gauss-Jordan method. Eigen value of a matrix by Power Method.

UNIT-II

INTERPOLATION AND APPROXIMATION 12

Interpolation with Newton's divided differences, Lagrange's polynomial, Newton forward and backward differences, central difference Formula (Stirling's and Bessel's).

UNIT-III

NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Numerical differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's (both $1/3^{rd}$ and $3/8^{th}$) rules. Rombergs rule, Two and Three point Gaussian quadrature formula. Double integrals using Trapezoidal and Simpson's rule.

UNIT-IV

INITIAL VALUE PROBLEMS OF ODE **12**

Solution of equations related to simple harmonic motion, Oscillations of a spring mass system, Simple pendulum, Oscillatory electrical circuit and Deflection of beams with initial conditions - using Taylor series. Euler, Modified Euler and Runge-Kutta methods.

UNIT-V

BOUNDARY VALUE PROBLEMS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS **12**

Finite difference solution for the second order ordinary differential equations, Finite difference solution for one dimensional heat equation (both implicit and explicit). One dimensional wave equation and two dimensional Laplace and Poisson equations.

Lecture Hours: 45

Tutorial Hours: 15

Total hours : 60

TEXT BOOK

1. N.Subramanian,Numerical Methods,SCM Publishers,Erode.
2. B.S.Grewal,"Higher Engineering Mathematics"Khanna Publishers,New Delhi.

REFERENCES

1. Sastry, S.S., " Introductory Methods of Numerical Analysis (Third Edition) ", Printice Hall of India, New Delhi, 1998.
2. T.Veerarajan, T.Ramachandran, " Numerical Methods with Programs in C and C++", Tata McGraw-Hill (2004).
3. Grewal, B.S. and Grewal, J.S., Numerical Methods in Engineering and Science Khanna Publishers, New Delhi, 1999.
4. A.Singaravelu " Numerical Methods"Meenakshi Agency,Chennai.

SEMESTER	SUBJECT	L	T	P	C
IV	DYNAMICS OF MACHINES	3	1	0	4

Aim	*The aim of the subject is to provide knowledge in various mechanisms, vibrations and balancing of masses*
Objective	*1. To study about forces acting on various parts of mechanisms.* *2. To learn static and dynamic balancing of masses.* *3. To study the characteristics of free and forced vibrations.* *4. To study and analyze various types of Governors and effect of gyroscopic forces.* *5. To learn about Cam Dynamics - velocity and displacement and acceleration.*
Outcome	*The students would be able to understand the operations of governors, cam dynamics and vibrations.*

UNIT 1 Force Analysis **9**

Relation between members disregarding friction. Analysis of engine mechanism, four-bar mechanism and mechanisms having more than four links. Rigid Body dynamics in general plane motion – Equations of motion - Dynamic force analysis - Inertia force and Inertia torque – D'Alemberts principle - The principle of superposition - Dynamic Analysis in Reciprocating Engines – Gas Forces - Equivalent masses - Bearing loads - Crank shaft Torque - Turning moment diagrams - Fly wheels –Engine shaking Forces

UNIT –II BALANCING **9**

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine - Balancing Multi-cylinder Engines - Partial balancing in locomotive Engines - Balancing linkages - balancing machines.

UNIT -III FREE VIBRATIONS **9**

Basic features of vibratory systems - idealized models - Basic elements and lumping of parameters - Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion - natural frequency - Types of Damping - Damped vibration- critical speeds of simple shaft - Torsional vibration - Natural frequency of two and three rotor systems.

UNIT –IV FORCED VIBRATIONS **9**

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

UNIT – V MECHANISMS FOR CONTROL **9**

Governors; Force analysis of Porter, Proel and spring controlled governors. Controlling force, stability, sensitiveness, effort and power of governors. Characteristics - Effect of friction.

Gyroscopic Forces: Gyroscopic couple, Effect of Gyroscopic couple on vehicle; Applicatons of Gyroscopic forces. - Ships and airplanes

TUTORIAL :15 **TOTAL HOURS :60**

TEXT BOOKS

1. Rattan S.S, “Theory of Machines”, Tata McGraw-Hill Publishing Company Ltd. New Delhi.
2. Khurmi.R.S. - Gupta, “Theory of Machines”. S.Chand & Co., 2011

REFERENCES

1. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 2005.
2. Ghosh A and A.K.Mallick, “Theory of Mechanisms and Machines”, Affiliated East-West Pvt. Ltd., New Delhi.
3 Shigley J.E and Vickes J.J, “Theory of Machines & Mechanism”, McGraw Hill, 2009

SEMESTER	SUBJECT	L	T	P	C
IV	MANUFACTURING TECHNOLOGY II	3	0	0	3

Aim	*The aim of the subject is to provide knowledge in cutting process of manufacturing sector.*
Objective	*1. To understand the metal cutting processes.* *2. To understand the types, construction and operations of lathes.* *3. To gain the knowledge of different operations on special machines* *4. To understand the types and operations of sawing, broaching and gear cutting machines.* *5. To learn the various machining processes that uses abrasives.*
Outcome	*The students would be able to operate lathe machines and special machines perform operations.*

UNIT – I THEORY OF METAL CUTTING 9

Introduction: metal cutting methods - mechanics of metal machining –chip formation – types of chips-chip breaker- Merchant Circle Diagram-cutting force calculation- Single point cutting tool nomenclature-Cutting tool materials –Tool wear - Tool life - cutting fluids.

UNIT – II CENTRE LATHE AND SPECIAL PURPOSE LATHES 9

Centre lathe- constructional features and various operations- taper turning methods- thread cutting methods- special attachments- machining time and power estimation.
Capstan and turret lathes - automats – Swiss type–automatic screw type.

UNIT – III SHAPER, PLANNER, MILLING AND DRILLING MACHINES 9

Shaper– planer– slotting Machines – quick return mechanism – Milling Machines–milling cutters– operations; Drilling- reaming– boring– tapping.

UNIT – IV SAWING - BROACHING AND GEAR CUTTING 9

Sawing machine: hack saw- band saw- circular saw; broaching machines –types-working principle-nomenclature. Gear Generation: forming- shaping- hobbing

UNIT – V ABRASIVE PROCESSES 9

Abrasive processes: grinding wheel – specifications and selection- types of grinding machines.
Honing- lapping- super finishing- polishing and buffing.

TOTAL HOURS :45

TEXT BOOKS

1. Serope Kalpajian- Steven R.Schmid- Manufacturing Engineering and Technology- Pearson Education- Inc. 2002 (Second Indian Reprint).
2. Rao- P.N. "Manufacturing Technology"- Metal Cutting and Machine Tools- TMH- 2003.
3. Hajra Choudhury- Elements of Workshop Technology- Vol. I and II- Media Promoters Pvt Ltd.- Mumbai- 2001

REFERENCES

1. Richerd R. Kibbe- John E. Neely- Roland O. Merges and Warren J. White- "Machine Tool Practices"- Prentice Hall of India- 2003.
2. P.C. Sharma- "A Text Book of Production Engineering"- S. Chand and Co. Ltd- IV edition, 2002.
3. Hajra Choudry, "Elements of Work Shop Technology – Vol. II"- Media Promoters. 2002.
4. B.L.Juneja G.S.Sekhon nithsethan ''Fundamentals of metal cutting and machine tools''

SEMESTER	SUBJECT	L	T	P	C
IV	DISASTER MITIGATION AND MANAGEMENT	3	0	0	3

Aim	*To impart awareness on disasters and preparedness during disasters*
Objective	*1.To Understand basic concepts in Disaster Management* *2. To Understand Definitions and Terminologies used in Disaster Management* *3. To Understand the Challenges posed by Disasters* *4. To understand Impacts of Disasters*
Outcome	*The students would be able to understand the various aspects of disasters and trained to face its challenges.*

UNIT 1 INTRODUCTION **9**

Concept of disaster; Different approaches; Concept of Risk; Levels of disasters; Disaster phenomena and events *(Global, national and regional)*; Natural and man-made hazards

UNIT 2 RISK ASSESSMENT AND VULNERABILITY ANALYSIS **9**

Response time, frequency and forewarning levels of different hazards; Characteristics and damage potential of natural hazards; hazard assessment ;Dimensions of vulnerability factors; vulnerability assessment; Vulnerability and disaster risk; Vulnerabilities to flood and earthquake hazards

UNIT 3 DISASTER MANAGEMENT MECHANISM **9**

Concepts of risk management and crisis management -Disaster management cycle ;Response and Recovery ; Development, Prevention, Mitigation and Preparedness-Planning for relief

UNIT 4 DISASTER RESPONSE **9**

Mass media and disaster management-Disaster Response Plan; Communication, Participation, and Activation of Emergency Preparedness Plan-Logistics Management-Psychological Response-Trauma and Stress Management-Rumour and Panic Management-Minimum Standards of Relief-Managing Relief-Funding

UNIT 5 DISASTER MANAGEMENT IN INDIA **9**

Strategies for disaster management planning; Steps for formulating a disaster risk reduction plan; Disaster management Act and Policy in India; Organisational structure for disaster management in India; Preparation of state and district disaster management plans

Text books

1. Alexander, D. *Natural Disasters*, ULC press Ltd, London, 1993.
2. Carter, W. N. *Disaster Management: A Disaster Management Handbook,* Asian Development Bank, Bangkok, 1991.
3. Chakrabarty, U. K. *Industrial Disaster Management and Emergency Response,* Asian Books Pvt. Ltd., New Delhi 2007.

References

1. Abarquez I. & Murshed Z. *Community Based Disaster Risk Management: Field Practitioner's Handbook,* ADPC, Bangkok, 2004.
2. Goudie, A. *Geomorphological Techniques,* Unwin Hyman, London 1990.
3. Goswami, S. C. *Remote Sensing Application in North East India,* Purbanchal Prakesh, Guwahati, 1997.
4. *Manual on Natural Disaster Management in India,* NCDM, New Delhi, 2001.
5. *Disaster Management in India,* Ministry of Home Affairs, Government of India, New Delhi, 2011.
6. *National Policy on Disaster Management,* NDMA, New Delhi, 2009.
7. *Disaster Management Act. (2005),* Ministry of Home Affairs, Government of India, New Delhi, 2005.

SEMESTER	SUBJECT	L	T	P	C
IV	THERMAL ENGINEERING	3	1	0	4

Aim	*To integrate the basic laws of thermodynamics into thermal systems towards applications.*
Objective	*1. To provide thorough knowledge on internal combustion engines.* *2. To inculcate advanced topics of internal combustion engines.* *3. To understand the function and applications of air compressors and steam turbines.* *4. To provide an in-depth knowledge of refrigeration systems functioning and applications.* *5. To provide details of air conditioning methodologies available for domestic and industrial applications.*
Outcome	*The students would be able to understand the working principle of IC Engines, refrigeration systems.*

UNIT 1 : VAPOUR POWER CYCLES, STEAM NOZZLES, STEAM TURBINES 9

Rankine cycles, effect of operating conditions on Rankine cycle efficiency, Modified Rankine cycle, regenerative cycle, reheat cycle, Binary Vapour cycle. Problems on Rankine cycle with reheat and regeneration conditions.

Steam nozzles, property calculation of steam flow through nozzles, metastable expansion of steam in a nozzle, steam injector. Problems for velocity and discharge calculation of steam.

Steam turbines, classifications , impulse and reaction turbine, compounding of steam turbines, bleeding , governing & control.

UNIT 2 : GAS POWER CYCLES AND INTERNAL COMBUSTION ENGINES 9

Air standard cycles, Carnot cycle, Otto cycle, Diesel cycle, Dual cycle, problems on determination of efficiency , mean effective pressure and work. Comparison of air standard cycles. Atkinson cycle, Ericsson cycle, Stirling cycle.

Internal Combustion engines, evolution and classification , components of internal combustion engines , two stroke and four stroke engine, S.I and C.I engines, Valve timing and port timing , fuel supply systems- carburettor and fuel injection , ignition systems, cooling systems – air cooling and liquid cooing systems, lubrication systems, perfomance of I.C engines. Problems on performance calculation.

UNIT 3 BRAYTON CYCLE , GAS TURBINES AND AIR COMPRESSORS 9

Brayton cycle , gas turbines, classification, open cycle and closed cycle, Gas turbine fuels, Calculation of work output and efficiency on Brayton cycle, Application of gas turbine, problems on Brayton cycle.

Air compressors- classification, reciprocating air compressor, staging, calculation of work and efficiency, clearance in compressors, intercooler, applications. Rotary compressor, classification, centrifugal compressor, axial flow compressor, compressor characteristics – surging, choking and stalling. Problems on air compressor – single stage and multi stage.

UNIT 4 : REFRIGERATION 9

Refrigeration – refrigeration systems , methods of refrigeration, Air refrigeration system, Reversed carnot cycle, reversed brayton cycle, vapour compression refrigeration cycle- components and functions , factors affecting the performance, vapour absorption systems- components and functions, COP calculations, refrigerant- classifications, properties of an ideal refrigerant, common refrigerants and its applications.

UNIT 5 : PSYCHROMETRICS AND AIRCONDITIONING 9

Psychrometry - terms and psychometric relations , psychrometers, psychrometric charts, processes, mixing of air stream, sensible heating, sensible cooling , cooling and dehumidification, cooling and humidification, heating and humudification. Problems using psychrometic charts.
Air-conditioning systems, components and its functions, air-conditioning cycle, classification of central air conditioning , zoned systems, unitary systems, unitary – central systems, selection criteria of systems, applications, window type package units and console type package units, filters – types and functions, fans, controls – methods. Air Distribution systems – methods and functions, cooling load estimation methods, Heat load estimation.

TEXTBOOKS :

1. P.K.Nag, Engineering Thermodynamics, Mc Graw Hill, 5th edition,2013.
2. R.K.Rajput, Thermal Engineering, Laxmi Publications, 9th Edn, 2015.
3. R.S.Khurmi, Thermal Engineering, S.Chand & Co., 2015.

REFERENCES

1. ARORA.C.P."Refrigeration and Air-conditioning," Tata McGraw Hill,
2. HOLMAN. J.P. - "Thermodynamics"- McGraw-Hill- 1985.
3. Mc KONEY and EASTOP, Applied Thermodynamics – Addison Wesley, 1999.
4. GANESAN .V, Internal Combustion Engines – Tata McGraw Hill, 1995
5. MANOHAR PRASAD, Refrigeration and Air-conditioning – New Age International (P) Ltd, 1995
6. MATHUR and METHA, Thermal Engineering – Jain Brothers – 1998

Content beyond the syllabus

- Six stroke engine
- Liquefaction of gases

SEMESTER	SUBJECT	L	T	P	C
IV	ENVIRONMENTAL SCIENCE AND ENGINEERING (COMMON TO ALL BRANCHES OF B.E./B.Tech./BBA/BCA)	3	0	0	3

AIM: To learn about the effect of environmental pollution due to industrialization and emergence of social issues and remedial measures

Objective:

- Understanding and appreciation of cultural aspects of society
- Understanding of professional and ethical responsibility of engineering practice
- Knowledge of contemporary issues

Outcome:

The student will come out with ethical responsibility in his/her profession

UNIT - I - ENVIRONMENT AND NATURAL RESOURCES 9 hrs

Environment - Definition, Objective & importance - Public awareness- Forest resources, mineral resources , water resources, food resources , energy resources (uses, over -exploitation & adverse effects in each case) - Objective & role of environmental engineers in conservation of natural resources - Sustainability development.

UNIT - II - ECOSYSTEMS AND BIO – DIVERSITY 9 hrs

Ecosystem - Definition, structure and function - Energy flow -Ecological succession - food chain, food web, ecological pyramids- Introduction, types, characteristics, structure and function of forest, grassland, desert and Aquatic ecosystems - Bio - Diversity :values and uses, hotspots, threats and conservation.

UNIT - III - ENVIRONMENTAL POLLUTION

Pollution - Definition , man made impacts and control measures of air, water and land pollution - Water quality standards & characterization - Importance of sanitation -Nuclear hazards – Hazardous waste management : Solid waste, waste water and biomedical waste - Prevention of pollution and role of individual – Disasters management : Floods, earthquake, cyclone and land slides - Clean technology options.

UNIT - IV - SOCIAL ISSUES AND ENVIRONMENT 9 hrs

Urban problems related to energy - Water conservation – Resettlement and rehabilitation of people - Environmental ethics - Climate change - Global warming - Acid rain - Ozone depletion-
Waste land reclamation, Environment Protection Act for air, water, wild life and forests - Pollution Control Board.

UNIT - V - HUMAN POPULATION AND ENVIRONMENT 9 hrs

Population growth - Population explosion - Family welfare programme - Environment & human health - Human rights – Value education - Women and child welfare, Role of information techno8logy in environment and human health.

Total: 45 hours

TEXT BOOKS :

1. Environmental Science and Engineering by Dr.A. Ravikrishnan, Sri Krishna Publications, Chennai.

REFERENCES :

1. Wager K.D. "Environmental Management", W.B. Saunders Co. Philadelphia, USA, 1998.
2. Bharucha Erach "The Biodiversity of India" Mapin Publishing Pvt Ltd, Ahmedabad, India
3. Trivedi R.K. " Handbook of Environmental Laws", Rules, Guidelines,Compliances and Standards Vol I & II, Enviro media.

4. Environmental Science and Engineering by Dr. J. Meenambal ,MJP Publication , Chennai Gilbert M. Masters : Introduction to Environmental Engineering and Science , Pearson Education PvtLtd., II Edition, ISBN 81-297-0277-0, 2004
5. Miller T.G. Jr Environmental Science Wadsworth Publishing Co.
6. Townsend C. Harper J. and Michael Begon, Essentials of Ecology,Blackwell Science.

SEMESTER	SUBJECT	L	T	P	C
IV	DYNAMICS LAB	0	0	4	2

Aim	*The aim of the subject is to provide knowledge in mechanisms related to machine dynamics.*
Objective	*To understand about governors, GyroObjectives, Speed measurement, spring mass system and compound pendulum*
Outcome	*The students would be able to understand the working principle of vibrations, balancing of masses.*

1. To perform an experiment on Watt and Porter Governor to prepare performance characteristic curves and to find stability and sensitivity.
2. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
3. To analyse the motion of a motorized gyroObjective when the couple is applied along its spin axis and determine gyroscopic couple.
4. Determine the Moment of Inertia by compound pendulum and tri-filar suspension.
5. To determine the frequency of undamped free vibration and damped forced vibration of an equivalent spring mass system.
6. To determine whirling speed of shaft theoretically and experimentally.
7. To analyse forced vibrations of a cantilever beam.
8. To determine the natural frequency of undamped torsional vibration of a single rotor shaft system.
9. To perform an experiment for static balancing on a static balancing machine.
10. To perform an experiment for dynamic balancing on a dynamic balancing machine.

TOTAL HOURS : 30

SEMESTER	SUBJECT	L	T	P	C
IV	MANUFACTURING TECHNOLOGY LAB-II	0	0	4	2

Aim	*The aim of the subject is to provide knowledge in special machines.*
Objective	*To understand about opeating principle of various special machines.*
Outcome	*The students would be able to get hands on training of the operations in shaper ,grinder, milling machine, etc*

LIST OF EXPERIMENTS

1. Study of different machineries of special machines lab.
2. To shape a square rod from a round bar.
3. To manufacture a V- Groove in a given specimen.
4. To manufacture a hexagonal block from a given round stock.
5. To mill plain surfaces on the given specimen.
6. To manufacture a spur gear from the given blank in a Universal Milling Machine.
7. To manufacture a groove in a given rectangular bar stock and also do letter sink on it in a vertical milling machine.
8. To manufacture a keyway on a given specimen in a vertical slotting machine.
9. To grind a machined surface to the given specification in a universal cylindrical grinder.
10. To drill holes as per given dimensions and locations on the given specimen in a radial drilling machine and tap the hole for given thread dimension.

TOTAL HOURS : 30

SEMESTER	SUBJECT	L	T	P	C
IV	ENGINE TESTING LAB	0	0	4	2

Aim	*The aim of the subject is to provide knowledge in performance characteristics of internal combustion engine.*
Objective	*To understand about characteristics of conventional and alternative fuels*
Outcome	*The students would be able to understand the importance of alternate fuels and their capability as alternate to fossil fuels.*

1. Determination of Viscosity of the given specimen oil by using Red Wood Viscometer.
2. Determination of Flash Point and Fire Point of the given fuel sample.
3. Construction of actual valve timing diagram of a four stroke engine and comparison with Theoretical valve timing diagram.
4. Construction of actual port timing diagram of a two stroke engine and comparison with Theoretical port timing diagram.
5. Performance test on a four stroke single/ twin cylinder diesel engine.
6. Determination of frictional power of a four cylinder petrol engine by conducting a Morse test.
7. Conduct a retardation test and determine frictional power in a diesel engine.
8. Determination of the COP of a LPG refrigerator test rig.
9. Performance test on twin cylinder diesel engine with biofuel.

TOTAL HOURS : 30

SEMESTER	SUBJECT	L	T	P	C
V	DESIGN OF MACHINE ELEMENTS	3	1	0	4

(Use of approved Design Data Book is permitted in the University examination)

Aim	*The aim of the subject is to provide basic knowledge in designing various machine elements.*
Objective	*1. To understand basic design procedures, steady and variable stresses, failure Theories.* *2. To study the design concepts of shafts and couplings.* *3. To study the design parameters of fasteners and welded joints.* *4. To learn the design parameters of different types of springs and levers.* *5. To understand the design concepts of bearings and flywheel.*
Outcome	*The students would be able to design any machine elements with standard procedures and formulae.*

UNIT 1: STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9

Introduction to the design process - factor influencing machine design- Direct- Bending and torsional stress equations -Calculation of principal stresses for various load combinations- Factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg- Goodman and Gerber relations

UNIT 2: DESIGN OF SHAFTS AND COUPLINGS 9

Design of solid and hollow shafts based on strength- rigidity and critical speed – Design of rigid and flexible couplings

UNIT 3: DESIGN OF FASTENERS AND WELDED JOINTS 9

Threaded fasteners - Design of bolted joints including eccentric loading – Design of welded Joints for pressure vessels and structures - Theory of bolted joints.

UNIT 4 :DESIGN OF SPRINGS 9

Design of helical- leaf- disc and torsional springs under constant loads and varying loads – Concentric torsion springs

UNIT 5: DESIGN OF BEARINGS AND FLYWHEELS 9

Design of bearings – sliding contact and rolling contact types– Design of journal bearings calculation of bearing dimensions – Design of flywheels involving stresses in rim and arm.

TUTORIAL :15 TOTAL HOURS :60

TEXT BOOKS

1. Shigley, Mischke, Mechanical Engineering Design, Tata Mc Graw Hill.
2. Bhandari V.B, "Design of Machine Elements", Tata McGraw-Hill Book Co,2003.

REFERENCES

1. Juvinall R.C- and Marshek K.M- "Fundamentals of Machine Component Design"- John Wiley & Sons- Third Edition- 2002.
2. Norton R.L- "Design of Machinery"- Tata McGraw-Hill Book Co- 2004.
3. Orthwein W- "Machine Component Design"- Jaico Publishing Co- 2003.
4. Spotts M.F.- Shoup T.E "Design and Machine Elements" Pearson Education- 2004.
5. Md.Jalaludeen- Machine Design- Anuradha Publicatiions,Chennai.

SEMESTER	SUBJECT	L	T	P	C
V	MECHANICAL BEHAVIOUR OF MATERIALS AND METALLURGY	3	0	0	3

Aim	*The aim of the subject is to provide basic knowledge in materials behavior and metallurgy.*
Objective	*1. To understand the classification, properties and application of various engineering materials.* *2. To learn the heat treatment methodologies and mechanical treatment methodologies.* *3. To understand the various deformation mechanisms, failure modes and phase diagram.* *4. To understand the various forms of corrosion, protection methods.* *5. To understand the basic concepts in powder metallurgy, composite materials and working of SEM.*
Outcome	*The students would be able to understand the behavior of materials, their heat and mechanical treatment.*

UNIT I METALLIC & NON-METALLIC MATERIALS 9

Classification-Metallic Materials-Ferrous-steel, types, effects of alloying elements in steel, cast iron-types; Non-Ferrous-aluminium, copper and alloys. Non-Metallic Materials-polymers, ceramics; Properties and applications.

UNIT II BEHAVIOR OF MATERIALS 9

Introduction to plastic deformation - Slip and twinning – Types of fracture-brittle, ductile, creep & fatigue.
Grain Growth: Recovery & Recrystallisation. Phase diagrams- Iron – Iron carbide equilibrium diagram-TTT & CCT curve

UNIT III MATERIAL TREATMENT 9

Heat treatment- annealing, Normalizing- hardening and Tempering, Case hardening, Hardenability - Jominy end quench test.
Mechanical Treatment-strengthening mechanisms-strain hardening, solid solution hardening, grain size reduction

UNIT IV CORROSION 9

Introduction- forms of corrosion-pitting, intergranular, stress corrosion, corrosion fatigue, dezincification, erosion-corrosion, Crevice Corrosion, Fretting-Protection methods-PVD, CVD.

UNIT V ADVANCED MATERIALS & CHARACTERIZATION 9

Powder metallurgy –powder production, blending, compaction, sintering-applications
Composites-Types-MMC, PMC, CMC-properties & applications
SEM-working principle, set-up, sample preparation method-evaluation mode-EDAX

TOTAL HOURS :45

TEXT BOOKS

1. William D Callister “Material Science and Engineering”, John Wiley and Sons 2005.
2. Sydney H.Avner “Introduction to Physical Metallurgy” McGraw Hill Book Company.

REFERENCE BOOKS

1. Kenneth G.Budinski and Michael K.Budinski “Engineering Materials” Prentice-Hall of India Private Limited- 4th Indian Reprint 2002.
2. George E.Dieter, “Mechanical Metallurgy”

SEMESTER	SUBJECT	L	T	P	C
V	**ENGINEERING METROLOGY AND MEASUREMENTS (**Common TO MECH & MECT**)**	**3**	**0**	**0**	**3**

Aim	*The aim of the subject is to provide basic knowledge in instrumentation and measurements*
Objective	1. *To understand the basic measurement system.* 2. *To understand the various instruments used for linear and angular measurement.* 3. *To understand the various instruments used for form measurement and surface finish.* 4. *To understand the principle, applications and advancements of laser.* 5. *To understand the various instruments to acquire the data and store in computer*
Outcome	*The students would be able to understand the working principle of various measuring instruments.*

UNIT 1. BASIC PRINCIPLES & LINEAR / ANGULAR MEASUREMENT 9

Basic principles of measurement - generalized configuration and functional descriptions of measuring instruments - Sensitivity- Readability - Range of accuracy - Precision - Static and dynamic performance characteristics –sources of error, classification and elimination of error. Repeatability - Systematic and random errors – Correction - Calibration - Interchangeability.

Linear and angular Measurements : Vernier – micrometer - interval measurement - Slip gauges and classification - optical flats - limit gauges - Comparators: mechanical - pneumatic and electrical types – applications. -Sine bar - optical bevel protractor - Autocollimator- Angle Decker – Taper measurements.

UNIT 2 : DISPLACEMENT, SPEED & ACCELERATION / VIBRATION MEASUREMENT 9

Measurement of displacement: Theory and construction of various transducers to measure displacement – piezo electric, inductive, capacitance, resistance, ionization and photo electric transducers, calibration Procedures. Measurement of speed**:** Mechanical tachometers, electrical tachometers, stroboObjective, noncontact type of tachometer. Measurement of acceleration and vibration : Piezoelectric Accelerometer, Seismic Accelerometer , principles of seismic instruments – vibrometer.

UNIT 3 : TEMPERATURE, PRESSURE AND FLOW MEASUREMENT 9

Measurement of temperature: Classification , ranges, various principles of measurement, expansion, electrical resi tance, thermistor , thermocouple, pyrometers , temperature indicators.Measurement of pressure **:** Units, classification , different principles used., manometers, piston, bourdon , pressure gauges, bellows– diaphragm gauges. low pressure measurement, thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge, Knudsen gauge. calibration of pressure gauges. Measurement of level : Direct method – indirect methods– capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – bubler level indicators.

Measurement of flow : Rotameter, magnetic, ultrasonic, turbine flow meter, hot – wire anemometer, Laser Doppler anemometer (LDA).

UNIT 4 : FORCE, TORQUE, & STRAIN MEASUREMENTS 9

Measurement of force : Load cells, cantilever beams, proving rings, differential transformers. Measurement of torque: Torsion bar dynamometer, servo controlled dynamometer, absorption dynamometers. Power Measurements. Strain Measurements**:** Various types of stress and strain measurements – electrical strain

gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, Strain gauge, Rosettes. Strain gauge calibration.

UNIT 5 : FORM MEASUREMENTS AND OPTICAL MEASUREMENTS 9

Form measurements : Measurement of screw threads - thread gauges - Floating carriage micrometer-measurement of gears-tooth thickness-constant chord and base tangent method-Gleason gear testing machine – radius measurements-surface finish - Straightness - Flatness and roundness measurements.Optical measurements : Optical MicroObjective , interference microObjective, tool makers microObjective, profile projector, vision Systems, laser interferometer – linear and angular measurements.

TOTAL HOURS 45

TEXTBOOKS:

1. Kumar D.S., Mechanical Measurements and Control, Tata Mc Graw Hill.
2. Jain R.K., Engineering Metrology, Khanna Publishers, 1994
3. Gupta S.C.- "Engineering Metrology"- Dhanpatrai Publications- 1984

REFERENCES;

1. Alan S. Morris- "The Essence of Measurement"- Prentice Hall of India- 1997
2. Jayal A.K- "Instrumentation and Mechanical Measurements"- Galgotia Publications 2000
3. Beckwith T.G- and N. Lewis Buck- "Mechanical Measurements"- Addison Wesley- 1991
4. Donald D Eckman- "Industrial Instrumentation"- Wiley Eastern-1985.

SEMESTER	SUBJECT	L	T	P	C
V	GAS DYNAMICS AND JET PROPULSION	3	0	0	3

Aim	*The aim of the subject is to provide knowledge in gas dynamics and jet propulsion.*
Objective	*1. To understand the basics of compressible flow and its significance.* *2. To understand flow through variable areas ducts and the significance of flow through nozzles and diffusers.* *3. To understand flow through constant area ducts and its significance.* *4. To provide a basic understanding of normal shock behavior.* *5. To provide an overview of jet propulsion technology and its basics.*
Outcome	*The students would be able to understand the gas dynamics and various propulsion systems.*

1. COMPRESSIBLE FLOW – FUNDAMENTALS 8

Energy and momentum equations for compressible fluid flows - various regions of flows - reference velocities - stagnation state - velocity of sound - critical states - Mach number - critical Mach number - types of waves - Mach cone - Mach angle - effect of Mach number on flow.

2. FLOW THROUGH VARIABLE AREA DUCTS 8

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.

3. FLOW THROUGH CONSTANT AREA DUCTS 9

Flow in constant area ducts with friction (Fanno flow) – Fanno curves and Fanno flow equation - 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) - Rayleigh line and Rayleigh flow equation - variation of flow properties - Maximum heat transfer.

4. **NORMAL SHOCK 10**

Governing equations - Variation of flow parameters like static pressure, static temperature , static density, stagnation pressure and entropy across the normal shock - Prandtl-Meyer equation - impossibility of shock in subsonic flows - flow in convergent and divergent nozzle with shock - normal shock in Fanno and Rayleigh flows, flow with oblique shocks.

5. PROPULSION 10

Jet Propulsion: Aircraft propulsion – types of jet engines – energy flow through jet engines- performance of turbo jet engines – thrust - thrust power - propulsive and overall efficiencies - thrust augmentation in turbo jet engine - ram jet and pulse jet engines

Space Propulsion: Types of rocket engines - Propellants - Ignition and combustion - Theory of rocket propulsion –Terminal and characteristic velocity - Applications - Space flights.

TOTAL HOURS :45

TEXTBOOKS

1. YAHYA. S.M. - “Fundamental of compressible flow”- New Age International (p) Ltd. - New Delhi- 1996.
2. PATRICH.H. OOSTHVIZEN- WILLIAM E.CARSCALLEN- “Compressible fluid flow”- McGraw-Hill- 1997

REFERENCES

1. COHEN. H. - ROGERS R.E.C AND SRAVANAMUTOO- “Gas turbine theory”- Addison Wesley Ltd. - 1987.
2. GANESAN. V. - “Gas Turbines”- Tata McGraw-Hill- New Delhi- 1999
3. RATHAKRISHNAN.E- “Gas Dynamics”- Prentice Hall of India- New Delhi- 2001
4. HILL.D and PETERSON .C, Mechanics & Thermodynamics of propulsion – Adisson Wesley Publishing Company, 1999.
5. G.P.Sutton- “Rocket Propulsion Elements "- John Wiley- 1986- New York.
6. ZUCROW N.J Aircraft and Missile Propulsion, Vol II – John Wiley Newyork, 1975
7. ZUCROW N.J Principles of Jet Propulsion and Gas Turbines – John Wiley Newyork, 1970

SEMESTER	SUBJECT	L	T	P	C
V	ELECTRICAL MACHINES AND DRIVES	3	0	0	3

Aim	*The aim of the subject is to provide basic knowledge in electrical machines and drives.*
Objective	• *To study the basic concept of D.C. and A.C. circuits and to learn the concept of transformers and do simple problems.* • *To study the performance characteristics of D.C. motors, three phase induction motor and single phase induction motor.* • *To study the methods of speed control of D.C. and A.C. motors and methods of starting of D.C. and A.C. motors.* • *To study the basics of selection of drive for a given application.* • *To study the concept of controlling the speed of D.C. and A.C. motors using solid state devices.*
Outcome	*The students would be able to understand the working principle of various drives.*

UNIT I CIRCUITS AND TRANSFORMERS 6

D.C. Voltage, current, power – Ohms law – series, parallel circuits – Kirchoff's laws – mesh analysis – A.C. voltage – sinusoidal waves, Phasor representation – power factor – complex power – basic idea of transformers – simple problems.

UNIT II ELECTRICAL MOTORS 12

Constructional details, principle of operation and performance characteristics of D.C. motors, single phase induction motor, three phase induction motor, synchronous motors, universal motors, stepper motors and reluctance motor.

UNIT III SPEED CONTROL AND STRATING **9**

Speed control of D.C. motors – three phase induction motors – starting methods of D.C. motor and three phase induction motor – electrical braking – simple problems.

UNIT IV ELECTRICAL DRIVES **9**

Type of Electrical Drives – Selection & factors influencing the selection – heating and cooling curves – loading condition and classes of duty – determination of power rating – simple problems.

UNIT V SOLID STATE DRIVES(QUALITATIVE TREATMENT ONLY) **9**

Advantages of solid state drives – D.C. motor control using rectifiers and choppers – control of induction motor by V, V/f and slip power recovery scheme using inverters and A.C. power regulators.

TOTAL: 45 PERIODS

TEXT BOOK

1. I.J.Nagrath, T.P. Kothari., "Basic Engineering", McGraw – Hill Publishing company Ltd., Second edition, 2002.

2.G.K. Dubey "Fundamental Electrical Drives" second edition 2002, Narosa Publications, Second edition, 2002.

REFERENCES

1. S.K. Bhattacharya "Electrical Machines", second edition 1999, Tata McGraw – Hill Pvt. Company Ltd., Second edition, 1999.

2. N.K.De.,P.K.Sen "Electric Drives", Prentice Hall, First edition 1999.

3. Pillai, S.K., " A First course on Electrical Drives", Wiley Eastern Ltd., New Delhi, 1982.

SEMESTER	SUBJECT	L	T	P	C
V	METROLOGY AND MEASUREMENTS LAB	0	0	4	2

Aim	*The aim of the subject is to provide basic knowledge in working principles of various measuring instruments.*
Objective	*To expose the students the measurement systems and its procedures.*
Outcome	*The students would be able to understand the working principle of various equipments and their applications.*

1. Temperature measurement using a Thermocouple.
2. Displacement measurement using a Linear Variable Differential Transformer (LVDT).
3. Speed measurement using Stroboscope.
4. Measurement of cutting forces in a turning process in a Lathe using a Lathe Tool Dynamometer.
5. Measurement of Linear Parameters using micrometer, Vernier caliper and Vernier height gauge.
6. Angular Measurements using Bevel Protactor and Sine Bar.
7. Flow Measurement using a Rotameter.
8. Straightness measurement using an autocollimator.
9. Measurement of delicate parts in a Tool Makers Microscope.
10. Fundamental dimension measurement of a gear using a contour projector.

SEMESTER	SUBJECT	L	T	P	C
V	METALLURGY LAB	0	0	4	2

Aim	*The aim of the subject is to provide basic knowledge in physical metallurgy - metallography*
Objective	*1. To get a basic understanding of microstructures of specimens of different materials* *2. To understand the process of heat treatment.*
Outcome	*The students would be able to understand the characteristics, applications of various metals and also about the heat treatment processes.*

LIST OF EXPERIMENTS

1. Introduction to Metallography
2. Preparation of Metallographic specimen
3. Identification of Ferrous specimens (minimum 4)
4. Identification of Non-Ferrous specimens (minimum 2)
5. Heat treatment – Annealing- comparison between annealed and un heat treated specimen
6. Heat treatment – Normalizing- comparison between normalized and un heat treated specimen
7. Heat treatment – Hardening- comparison between hardened and un heat treated specimen
8. Heat treatment -Tempering- comparison between hardened and un heat treated specimen
   (For heat treatment experiments low carbon steel could be used)

SEMESTER	SUBJECT	L	T	P	C
V	ELECTRICAL MACHINES AND DRIVES LAB	0	0	4	2

Aim	*The aim of the subject is to provide basic knowledge in working principles of electrical drives.*
Objective	*To expose the students the operation of electric drives and give them hands on experience.*
Outcome	*The students would be able to understand the working principle of various electrical drives, their performance characteristics.*

LIST OF EXPERIMENTS

1. Load test on D.C. shunt motor
2. Speed control of D.C. shunt motor
3. Swinburnes's test
4. Load test on three phase induction motor
5. Load test on single phase induction motor
6. Performance characteristics of single phase transformer
7. AC to DC half and fully controlled converter
8. IGBT based choppers
9. IGBBT based PWM inverter
10. Converter - DC motor drive
11. Inverter fed induction motor drive

SEMESTER	SUBJECT	L	T	P	C
VI	AUTOMOBILE ENGINEERING	3	0	0	3

Aim	*The aim of the subject is to provide an overview of a complete automobile engineering.*
Objective	*1. To study construction and working of different engine components.* *2. To study about the different auxiliary systems of an automobile.* *3. To study about the transmission system of an automobile.* *4. To understand the different types of steering, brakes and suspension systems of an automobile.* *5. To study the various modern alternate technologies of automobiles.*
Outcome	*The students would be able to understand the various parts of automobiles and mechanisms.*

UNIT I VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, resistances to vehicle motion and need for a gearbox, components of engine-their forms, functions and materials

UNIT II ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system for SI engines. Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system ,Turbo chargers, Engine emission control by three way catalytic converter system .

UNIT III TRANSMISSION SYSYTEMS 9

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

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock. Braking System and Traction Control

UNIT V ALTERNATIVE TECHNOLOGIES 9

Use of Natural Gas, Liquefied Petroleum Gas. Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell.

TOTAL HOURS : 45

TEXT BOOKS

1. R.B. Gupta- “Automobile Engineering "- SatyaPrakashan- 1993.
2. Kirpal Singh, “ Automobile Engineering Vol 1 & 2 “, Standard Publishers, Seventh Edition, 1997, New Delhi
3. Jain, K.K., and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi, 2002

REFERENCES:

1. William Crouse- “Automobile Engineering Series "- McGraw-Hill- 1988.
2. Newton and Steeds- “Motor Vehicles "- ELBS- 1985
3. Duffy Smith- “Auto Fuel Systems "- The Good Heat Willcox Company Inc. - 1987
4. Osamu Hirao and Richard K. Pefley- “Present and Future Automotive Fuels "- John Wiley and Sons- 1988.

SEMESTER	SUBJECT	L	T	P	C
VI	HEAT AND MASS TRANSFER	3	1	0	4

(Use of approved Design Data Book is permitted in the University examination)

Aim	*The aim of the subject is to provide knowledge in heat and mass transfer*
Objective	*1. To study about conduction mode of heat transfer.* *2. To study about transient mode of heat transfer.* *3. To study about convection mode of Heat transfer* *4. To study about radiation mode of heat transfer and heat exchanger* *5. To study heat transfer with mass transfer*
Outcome	*The students would be able to understand the basic concepts in heat power systems, integration of thermodynamics in heat power systems.*

UNIT –I CONDUCTION - I 9

Fourier law of conduction, General equation in Cartesian, Cylindrical and Spherical coordinates one dimensional steady state conduction across plane wall- composite wall – Composite cylinder – Composite sphere with convection boundaries, overall heat transfer coefficients, and critical thickness of insulation, conduction with generation, thermal contact resistance, and variable conductivity.

UNIT –II CONDUCTION - II 9

Fins or extended surfaces- Pin fins, annular fins, longitudinal fins.Unsteady state conduction – lumped capacity system, semi – infinite solids and multi dimensional systems, numerical solutions of two-dimensional steady and unsteady conduction.

UNIT –III CONVECTION 9

Hydrodynamic and thermal boundary layers – Principles and governing equations, forced convection – external flow over a Flat plate, cylinder, sphere and non-circular ducts, internal flow through pipes – annular spaces and noncircular conducts. Natural convection from vertical, inclined and horizontal surfaces. Problems. Boiling – Pool Boiling and regimes flow boiling through horizontal and vertical pipes. Condensation – Film and dropwise - derivation of the basic equations.

UNIT –IV RADIATION AND HEAT EXCHANGERS 9

Electromagnetic spectrum, black body emission, Emissive power, Laws of radiation, radiation shape factor, electrical analogy, Radiation shields, gas radiation.Heat exchangers – types of derivation of LMTD and NTU – effectiveness equation, Fouling factor, Compact heat exchangers.

UNIT –V MASS TRANSFER AND HEAT PIPES 9

Fick’s law, Equimolar diffusion, Stefan’s law, mass transfer coefficient, non-dimensional number used in mass transfer, atmospheric evaporation. Problems.

Heat pipes – Introduction, Types and applications.

TUTORIAL HOURS: 15; TOTAL HOURS: 60

TEXT BOOKS

1. KOTHANDARAMAN C.P "Fundamentals of Heat and Mass Transfer" New Age International-
2. SACHDEVA R C- "Fundamentals of Engineering Heat and Mass Transfer" New Age International

REFERENCES

1. OZISIK M.N- "Heat Transfer"- McGraw-Hill Book Co. - 1994.
2. NAG P.K- "Heat Transfer"- Tata McGraw-Hill- New Delhi- 2002
3. HOLMAN J.P "Heat and Mass Transfer" Tata McGraw-Hill- 2000.
4. INCROPRA and DEWITE, Heat Transfer – John Wiley.

SEMESTER	SUBJECT	L	T	P	C
VI	DESIGN OF TRANSMISSION SYSTEMS	3	1	0	4

(Use of approved Design Data Book is permitted in the University examination)

Aim	*The aim of the subject is to provide knowledge in various transmission system design principle.*
Objective	*1. To study the design procedure for power transmission by belt, ropes and pulleys.* *2. To study the design procedure for spur and helical gears.* *3. To study the design procedure for bevel, worm and cross helical gears.* *4. To study the design procedure for various types of gear box.* *5. To study the design procedure for clutches and brakes.*
Outcome	*The students would be able to understand the design of belts, gears and gear boxes.*

UNIT – I - DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS 9

Selection of Flat belts and pulleys-Selection of V belts and pulleys – Wire ropes and pulleys – Selection of Transmission chains.

UNIT – II -SPUR GEARS AND HELICAL GEARS 9

Gear Terminology-Gear materials -power rating calculations based on strength and wear considerations - Parallel axis Helical Gears**.** Simple gear design procedure.

UNIT – III –BEVEL GEARS AND WORM GEARS 9

Straight bevel gear-. Estimating the dimensions of pair of straight bevel gears. Simple gear design procedure. Worm Gear- terminology. -Forces and stresses- efficiency- estimating the dimensions of the worm gear pair. Simple gear design procedure.

UNIT – IV -DESIGN OF GEAR BOXES 9

Geometric progression - Standard step ratio - Ray diagram- kinematics layout -– Design of multi speed gear box, simple gear box design problems (No. of speeds not more than 14).

UNIT – V -DESIGN OF CLUTCHES AND BRAKES 9

Design of plate clutches –axial clutches-cone clutches- internal and external shoe brakes-simple problems.

TUTORIAL : 15
TOTAL HOURS : 60

TEXT BOOKS

1. Bhandari- V.B. - "Design of Machine Elements"- TMH Publishing Company Ltd. - 1994
2. Prabhu. T.J. - "Design of Transmission Elements"- Mani Offset- Chennai- 2000-

REFERENCES

1. Maitra G.M. - Prasad L.V. - "Hand book of Mechanical Design"- II Edition- Tata McGraw-Hill- 1985.
2. Shigley J.E and Mischke C. R. - "Mechanical Engineering Design"- McGraw-Hill International Editions- 1989.
3. Norton R.L- "Design of Machinery"- McGraw-Hill Book co- 2004.
4. Hamrock B.J. - Jacobson B. - Schmid S.R.- "Fundamentals of Machine Elements"- McGraw-Hill Book Co.- 1999.
5. Juvinall R. C. - Marshek K.M. - "Fundamentals of Machine component Design"-John Wiley & Sons Third Edition.

SEMESTER	SUBJECT	L	T	P	C
VI	COMPUTER INTEGRATED MANUFACTURING	3	0	0	3

Aim	*The aim of the subject is to provide knowledge in computer integrated manufacturing*
Objective	*1. To understand the importance of CIM and business aspects* ***2.*** *To gain knowledge about GT and CAPP* ***3.*** *To enable student to learn about FMS and SFC* ***4.*** *To understand about architecture and network concepts* *5. To learn about automation protocol and database*
Outcome	*The students would be able to understand the various concepts viz. group technology, CAPP,FMS.*

UNIT I INTRODUCTION TO CAD/CAM 9

The design process Morphology of design, Product cycle Computer Aided Design, Benefits of CAD. Role of computers - principles of computer graphics - Current trends in manufacturing engineering - - Design for Manufacturing and Assembly - Sequential and concurrent engineering,-Rapid prototyping

UNIT II SOLID MODELING 9

Graphic software: coordinate representation- graphic functions, software standards. Graphical Kernel system (GKS) - Initial graphics exchange system (IGES) - Graphic packages. Geometric Modeling - Wire frame, Surface and Solid models - Constructive Solid Geometry (CSG) and Boundary Representation (B-REP) Techniques - Features of Solid Modeling Packages.

UNIT III FUNDAMENTALS OF CNC MACHINES 9

CNC Technology - Functions of CNC Control in Machine Tools - Classification of CNC systems - Contouring System - Interpolators, open loop and closed loop CNC systems - CNC Controllers, Direct Numerical Control (DNC Systems). - Work holding devices and tool holding devices -Automatic Tool changers. Feedback devices - Principles of Operation-Machining Centres - Tooling for CNC machines

Numerical control codes - Standards - Manual Programming - Canned cycles and subroutines - Computer Assisted Programming, CAD / CAM approach to NC part programming - APT language, machining from 3D models.

UNIT IV GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 10

Introduction to CIM and its related activities-History of group technology- role of G.T. in CAD/CAM integration - part families - classification and coding - DCLASS and MICLASS and OPITZ coding systems-facility design using G.T. - benefits of G.T. - cellular manufacturing. Process planning - role of process planning in CAD/CAM integration - approaches to computer aided process planning - variant approach and generative approaches - CAPP and CMPP process planning systems.

UNIT V SHOP FLOOR CONTROL AND INTRODUCTION OF FMS 9

Shop floor control-phases -factory data collection system -automatic identification methods- Bar code technology-automated data collection system. MS-components of FMS - types -FMS workstation -material handling and storage systems- FMS layout -computer control systems-application and benefits.

Total Hours : 45

TEXT BOOKS

1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated manufacturing", Pearson Education 2001.
2. Radhakrishnan P, Subramanyan.S. and Raju V., "CAD/CAM/CIM", 2nd Edition New Age International (P) Ltd., New Delhi, 2000.

REFERENCES

1. Yorem koren, "Computer Integrated Manufacturing System", McGraw-Hill, 1983.
2. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 1986.
3. David D.Bedworth, Mark R.Hendersan, Phillip M.Wolfe "Computer Integrated Design and Manufacturing", McGraw-Hill Inc.
4. Roger Hanman "Computer Integrated Manufacturing", Addison – Wesley, 1997.
5. Mikell.P.Groover and Emory Zimmers Jr., "CAD/CAM", Prentice Hall of India Pvt. Ltd., New Delhi-1, 1998.
6. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.

SEMESTER	SUBJECT	L	T	P	C
VI	PROFESSIONAL ETHICS AND HUMAN VALUES	3	0	0	3

Aim	*The aim of the subject is to create ethics and inculcate right virtues.*
Objective	*To create an awareness on Ethics and Human Values in engineering professions and to inspire moral and social values and Loyalty to appreciate the rights of others*
Outcome	*The students would be able to understand the responsibility of every citizen and right virtues.*

Unit – I: HUMAN VALUES **9**

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

Unit – II: ENGINEERING ETHICS **9**

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

Unit – III: ENGINEERING AS SOCIAL EXPERIMENTATION **9**

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

Unit – IV: SAFETY, RESPONSIBILITIES AND RIGHTS **9**

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and Chernobyl case studies.

Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

Unit – V: GLOBAL ISSUES **9**

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE),India, etc.

Total Hours 45

TEXT BOOK

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

REFERENCES

1. Charles D. Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint).
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics: Concepts and Cases”, Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available)
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
5. Naagarazan. R. S, A Textbook on Professional Ethics and Human Values , New Age Publications.

SEMESTER	SUBJECT	L	T	P	C
VI	COMPUTER AIDED MANUFACTURING LAB	0	0	4	2

Aim	*The aim of the subject is to provide basic knowledge in working of CNC machines.*
Objective	*1. To gain knowledge about CNC programming* *2. To get the hands on training in CNC trainer machines* *3. To simulate various CNC maching and generate codes using CAM software*
Outcome	*The students would be able to operate CNC machine using part programming.*

Introduction:

1. Study of G and M codes
2. Manual Part Programming for CNC Machines using Stand G and M Code.
3. Machining practice on Trainer Type CNC Machines-
4. Simulation of tool path using any CAM Software

Part programming in CNC Milling:

1. Point to point motions
2. Linear motions
3. Circular interpolations
4. Contour motions
5. Rectangular pocketing
6. Mirroring
7. Circular Pocketing
8. Fixed /canned cycles
9. Subroutines

Part programming for CNC Turning :

1. Turning and facing
2. Step turning, Taper Turning
3. Grooving
4. Fixed/Canned Cycles :
5. Thread cutting Cycles
6. Peek Drilling Cycles

SEMESTER	SUBJECT	L	T	P	C
VI	HEAT TRANSFER LAB	0	0	4	2

Aim	*The aim of the subject is to provide basic knowledge in heat transfer systems..*
Objective	*To gain knowledge in various heat transmissions systems and modes viz, conduction, convection and radiation.*
Outcome	*The students would be able to understand the modes of heat transfer with hands on training..*

1. To determine the thermal conductivity of a lagged pipe.
2. To determine the thermal conductivity of a solid by the guarded hot plate method.
3. To determine the heat transfer through composite wall apparatus.
4. To find the effectiveness of a pin fin in a rectangular duct under natural convective & forced convective condition and plot temperature distribution along its length.
5. To determine the surface heat transfer coefficient for a heated vertical tube under natural convection and plot the variation of local heat transfer coefficient along the length of the tube. Also compare the results with those of the correlation.
6. To determine average heat transfer coefficient for an externally heated horizontal pipe under forced convection & plot Reynolds and Nusselt numbers along the length of pipe. Also compare the results with those of the correlations.
7. To measure the emissivity of the gray body (plate) at different temperature and plot the variation of emissivity with surface temperature.
8. To find overall heat transfer coefficient and effectiveness of a heat exchange under parallel & counter flow conditions. Also plot the temperature distribution in both the cases along the length of heat of heat exchanger.
9. To verify the Stefan-Boltzmann constant for thermal radiation.
10. Study and demonstration of boiler.

SEMESTER	SUBJECT	L	T	P	C
VI	AUTOMOBILE ENGINEERING LAB	0	0	4	2

Aim	*The aim of the subject is to provide overall knowledge about automobile engineering.*
Objective	*To study about the various parts of an automobile.*
Outcome	*The students would be able to understand the assembly and disassembly of various automobile Parts and also about other mechanisms.*

List of Experiments :

1. Dismantling and assembling of Compression Ignition diesel engine.
2. Dismantling and assembling of Petrol engine.
3. Dismantling and assembling of Mesh Type gear box.
4. Dismantling and assembling of Rear Axle assembly with Differential.
5. Study of simple Carburetor by dismantling and assembling.
6. Dismantling and assembling of S.U.Carburetor
7. Study of engine Self Starting system.
8. Study of Manual Steering.
9. Study of Braking System.
10. Study of Differential Gear.
11. Study of diesel fuel supply system

SEMESTER	SUBJECT	L	T	P	C
VII	HYDRAULICS AND PNEUMATIC SYSTEMS	3	0	0	3

Aim	*The aim of the subject is to provide knowledge about various fluid power systems*
Objective	*1. To study about basics of fluid power systems* *2. To gain knowledge about components used in hydraulic and pneumatic systems* *3. To learn various valves and actuators* *4. To learn about different hydraulic circuits* *5. To learn about different pneumatic circuits*
Outcome	*The students would be able to understand the applications of hydraulics and pneumatic systems .*

UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS 9

Introduction to fluid power, Advantages and Applications of fluid power system. Types of fluid power systems, Properties of fluids – General types of fluids – Fluid power symbols. Basic Laws in Fluid power system. Low cost automation.

UNIT II HYDRAULIC SYSTEM & PNEUMATIC SYSTEMS 9

Pump classification – Gear pump, Vane Pump,piston pump, construction and working of pumps– Variable displacement pumps.
Pneumatic Components: Compressors-types. Filter, Regulator, Lubricator Unit, Muffler– Air control valves, Quick exhaust valves.

UNIT III VALVES AND ACTUATORS 9

Construction of Control Components: Director control valve – 3/2 way valve ,4/2 way valve,
Shuttle valve ,check valve – pressure control valve –pressure reducing valve, sequence valve-Flow control valve.
Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like Telescopic, Cushioning mechanism,
Construction of double acting cylinder.

UNIT IV DESIGN OF HYDRAULIC CIRCUITS 9

Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, intensifier – Intensifier circuit. Circuits: Reciprocating - Quick return – Sequencing – Synchronizing - Safety circuits - Press – Planer.

UNIT V DESIGN OF PNEUMATIC CIRCUITS 9

Fluid Power Circuit Design : Speed control circuits, synchronizing circuit, Pneumo-hydraulic circuit.
Sequential circuit design for simple applications using cascade method.
Fluid power circuits- failure and troubleshooting.

TOTAL HOURS : 45

TEXT BOOKS:

1. Hydraulicas And Pneumatic Controls, Srinivasan, TMH
2. Andrew Parr- “Hydraulics and Pneumatics (HB) "- Jaico Publishing House- 2005
3. Anthony Esposito- “Fluid Power with Applications”- Pearson Education 2008

REFERENCES:

1. Dudleyt- A. Pease and John J. Pippenger- “Basic Fluid Power "- Prentice Hall- 1987.
2. Anthony Esposite- “Fluid Power with Applications "- Prentice Hall- 1980.
3. Majumdar S.R.- “Oil Hydraulics”- Tata McGraw-Hill- 2000.
4. Majumdar S.R.- “Pneumatic systems – Principles and maintenance”- Tata McGraw Hill- 1995
5. Anthony Lal- “Oil hydraulics in the service of industry”- Allied publishers- 1982.
6. Dudelyt- A. Pease and John T. Pippenger- “Basic Fluid Power”- Prentice Hall- 1987.

SEMESTER	SUBJECT	L	T	P	C
VII	FINITE ELEMENT ANALYSIS	3	1	0	4

Aim	*The aim of the subject is to provide knowledge in finite element analysis.*
Objective	1. *To understand the basics of Finite element techniques and 1D element equation formulation* 2. *To gain knowledge about 2D problems in structural and Thermal* 3. *To enable student to learn about Natural coordinates and Iso-Parametric Elements* 4. *To understand about Elasticity concepts and Virtual work* 5. *To study about dynamic analysis*
Outcome	*The students would be able to understand the basic concepts in mathematical problem analysis.*

UNIT I: INTRODUCTION TO FINITE ELEMENT METHODS (12)

General description of Finite Element Method – Historical development – Comparison with Classical methods – General procedure of FEM - Applications of FEM – FEA software's. General Field problems, discrete and continuous models, Variational formulation in finite Elements – Ritz method - Weighted residual methods – Galerkin – sub domain – method of Least squares and collocation method - Numerical problems.

UNIT II: ONE-DIMENSION PROBLEMS (12)

Finite element modeling-coordinates and shape functions-potential energy approach-Galerkin method-Element matrices and vectors-Assembly for global equations- Boundary conditions-Higher order elements-Shapes function-Application to axial loadings of rods-Extension to plane trusses-Bending of beams-Finite element formulation of stiffness matrix and load vectors-Assembly to global equations-Boundary conditions-Solutions and post processing –Example problems

UNIT III: TWO DIMENSION SCALAR VARIABLE PROBLEMS (12)

Finite element modeling-Element equations-Load vectors and boundary condition-Assembly-Applications to scalar variable problems such as torsion, heat transfer, etc.,-Examples

UNIT IV: TWO DIMENSION VECTOR VARIABLE PROBLEMS (12)

Vector variable problems-Elasticity equations-Plane stress, Plane strain and Axissymmetric problems-CST and LST Elements-Formulation-Element matrices-Assembly-Boundary conditions and solutions-Examples

UNIT V: ISOPARAMETRIC ELEMENT FORMUALTIONS (12)

Natural coordinates-Isoparametric elements-Elements shapes functions-Element equations-Gaussian quadrature-Examples

Text Books:

1. Chandruputla & Belagundu, “Finite Elements in Engineering”, Prentice Hall of India Private Ltd., 1997.
2. Rao S.S., “Finite Element Method in Engineering” , Pergamon Press, 1989

REFERENCE BOOKS:

1. Reddy J.N. “An Introduction to the Finite Element Method”, Mc Graw Hill, International Edition, 1993.
2. Segerlind L.J., “Applied Finite Element Analysis”, John Wiley, 1984.

SEMESTER	SUBJECT	L	T	P	C
VII	RENEWABLE SOURCES OF ENERGY	3	0	0	3

Aim	*The aim of the subject is to provide an overview of availability of renewable energy*
Objective	*1. To impart the importance of solar energy.* *2. To inculcate the importance of wind energy.* *3. To know the importance of bio energy.* *4. To know various renewable energy power plants.* ***5.*** *To impart the necessity of latest and modern energy sources.*
Outcome	*The students would be able to understand the availability, utilization and conservation of renewable energy sources.*

UNIT I SOLAR ENERGY **9**

Introduction to solar energy conversion, principle-solar insolation-instrument- solar radiation data-measurement & analysis – fundamentals of solar cells, types of semiconducting materials-solar cell property-solar PV cell interconnection-thin film solar cell-solar thermal conversion-principle and application.

UNIT II WIND ENERGY **9**

Fundamentals of wind resource-site selection criteria-instruments-data analysis, frequency distribution
Wind energy conversion principles; General introduction- Aerodynamic principle-types and classification of wind electric conversion system-water pumping wind mill performance characteristics-small wind turbine design and performance characteristics study.

UNIT III BIO–ENERGY **9**

Biomass, Biogas, Source, Composition, biomass conversion technologies– Biomass direct
Combustion – Biomass gasifier – Biogas plant – Digesters – Alternative liquid fuels (Ethanol, Methonal, & Bio-Diesel production) - Environment impact of bio-energy. Biomass conversion technologies, Methonal production, Environment impact of bio-energy.

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

Tidal energy – Wave energy –Open and closed OTEC Cycles – Small hydro plant turbines – Geothermal energy sources- Environmental issues.

UNIT V NEW ENERGY SOURCES **9**

Hydrogen generation, storage, transport and utilization, Applications – Fuel cells – technologies, types - Power generation & transport – Hybrid systems.

TOTAL: **45 hours**

TEXT BOOKS:

1. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, New Delhi, 1999.
2. S.P. Sukhatme, Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

REFERENCES:

1. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 1996.
2. Twidell, J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 1986.
3. G.N. Tiwari, solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002.
3. L.L. Freris, Wind Energy Conversion systems, Prentice Hall, UK, 1990.

SEMESTER	SUBJECT	L	T	P	C
VII	MECHATRONICS	3	0	0	3

Aim	*The aim of the subject is to provide knowledge about mechatronics system- an integration.*
Objective	*1. To study about basic electronic components and to design circuits for mechanical applications.* *2. To study about sensors and transducers and their significant applications in mechanical engineering applications.* *3. To study about the microprocessor and microcontroller architecture and its important applications in machineries and automotives.* *4. To study about programmable logic controller and to develop applications for mechanical systems.* *5. To study designing of Mechatronic systems for automotive, electronic appliances etc.*
Outcome	*The students would be able to understand the automation principle, sensors, relays and their applications.*

UNIT – I - INTRODUCTION 9

Introduction to Digital electronics, components, general electronic circuits, logical gates, registers; flip flops, microprocessors and applications – Design of electronic circuits for mechanical applications - Measurement Systems-Control Systems**.**

UNIT – II - SENSORS AND TRANSDUCERS 9

Sensors – Types and Functions - Position , Proximity, Velocity and Motion, Fluid Pressure, Temperature Sensors, Light Sensors, Emission Gas Sensors - Performance parameters - Selection of Sensors.

Transducers – Classification, selection, resistive, capacitive and inductive transducers, piezo-electric transducers, optical and digital transducers. Transducers for Measurement - displacement, temperature, level, flow, pressure, velocity, torque, speed,

UNIT – III - MICROPROCESSOR AND MICROCONTROLLERS 9

8085 Microprocessor – Architecture, Pin Configuration, Instruction set, Programming. Interfacing input and output devices, Interfacing D/A converters and A/D converters, Applications- Temperature control, Stepper motor control, Traffic light controller. Introduction to 8086, microprocessors.

8051 Microcontroller – Signals, Operational features, Memory and I/O addressing, Interrupts, serial communication, and instruction set. Applications in cutting machinery and automotives.

UNIT – IV - PROGRAMMABLE LOGIC CONTROLLERS 9

Introduction-Basic structure-Input/Output Processing-Programming-Mnemonics-Timers- Internal relays and counters-Data handling-Analog Input/Output-Selection of a PLC. SCADA , Industrial applications of PLC in conveyor systems, product line automations etc.

UNIT – V - DESIGN OF MECHATRONICS SYSTEMS 9

Stages in designing mechatronic systems, traditional and mechatronic design, possible design solutions. Design of following mechatronic systems - Pick and place robot, automatic car park system, engine management system, machinery automation.

TOTAL HOURS :45 PERIODS

TEXT BOOK:

1. W.Bolton- Mechatronics-Longman-Second Edition- 2010.
2. K.Ram- “Fundamentals of Microprocessors and Microcomputers "- Dhanpat Rai Publications- Fourth Revised Edition- 2005.

REFERENCES:

1. Michael B. Histand and David G.Alciatore- “Introduction to Mechatronics and Measurement Systems "- McGraw Hill International Editions- 1999.
2. HMT Ltd. - “Mechatronics "- Tata McGraw Hill Publishing Co. Ltd. - 1998.
3. D.A.Bradley- D.Dawson- N.C.Buru and A.J.Loader- “Mechatronics "- Chapman and Hall- 1993.
4. Ramesh S. Gaonkar- “Microprocessor Architecture "- Programming and Applications- Wiley Eastern- 1997.
5. Dan Necsulescu- "Mechatronics"-Pearson Education Asia-2002(Indian reprint).

SEMESTER	SUBJECT	L	T	P	C
VII	FINITE ELEMENT ANALYSIS LAB	0	0	4	2

Aim	*The aim of the subject is to provide hands on experience in finite element analysis software*
Objective	*To gain knowledge in various procedures in drafting and analysing a component using FEA software.*
Outcome	*The students would be able to understand and analyse any component using software.*

LIST OF EXPERIMENTS:

1. Study of analysis and its benefits
2. Application of distributed loads
3. Nonlinear analysis of a cantilever beam
4. Buckling analysis
5. Stress analysis of cantilever beam
6. Stress analysis of axi-symmetry vessels
7. Stress analysis of two dimensional truss
8. Transient thermal conduction
9. Simple conduction
10. Plane stress bracket
11. Modal analysis of a cantilever beam
12. Harmonic analysis of a cantilever beam

SEMESTER	SUBJECT	L	T	P	C
VII	AUTOMATION LAB	0	0	4	2

Aim	*The aim of the subject is to provide overall knowledge about automation sector.*
Objective	*To train the students with hands on experience in fluid power systems and automation.*
Outcome	*The students would be able to understand the operation of various logical sequence with software.*

LIST OF EXEPRIMENTS:

1. Design and testing of fluid power circuits to control
   (i) Velocity (ii) direction and
   (iii) force of single and double acting actuators
2. Design of circuits with logic sequence using Electro pneumatic trainer kits.
3. Simulation of basic Hydraulic, Pneumatic and Electric circuits using software
4. Design and Testing of Circuits with multiple cylinder sequences in Electro pneumatic using PLC.

SEMESTER	SUBJECT	L	T	P	C
VII	MINI PROJECT	0	0	3	2

AIM : To translate the theoretical concept into practical output at small level

OBJECTIVE

- The objective of the mini project work is to enable the students to form the groups of not more than 4 members on a project involving the activity based learning concept and to design a model / mechanism related to the branch of study.

OUTCOME: To learn the concept of design, manufature and assembly

-
- Formation of Group as follows
  - Category A : 8.5CGPA and above
  - Category B : 7 to 8.49 CGPA
  - Category C : 5 to 6.9 CGPA

    A group will be formed with atleast one student from each category.

- Every mini project work shall have a guide who is the member of the faculty of the institution. Three periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the mini project.

SEMESTER	SUBJECT	L	T	P	C
VIII	PROJECT WORK AND VIVA VOCE	0	0	8	6

AIM : To translate the theoretical concept into practical output

OBJECTIVE

- The objective of the project work is to enable the students to form the groups of not more than 4 members on a project involving theoretical and experimental studies related to the branch of study.

OUTCOME:

- The outcome of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

- This final report shall be typewritten form as specified in the guidelines.

- Every project work shall have a guide who is the member of the faculty of the institution. Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.
- Formation of Group as follows
  - Category A : 8.5CGPA and above
  - Category B : 7 to 8.49 CGPA
  - Category C : 5 to 6.9 CGPA

    A group will be formed with atleast one student from each category.

- The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.

- Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.
- The continuous assessment shall be made as prescribed in the regulations

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ELECTIVE SUBJECTS

SUBJECT	L	T	P	C
OPERATIONS RESEARCH	3	0	0	3

Objectives:

- **Linear Programming is useful in finding either maximum or minimum of an expression subject to given constraints**
- **To minimize the cost of transporting items from various sources to different destinations**
- **When number of activities are to be carried out most economical way with less time consumptions can be found**
- **Inventory is essential to provide flexibility in operating a system or organization.**
- **Decision making is an integral part of any business organization. It uses to select the best among several decisions through a proper evaluation of the parameters of each decision environment**

1. Linear programming 9

Linear programming problem – Graphical method - Simplex method – Big M method – Duality principle.

2. Transportation model 9

Transportations problem – Assignment problem – Under Assignment -Traveling salesman problem

3. Network model 9

Project Network – CPM and PERT Networks – Critical path scheduling – Sequencing Models.

4. Inventory Models 9

Inventory Model – Economic Order Quantity Model – Purchasing Model (with and without shortages) – Manufacturing Model (with and without shortages) - Stochastic Inventory Model (Stock in discrete and continuous units).

5. Decision Model 9

Decision Model – Game theory – Two Person Zero sum game – Algebraic solutions Graphical solutions – Replacement model – Model based on Service life – Economic life single / multivariable search technique.

Tutorial : 15
Total Hours : 60

TEXT BOOK

1.Sundarasen.V, Ganapathy subramaniyam . K.S. Ganesan.K. "Operations Research" ,A.R. Publications.

RFERENCES:

1. Premkumar Gupta, Hira, "Operations Research" Chand & company New Delhi.
2. H.A.Taha, "Operations Research",Prentice Hall of India , 1999, Six Edition.
3. Kanti Swarup,P.K.Gupta,Man Mohan, SultanChand& Sons, New Delhi(2010)

SUBJECT	L	T	P	C
REFRIGERATION AND AIRCONDITIONING	3	0	0	3

Objectives:

1. *To understand the importance of refrigeration cycle.*
2. *To know about various refrigerants.*
3. *To explain the principles of psychrometry.*
4. *To understand various AC systems.*
5. *To understand various new and unconventional refrigeration systems.*

UNIT I REFRIGERATION CYCLE 7

Review of thermodynamic principles of refrigeration. Carnot refrigeration cycle – Vapour compression refrigeration cycle – use of P-H charts – multistage and multiple evaporator systems – cascade system – COP comparison. Air Refrigeration cycles.

UNIT II REFRIGERANTS AND SYSTEM COMPONENTS 10

Compressors – reciprocating and rotary. Types of condensers, evaporators, cooling towers – functional aspects. Refrigerants – properties – selection of refrigerants – impact on environment. Alternate Refrigerants - Cycling controls.

UNIT III PSYCHROMETRY 10

Psychometric processes use of psychometric charts – Grand and Room Sensible Heat Factors – bypass factor – air washers. Requirements of comfort air conditioning - summer and winter air conditioning.

UNIT IV AIR CONDITIONING SYSTEMS 9

Cooling load calculation - working principles of centralized air conditioning systems, split, ductable split, packaged air conditioning, VAV & VRV Systems. Duct Design by equal friction method, Indoor Air quality concepts.

UNIT V UNCONVENTIONAL REFRIGERATION CYCLES 9

Vapor Absorption system – Ejector jet, Steam jet refrigeration, and Thermo electric refrigeration - applications. Ice plant – food storage plants – milk – chilling plants.

TOTAL HOURS :45

TEXT BOOKS:

1. Manohar Prasad, “Refrigeration and Air Conditioning”, Wiley Eastern Ltd., 1983.
2. Arora C.P., “Refrigeration and Air Conditioning”, Tata McGraw Hill, New Delhi, 1988.
3. Lang Paul, Principles of Air Conditioning, CBS Publishers, 2003.

REFERENCES:

1. Roy. J. Dossat, “Principles of Refrigeration”, Pearson Education 1997.
2. Jordon and Priester, “Refrigeration and Air Conditioning”, Prentice Hall of India Pvt. Ltd., 1985.
3. Stoecker N.F. and Jones, “Refrigeration and Air Conditioning”, TMH, 1981.
4. Marsh and Olivo, Principles of Refrigeration, CBS Publishers, 2005.

SUBJECT	L	T	P	C
UNCONVENTIONAL MANUFACTURING PROCESSES	3	0	0	3

Objectives:

1. *To gain knowledge and understanding of basic concepts of unconventional machining processes*
2. *To impart the knowledge and understanding of various mechanical methods*
3. *To impart the knowledge and understanding of electrical energy based processes*
4. *To impart the knowledge and understanding of chemical and hybrid processes*
5. *To impart the knowledge and understanding of thermal energy based processes*

UNIT I INTRODUCTION 6

Unconventional machining Process – Need – classification – Brief overview–merits –demerits–Applications

UNIT II MECHANICAL ENERGY BASED PROCESSES 9

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining. Working Principles & Applications – equipment used – process parameters – MRR - Variation in techniques used.

UNIT III ELECTRICAL ENERGY BASED PROCESSES 10

Electric Discharge Machining - working principle and applications – equipments - process parameters - surface finish and MRR- Power and control circuits–Wire cut EDM – working principle and Applications.

UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 10

Chemical machining and Electro-Chemical Machining- Electro Chemical Grinding and Electro chemical Honing-working principle and applications-Process Parameters -Surface finish and MRR -Etchants–Maskants.

UNIT V THERMAL ENERGY BASED PROCESSES 10

Laser Beam Machining and drilling, Plasma Arc Machining and Electron Beam Machining Working principles & Applications – Equipment –Types - Beam control techniques. Micromachining and Nanofabrication Techniques

TOTAL HOURS :45

TEXT BOOKS:

1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., 2007
2. P.K.Mishra , " Non Conventional Machining "- - The Institution of Engineers (India) Text Books: Series- 1997.

REFERENCES:

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

SUBJECT	L	T	P	C
INDUSTRIAL ROBOTICS	3	0	0	3

Objectives:

1. *To learn the basics about Robotics and Robot manipulation in space.*
2. *To understand the controlling of Robots and devices system.*
3. *To learn the Sensor technology*
4. *To learn the knowledge of Robot programming and Expert system.*
5. *To understand* about *Robot cell design, applications and economics*

UNIT I FUNDAMENTALS OF ROBOT 7

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

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 10

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C.Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III ROBOT SENSORS 9

Transducers and sensors – Sensors in robot – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image processing and analysis – Image segmentation – Pattern recognition – Training of vision system

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 10

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems. Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End Effectors commands and simple programs.

UNIT V CELL DESIGN APPLICATIONS AND ECONOMICS OF ROBOTICS 9

Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple robots and machine interference – Robot cycle time analysis – Industrial applications of robots.

Economic Analysis of Robots – Pay back Method, EUAC Method, and Rate of Return Method.

TOTAL HOURS : 45

Text Books:

1. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey "Industrial Robotics Technology, Programming and Applications", Mc Graw Hill, Int., 1986.
2. Fu.K.S., Cgonzalez R. Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence" Mc Graw hill ,

Reference Books:

1. Richar. D., Klafter, Thomas, A, Chmielewski, "Machine Negin Robotics Engineering – An Integrated Approach", Prentice Hall of India Pvt., Ltd., 1984.
2. Kozyrey, Yu. "Industrial Robotics" MIR Publishers Moscow, 1985.
3. Deb, S.R. "Robotics Technology and Flexible Automation", Tata McGraw Hill, 1994.
4. Timothy Jordonides etal, "Expert Systems and Robotics", Springer – Verlag, New York, May 1991.

SUBJECT	L	T	P	C
ADVANCED I.C ENGINES	3	0	0	3

Objectives:

1. *To learn about SI engines.*
2. *To learn about CI engines.*
3. *To learn to control various pollutants.*
4. *To know about various alternative fuels.*
5. *To know various latest trends in automobiles.*

1. SPARK IGNITION ENGINES **9**

Spark ignition Engine mixture requirements - Feedback Control Carburetors -Fuel - Injection systems - Monopoint and Multipoint injection - Stages of combustion - Normal and Abnormal combustion-Factors affecting knock - Combustion Chambers - Introduction to Thermodynamic analysis S.I. Engine combustion

2. COMPRESSION IGNITION ENGINES **9**

States of combustion in C.I. Engine - Direct and indirect injection systems - Combustion chambers - Fuel spray behaviour - spray structure- spray penetration and evaporation - Air motion - Turbocharging - Introduction to Thermodynamic Analysis of C.I. Engine combustion.

3. POLLUTANT FORMATION CONTROL **9**

Pollutant - Sources and types - formation of NOx - Hydro-carbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions - Methods of controlling Emissions- Catalytic converters and Particulate Traps -Methods of measurements and Driving cycles.

4. ALTERNATIVE FUELS **9**

Alcohol- Hydrogen- Natural Gas and Liquefied Petroleum Gas - Properties- Suitability- Engine Modifications- Merits and Demerits as fuels.

5. RECENT TRENDS **9**

Learn Burn Engines - Stratified charge Engines - Gasoline Direct Injection Engine - Homogeneous charge compression Ignition - Plasma Ignition - Measurement techniques.

TOTAL HOURS : 45

TEXT BOOK:

1. John B. Heywood- "Internal Combustion Engine Fundamentals"- McGraw Hill- 1988.

REFERENCES:

1. R.B.Mathur and R.P.Sharmal- “Internal Combustion Engines ".
2. Rowland S.Benson and N.D.Whitehouse- " Internal combustion Engines "- Vol.I and II- Pergamon Press- 1983.
3. Duffy Smith- “Auto fuel Systems "- The Good Heart Willox Company- Inc. - 1987.

SUBJECT	L	T	P	C
CRYOGENIC ENGINEERING	3	0	0	3

Objectives:

1. *To introduce the importance of cryogenic engineering.*
2. *To study the low temperature refrigeration system.*
3. *To study the gas separation systems.*
4. *To know the vacuum technology.*
5. *To understand about cryogenic storage.*

UNIT 1 CONSTRUCTION DETAILS AND HEAT TRANSFER 9

Introduction to Cryogenic Systems Low Temperature properties of Engineering Materials. Cryogenic fluids and their properties. Applications in space- Food Processing- super Conductivity- Electrical Power- Biologyedicine- Electronics and Cutting Tool Industry.

UNIT II LIQUEFACTION AND LOW TEMPERATURE REFRIGERATION 9

Liquefaction systems ideal system- Joule Thomson expansion- Adiabatic expansion- Linde Hampson a Cycle- Claude & Cascaded System- Magnetic Cooling- Stirling Cycle Cryo Coolers.

UNIT 1II SEPARATION AND PURIFICATION SYSTEMS 9

General characteristics of mixtures-composition diagrams. Gas separation-principles of rectification-flash calculations - Rectification column analysis- Flash calculations.

UNIT IV INSULATION AND VACUUM TECHNOLOGY 9

Thermal insulation and their performance at cryogenic temperatures- Super Insulations- Vacuum insulation- Powder insulation- Cryo pumping Applications.

UNIT V STORAGE AND INSTRUMENTATION 9

Cryogenic Storage vessels and Transportation- Transfer devices. Pressure flow-level and temperature measurements.

TOTAL HOURS :45

TEXT BOOK:

1. Klaus D.Timmerhaus and Thomas M.Flynn- “Cryogenic Process Engineering “Plenum Press- New York- 1989.

REFERENCES:

1. Randal Barron- “Cryogenic Systems "- McGraw Hill- 1986.
2. R.B.Scoott- “Cryogenic engineering "- Van Nostrand Company Inc. - 1985.
3. J.H.Bell- “Cryogenic Engineering "- Prentice Hall Inc. - 1963.

SUBJECT	L	T	P	C
RAPID PROTOTYPING AND TOOLING	**3**	**0**	**0**	**3**

Objectives:

1. *To understand Rapid prototyping history and its development.*
2. *To gain knowledge about liquid and powder based RP process*
3. *To enable student to learn about solid based RP process*
4. *To inherit knowledge about Rapid Tooling*
5. *To elaborate about principles of reverse engineering*

UNIT I INTRODUCTION ***9***

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping on Product Development –Digital prototyping - Virtual prototyping-Data Processing for Rapid Prototyping: CAD model preparation, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

UNIT II LIQUID AND POWDER BASED RP PROCESSES 9

Liquid based process: Principles of STL and typical processes such as the SLA process, solid ground curing and others - Powder based process: Principles and typical processes such as selective laser sintering and some 3D printing processes.

UNIT III SOLID BASED RP PROCESSES 9

Principles and typical processes such as fused deposition modeling laminated object modeling and others.

UNIT IV RAPID TOOLING 9

Principles and typical processes for quick batch production of plastic and metal parts though quick tooling.

UNIT V REVERSE ENGINEERING 9

3D scanning, 3D digitizing and Data fitting, high speed machining- Hardware and software - Applications: Evaluation, bench marking and various case studies.

TOTAL HOURS: 45

Text Books:

1. Chua. C.K, “Rapid Prototyping”, Wiley, 1997.
2. Hilton. P.D. et all, “Rapid Tooling”, Marcel, Dekker 2000.

REFERENCES:

1. Burns. M, “Automated Fabrication”, PHI, 1993.
2. Beaman J.J et all, “Solid freeform fabrication”, Kluwer, 1997.
3. Jacohs P.F., “Stereolithography and other Rapid Prototyping and Manufacturing Technologies”, ASME, 1996.
4. Pham D.T. and Dimov S.S., “Rapid Manufacturing; the technologies and application of RPT and Rapid tooling”, Springer, London 2001.
5. Rafiq I. Noorani, Rapid Prototyping – Principles and Applications, Wiley & Sons, 2006.

SUBJECT	L	T	P	C
POWER PLANT ENGINEERING	3	0	0	3

UNIT I

Introduction: Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants.

Hydro Electric Power Plants : Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants.

Unit II

Steam Power Plants: Layout and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator.

Gas Turbine and Combined Cycle Power Plants : Constant pressure gas turbine power plants, Arrangements of combined plants (steam & gas turbine power plants), re-powering systems with gas production from coal using PFBC systems, with organic fluids, parameters affecting thermodynamic efficiency of combined cycles.

Unit III

Nuclear Power Plants: Principles of nuclear energy, basic nuclear reactions, nuclear reactors-PWR, BWR, CANDU, Sodium graphite, fast breeder, homogeneous; gas cooled. Advantages and limitations, nuclear power station, waste disposal.

Non-Conventional Power Generation: Solar radiation estimation, solar energy collectors, Low, medium & high temperature power plants, OTEC, wind power plants, tidal power plants, geothermal power plants.

Unit IV

Power Plant Economics: Load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance & operating characteristics of power plants- incremental rate theory, input-out put curves, efficiency, heat rate, economic load sharing, Problems.

Unit V

Direct Energy Conversion Systems: Fuel cell, MHD power generation-principle, open & Closed cycle's systems, thermoelectric power generation, thermionic power generation.

TOTAL HOURS :60

Text Books:

1. Power station Engineering and Economy by Bernhardt G.A. skrotzki and William A. Vopat – Tata Mc Graw Hill Publishing Company Ltd., New Delhi
2. Power Plant Engineering: P.K. Nag Tata McGraw Hill second Edition 2001.

Reference Books:

1. Power Plant Engg. : M.M. El-Wakil McGraw Hill 1985.

SUBJECT	L	T	P	C
LEAN MANUFACTURING SYSTEMS	3	0	0	3

Objectives:

1. *To gain the knowledge and understanding of basic concepts of lean manufacturing process*
2. *To understand the various quality improvement methods in lean manufacturing.*
3. *To gain the knowledge and understanding of basic concepts of scheduling systems.*
4. *To gain the knowledge and understanding of basic concepts of JIDOKA*
5. *To gain the knowledge and understanding of basic concepts of employee involvement and systematic planning*

UNIT I INTRODUCTION 9

The mass production system – Origin of lean production system – Necessity – Lean revolution in Toyota – Systems and systems thinking – Basic image of lean production – Customer focus – Muda (waste).

UNIT II STABILITY OF LEAN SYSTEM 9

Standards in the lean system–5S system–Total Productive Maintenance–standardized work–Elements of standardized work–Charts to define standardized work–Man power reduction–Overall efficiency–standardized work and Kaizen–Common layouts.

UNIT III JUST IN TIME 9

Principles of JIT – JIT system – Kanban rules – Expanded role of conveyance – Production leveling – Pull systems – Value stream mapping.

UNIT IV JIDOKA (AUTOMATION WITH A HUMAN TOUCH) 9

Jidoka concept – Poka-Yoke (mistake proofing) systems – Inspection systems and zone control – Types and use of Poka-Yoke systems – Implementation of Jidoka.

UNIT V WORKER INVOLVEMENT AND SYSTEMATIC PLANNING METHODOLOGY 9

Involvement – Activities to support involvement – Quality circle activity – Kaizen training - Suggestion Programmes – Hoshin Planning System (systematic planning methodology) – Phases of Hoshin Planning – Lean culture.

TOTAL HOURS : 45

TEXTBOOKS:

1. Pascal Dennis, Lean Production Simplified: A Plain-Language Guide to the
2. World's Most Powerful Production System, (Second edition), Productivity Press,New York, 2007.
3. Mike Rother and John Shook, Learning to See: Value Stream Mapping to Add
4.Value and Eliminate MUDA, Lean Enterprise Institute, 1999.

REFERENCES:

1. Jeffrey Liker, the Toyota Way: Fourteen Management Principles from the World's Greatest Manufacturer, McGraw Hill, 2004.
2. Michael L. George, Lean Six SIGMA: Combining Six SIGMA Qualities with Lean Production Speed, McGraw Hill, 2002.

SUBJECT	L	T	P	C
TOTAL QUALITY MANAGEMENT	**3**	**0**	**0**	**3**

UNIT –I INTRODUCTION **9**

Definition of Quality- Dimensions of Quality- Quality Planning- Quality costs – Analysis Techniques for Quality Costs- Basic concepts of Total Quality Management- Historical Review- Principles of TQM- Leadership – Concepts- Role of Senior Management- Quality Council- Quality Statements- Strategic Planning- Deming Philosophy- Barriers to TQM Implementation.

UNIT –II - TQM PRINCIPLES **9**

Customer satisfaction – Customer Perception of Quality- Customer Complaints- Service Quality- Customer Retention- Employee Involvement – Motivation- Empowerment- Teams- Recognition and Reward- Performance Appraisal- Benefits- Continuous Process Improvement – Juran Trilogy- PDSA Cycle- 5S- Kaizen-Basic Concepts- Strategy- Performance Measure.

UNIT –III - STATISTICAL PROCESS CONTROL (SPC) **9**

The seven tools of quality- Statistical Fundamentals – Measures of central Tendency and Dispersion- Population and Sample- Normal Curve- Control Charts for variables and attributes- Process capability- Concept of six sigma- New seven Management tools.

UNIT –IV - TQM TOOLS **9**

Benchmarking – Reasons to Benchmark- Benchmarking Process- Quality Function Deployment (QFD) – House of Quality- QFD Process- Benefits- Taguchi Quality Loss Function- Total Productive Maintenance (TPM) – Concept- Improvement Needs- FMEA – Stages of FMEA.

UNIT –V - QUALITY SYSTEMS **9**

Need for ISO 9000 and Other Quality Systems- ISO 9000:2000 Quality System – Elements- Implementation of Quality System- Documentation- Quality Auditing- QS 9000- ISO 14000 – Concept- Requirements and Benefits.

Total Hours : 45

TEXT BOOK:

1. Dale H.Besterfiled- et at. - Total Quality Management- PHI-1999. (Indian reprint 2002).
2. Feigenbaum.A.V. "Total Quality Management- McGraw-Hill- 1991.

REFERENCES:

1. James R.Evans & William M.Lidsay- The Management and Control of Quality- (5^{th} Edition)- South-Western (Thomson Learning)- 2002 (ISBN 0-324-06680-5).
2. Oakland.J.S. "Total Quality Management Butterworth – Hcinemann Ltd.- Oxford. 1989.
3. Narayana V. and Sreenivasan- N.S. Quality Management – Concepts and Tasks- New Age International 1996.

SUBJECT	L	T	P	C
INDUSTRIAL TRIBOLOGY	3	0	0	3

Objectives:

1. *To gain knowledge about surfaces and to study the different types of friction in materials.*
2. *To gain knowledge in wear mechanisms, types of wear for different environment and materials.*
3. *To study the properties of fluid film for bearing applications.*
4. *To have a theoretical understanding of the film lubrication theory.*
5. *To learn the various ways of modifying the surface of the materials for bearing.*

UNIT I SURFACES AND FRICTION 9

Topography of Engineering surfaces- Contact between surfaces - Sources of sliding friction – Adhesion- Ploughing- Energy dissipation mechanisms Friction Characteristics of metals - Friction of non metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction – Stick slip motion - Measurement of Friction.

UNIT II WEAR 9

Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear – Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture - wear - Wear of Ceramics and Polymers - Wear Measurements.

UNIT III LUBRICANTS AND LUBRICATION TYPES 9

Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication – Elasto-hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication - Hydrostatic Lubrication.

UNIT IV FILM LUBRICATION THEORY 9

Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings – Reaction torque on the bearings - Virtual Co-efficient of friction - The Sommerfield diagram/.

UNIT V SURFACE ENGINEERING AND MATERIALS FOR BEARINGS 9

Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes – Surface coatings - Plating and anodizing - Fusion Processes – Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

TOTALHOURS : 45

TEXT BOOK:

1. A.Harnoy “Bearing Design in Machinery “Marcel Dekker Inc, New York, 2003

REFERENCES:

1. M.M.Khonsari & E.R.Booser, “Applied Tribology”, John Willey &Sons, New York, 2001
2. E.P.Bowden and D.Tabor. "Friction and Lubrication ", Heinemann Educational Books Ltd., 1974.
3. A.Cameron, “Basic Lubrication theory ", Longman, U.K.., 1981.
4. M.J.Neale (Editor), “Tribology Handbook ", Newnes. Butter worth, Heinemann, U.K.,

SUBJECT	L	T	P	C
COMBUSTION ENGINEERING	3	0	0	3

Objectives:

1. *To know about the combustion process.*
2. *To explain about the thermo chemistry.*
3. *To explain about the kinetics of combustion.*
4. *To explain about various flames.*
5. *To know the combustion process in an engine.*

UNIT I COMBUSTION OF FUELS 9

Combustion equations- Theoretical air- excess air- air fuel ratio- equivalence ratio- exhaust gas composition- Air- fuel ratio from exhaust gas composition- heating value of fuels.

UNIT II THERMODYNAMICS OF COMBUSTION 9

Thermo-chemistry- First law analysis of reacting systems- Adiabatic combustion temperature- Second law analysis of reacting systems- criterion for chemical equilibrium- Equilibrium constant for gaseous mixtures- Evaluation of equilibrium composition- chemical availability.

UNIT III KINETICS OF COMBUSTION 9

Rates of reaction- Reaction order and molecularity complex reactions- chain reactions- Arrhenius rate equation- Collection theory- activated complex theory- Explosive and general oxidative characteristics of fueled.

UNIT IV FLAMES 9

Laminar and Turbulent flames- Premixed and Diffusion flames- Burning velocity and its determination- Factors affecting burning velocity- Quenching- Flammability and Ignition- Flame stabilization in open burners.

UNIT V ENGINE COMBUSTION 9

Combustion in SI and CI engines- stages of combustion in SI and CI engines- Normal combustion and abnormal combustion- Emissions from premixed combustion- Emission from Nonpremixed combustion- Control of emissions

TOTAL HOURS : 45

TEXT BOOK:

1. Stephen R.Turns-"An Introduction to Combustion"-McGraw Hill, 1996.

REFERENCES:

1. Irwin Glassman- “Combustion "- Third Edition- Academic Press, 1996.
2. S.P. Sharma and Chandra Mohan- “Fuels and Combustion "- Tata McGraw Hill Book Co. - 1984.
3. Samir Sarkar- “Fuels and Combustion "- Orient Longman- 1984.
4. K.K.Kuo- “Principles of Combustion "- John Wiley & Sons- 1984.
5. J.B. Heywood- “Internal Combustion Engine Fundamentals "- Mcc Graw Hill Book Co. - 1988.

SUBJECT	L	T	P	C
EMERGING MATERIALS	3	0	0	3

Objective:

1. *To understand the classification of Engineering Materials and their relevant applications.*
2. *To understand the powder metallurgy concepts, process techniques, applications.*
3. *To understand the basics in composites, fabrication methods, types and applications.*
4. *To understand the various forms of Smart Materials, applications.*
5. *To understand the various types of Nano-material's, production & applications.*

UNIT 1: ENGINEERING MATERIALS CLASSIFICATION, PROPERTIES & APPLICATIONS 9

Classification of engineering materials- Metallic materials-ferrous materials-steel & cast iron and non ferrous materials –aluminium and copper. Non-Metallic materials – glasses , ceramics ,Polymer and plastics – their characteristics and unique properties- Material for structural applications - Light weight structural materials for automobiles and aero plane applications – Structural materials for high temperature applications

UNIT 2: POWDER METALLURGY 9

Powder Metallurgy – Near net shaping process methods and principles - chemical methods – electro-chemical methods - atomization – mechanical alloying – rapid solidification – processing – Nano size powders. Powder physical and chemical characterization – process characteristics - Applications – Tools – Contact materials – Structural parts and others.

UNIT 3: COMPOSITES 9

Composites – Types of composites - Naturally occurring, synthetic & engineered composites - MMC – CMC – PMC - Fibre and whisker reinforced composites (continuous and discontinuous) - particulate composites layered or sheet composites, composite coating or thin fibre, inter metallic composites - properties and characteristics of composites – commercially important components and their applications

UNIT 4: SMART MATERIALS 9

Introduction to intelligent/smart materials, shape memory alloys-types, NiTiNol-origin, properties, martensitic transformation, Memorization process- applications-medical, satellite etc.

UNIT 5: NANO MATERIALS 9

Nanomaterials-Definition, Classification of Nanostructured materials, causes of interest in nanomaterials, some present and future applications of nanomaterials. Processes for producing ultrafine powders-mechanical grinding, wet chemical synthesis of nanomaterials. Gas phase synthesis of Nano materials, gas condensation processes, chemical vapour condensation, laser ablation. Carbon nanotubes, Nano composites.

TEXTBOOKS:

1. Budinski, Kenneth G, Budinski, Michael K, Engineering Materials: Properties and Selection, 9th Edition, PHI.
2. M.V.Gandhi., Thomson - Smart Materials and Structures- Chapman and Hall
3. A.K.Bandhopadyay-Nanomaterials-New Age

REFERENCES:

1. Srinivasan.K, Composite Materials, Narosa Publishing House, 2009.
2. Ramesh, Nanomaterials: Mechanics and Mechanisms, Springer Verlag, EPZ, Paperback edition.
3. Angelo P.C., Subramanian R., Powder Metallurgy, Science, Technology and Applications, Prentice Hall of India, 2012.

SUBJECT	L	T	P	C

NANO TECHNOLOGY	3	0	0	3

Objectives:

1. *To understand the basic fundamentals of Nanotechnology and applications.*
2. *To understand the basic fundamentals of Nanoparticles and applications.*
3. *To understand the various properties of nanomaterials.*
4. *To understand the basic fundamentals of Nanopowders.*
5. *To understand* the recent developments in Nanotechnology and latest applications.

UNIT I INTRODUCTION AND DEFINITION OF NANOTECHNOLOGY 9

Introduction, Definition, Length scales, Importance of Nanoscale and Technology, History of Nanotechnology, Future of Nanotechnology: Nanotechnology Revolution, Silicon based Technology, Benefits and challenges in Molecular manufacturing, The Molecular assembler concept, Controversies and confusions, Understanding advanced capabilities, Visions and Objective of Nanotechnology, Nanotechnology in Different Fields: Automobile, Electronics, Nano biotechnology, Materials, Medicine, Dental care, Nano computers, Power storage, Nanotechnology products.

UNIT-II NANO PARTICLES 9

Introduction, Types of Nanoparticles, Pure Metal, Gold, Silicon, Silver, Cobalt, Metal Oxides, Silica, Zinc oxide, Iron oxide, Alumina, Titania, Techniques to Synthesize Nanoparticles, Characterization of Nanoparticles, Applications, Toxic effects of Nanomaterials, Significance of Nanoparticles.

UNIT-III PROPERTIES 9

Mechanical properties: Strength of Nano crystalline SiC, Preparation for strength measurements, Mechanical properties, Magnetic properties. Electrical properties: Switching glasses with nanoparticles, Electronic conduction with nanoparticles. Optical properties: Optical properties, special properties and the coloured glasses

UNIT-IV NANO-POWDERS 9

Process of synthesis of Nano powders, Electro deposition, Important Nanomaterials

UNIT -V LATEST DEVELOPMENTS IN NANOTECHNOLOGY & APPLICATIONS 9

Introduction, Current situation, Future Assumptions, Latest Developments, Nano copters, Nanotubes, Biosensors, Nano structure fluid, Computers, Plastic electronics, Light emitting diodes, Solar cells, Nanotechnology in Mechanical Industries, Nanotechnology in Health and Life Sciences, Nanotechnology in Smart Materials, Nanotechnology in Defense, Nanotechnology in Optics, Optical industry, Metrology, Nanotechnology in Environment.

TEXT BOOKS:

1. Nano Materials- A.K.Bandyopadhyay, New Age Publishers
2. Nano Essentials- T.Pradeep, TMH
3. Springer Handbook of Nanotechnology - Bharat Bhusan

SUBJECT	L	T	P	C
AUTOMOTIVE INFOTRONICS	3	0	0	3

Objectives:

1. *To impart about automotive components.*
2. *To know various ignition systems and emission.*
3. *To know how to use various instruments.*
4. *To know about the use of electronics in brakes and clutches.*
5. *To know about the engine management system.*

UNIT– I: INTRODUCTION TO AUTOMOTIVE SYSTEMS 9

Introduction to Electronic – "Intensive automobile"
Use of electronic in vehicles today – communications networks and protocols – software applications – control of engine and transmission – Electronic controls in "Electric – Drive Vehicles" – Vehicle starting and charging systems navigation and communications partially and fully automated vehicle.

UNIT – II: IGNITION SYSTEMS AND EMISSION 9

Ignition systems: Ignition fundamental, Electronic ignition systems, Programmed ignition, Distribution less ignition, direct ignition, Spark plugs.
Electronic Fuel Control: fuelling and exhaust. Electronic Petrol fuel injection and Diesel fuel injection.

UNIT – III: INSTRUMENTATION SYSTEMS 9
Instrumentation Systems: Introduction to instrumentation systems-application of various sensors-Driver instrumentation systems – Dash board instrumentation - vehicle condition monitoring-different types of visual Display.

UNIT – IV: ELECTRONIC BRAKING CLUTCHES AND STEERING 9
Traction and stability control – Adoptive cruise control - Electronic control of Automatic Transmission: Introduction and description Control of gear shift and torque converter lockup-Break power assistance and lockup control – Breaking and stability control in Electric vehicle – suspension control – power steering assist.

UNIT V. VEHICLE MANAGEMENT SYSYEM 9
Combined ignition and fuel management systems-Exhaust emission control - Artificial intelligence and Engine management - Lighting and Security Systems: Vehicles lighting Circuits, - Central locking and electric windows- security systems - Alarm occupant protection system – self diagnostics – event data recorders – next generation systems: - Steering – by wire and break – by – wire – vehicle to vehicle and vehicle to infrastructure communications – (V_2V) & (V_2I).

TOTAL HOURS: 45

TEXT BOOKS:

1. Human factors in the design of automotive electronics systems, Lane departure warning and keeping parallel packing assistance.
2. DON KNOWLES, Automotive Electronic and Computer controlled Ignition Systems, Don Knowles, Prentice Hall, Englewood Cliffs, and New Jersey 1988.
3. WILLIAM, T.M., Automotive Mechanics, McGraw Hill Book Co.,3.WILLIAM, T.M., Automotive Electronic Systems, Heinemann Ltd., London, 1978.
4. Ronald K Jorgen, Automotive Electronics Handbook, McGraw Hill, Inc, 1999.

REFERENCES:

1. The Safety promise and challenge of automotive electronics national research council of the national academics TRB Washington DC 2012.

2. TOM DENTON, Automobile Electrical and Electronic Systems, Edward Arnold PB. 1995.

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

Objectives:

1. *To understand the basics of governing equations and boundary conditions*
2. *To gain knowledge about finite difference method*
3. *To enable student to learn about FVM – Diffusion.*
4. *To inherit knowledge about FVM-Convection diffusion.*
5. *To elaborate about FVM flow field calculation*

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9

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

UNIT II FINITE DIFFERENCE METHOD 9

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – solution methods for finite difference equations – Elliptic equations – Iterative solution Methods – Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations.

UNIT III FINITE VOLUME METHOD (FVM) FOR DIFFUSION 9

Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank – Nicolson and fully implicit schemes.

UNIT IV FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9

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

UNIT V CALCULATION FLOW FIELD BY FVM 9

Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, simple algorithm and its variants. Turbulence models, mixing length model, two equation (k-Є) models – High and low Reynolds number models

TOTAL :45

TEXT BOOKS:

1. T.J. Chung, Computational Fluid Dynamics, Cambridge University, Press, 2002.
2. Versteeg, H.K., and Malalasekera, W., An Introduction to Computational Fluid Dynamics: The finite volume Method, Longman, 1998.
3. Ghoshdastidar , P.S., Computer Simulation of flow and heat transfer, Tata McGraw

REFERENCES:

1. Patankar, S.V. Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation, 2004.
2. Muralidhar, K., and Sundararajan, T., computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi, 1995.
3. Ghoshdastidar P.S., Heat Transfer, Oxford University Press, 2005.
4. Prodip Niyogi, Chakrabarty .S.K., Laha .M.K. Introduction to Computational Fluid Dynamics, Pearson Education, 2005.
5. Introduction to Computational Fluid Dynamics Anil W. Date Cambridge University Press, 2005.

SUBJECT	L	T	P	C
TURBOMACHINERY	3	0	0	3

Objectives:

1. *To learn the principles of fluid machinery.*
2. *To understand various fans and blowers.*
3. *To understand the concept of compressors.*
4. *To learn the concept of axial flow compressors.*
5. *To understand the concept of various turbines.*

UNIT I PRINCIPLES 9

Energy transfer between fluid and rotor-classification of fluid machinery,-dimensionless Parameters-specific speed-applications-stage velocity triangles-work and efficiency.

UNIT II CENTRIFUGAL FANS AND BLOWERS 9

Types- stage and design parameters-flow analysis in impeller blades-volute and Diffusers, losses, characteristic curves and selection, fan drives and fan noise.

UNIT III CENTRIFUGAL COMPRESSOR 9

Construction details, impeller flow losses, slip factor, diffuser analysis, losses and Performance curves.

UNIT IV AXIAL FLOW COMPRESSOR 9

Stage velocity diagrams, enthalpy-entropy diagrams, stage losses and efficiency, work Done simple stage design problems and performance characteristics.

UNIT V AXIAL AND RADIAL FLOW TURBINES 9

Stage velocity diagrams, reaction stages, losses and coefficients, blade design Principles, testing and performance characteristics.

TOTAL HOURS :45

TEXT BOOK:

1. Yahya, S.H., Turbines, Compressors and Fans, Tata McGraw-Hill Publishing Company, 1996.

REFERENCES:

1. Bruneck, Fans, Pergamom Press, 1973.
2. Earl Logan, Jr., Hand book of Turbo machinery, Marcel Dekker Inc., 1992.
3. Dixon, S.I., Fluid Mechanics and Thermodynamics of Turbo machinery, Pergamon Press, 1990.
4. Shepherd, D.G., Principles of Turbo machinery, Macmillan, 1969.
5. Stepanpff, A.J., Blowers and Pumps, John Wiley and Sons Inc. 1965.
6. Ganesan, V., Gas Turbines, Tata McGraw Hill Pub. Co., 1999.
7. Gopalakrishnan .G and Prithvi Raj .D, A Treatise on Turbomachines, Scifech Publications (India) Pvt. Ltd., 2002.

SUBJECT	L	T	P	C
ENTREPRENEURIAL SKILLS DEVELOPMENT FOR ENGINEERS	**3**	**0**	**0**	**3**

Objectives:

1. *To understand the importance of entrepreneurship for engineering students.*
2. *To inculcate entrepreneurship skills for engineering students.*
3. *To create awareness of business and train in preparing the project report and crate awareness for engineering students*
4. *To understand the importance of finance and its transactions.*
5. *To develop the skills of consequences of business sickness and take corrective measures.*

UNIT I ENTREPRENEURSHIP 9

Entrepreneur –Definition-Evolution and importance of entrepreneurship-Views and Theories of Entrepreneurship-Traits of Entrepreneurs- Types of Entrepreneurs – Risks and Rewards-Entrepreneur - Technocrat –Manager -Comparison–Role of Entrepreneurship in Economic Development- Factors affecting Entrepreneurial Growth-Engineers as Entrepreneurs-Ten commandments for the beginning entrepreneur.

UNIT 2 MOTIVATION 9

Motivation-Definition and objectives-Types of motivation-Theories of Motivation- Achievement Motivation Training- Self Rating- Business games- Thematic Apperception Test - Stress Management. Entrepreneurship Development Programmes - Need- objectives.

UNIT 3 BUSINESS AND ENTERPRISE MANAGEMENT 9

Business-definition- Classification –Small Enterprises- Characteristics- ownership structure-Various types of ownership-Project Formulation – Steps involved in setting up a Business - Market survey and Research-Techno economic Feasibility Report - Preliminary Project Report-Importance of Project Appraisal-Sources of information-Classification of needs and Agencies – Intellectual Property Rights.

UNIT 4 FINANCIAL MANAGEMENT 9

Need and objectives of financial management for engineers-Sources of Finance- Term Loans- Capital structure- Financial Institutions- Management of working capital- Costing - Break Even Analysis-Managerial uses of Breakeven analysis-Network analysis Techniques –Problems on PERT &CPM – Taxation

UNIT 5 BUSINESS SICKNESS AND GROWTH STRATEGIES 9

Sickness in small Business –Definition of sick unit- Symptoms of Sickness- Magnitude- Causes and Consequences-Preventive and Corrective measures - Institutional Support to Entrepreneurs- Government Policy for small Enterprises - Growth strategies in small Industry - Expansion- Diversification- Joint venture- Merger- sub-contracting.

TOTAL HOURS :45

TEXT BOOKS:

1. S.S. Khanka- Entrepreneurial Development- Chand & Co. Ltd- Ram Nagar - New Delhi- 2005.
2. BhramarbarBadhai-"Entrepreneurship for Engineers"-Dhanpat Rai&co (P) ltd, Delhi-2001.

REFERENCES:

1. EDII - "A manual for Entrepreneurs"- Entrepreneurship Development Institute of India, Ahmedabad- Tata McGrawHill-2006...
2. MSME-'A guide book for new entrepreneurs'-2nd edition-2010.
3. Lawrence R.Jauch, Rajiv Gupta,William F.Glueck-"Business Policy & Strategic Management"-7th edition-Frank Bros&co.(publishers) ltd,.2007
4. Robert DHisrich, Michael P Peters &Dean A Shepherd-"Entrepreneurship"-TataMcGrawHill, 2008.
5. Mary K Coulter, "Entrepreneurship in Action", Prentice Hall-2006.

SUBJECT	L	T	P	C
MARKETING TECHNIQUES FOR ENGINEERS	3	0	0	3

Objectives:

1. *To learn marketing skills for engineering students.*
2. *To understand the behaviourial pattern of customers*
3. *To learn marketing research and develop skills of sales forecasting.*
4. *To learn the skills of developing a market plan and formulation of strategies.*
5. *To understand various promotion mix details.*

UNIT I MARKETING ENGINEERING APPROACH 9

Definition and introduction to Marketing Process- The emerging marketing decision environment-Trends that favour marketing engineering-Examples of Marketing success- Tools for marketing engineering-Business values of marketing engineering-B2B marketing-Dynamics- Selling Vs. Marketing- Marketing segmentation and targeting-Positioning approach.

UNIT II BUYING BEHAVIOUR & MARKET SEGMENTATION 9

.

Customer value assessment and valuing customers- Understanding customer needs and wants-Customer Buying behavior- Motives- types- Buying decisions- segmentation factors- Demographic- Psychographic & Geographic Segmentation- Buying Patterns-Social and Ethical considerations .

UNIT III MARKETING RESEARCH& SALES FORECASTING 9

Objectives and Process of Marketing Research-Forecasting Methods-Judgment Methods-Time series-Product Life cycle-Forecasting methods for new products –Models.

UNIT IV MARKETING PLANNING & STRATEGY FORMULATION 9

Components of a marketing plan- strategy formulation –New Product and Service Design-New product development process-Models for idea generation and evaluation-implementation- Portfolio analysis-Marketing Mix- Pricing Decisions and Pricing methods- Pricing Management. Introduction- Uses.

UNIT V POSITIONING AND PROMOTION MIX 9

Characteristics- Impact- goals- types- Sales promotion-Brand Positioning- Brand Management-Distribution channels. Characteristics- Wholesaling- Retailing- channel design- logistics- Modern Trends in retailing.

TOTAL HOURS :45

TEXT BOOKS:

1. Gary. L. Lillian, Arvind Rangaswamy, Arnaud DeBrriyn-"Principles of Marketing Engineering"-2nd edition-Decision Pro.inc. PA16801.
2. Patric Forsyth-"Demystifying Marketing-A Guide to the fundamentals for Engineers",-The institution of engineering and technology, London, UK-2007.

REFERENCES:

1. Brian Richardson-"Marketing for Architects and Engineers-A New Approach"-Chapman and Hall India-1996.
2. Ramaswamy.V.S. and S.Namakumari- " Marketing Environment: Planning- Implementation and Control the Indian Context "- 1990.
3. Jean Plerre Jannet Hubert D Hennessey Global Marketing Strategies.
4. Govindarajan.M. 'Modern Marketing Management'- Narosa Publishing House- New Delhi- 1999.
5. Philip Kotler- " Marketing Management: Analysis- Planning- Implementation and Control "- 1998.

SUBJECT	L	T	P	C
INDUSTRIAL ENGINEERING	**3**	**0**	**0**	**3**

Objectives:

1. *To understand the importance of work study methods and its importance in various fields.*
2. *To develop the skills of selection of a plant and also material handling equipment required.*
3. *To learn PPC and its functions.*
4. *To learn the skills of purchasing materials and their management.*
5. *To learn the awareness on various labour acts and management principles.*

UNIT-I WORK STUDY 9

Evolution and importance of industrial engineering –Production-Classification-Productivity- Factors influencing productivity, Work study - Definition-Procedure and benefits of work study –Method study-Charting techniques-Time study-Procedure and techniques of work measurement –Stop watch time study-Motion study –SIMO chart.

UNIT-II PLANT LAYOUT AND MATERIALS HANDLING 9

Plant location-Factors influencing the location-selection of site-Plant layout- Types of layout-Plant layout procedure- Material handling –Objective and Principles of Material Handling-Types of Material Handling equipment–Relationship to plant layout.

UNIT-III: PRODUCTION PLANNING AND CONTROL 9

Introduction-Advantages of PPC-Functions of PPC-Demand Forecasting- Types of Forecasting-Routing-Objectives and procedure of routing-Scheduling-purpose and preparation of schedules-Scheduling techniques like CPM and PERT-Functions and types of dispatching-

UNIT-IV: MATERIAL MANAGEMENT 9

Procurement of materials-codification of materials-Inventory control-Objectives of inventory control-EOQ-Inventory models-ABC analysis-Material requirements planning (MRP)-Enterprise resource planning (ERP)-supply chain Management (SCM)-Inspection and quality control-SQC-control charts-sampling procedures-Bench marking.

UNIT-V: INDUSTRIAL LEGISLATION AND MANAGEMENT CONCEPTS 9

Importance and necessity of Labour acts-principles of labour legislation-various acts-Industrial Ownership and various types-Functions of management-Manpower Planning-Recruitment and Selection-Break Even Analysis-Managerial applications of breakeven point-Decision making -Techniques of decision making.

TOTAL HOURS :45

TEXT BOOKS:

1. M.L.Khan-"Industrial Engineering"-New Age international (p) ltd. New Delhi,-2007.
2. O.P. Khanna- "Industrial Engineering. & Management", Dhanpat Rai Publications(P)Ltd

REFERENCES:

1. H.Koontz& C.O. Donnel–"Principles of management. An analysis of managerial functions"-Tata McGrawHill Co.1972.
2. GavrielSalvendy-"A Hand book of Industrial Engineering-Technology operations and Management"-3rd edition, Institute of Industrial engineers, USA.
3. Vijay Seth-"Industrial Engineering-methods and practices"-Pernam International publishing,Mumbai-2005
4. Buffa, E.S ,Sarin R.K-"Modern production/ operations Management-8thedition. John Wiley&sons, Inc. UK-1987.
5. I.L.O –"Introduction to Work Study", 3rd Revised Edn. 1986.

SUBJECT	L	T	P	C
INTRODUCTION TO AIRCRAFT INDUSTRY AND AIRCRAFT SYSTEMS	**3**	**0**	**0**	**3**

OBJECTIVE

At the end of this elective, student shall be able to:

1. Get an exposure to the Aerospace Industry.
2. Understand the Basics of Aircraft Systems and Aircraft Structures.

Chapter-1 –Aircraft industry overview, Duration- 3 hours

Evolution and History of Flight, Types Of Aerospace Industry, Key Players in Aerospace Industry, Aerospace Manufacturing, Industry Supply Chain, Prime contractors, Tier 1 Suppliers, Key challenges in Industry Supply Chain, OEM Supply Chain Strategies, Mergers and Acquisitions, Aerospace Industry Trends, Advances in Engineering/CAD/CAM/CAE Tools and Materials technology, Global and Indian Aircraft Scenario

Chapter-2 –Introduction to Aircrafts, Duration- 5 hrs

Basic components of an Aircraft, Structural members, Aircraft Axis System, Aircraft Motions, Control surfaces and High lift Devices. Types of Aircrafts - Lighter than Air/Heavier than Air Aircrafts Conventional Design Configurations based on Power Plant Location, Wing vertical location, intake location, Tail Unit Arrangements, Landing Gear Arrangements. Unconventional Configurations-Biplane, Variable Sweep, Canard Layout, Twin Boom Layouts, Span loaders, Blended Body Wing Layout, STOL and STOVL Aircraft, Stealth Aircraft. Advantages and disadvantages of these Configurations.

Chapter-3-Introduction to Aircraft Systems, Duration- 16 hrs

Types of Aircraft Systems.Mechanical Systems.Electrical and Electronic Systems.Auxiliary systems. Mechanical Systems: Environmental control systems (ECS), Pneumatic systems, Hydraulic systems, Fuel systems, Landing gear systems, Engine Control Systems, Ice and rain protection systems, Cabin Pressurization and Air Conditioning Systems, Steering and Brakes Systems Auxiliary Power Unit, Electrical systems: Avionics, Flight controls, Autopilot and Flight Management Systems, Navigation Systems, Communication, Information systems, Radar System

Chapter-4-Basic Principles of Flight, Duration- 10 hrs

Significance of speed of Sound, Air speed and Ground Speed, Properties of Atmosphere, Bernoulli's Equation, Forces on the airplane, Airflow over wing section, Pressure Distribution over a wing section, Generation of Lift, Drag, Pitching moments, Types of Drag, Lift curve, Drag Curve, Lift/Drag Ratio Curve, Factors affecting Lift and Drag, Center of Pressure and its effects. Aerofoil Nomenclature, Types of Aerofoil, Wing Section- Aerodynamic Center, Aspect Ratio, Effects of lift, Drag, speed, Air density on drag,

Chapter-5-Basics of Flight Mechanics , Duration 6 hrs

Mach Waves, Mach Angles, Sonic and Supersonic Flight and its effects

Stability and Control

Degree of Stability- Lateral, Longitudinal and Directional Stability and controls of Aircraft. Effects of Flaps and Slats on Lift Coefficients, Control Tabs, Stalling, Landing, Gliding Turning, Speed of Sound, Mach Numbers, Shock Waves

Aircraft Performance and Maneuvers

Power Curves, Maximum and minimum speeds of horizontal flight, Effects of Changes of Engine Power, Effects of Altitude on Power Curves, Forces acting on aAeroplane during a Turn, Loads during a Turn, Correct and incorrect Angles of Bank, Aerobatics, Inverted Maneuvers, Maneuverability

Reference Books:

1. Flight without Formulae by A.C Kermode, Pearson Education,10th Edition
2. Mechanics of Flight by A.C Kermode, Pearson Education,5th Edition
3. Fundamentals Of Flight, Shevell, Pearson Education, 2nd Edition
4. Introduction to Flight by Dave Anderson
5. Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration by Ian moir, Allan Seabridge
6. An Introduction to Aircraft Certification; A Guide to Understanding Jaa, Easa and FAA by Filippo De Florio, Butterworth-Heinemann

SUBJECT	L	T	P	C
DESIGN OF AIRCRAFT STRUCTURES	**3**	**0**	**0**	**3**

At the end of this elective, student shall be able to:

1. Industry Practices on Design of Aircraft Structures.
2. Understand the applicability of Design aspects in Aircraft Design.
3. Relate the theoretical knowledge with the design of Aircraft Structures.

Chapter-1-Overview of the Aircraft Design Process, Duration- 2hrs

Introduction, Phases of Aircraft Design, Aircraft Conceptual Design Process, Conceptual Stage, Preliminary Design, Detailed Design, Design Methodologies

Chapter 2-Fundamentals of Structural Analysis, Duration 2 hrs

Review of Hooke's Law, Principal stresses, Equilibrium and Compatibility, Determinate Structures, St Venant's Principle, Conservation of Energy, Stress Transformation, Stress Strain Relations

Chapter 3-Introduction to Aircraft Structures, Duration 3 hrs

Types of Structural members of Fuselage and wing section Ribs, Spars, Frames, Stringers, Longeron, Splices, Sectional Properties of structural members and their loads, Types of structural joints, Type of Loads on structural joints

Chapter-4 Aircraft Loads, Duration- 4 hrs

Aerodynamic Loads, Inertial Loads, Loads due to engine, Actuator Loads, Maneuver Loads, VN diagrams, Gust Loads, Ground Loads, Ground conditions, Miscellaneous Loads

Chapter-5-Aircraft Materials and Manufacturing processes Duration- 4 hrs

Material selection criteria, Aluminum Alloys, Titanium Alloys, Steel Alloys, Magnesium Alloys, copper Alloys, Nimonic Alloys, Non Metallic Materials, Composite Materials, Use of Advanced materials Smart materials, Manufacturing of A/C structural members, Overview of Types of manufacturing processes for Composites, Sheet metal Fabrication ,Machining, Welding, Super-plastic Forming And Diffusion Bonding

Chapter-6-Structural Analysis of Aircraft Structures Duration-20

Theory of Plates- Analysis of plates for bending, stresses due to bending, Plate deflection under different end conditions, Strain energy due to bending of circular, rectangular plates, Plate buckling, Compression buckling, shear buckling, Buckling due to in plane bending moments, Analysis of stiffened panels in buckling, Rectangular plate buckling, Analysis of Stiffened panels in Post buckling, Post buckling under shear. **Sample Exercises**.

Theory of Shells-Analysis of Shell Panels for Buckling, Compression loading, Shear Loading / Shell Shear Factor, Circumferential Buckling Stress, **sample exercises**

Theory of Beams-Symmetric Beams in Pure Bending, Deflection of beams, Unsymmetrical Beams in Bending, Plastic Bending of beams,Shear Stresses due to Bending in Thin Walled Beams, Bending of Open Section Beams, Bending of Closed Section Beams, Shear Stresses due to Torsion in Thin Walled Beams. **Sample Exercises**.

Theory of Torsion - Shafts of Non-Circular Sections, Torsion in Closed Section Beams, Torsion in Open Section Beams, Multi Cell Sections, **Sample Exercises**.

Chapter-7 Airworthiness and Aircraft Certification, Duration- 4 hrs
Definition, Airworthiness Regulations, Regulatory Bodies, Type certification, General Requirements, Requirements Related to Aircraft Design Covers, Performance and Flight Requirements, Airframe Requirements, Landing Requirements, Fatigue and Failsafe requirements, Emergency Provisions, Emergency Landing requirements

Chapter-8 Aircraft Structural Repair, Duration- 3 hrs
Types of Structural damage, Nonconformance, Rework, Repair, Allowable damage Limit, Repairable Damage Limit, Overview of ADL Analysis, Types of Repair, Repair Considerations and best practices

Reference Books:

1. Aircraft Design-A Conceptual Approach by Daniel P.Raymer, AIAA education series,6th Edition
2. Airframe Structural Design by Michael Niu, Conmilit Press, 1988,2nd Edition
3. Airframe Stress Analysis and Sizing by Michael Niu, Conmilit Press, 1999,3rd Edition
4. The Elements of Aircraft Preliminary Design – Roger D. Schaufele, Aries Publications, 2000
5. Aircraft Structural Maintenance by Dale Hurst, Avotek publishers, 2nd Edition, 2006
6. Aircraft Maintenance & Repair by Frank Delp, Michael J. Kroes& William A. Watkins, Glencoe &McGraw-Hill,6th Edition, 1993

SUBJECT	L	T	P	C
FUNDAMENTALS OF PIPING ENGINEERING	**3**	**0**	**0**	**3**

Objectives:

1. *To understand the basics of pipes and their material's selection.*
2. *To understand the various pipeline accessories and fittings.*
3. *To know about various valves and their selection.*
4. *To know about various special piping elements.*
5. *To understand about various flows of fluids and frictional losses through pipes due to the flow.*

UNIT 1: FUNDAMENTALS OF PIPING **9**

Introduction and Objective of Piping – Definition and Application of Pipes –Pipe networks-Selection of Materials-Codes and Standards.

UNIT 2: ACCESORIES AND FITTINGS **9**

Selection – Standards - Dimensions – Types of Fittings - Pipe Bends –Connection – Reducers – Couplings-Pipe Flanges–Types-Facings-Gaskets.

UNIT 3: VALVES **9**

Definition – Types – Functions – Operators- Valves Layout Considerations – Valve Data Sheet - Valve Selection

UNIT 4: PIPING SPECIAL ELEMENTS **9**

Strainers – Expansion joints/Bellows – Rupture Disc – Spectacle Blind – Blanks – Spacers – Spray Nozzles – Steam trap – Flame Arrestor – Vortex Breaker

UNIT 5: **FLOW THROUGH PIPES** **9**

Types of Flow- visualization of Flow-losses in Pipes-Darcy Weisbachs Equation – Pipe Roughness – Friction – Moody's Diagram – Minor Losses - Flow through Pipe in Parallel and Series

TOTAL HOURS :45

BOOKS:

1. Piping and valves – Frank R. Spellman, Joanne.E.Drinan-CRC pressLLC, Florida-2001.
2. Fundamentals of pipeline engineering – Jacques Vincent-Genod-Editions Technip, Paris-1984.

REFERRENCES:

1. Piping handbook -Mohinder L. Nayyar-McGrawHil-2000.
2. Valves, Piping& Pipelines Hand book-Elsevier science ltd. – 3rd edition, 2001.
3. Fluid mechanics –Frank kreith-CRC Press-2000.
4. A Text Book of Fluid Mechanics – Dr. R.K .Bansal-Laxmi Publications (p) ltd.,-1st edition-2008.
5. Piping and pipeline calculations manual - Construction, Design Fabrication and Examination – Philip Ellenberger-BH (Elsevier Inc.)-2010.

SUBJECT	L	T	P	C
ADVANCED CERAMIC TECHNOLOGY	3	0	0	3

Objectives:

1. *To make the students to understand the importance of ceramics in various advanced fields.*
2. *The application of ceramic in bio and medical field will help the students to gain knowledge in those fields.*
3. *To familiarize the ceramics applications in electronic industries.*
4. *To understand the application of ceramics in special and precious items*
5. *To enable students to understand about the Nano technology in ceramic field.*

UNIT 1: CERAMICS USED IN ADVANCED APPLICATIONS: 9

Ceramics used in Nuclear energy - Magneto- hydrodynamic generation - Gas turbine blades - Abrasives – Aerospace - Diesel engines – Heat Exchangers - Cutting Tools Applications.

UNIT 2: CERAMICS FOR MEDICAL AND SCIENTIFIC PRODUCTS: 9

Tissue attachment mechanism- Bio- active materials-Nearly inert crystalline ceramics- Porous ceramics- bioactive glass and glass ceramics- calcium phosphate ceramics- carbonbased implants materials- ceramics for dental applications.

UNIT 3: CERAMICS FOR OPTICAL APPLICATIONS: 9

CRT and TV picture tubes - Telecommunication and related uses - Information display - Laser – Fibre optics - Electromagnetic windows.

UNIT 4: MAGNETIC CERAMICS: 9

Spinel Ferrites - Hexagonal Ferrites - Garnet - Processing -Single crystal ferrite -Applications.

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UNIT 5: CERAMIC SUPERCONDUCTORS AND NANOCERAMICS: 9

High Tc Superconductors - Structure of Y-Ba-Cu oxide system - Powder synthesis - Theory of Superconductivity - Nano Ceramics - Applications.

Total Hours :45

BOOKS:-

1. FREDERICK HARWOOD NORTAN-"ELEMENTS OF CERAMICS"-Addison-Wesley Longman, incorporated, 1974.
2. CB Carter, MGNorton-'Ceramic Materials-Science and Engineering"-Springer.

REFERENCES:

1. Philip Raw son-"Ceramics"-Pennsylvania press-1984.
2. The ceramic society of Japan-"Advanced ceramic technologies & Products"-Springer.
3. LL Hench, JK West-"Principles of electronic ceramics-1990.
4. Laurent sedal,ChristianRey-"Bio ceramics"-volume 10,proceedings of ceramics in medicine,1997
5. Philippe Boach,Jean-claude niepce-"Ceramic Materials-Processes, Properties and Applications"-ISTE ltd. London-2007.

SUBJECT	L	T	P	C
VIBRATIONS AND NOISE CONTROL	3	0	0	3

Objectives:

1. *To understand the various types of vibration and analyses.*
2. *To understand the basics of Noise and the relevant parameters.*
3. *To understand the noise sources relevant to automotives.*
4. *To understand the various vibration control techniques.*
5. *To understand the various noise control techniques.*

UNIT I BASICS OF VIBRATION 9

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

UNIT II BASICS OF NOISE 9

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

UNIT III AUTOMOTIVE NOISE SOURCES 9

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

UNIT IV CONTROL TECHNIQUES 9

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

UNIT V SOURCE OF NOISE AND CONTROL 9

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

Total Hours : 45

TEXT BOOKS :

1. Singiresu S.Rao - “Mechanical Vibrations” - Pearson Education, ISBM –81-297- 0179-0 - 2004.

2. Kewal Pujara “Vibrations and Noise for Engineers”, Dhanpat Rai & Sons, 1992.

REFERENCES:

1. Bernard Challen and Rodica Baranescu - “Diesel Engine Reference Book” - Second Edition - SAE International - ISBN 0-7680-0403-9 – 1999.
2. Julian Happian-Smith - “An Introduction to Modern Vehicle Design”- Butterworth-Heinemann, ISBN 0750-5044-3 - 2004
3. John Fenton - “Handbook of Automotive body Construction and Design Analysis - Professional Engineering Publishing, ISBN 1-86058-073- 1998.

SUBJECT	L	T	P	C

CYBER SECURITY (Common to all Branches)	3	0	0	3

AIM

To study the critical need for ensuring Cyber Security in real time problems

OBJECTIVES

1. To understand the basics of Cyber Security
2. To know the legal, ethical and professional issues in Cyber Security
3. To know the various attacker techniques

UNIT I CYBER SECURITY FUNDAMENTALS

Network and security concepts – basic cryptography – Symmetric encryption – Public key Encryption – DNS – Firewalls – Virtualization – Radio Frequency Identification – Microsoft Windows security Principles.

UNIT II ATTACKER TECHNIQUES AND MOTIVATIONS

Antiforensics – Tunneling techniques – Fraud Techniques - Threat Infrastructure.

UNIT III EXPLOITATION

Techniques to gain a foot hold – Misdirection, Reconnaissance, and disruption methods.

UNIT IV MALICIOUS CODE

Self Replication Malicious code – Evading Detection and Elevating privileges – Stealing Information and Exploitation.

UNIT V DEFENSE AND ANALYSIS TECHNIQUES

Memory Forensics – Honeypots – Malicious code naming – Automated malicious code analysis systems – Intrusion detection systems – Defense special file investigation tools.

TEXT BOOK

1. James Graham, Richard Howard and Ryan Olson, "Cyber Security Essentials", CRC Press, Taylor & Francis Group, 2011.

REFERENCE BOOKS

1. By Dan Shoemaker, Ph.D., William Arthur Conklin, Wm Arthur Conklin, "Cybersecurity: The Essential Body of Knowledge**",** Cengage Learning, 2012.

2. Ali Jahangiri, "Live Hacking: The Ultimate Guide to hacking Techniques & Counter measures for Ethical Hackers & IT Security Experts", 2009.

SUBJECT	L	T	P	C
PETROLEUM PRODUCTION ENGINEERING	**3**	**0**	**0**	**3**

OBJECTIVE :
To provide knowledge of production operations in the oil and gas wells Such as artificial lifts and subsurface equipments.

UNIT I Components of the petroleum systems 9
Well productivity engineering. Production from under saturated oil reservoirs. Production from two-phase reservoirs. Production from gas reservoirs. Pseudo critical properties of natural gases. Gas well deliverability for non–Darcy flow.

UNIT II Well Production 9
The near-well bore condition and damage characterization, the effect of perforation conditions on well performance. Well bore flow performance. Well deliverability. Well head surface gathering systems. Artificial lift systems. Horizontal well production. System analysis.Production Chemistry Basics (Wax, Scale, Corrosion, Emulsions).

UNIT III Surface Equipment and Operations 9
Flow control and well heads. Gathering systems; service and cleaning systems; design and testing of flow lines. Separation and separators; separator components, stage separation; design and construction of separators. Meeting-Oil and gas metering techniques.

UNIT IV Flow Measurement System 9
Liquid level controllers. Emulsion problems; oil emulsions; emulsifying agents and de-emulsifiers, choice and dosage of de-emulsifiers, heat treatment, heat treaters, desalting, oil storage and tank farms. Gauging, sampling and quality control. Underground storage–caverns etc. Water disposal, corrosion. Water injection systems. Subsurface equipment.

UNIT V Completion Techniques 9
Well completion techniques and equipment, drill stem test (DST) flowing well performance, vertical lift performance, optimum size tubing and chokes, production forecast for a pool. Design and analysis of artificial methods of petroleum production. Work over and sand exclusion technique
.
TOTAL: 45 PERIODS

TEXT BOOKS:
1.“Gas Production Engineering” –S.Kumar-Gulf publishing Co.,-1987.
2.T.E.W.Nind”Principles of well Production”-2nd Edition Mc.Graw hill Book- Co. Ltd, Newyork 1981. ISBN 0070465762.
REFERENCE:
1.T.O.allen and A.P.Roberts. “Production operations” –SPE -Vol-I 4-th edition

SUBJECT	L	T	P	C
COAL MINING AND MECHANIZATION	3	0	0	3

UNIT I COAL FACE MECHANISATION **8**

Recent Trends, mechanised bord and pillar mining, case studies.

UNIT II MINING OF THICK SEAMS **8**

Problems, past experiences in India, current methods, mining of thick, contiguous, and steep seams

UNIT III HYDRAULIC MINING **9**

Applicability, operating parameters, equipment, layouts, Indian experience. Computer applications such as remote control and environmental monitoring in hydraulic mining.

UNIT IV LONGWALL MINING **10**

Powered supports, development of powered supports, their types and designs, selection for different conditions, last drivages for longwall panelling, remotely operated powered support and longwall faces, Indian experiments, salvaging in longwall.

UNIT V UNDERGROUND COAL GASSIFICATION **10**

Objective, application, methods of gasification, design of gasification plants, coal bed methane.Environmental monitoring techniques and computer applications in coal gasification techniques.

TEXT BOOKS:

1.Das S.K., Modern Coal Mining Technology, Lovely Prakashan, Dhanbad, 1994
2.Singh, T.N., and Dhar, B.B. Thick Seam Mining, Problems and Issues, Oxford & IBH Publishers, 1992
3.Mathur, S.P., Mining Planning for Coal, M G Consultants, Bilaspur, 1993

REFERENCES:

1. Peng S.S. and Chiang, H.S., Longwall Mining, John Willey and Sons, New York, 1992
2. T.N. Singh, Underground Winning of Coal, Oxford IBH Publishers, 1999
3. R.D. Singh, Principles and Practices of Modern Coal Mining, New Age International, 1997

SUBJECT	L	T	P	C
ENERGY CONSERVATION AND MANAGEMENT	3	0	0	3

UNIT I IMPORTANCE OF ENERGY CONSERVATION AND MANAGEMENT 8

World, national Energy consumption – environmental aspects – Energy prices, policies – Energy auditing: methodology, analysis, energy accounting – Measurements – Thermal and Electrical.

UNIT II ELECTRICAL SYSTEMS 12

AC / DC current systems, Demand control, power factor correction, load management, Motor drives : motor efficiency testing, energy efficient motors, motor speed control – Lighting : lighting levels, efficient options, daylighting, timers, Energy efficient windows – electrical distribution systems – Transformers – Power quality – harmonic distortion.

UNIT III THERMAL SYSTEMS 10

Boiler – efficiency testing, excess air control, Steam distribution & use – steam traps, condensate recovery, flash steam utilization, Thermal Insulation. Heat exchanger networking – concept of pinch, target settling, problem table approach.

UNIT IV ENERGY CONSERVATION 8

Energy conservation in Pumps, Fans (flow control) and blowers, Compressed Air Systems, Refrigeration and air conditioning systems – Waste heat recovery recuperators, heat sheets, heat pipes, heat pumps.

UNIT V ENERGY MANAGEMENT, ECONOMICS 7

Energy resource management – Energy Management information systems – Computerized energy management – Energy economics – discount rate, payback period, internal rate of Return, life cycle costing – Financing energy conservation Projects.

TOTAL: 45 PERIODS

TEXT BOOK:

1.L.C. Witte, P.S. Schmidt, D.R. Brown, Industrial Energy Management and Utilisation, Hemisphere Publ, Washington, 1988.

2.O. Callaghn, P.W. Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.

REFERENCES:

1.IDryden, I.G.C. The Efficient Use of Energy, Butterworths, London, 1982

2.Turner, W.C. Energy Management Hand Book, Wiley, New York, 1982.

3.Murphy, W.R. and Mc KAY, G. Energy Management, Butterworths, London 1987.

SUBJECT	L	T	P	C
NON DESTRUCTIVE TESTING	3	0	0	3

OBJECTIVES:

- To study and understand the various Non Destructive Evaluation and Testing methods, theory and their industrial applications.

UNIT I OVERVIEW OF NDT **7**

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

UNIT II SURFACE NDE METHODS **8**

Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers,advantages and limitations of various methods,
Testing Procedure, Interpretation of results. Magnetic Particle Testing-
Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

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

Thermography -Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation-
infrared radiation and infrared detectors, Instrumentations and methods, applications.Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement,Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT IV ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION(AE) **10**

Ultrasonic Testing-Principle, Transducers, transmission and pulse-
echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound,
Time of Flight Diffraction. Acoustic Emission Technique–Principle, AE parameters, Applications

UNIT V RADIOGRAPHY (RT) **10**

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

TOTAL : 45 PERIODS

TEXT BOOKS:

1.Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.

2.Ravi Prakash, "Non-Destructive Testing Techniques",1st revised edition,
New Age International Publishers,2010

REFERENCES:

1.ASM Metals Handbook,"Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.

2.Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005

3. Charles, J. Hellier," Handbook of Nondestructive evaluation", McGraw Hill, New York 2001.

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

SUBJECT	L	T	P	C
PROCESS PLANNING AND COST ESTIMATION	3	0	0	3

Objective :

1. To study tools and technique of work study.
2. To under stand process planning concepts.
3. To understand cost estimation.
4. To know about depreciation and ladder cost.
5. To study production cost estimation.

1. WORK STUDY AND ERGONOMICS **9**

Method study – Definition – Objectives-Motion economy- Principles – Tools and Techniques-Applications – Work measurements- purpose – use – procedure – tools and techniques- Standard time –Ergonomics – principles – applications.

2. PROCESS PLANNING **9**

Definition – Objective – Objective – approaches to process planning- Process planning activities – Finished part requirements - operating sequences - machine selection – material selection parameters- Set of documents for process planning - Developing manufacturing logic and knowledge- production time calculation – selection of cost optimal processes – Introduction to ERP

3. INTRODUCTION TO COST ESTIMATION **9**

Importance and aims of cost estimation – functions of estimation – costing – importance and aims of costing – difference between costing and estimation – importance of realistic estimates – estimation procedure. Types of estimates – methods of estimates – data requirements and sources- collection of cost- allowances in estimation.

4. ELEMENTS OF COST **9**

Introduction – Material Cost – determination of material cost , Labour cost – Analysis of Overhead Expenses – Factory Expenses – Depreciation – Methods – Administrative Expenses – Marketing Expenses - Ladder of Cost.

5. PRODUCTION COST ESTIMATION **9**

Estimation for forging - estimation for welding and gas cutting – estimation in foundry shop – estimation for machining – estimation for drilling and other metal removal operations - Illustrative Examples.

TOTAL HOURS :45

TEXT BOOKS

1. Sinha.B.P., “Mechanical Estimating and Costing”, Tata McGraw-Hill, Publishing Co., 1995
2.Banga.T.R., Sharma.S.C., Mehanical Estimating and Costing, Khanna Publishers, 2006.

REFERENCES

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