



# KARPAGAM UNIVERSITY

(Established Under Section 3 of UGC Act 1956)

COIMBATORE 641 021. INDIA

**B.E. MECHANICAL ENGINEERING**

## SEMESTER I

**12BECC101**

**COMMUNICATIVE ENGLISH – I**

**2 0 2 3 100**

### INTENDED OUTCOMES:

- To help students develop listening skills for academic and professional purposes.
- To help students acquire the ability to speak effectively in English in real-life situations.
- To inculcate reading habit and to develop effective reading skills.
- To help students improve their active and passive vocabulary.
- To familiarize students with different rhetorical functions of scientific English.
- To enable students write letters effectively in informal and business situations.

### UNIT - I LISTENING

Listening to a variety of passages – listening to conversations, descriptions, lectures, interviews, news reading, -- TV & Radio announcements, speeches on different occasions and dramas / listening to television channels for picking up pronunciation and accent – note taking while listening to lectures.

### UNIT - II READING

Reading for comprehension – reading aloud different kinds of passages like descriptive, narrative, objective, conversational and argumentative – reading with pause, stress and intonation. Reading strategies – skimming and scanning – prediction of content – intensive reading – text analysis.

### UNIT - III WRITING

Writing techniques – effective sentences and their structures – short paragraph writing – formal and informal letter writing – discourse features – writing on different situations.

### UNIT - IV SPEAKING

Spoken structures on different situations – introduction, greeting, leave taking, request, agreement, disagreement, etc – modal auxiliaries in oral communication – role play and conversation practice – public speaking techniques – introduction to phonetics – speaking with correct pronunciation and accent.

### UNIT - V LANGUAGE FOCUS

Basic grammar – parts of speech – grammatical functions of the same word – tenses—voice – concord – degrees of comparisons – prepositions – conditional sentences – active and passive vocabulary – reported speech.

**TEXT BOOKS:**

S. NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Mrs. Jewelcy Jawahar & Mrs. P. Rathna	Technical English-I	VRB Publishers Pvt. Ltd., Chennai.	2009
2	Mrs. Jewelcy Jawahar & Mrs. P. Rathna	English work Book I	VRB Publishers Pvt. Ltd., Chennai.	2009

**REFERENCES:**

S. NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Rizvi Ashraf, M	Effective Technical Communication	Tata McGraw-Hill, New Delhi.	2007
2	Rutherford Andrea, J.	Basic Communication Skills for Technology	Pearson Education, New Delhi.	2006
3	Lakshminarayanan, K.R. & Murugavel, T.	Communication Skills for Engineers	SCITECH Publications, Chennai	2008

**WEBSITES:**

1.	<a href="http://www.usingenglish.com">www.usingenglish.com</a>
2.	<a href="http://www.englishclub.com">www.englishclub.com</a>
3.	<a href="http://www.ispeakyouspeak.blogspot.com">www.ispeakyouspeak.blogspot.com</a>
4.	<a href="http://www.teachertube.com">www.teachertube.com</a>
5.	<a href="http://www.Dictionary.com">www.Dictionary.com</a>

**INTENDED OUTCOMES:**

- To develop analytical skills for solving different engineering problems.
- To understand the concepts of Matrices and 3D analytical geometry.
- To solve problems by applying Differential Calculus and Differential equations.

**UNIT-I MATRICES**

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties – Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic forms – Reduction to canonical form through orthogonal reduction.

**UNIT- II THREE DIMENSIONAL ANALYTICAL GEOMETRY**

Direction ratios of the Line Joining Two points-The plane- Plane through the intersection of two lines- The Straight Line- The Plane and the Straight Line-Shortest Distance between Two skew lines- Equation of Sphere.

**UNIT -III DIFFERENTIAL CALCULUS**

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

**UNIT -IV FUNCTIONS OF SEVERAL VARIABLES**

Partial derivatives – Euler’s theorem for homogenous functions – Total derivatives – Differentiation of implicit functions – Jacobians –Maxima and Minima of functions of two or more Variables - Method of Lagrangian multipliers.

**UNIT -V DIFFERENTIAL EQUATIONS**

Equations of the First order and Higher Degree-Linear Differential equations of second and higher order with constant coefficients-Euler’s Homogeneous Linear Differential equations. Mathematica Software Demonstration.

**TEXT BOOKS:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Veerarajan,T.	Engineering Mathematics for first year	Tata McGraw-Hill Publishing Company Limited, New Delhi.	2007
2	Sundaram, V. Lakhminarayan,K.A. and Balasubramanian,R.	Engineering Mathematics for first year..	Vikas Publishing Home , New Delhi	2006

**REFERENCES:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Ramana. B.V	Higher Engineering Mathematics	Tata McGraw Hill Publishing Company, New Delhi.	2007
2	Grewal. B.S	Higher Engineering Mathematics ,40 <sup>th</sup> Edition	Khanna Publications, Delhi.	2007
3	Narayanan. S, Manicavachagam pillay.T.K and Ramaniah.G	Advanced Mathematics for Engineering Students.Volumes II and II	Viswanathan S.(Printers and Publishers) Pvt. Ltd. Chennai.	2002
4	Bajpai A.C., Mustoe L.R and Walker D.	Advanced Engineering Mathematics. 2 <sup>nd</sup> Edition	John Wiley & Sons, New Delhi.	1989

**WEBSITES:**

1. [www.intmath.com/plane-analytic-geometry/intro.php](http://www.intmath.com/plane-analytic-geometry/intro.php)
2. [www.efunda.com](http://www.efunda.com)
3. [www.mathcentre.ac.uk](http://www.mathcentre.ac.uk)
4. [www.intmath.com/matrices-determinants](http://www.intmath.com/matrices-determinants)
5. [www.wolfran.com](http://www.wolfran.com)

**INTENDED OUTCOMES:**

- To understand the Properties of matter and thermodynamics
- To study about the Laser and fiber optics
- To learn the quantum and crystal physics
- To understand the nuclear Physics

**UNIT I      PROPERTIES OF MATTER AND THERMODYNAMICS**

Three types of modulus of elasticity – basic definitions, relation connecting the moduli (Derivation), poisson ratio- Torsional pendulum- bending of beams- bending moment – basic assumption of moment – uniform and non uniform bending

Concept of entropy- change of entropy in reversible and irreversible processes – refrigeration.

**UNIT II      LASER AND FIBER OPTICS**

Introduction – emission and absorption process- Einstein's coefficients derivation. Types of LASER -CO<sub>2</sub>, Semiconductor LASER Applications of LASER in industry and Medicine.

Total internal reflection – modes of propagation of light in optical fibers – numerical aperture and acceptance angle –derivations, types of optical fibers (Material, refractive index and mode) – fiber optical communication system (Block diagram)

**UNIT III      QUANTUM PHYSICS**

Introduction to quantum theory – Compton effect- dual nature of matter and radiation – de Broglie wavelength, uncertainty principle – physical significance of wave function, Schrödinger's wave equation – time dependent and time independent equations – particle in one dimensional box.

**UNIT IV      CRYSTAL PHYSICS**

Lattice – unit cell – Bravais lattice – lattice planes – Miller indices – calculation of number of atoms per unit cell, atomic radius, coordination number, packing factor for SC, BCC, FCC and HCP structures- crystal defects – point, line and surface defects

**UNIT V      NUCLEAR PHYSICS**

Introduction – basics about nuclear fission and fusion, nuclear composition – stable nuclei- liquid drop model, Radiation detectors – scintillation counter, semi conductor detector, cloud chamber. Reactors – essentials of nuclear reactor- power reactor, pressurized water reactor, Fast breeder reactor.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Ganesan.S and Iyandurai.N	Engineering Physics I	GEMS Publisher, Coimbatore-641 001	2012

**REFERENCES:**

<b>S.NO</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Serway and Jewett	Physics for Scientists and Engineers with Modern Physics	Thomson Brooks/Cole, Indian reprint, New Delhi	2007
2	Gaur, R.K. and Gupta, S.C	Engineering Physics	Dhanpat Rai Publications, New Delhi.	2003

**WEBSITES:**

1. [www.mediafire.com](http://www.mediafire.com)
2. [www.physicsclassroom.com](http://www.physicsclassroom.com)
3. [www.ap.columbia.edu](http://www.ap.columbia.edu)
4. [www.sqbyasi.typepad.com](http://www.sqbyasi.typepad.com)

**INTENDED OUTCOMES :**

- To understand about the water technology
- To study about the corrosion and protective coatings
- To gain knowledge on the Non-conventional energy sources and storage devices
- To get the information on engineering materials, fuels and combustion.

**UNIT I WATER TECHNOLOGY**

Characteristics – Alkalinity – types of alkalinity and determination – Hardness – Types and estimation by EDTA method (problems) - Domestic water treatment – Disinfection methods (Chlorination, Ozonation, UV treatment) – Boiler feed water – Requirements – Disadvantages of using hard water in boilers – Internal conditioning (Phosphate, Calgon and Carbonate conditioning methods) – External conditioning – Demineralization process – Desalination and Reverse osmosis.

**UNIT II CORROSION AND PROTECTIVE COATINGS**

Chemical and Electrochemical corrosion - Galvanic corrosion - Differential aeration corrosion - Corrosion control - Sacrificial anode and Impressed current cathodic methods - Corrosion inhibitors - Protective coatings - Paints - Constituents and functions – Metallic coatings - Electroplating (Au) and Electroless plating (Ni) - Surface conversion coating and Hot dipping.

**UNIT III FUELS AND COMBUSTION**

Coal - Proximate and Ultimate analysis - Metallurgical coke - Manufacture by Otto-Hoffman oven's - Petroleum processing and fractions - Cracking - Catalytic cracking methods - Synthetic petrol - Bergius and Fischer-Tropsch method - Knocking - Octane number and Cetane number - Gaseous fuels - Water gas, Producer gas, CNG and LPG; Combustion - Calorific values -Types - Theoretical calculation of calorific values (simple problem) - Calculation of minimum requirement of air (simple problem) - Flue gas analysis - Orsat's apparatus.

**UNIT IV NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES**

Nuclear energy - Fission and fusion reactions and Light water nuclear reactor for power generation - Breeder reactor. Solar energy conversion - solar cells - wind energy - Fuel cells - hydrogen - oxygen fuel cell - Batteries - Alkaline batteries – Lead-acid and Nickel-cadmium, Lithium batteries and lithium ion batteries.

**UNIT V ENGINEERING MATERIALS**

Refractories - classification - acidic, basic and neutral refractories - properties (refractoriness, under load, dimensional stability, porosity, thermal spalling) - manufacture of alumina, magnasite and zirconia bricks, Abrasives-natural and synthetic abrasives-Quartz, corundum, emery, garnet, diamond, silicon carbide and boron carbide. Polymers- Classification (based on chemical reaction, Thermal behavior and crystallinity), Addition - condensation, Thermoplastics and thermosetting plastics, stereoregular polymers-examples-specific polymers-properties and their uses-PVC, teflon, nylon - 6,6, Bakelite and vulcanization of rubber.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Ravikrishnan, A	Engineering Chemistry I & II	Sri Krishna Hi tech Publishing Company Private Ltd., Chennai.	2008
2.	Jain, P.C. and Monika Jain	Engineering Chemistry	Dhanpat Rai Publishing Company (P) Ltd., New Delhi.	2007

**REFERENCE BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Kuriakose, J.C. and Rajaram	Chemistry in Engineering and Technology. Vol.. I & II	Tata McGraw Hill Publishing Company, New Delhi.	1996
2.	Sharma, B. K	Engineering Chemistry	Krishna Prakasam Media (P) Ltd., Meerut	2001
3.	Sivasankar, B	Engineering Chemistry	Tata McGraw-Hill Publishing Co.Ltd., NewDelhi.	2008
4.	Dara, S.S	A text book of Engineering Chemistry.	S.Chand & Co.Ltd., New Delhi	2006

**WEBSITES:**

- 1.<http://www.mediafire.com>
- 2.<http://www.ziddu.com>
- 3.<http://library.olivet.edu/pubserv/ins/chemistry/index.html>
- 4.<http://www.chemistry.org/portal/Chemistry>
- 5.<http://chemfinder.cambridgesoft.com>



**INTENDED OUTCOMES:**

- To enable the students to understand the DC circuit analysis and network theorems
- To learn the Sinusoidal steady state analysis
- To understand transients and resonance in RLC circuits and coupled circuits

**UNIT I ELECTRICAL CIRCUITS**

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Values – Power and Power factor – Single Phase and Three Phase Balanced Circuits - Two wattmeter method of Three phase power measurements.

**UNIT II ELECTROMAGNETICS**

Magnetic field - Biot Savart's law - Force on current carrying in magnetic field -Hysteresis - Magneto motive force - Magnetic field strength – Reluctance - Laws of magnetic circuits - Faraday's laws of electromagnetic induction – Lenz law - Fleming's rules - Statically and Dynamically induced emf - Energy stored in magnetic field.

**UNIT III ELECTRICAL MACHINES**

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor, 3 Phase induction motor and Synchronous motor.

**UNIT IV MEASURING INSTRUMENTS**

Classification of measuring instruments - Essential features of indicating instruments-deflecting torque, controlling torque and damping torque in indicating instruments – Construction and operating principles of moving coil and moving iron instruments - Voltmeters and ammeters - Dynamometer type wattmeter - Induction type energy meter -Megger.

**UNIT V ELECTRICAL INSTALLATION**

Types of wiring systems - Wiring accessories – Earthing - Fluorescent tubes – CFL - Sodium vapour lamp - Simple domestic wiring layouts - Staircase wiring - IE rules -Testing of electrical installation.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Mittle, V.M.	Basic Electrical Engineering	Tata McGraw Hill Edition, New Delhi.	2004
2	Mehta, V K	Principles of Electrical Engineering.	S.Chand & Company Ltd, New Delhi.	2003

**REFERENCES:**

<b>S.NO</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Soni, M.L., Gupta, J.C. and Gupta, P.V	A Course in Electrical Circuits and Fields	Dhanpat Rai and Sons, New Delhi.	1998
2	Rajput, R.K	Basic Electrical Engineering	Dhanpat Rai and Sons, New Delhi.	2007
3	Nagsarkar, T. K. and Sukhija, M. S	Basics of Electrical Engineering.	Oxford press.	2006
4	Mahmood Nahvi and Joseph A. Edminister	Electric Circuits Schaum Outline Series	McGraw Hill, New Delhi.	2006

**INTENDED OUTCOMES:**

- To have knowledge on computer hardwares and softwares.
- To understand the various data representation techniques.
- To make the students to get knowledge on software engineering methodologies

**UNIT I      HARDWARE AND I/O**

Basic Structure of a digital computer - Structure of a memory cell - Memory organization - Cache memory – Input devices - Output devices - Secondary Storage devices - Optical storage devices – Magneto optical disk - Mass storage device.

**UNIT II      DATA REPRESENTATION**

Number system - Basic conversion - Representation of Integers, fraction and characters - Signed and unsigned number representation - Fixed and Floating point representation - Complements – BCD - Excess 3 – Gray and ASCII codes - Error detecting codes. Binary Arithmetic.

**UNIT III     OPERATING SYSTEM**

Basics of Operating systems - Evolution of operating systems - Serial processing - Batch processing – Multiprogramming - Time sharing systems - Online and real time systems - overview of UNIX, LINUX and Windows.

**UNIT IV     NETWORK**

Network concepts: LAN, WAN, MAN - Network Topologies - Transmission media: Coaxial, Twisted pair, Optical fiber, Wireless media - TCP / IP model - Internet – WWW – Webpage – URL – Web Server - Web browser – ISP - Internet Applications - VPN.

**UNIT V      SOFTWARE ENGINEERING**

Software Development life cycle - Software Testing – Structure of database – Database Management Architecture - Database models – E - Commerce- Multimedia and Virtual reality- Security – Threats and Protection.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	ITL Education Solutions Ltd	Introduction to Information Technology	Pearson Education.	2008
2	Rajaraman, V	Fundamentals of Computers. IV Edition	Prentice Hall.	2006

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Behrouz A. Foruzan.	Data communication and Networking	Tata McGraw-Hill.	2004
2	William Stallings	Computer Organization & Architecture – Designing for Performance. VI Edition	Pearson Education	2003
3	Morris Mano, M.	Digital Logic and Computer Design	Prentice Hall.	2007

**INTENDED OUTCOMES:**

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

**PART - A****I CIVIL ENGINEERING PRACTICE****Plumbing Works:**

## 1. Hands-on-exercise:

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

**II MECHANICAL ENGINEERING PRACTICE****Welding:**

## 2. Preparation of arc welding of butt joints, lap joints and tee joints.

## 3. Gas welding practice

**Basic Machining:**

## 4. Simple Turning and Taper turning

## 5. Drilling Practice

**Sheet Metal Work:**

## 6. Forming &amp; Bending

## 7. Model making – Trays, funnels, etc.

**Demonstration on**

## 8. Smithy operations

## 9. Foundry operations

**PART –B****I ELECTRICAL ENGINEERING PRACTICE**

## 1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.

## 2. Fluorescent lamp wiring.

## 3. Stair-case wiring.

## 4. Measurement of electrical quantities – voltage, current, power &amp; power factor in RLC circuit.

## 5. Measurement of energy using single phase energy meter.

**II ELECTRONICS ENGINEERING PRACTICE**

## 6. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period and frequency) using CRO.

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Jeyachandran, K., Natarajan, S. and Balasubramanian, S	A Premier on Engineering Practices Laboratory	Anuradha Publications, Kumbakonam	2007
2	Jeyapooan, T., Saravanapandian, M. and Pranitha, S	Engineering Practices Lab Manual	Vikas Pupliching House Pvt. Ltd, Chennai.	2006
3	Bawa, H.S	Workshop Practice	Tata McGraw – Hill Publishing Company Limited, New Delhi	2007

**INTENDED OUTCOMES:**

- To Develop basic laboratory skills demonstrating the application of physical and chemical principles

**LIST OF EXPERIMENTS - PHYSICS**

1. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
2. Determination of wavelength of mercury spectrum – spectrometer grating.
3. Determination of Young's modulus of the material – Non uniform bending or Uniform bending.
4. Determination of Viscosity of liquid – Poiseuille's method.
5. Spectrometer Dispersive power of a prism.
6. Torsional pendulum – Determination of Rigidity modulus.

**LIST OF EXPERIMENTS - CHEMISTRY**

1. Estimation of alkalinity of Water sample
2. Estimation of hardness of Water by EDTA
3. Determination of DO in water (Winkler's method)
4. Estimation of Chloride in Water sample (Argentometric method)
5. Determination of molecular weight and degree of polymerization using viscometry.
6. Conduct metric Titration (Simple acid base).

**INTENDED OUTCOMES:**

- To introduce the basic concepts and the use of engineering drawing in the design and manufacturing field.
- To develop graphic skill for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings

**UNIT I DRAFTING TECHNOLOGY AND INTRODUCTION TO ANY DRAFTING SOFTWARE/PACKAGE**

Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice, Dimensioning – linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension. Basic operation of drafting packages, use of various commands for drawing, dimensioning, editing, modifying, saving and printing/plotting the drawings. Introduction to 3D primitives.

**UNIT II SCALES & PLANE CURVES**

SCALES: Reducing Scale, Enlarging Scale, Plain Scale, Diagonal Scale and Vernier Scale. Conics – Construction of Ellipse, Parabola and Hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

**UNIT III 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 IV PROJECTION OF POINTS, LINES AND PLANE SURFACES**

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Traces-Projection of polygonal surface and circular lamina inclined to both reference planes.

**UNIT V PROJECTION OF SOLIDS**

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

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Bhatt, N.D	Engineering Drawing-46th Edition	Charotar Publishing House, Chennai	2003
2.	Natarajan, K.V	A text book of Engineering Graphics	Dhanalakshmi Publishers, Chennai	2006.

**REFERENCES:**

<b>S.NO</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1.	Venugopal, K. and Prabhu Raja, V	Engineering Graphics	New Age International (P) Limited, New Delhi	2008
2.	Shah, M.B and Rana, B.C	Engineering Drawing	Pearson Education, New Delhi	2005
3.	Gopalakrishnana, K.R	Engineering Drawing (Vol. I & II)	Subhas Publications, Chennai	1998

**PUBLICATION OF BUREAU OF INDIAN STANDARDS:**

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

**INTENDED OUTCOMES:**

- To familiarize the students with technical vocabulary.
- To focus on question forms and to make them understand the importance of using question tags and also the functional use of transformation of sentences.
- To improve their reading habits and to train them in critical and analytical reading.
- To hone their listening skills.
- To guide the students to write business letters and other forms of technical writing.
- To enable students to prepare for oral communication in formal contexts

**UNIT - I LANGUAGE FOCUS**

Technical vocabulary – scientific vocabulary – formal phrases and idioms – homophones, homonyms, often misspelt and confused words – conjunctions – formation of new words – irregular verbs – subject-verb agreement – plurals – gerund – phrasal verbs.

**UNIT - II GRAMMAR FOCUS**

Finite and non-finite verbs – transformation of sentences – simple, complex and complex sentences – phrases and clauses – question forms and question tags – expression of cause and effect, purpose and function.

**UNIT - III READING AND LISTENING**

Extensive and intensive reading – active and passive reading – eye reading and visual perception – reading for a purpose – speed reading – reading with purpose – story telling – critical and analytical reading.

Hearing and listening – types of listening – superficial, appreciative, focused, evaluative, attentive, and empathetic – barriers to listening – physical, psychological, linguistic and cultural – improving listening comprehension – listening and note taking.

**UNIT - IV WRITING**

Cohesion and coherence in sentences and paragraphs – Business letters of different kinds – report writing – writing strategies – writing comments, instructions and recommendations – describing processes and products – introduction to writing articles.

**UNIT - V SPEAKING**

Applied English Communication – welcome address, vote of thanks, debates, role plays, group discussions, correlation between verbal and non-verbal communication – checklist of making oral presentations – vocal communication techniques – voice, quality, volume, pitch, etc.

**TEXT BOOKS:**

S.NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Mrs. Jewelcy Jawahar & Mrs. P. Rathna	Technical English-II	VRB Publishers Pvt. Ltd., Chennai.	2009
2	Mrs. Jewelcy Jawahar & Mrs. P. Rathna	English work Book II	VRB Publishers Pvt. Ltd., Chennai.	2009



**REFERENCES:**

<b>S.NO.</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Rizvi Ashraf, M	Effective Technical Communication	Tata McGraw-Hill, New Delhi.	2007
2	Rutherford Andrea,J.	Basic Communication Skills for Technology 2 <sup>nd</sup> Edition	Pearson Education, New Delhi.	2006
3	Lakshminarayanan, K.R. & Murugavel, T.	Communication Skills for Engineers	SCITECH Publications, Chennai	2008

**WEBSITES :**

1. <a href="http://www.usingenglish.com">www.usingenglish.com</a>
2. <a href="http://www.englishclub.com">www.englishclub.com</a>
3. <a href="http://www.ispeakyouspeak.blogspot.com">www.ispeakyouspeak.blogspot.com</a>
4. <a href="http://www.teachertube.com">www.teachertube.com</a>
5. <a href="http://www.Dictionary.com">www.Dictionary.com</a>

**INTENDED OUTCOMES:**

- To impart analytical skills to the students in the areas of multiple integrals and applications of vector calculus.
- To understand the concepts and applications of laplace transforms.
- To study about analytic functions and complex integration.

**UNIT-I MULTIPLE INTEGRALS**

Double integration – Cartesian coordinates – Polar coordinates – Change of order of integration – Triple integration in Cartesian co-ordinates – Area as double integrals.

**UNIT-II VECTOR CALCULUS**

Gradient, Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Problem solving using Green's theorem, Gauss divergence theorem and Stoke's theorems (Excluding proof)- Simple applications involving cubes and rectangular parallelepipeds.

**UNIT-III ANALYTIC FUNCTIONS**

Analytic functions - Necessary and Sufficient conditions for an analytic function (without proof) – Cauchy-Riemann equations – Harmonic - Properties of analytic functions – Constructions of an analytic function - Conformal mapping:  $w = z+a$ ,  $az$ ,  $1/z$ ,  $Z^2$  and bilinear transformation.

**UNIT-IV COMPLEX INTEGRATION**

Complex Integration - Problems solving using Cauchy's integral theorem and integral formula – Taylor and Laurent expansions - Residues – Cauchy's residue theorem - Applications of Residue theorem to evaluate real integrals.

**UNIT-V LAPLACE TRANSFORMS**

Transforms of elementary functions – Basic properties – Transforms of derivatives and integrals – Initial and final value theorems. Inverse Laplace transforms – Convolution theorem – Solution of Ordinary Differential Equations with constant coefficients using Laplace transforms – Transform of periodic functions

**TEXT BOOKS:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Veerarajan,T.	Engineering Mathematics for first year	Tata McGraw-Hill Publishing Company Limited, New Delhi.	2007
2	Sundaram, V. Lakhminarayan, K.A. and Balasubramanian, R.	Engineering Mathematics for first year	Vikas Publishing Home , New Delhi	2006

**REFERENCES:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Erwin Kreyszig	Advanced Engineering Mathematics.	John Wiley & Sons	1999
2	Glyn James	Advanced Modern Engineering Mathematics,	Pearson Education Ltd, New Delhi	2004
3	Bali, N. P. and Manish Goyal	Text book of Engineering Mathematics.	Laxmi Publications (p) Ltd., Chennai	2008
4	Venkataraman, M. K.	Engineering Mathematics.	The National Publishing Company, Chennai	2004
5	Narayanan. S, Manicavachagam pillay.T.K and Ramaniah.G	Advanced Mathematics for Engineering Students.	Viswanathan S.(Printers and Publishers) Pvt. Ltd. Chennai.	2002

**WEBSITES:**

1. [www.maths-dur.ac](http://www.maths-dur.ac)
2. [www.efunda.com](http://www.efunda.com)
3. [www.mathcentre.ac.uk](http://www.mathcentre.ac.uk)
4. [www.sosmath.com/diffeq/laplace/basic/basic.html](http://www.sosmath.com/diffeq/laplace/basic/basic.html)

**INTENDED OUTCOMES:**

- To impart knowledge on the structure, properties and applications of engineering materials.
- To identify and select suitable materials for various engineering applications.

**UNIT - I CONDUCTING MATERIALS**

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

**UNIT - II SEMICONDUCTING MATERIALS**

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – extrinsic semiconductors – carrier concentration derivation in n-type semiconductor – variation of Fermi level with temperature and impurity concentration – compound semiconductors – Hall effect –Determination of Hall coefficient – Applications.

**UNIT - III MAGNETIC AND SUPERCONDUCTING MATERIALS**

Origin of magnetic moment – Bohr magneton – Dia and para magnetism – Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti – ferromagnetic materials – Ferrites – applications.

Superconductivity : properties - Types of super conductors – BCS theory of superconductivity(Qualitative) - High Temperature superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

**UNIT - IV DIELECTRIC MATERIALS**

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Clausius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – Applications of dielectric materials – ferroelectricity and applications.

**UNIT - V MODERN ENGINEERING MATERIALS**

Metallic glasses: preparation, properties and applications.

Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA

Nanomaterials: synthesis – top down and bottom up approach – Physical and chemical vapour deposition – sol-gels – electrodeposition – ball milling - properties of nanoparticles and applications.

Carbon nanotubes: structure – properties and applications.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Ganesan.S and Iyandurai.N	Engineering Physics II	GEMS Publisher, Coimbatore-641 001	2011

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	William D Callister Jr	Material Science and Engineering-An Introduction	John Wiley and Sons Inc., UK,	2006
2	James F Shackelford	Introduction to materials Science for Engineers	Macmillan Publication Company, New York	2004
3	Charles Kittel	Introduction to Solid State Physics	John Wiley & sons, Singapore.	2007

**WEBSITES:**

1. [www.engineersedge.com](http://www.engineersedge.com)
2. [www.uom.ac.mu](http://www.uom.ac.mu)
3. [www.infibeam.com](http://www.infibeam.com)
4. [www.efunda.com](http://www.efunda.com)

**INTENDED OUTCOMES:**

To impart knowledge on

- Constructional details, principle of operation and characteristics of various electronic devices
- Digital Electronics Fundamentals
- Fundamentals of Communication systems

**UNIT- I SEMICONDUCTING MATERIALS**

Introduction to semiconductor - Intrinsic semiconductor – band gap determination with Fermi level– extrinsic semiconductors – n-type, p-type - band gap determination with Fermi level semiconductor – variation of Fermi level with temperature and impurity concentration – compound semiconductors – Hall effect – Applications.

**UNIT -II SEMICONDUCTOR DIODE AND BJT**

PN Junction – Current components in a PN diode – Junction capacitance – Zener diode – Varactor diode – Tunnel diode – Schottky diode – Transistor Structure – Basic Transistor operation – Transistor characteristics and parameters – The transistor as a switch, as an amplifier. Transistor bias circuits: Voltage divider bias circuits, base bias circuits, emitter bias circuits, collector feedback bias circuits.

**UNIT -III FET, UJT and SCR**

JFET characteristics and parameters – JFET biasing, self bias, voltage divider bias – Q - point, stability over temperature – MOSFET D-MOSFET, E-MOSFET – working, Characteristics and applications of UJT, SCR, DIAC, TRIAC.

**UNIT -IV NUMBER SYSTEMS**

Binary, Octal, Decimal, Hexadecimal-Number base conversions – complements – signed Binary numbers. Binary Arithmetic- Binary codes: Weighted –BCD-2421-Gray code-Excess 3 code – conversion from one code to another-Boolean postulates and laws –De-Morgan's Theorem – Karnaugh map Minimization

**UNIT- V LOGIC GATES**

AND, OR, NOT, NAND, NOR, Exclusive – OR and Exclusive – NOR- Implementations of Logic Functions using gates, NAND –NOR implementations –Multi level gate implementations- Multi output gate implementations

**TEXT BOOKS:**

<b>S.NO</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Millman and Halkias	Electronic Devices and Circuits.	Tata McGraw–Hill.	2007
2	Morris Mano	Digital logic and Computer Design	Prentice Hall of India.	2001
3	Herbert Taub and Donald L. Schilling.	Principles of Communication Systems. 3rd Edition	Tata McGraw Hill.	2008

**REFERENCES:**

<b>S.NO</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Floyd, T.L	Electronic Devices.6th Edition	Pearson Education	2003
2	Millman and Halkias	Integrated Electronics	McGraw-Hill.	2004
3	William I.Fletcher	An Engineering Approach to Digital Design	Prentice Hall.	1980

**INTENDED OUTCOMES:**

- To impart the knowledge about the fundamentals of Engineering Mechanics and also Basics of Building Components

**UNIT I BASICS**

Introduction - Units and Dimensions - Laws of Mechanics – Vectors - Vectorial representation of forces and moments - Vector operations.

**STATICS OF PARTICLES**

Coplanar forces - Resolution and Composition of forces - Equilibrium of a particle - Equivalent system of forces - Principle of transmissibility - Single equivalent force.

**UNIT II EQUILIBRIUM OF RIGID BODIES** Free body diagram - Types of supports and their reactions - Equilibrium of rigid bodies in two dimensions.

**UNIT III PROPERTIES OF GEOMETRICAL SECTIONS**

Determination of areas - First moment of area and the Centroid - Second and product moments of plane area - Parallel axis theorem and Perpendicular axis theorem - Polar moment of Inertia - Principal moment of Inertia of plane areas.

**UNIT IV BUILDING CONSTRUCTION**

Building components - Their functions - Requirements - Orientation of Buildings - Principles of planning.

**FOUNDATION**

Types of footings - Importance - Settlement - Bearing capacity - Shallow footings - Pile foundations. Concrete - Plain and Reinforced - Materials - Mixing, Placing.

**UNIT V MASONRY CONSTRUCTION**

Brick Masonry - Stone Masonry - Load bearing walls - Partition walls - Different types of Flooring – Different types of Roofing.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Rajasekaran, S. and Sankara Subramanian, G	Engineering Mechanics	Vikas Publishing House (p) Limited, New Delhi.	2005
2	Punmia B.C	Building Construction	Laxmi Publications, New Delhi.	1997

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Beer and Johnston.	Vector Mechanics for Engineers Vol.11 Statics	Mc-Graw Hill International Edition	1995
2	Irving Shames	Engineering Mechanics	Prentice Hall of India.	1993



**INTENDED OUTCOMES:**

- To know the correct and efficient ways of solving problems.
- To learn to develop algorithm for simple problem solving.
- To learn to program in C.

**UNIT I FUNDAMENTALS OF C**

Introduction to C- Introduction to C – Compiler – Types of menus – description - Types of commands - Structure of C program - Character set, Tokens, Keywords and Identifiers- Constants - Data types – Variables – Editing a program.

**UNIT II BRANCHING AND LOOPING**

Operators, Expressions - Managing Input and Output operations - Decision Making and Branching Statements - Decision Making and Looping Statements – Simple applications – debugging.

**UNIT III ARRAYS AND FUNCTIONS**

Arrays: Definition, Compile time Initialization, Dynamic Initialization- Character arrays and Strings - Library Functions - User Defined Functions: Definition, Declaration - Categories of Functions - Recursion Function – Call by Value – Call by Reference- Passing Arrays and Strings to Functions.

**UNITIV STRUCTURES AND UNIONS**

Structures: Definition-Declaration- Initialization- Array of Structures- Structures within structures- Passing Structures as argument – Unions: Definition, Declaration and Initialization – Passing Unions to Function.

**UNIT V POINTERS AND FILE MANIPULATION**

Pointers: Definition – Declaration- array of Pointers - Pointers as argument to Function - File Management: Defining File, Opening and Closing Files, Input and Output Operations on Files, Command line arguments.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Balagurusamy, E.	Programming in ANSI C	Tata McGrawHill Company Ltd.New Delhi.	2004

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Byron Gottfried	Programming with C	Tata McGrawHill Company Ltd., New Delhi.	2002
2	Yashavant kanetkar	Let Us C	BPB Publishers, Chennai.	2008

**INTENDED OUTCOMES:**

- To Develop basic laboratory skills demonstrating the application of physical and chemical principles

**LIST OF EXPERIMENTS**

1. (a) Particle size determination using Diode Laser  
(b) Determination of Laser parameters – Wavelength, and angle of divergence.  
(c) Determination of acceptance angle in an optical fiber.
2. Determination of thickness of a thin wire – Air wedge method
3. Determination of thermal conductivity of a bad conductor – Lee’s Disc method.
4. Determination of Hysteresis loss in a ferromagnetic material
5. Determination of Band Gap of a semiconductor material.
6. Determination of Specific resistance of a given coil of wire – Carey Foster Bridge.

**LIST OF EXPERIMENTS**

1. Conduct metric Titration (Mixture of weak and strong acids).
2. Conduct metric Titration using  $\text{BaCl}_2$  vs  $\text{Na}_2\text{SO}_4$ .
3. Potentiometric Titration ( $\text{Fe}^{2+}$  /  $\text{KMnO}_4$  or  $\text{K}_2\text{Cr}_2\text{O}_7$ ).
4. pH Titration (acid & base).
5. Determination of water of crystallization of a crystalline salt (Copper sulphate).
6. Estimation of Ferric iron by spectrophotometry.

**INTENDED OUTCOMES:**

- To know the correct and efficient ways of solving problems
- To learn to develop algorithm for simple problem solving
- To learn to program in C

**LIST OF EXERCISES**

1. Write a C program to find Factorial of a given number using do while loop.
2. Write a C Program to print Fibonacci series using while loop.
3. Write a C Program to check a given number is Prime or Not.
4. Write a C Program to compute the sum of even numbers for a given n value.
5. Write a C Program to check the given string is Palindrome or Not.
6. Write a C Program to check the given number is Armstrong or Not using functions.
7. Write a C Program to count the number of vowels from the given string using switch case.
8. Write a C Program to read a line of text from keyboard and print the number of characters, words and spaces.
9. Write a C Program to print the student's record using structure.
10. Write a C Program to find factorial of a number using recursion function.
11. Write a C Program to swap two numbers using pointers.
12. Write a C Program to copy the contents of one file to the other.

**INTENDED OUTCOMES:**

- To introduce students the basic concepts and the use of engineering drawing in the design and manufacturing field.
- To develop in student's graphic skill for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings

*(Through software only)*

**UNIT I SECTION OF SOLIDS**

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.

**UNIT II DEVELOPMENT OF SURFACES**

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

**UNIT III INTERSECTION OF SURFACES**

Methods used to determine the line of intersection – line method, cutting plane method, Intersection of solids like cone and cylinder, cylinder and cylinder, prism and prism, cylinder and prism.

**UNIT IV ISOMETRIC PROJECTIONS**

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.

**UNIT V PERSPECTIVE PROJECTIONS**

Perspective projection of prisms, pyramids, cylinders and cone by visual ray method and vanishing point method.

*Note: All the Exercise to be done using 'solid works' or using any other software*

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Bhatt, N.D	Engineering Drawing	Charotar Publishing House, Chennai	2003
2.	Natarajan, K.V	A text book of Engineering Graphics	Dhanalakshmi Publishers, Chennai	2006.

**REFERENCES:**

<b>S.NO</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Venugopal, K. and Prabhu Raja, V	Engineering Graphics	New Age International (P) Limited, New Delhi	2008
2	Shah, M.B and Rana, B.C	Engineering Drawing	Pearson Education, New Delhi	2005
3	Gopalakrishnana, K.R	Engineering Drawing (Vol. I & II)	Subhas Publications, Chennai	1998

**PUBLICATION OF BUREAU OF INDIAN STANDARDS:**

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

## SEMESTER III

### 12BECC301 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

3 0 1 4 100

#### INTENDED OUTCOMES:

- To develop the skills of the students in the areas of transforms and partial differential equations.
- To understand the applications of partial differential equations.

#### UNIT- I      **FOURIER SERIES**

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

#### UNIT -II      **FOURIER TRANSFORM**

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

#### UNIT- III      **PARTIAL DIFFERENTIAL EQUATIONS**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients.

#### UNIT- IV      **APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**

Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

#### UNIT- V      **Z -TRANSFORM AND DIFFERENCE EQUATIONS**

Z-transform - Elementary properties – Inverse Z – transform – Convolution theorem -Formation of difference equations – Solution of difference equations using Z - transform.

#### TEXT BOOK:

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Kandasamy,P., Thilagavathy,K. and Gunavathy,K.	Engineering Mathematics Volume III.	S. Chand & Company Ltd., New Delhi.	1998

**REFERENCES:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Andrews, L.A. and Shivamoggi B.K.	Integral Transforms for Engineers and Applied Mathematicians	Macmillen, New York	1988
2	Narayanan, S., Manicavachagom Pillay, T.K. and Ramaniah, G	Advanced Mathematics for Engineering Students. Volumes II and III,	Viswanathan S Printers and Publishers Pvt. Ltd. Chennai.	2002
3	Churchill, R.V. and Brown, J.W.	Fourier Series and Boundary Value Problems	McGraw-Hill Book Co., Singapore.	1987
4	Wylie C. Ray and Barrett Louis, C.	Advanced Engineering Mathematics	McGraw-Hill, Inc., New York	1995
5	Grewal, B.S.	Higher Engineering Mathematics	Khanna Publishers, Delhi.	2001

**WEBSITES :**

1. <a href="http://www.sosmath.com">www.sosmath.com</a>
2. <a href="http://mathworld.wolfram.com/FourierSeries.html">http://mathworld.wolfram.com/FourierSeries.html</a>
3. <a href="http://www.math.umn.edu/~olver/pdn.html">http://www.math.umn.edu/~olver/pdn.html</a>
4. <a href="http://www.facstaff.bucknell.edu/mastascu/econtrolhtml/sampled/sampled.html">http://www.facstaff.bucknell.edu/mastascu/econtrolhtml/sampled/sampled.html</a>

**INTENDED OUTCOMES:**

- To understand the statics of particles and rigid bodies
- To study the principles involved in friction and kinematics of particles

**UNIT I      STATICS OF PARTICLES**

Forces – system of forces - concurrent forces in plane and space- resultant - problems involving the equilibrium of a particle-free body diagram-equilibrium of particle in space.

**UNIT II      STATICS OF RIGID BODIES IN TWO DIMENSIONS**

Rigid bodies-moment of force about an axis-moment of a couple-equivalent system of coplanar forces-Rigid body in equilibrium-problems involving equilibrium of rigid body-types of supports-reactions of beams and frames.

**UNIT III      CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA**

Centroids of areas, composite areas, determination of moment of inertia of plane figures, polar moment of inertia-radius of gyration – mass moment of inertia of simple solids.

**UNIT IV      KINEMATICS OF PARTICLES**

Introduction-plane, rectilinear motion - time dependent motion-rectangular coordinates-projectile motion.

IMPULSE AND MOMENTUM: Concept of conservation of momentum- Impulse-Momentum principle- Impact-Direct central impact-oblique central impact.

**UNIT V      FRICTION**

Laws of friction-coefficient of friction-problems involving dry friction- wedge and ladder friction.

KINETICS OF PARTICLES: Equations of motion-rectilinear motion-Newton's II law – D'Alembert's principle- Energy - potential energy-kinetic energy-conservation of energy-work done by a force - work energy method.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Beer F P and Johnston E.R	Vector Mechanics for Engineers-Statics and Dynamics	Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi.	2009
2	Rajasekaran S and Sankarasubramanian G	Engineering Mechanics- Statics and Dynamics	Vikas Publishing House Pvt. Ltd., New Delhi.	2006



**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Bansal R K	Engineering Mechanics	Laxmi Publications Pvt. Ltd., New Delhi.	2006
2	Young D H and Timashenko S	Engineering Mechanics	Tata McGraw-Hill, New Delhi.	2006
3	Jivan Khachane and Ruchi Shrivastava	Engineering Mechanics: Statics and Dynamics	ANE Books, New Delhi.	2006

**WEBSITES:**

1. [http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Guwahati/engg\\_mechanics/index.htm](http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Guwahati/engg_mechanics/index.htm)
2. <http://nptel.iitm.ac.in/video.php?subjectId=112103108>
3. <http://web.mit.edu/emech/dontindex-build/index.html>
4. <http://www.indiabix.com/engineering-mechanics/questions-and-answers/>

**INTENDED OUTCOMES:**

- To introduce the students the concepts of some basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and plastics component manufacture.

**UNIT I METAL CASTING PROCESSES**

Sand casting – Sand moulds - Type of patterns – Pattern materials – Pattern allowances – Types of Moulding sand – Properties – Core making – Methods of Sand testing – Moulding machines – Types of moulding machines - Melting furnaces – Working principle of Special casting processes – Shell, investment casting – Ceramic mould – Lost Wax process – Pressure die casting – Centrifugal casting – CO<sub>2</sub> process – Sand Casting defects – Inspection methods

**UNIT II JOINING PROCESSES**

Fusion welding processes – Types of Gas welding – Equipments used – Flame characteristics – Filler and Flux materials - Arc welding equipments - Electrodes – Coating and specifications – Principles of Resistance welding– Percussion welding - Gas metal arc welding – Flux cored – Submerged arc welding – Electro slag welding – TIG welding – Principle and application of special welding processes - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding – Diffusion welding – Weld defects – Brazing and soldering process – Methods and process capabilities.

**UNIT III BULK DEFORMATION PROCESSES**

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – Characteristics of the process – Types of Forging Machines – Typical forging operations – Rolling of metals – Types of Rolling mills - Flat strip rolling – Shape rolling operations – Defects in rolled parts - Principle of rod and wire drawing - Tube drawing — Principles of Extrusion – Types of Extrusion – Hot and Cold extrusion — Equipments used.

**UNIT IV SHEET METAL PROCESSES**

Sheet metal characteristics - Typical shearing operations, bending and drawing operations – Stretch forming operations — Formability of sheet metal – Test methods – Working principle and application of special forming processes - Hydro forming – Rubber pad forming – Metal spinning – Introduction to Explosive forming, Magnetic pulse forming, Peen forming, Super plastic forming.

**UNIT V MANUFACTURING OF PLASTIC COMPONENTS**

Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines – Compression moulding, Transfer moulding – Typical industrial applications – Introduction to Blow moulding – Rotational moulding – Film blowing – Extrusion - Thermoforming, - Bonding of Thermoplastics.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Serope Kalpajian, Steven R.Schmid	Manufacturing Engineering and Technology (Second Indian Reprint).	Pearson Education, Inc	2002
2	S.Gowri, P.Hariharan, and A.Suresh Babu	Manufacturing Technology 1	Pearson Education	2008

**REFERENCE BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	P.N. Rao	Manufacturing Technology II Edition	Tata McGraw-Hill Publishing Limited,	2002
2	P.C. Sharma	A text book of production technology IV Edition	S. Chand and Company	2003
3	Begman	Manufacturing Process VIII Edition	John Wiley & Sons	2005
4	Hajra Choudhury	Elements of Workshop Technology, Vol. I and II	Media Promoters Pvt Ltd., Mumbai	2001

**WEBSITES:**

1. [www.themetalcasting.com](http://www.themetalcasting.com)
2. [www.industrialmetalcastings.com](http://www.industrialmetalcastings.com)
3. [www.purolator-lp.com](http://www.purolator-lp.com)
4. [www.manufacturercompanies.com/manufacturers](http://www.manufacturercompanies.com/manufacturers)
5. [www.amtonline.org](http://www.amtonline.org)

**INTENDED OUTCOMES:**

- To impart knowledge on the structure, properties, treatment, testing and applications of metals and
- To identify and select suitable materials for various engineering applications
- non-metallic materials

**Review (Not for Exam):**

Crystal structure – BCC, FCC and HCP structure – unit cell – crystallographic planes and directions, miller indices – crystal imperfections, point, line, planar and volume defects – Grain size, ASTM grain size number.

**UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS**

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron – Iron carbide equilibrium diagram - Classification of steel and cast Iron, microstructure, properties and applications.

**UNIT II HEAT TREATMENT**

Definition – Full annealing, stress relief, recrystallisation and spheroidizing –normalising, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on TTT diagram, CCT - Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening.

**UNIT III FERROUS AND NON FERROUS METALS**

Effect of alloying additions on steel (**Mn, Si, Cr, Mo, V, Ti & W**) - stainless and tool steels – HSLA - maraging steels – Gray, White malleable, spheroidal - Graphite - alloy cast irons Copper and Copper alloys – Brass, Bronze and Cupronickel – Aluminum and Al-Cu – precipitation strengthening treatment – Bearing alloys.

**UNIT IV NON-METALLIC MATERIALS**

Polymers – types of polymer, commodity and engineering polymers – Properties and Applications of thermoplastics (PP,PVC,APS,PMMA) and thermosetting plastics(PF,UF,MF) –Engineering Ceramics –Introduction to Fibre reinforced plastics.

**UNIT V MECHANICAL PROPERTIES AND TESTING**

Mechanism of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Impact test - Izod and Charpy, Fatigue and creep properties.S-N curves fatigue and creep testing.toughness tests.

**NON DESTRUCTIVE TESTING:** Non Destructive Testing basic principles and testing method for Radiographic testing, Ultrasonic testing, Magnetic particle inspection and Liquid penetrant inspections, Eddy current testing.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Kenneth G.Budinski and Michael K.Budinski	Engineering Materials	Prentice-Hall of India Private Limited , New Delhi.	2010

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	William D. Callister & David G. Rethwisch	Material Science and Engineering	John Wiley and Sons, Delhi	2010
2	Raghavan.V	Materials Science and Engineering	Prentice Hall of India Pvt., Ltd, New Delhi.	2006
3	Shackelford, J.F.,	Introduction to Materials Science for Engineers	Pearson Edition	2009

**WEBSITES :**

1. [www.materials.unsw.edu.au](http://www.materials.unsw.edu.au)
2. [ocw.MIT.edu](http://ocw.MIT.edu)
3. [www.istl.org](http://www.istl.org)
4. [metalurgy-screw-tutorial.tobyavujo.com](http://metalurgy-screw-tutorial.tobyavujo.com)

**INTENDED OUTCOMES:**

- To understand the structure and the properties of the fluid.
- To analyse and appreciate the complexities involved in solving the fluid flow problems.
- To understand the energy exchange process in fluid mechanics handling incompressible fluids.

**UNIT I FLUID PROPERTIES**

Units & measurement - Fluid properties - Density, Specific gravity, Viscosity, Surface tension, capillarity - Pascal's Law - pressure measurements — manometers. Fluid statics - Total pressure and centre of pressure - buoyancy and floatation- metacentre and metacentric height (definition only)

**UNIT II FLUID KINEMATICS AND FLUID DYNAMICS**

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 - Venturimeter, Orifice meter, Pitot tube - dimensional analysis - Buckingham's  $\pi$  theorem- applications - similarity laws and models.

**UNIT III INCOMPRESSIBLE FLUID FLOW**

Viscous flow - Navier-Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen Poiseuille's) - Hydraulic and energy gradient - flow through pipes - Darcy -Weisback'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.

**UNIT IV HYDRAULIC TURBINES**

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.

**UNIT V HYDRAULIC PUMPS**

Classification - centrifugal pump-working principle-head, discharge, efficiencies and losses - performance curves - specific speed. Reciprocating pump-components and working-slip-indicator diagram - air vessel - Jet pump - Gear pump - Submersible pump.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Streeter V.L, and Wylie E.B	Fluid Mechanics	McGraw-Hill, New Delhi.	1998
2	Kumar K.L	Engineering Fluid Mechanics	S. Chand	2004

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Bansal, R.K.,	Fluid Mechanics and Hydraulics Machines	Laxmi publications (P) Ltd, New Delhi.	2005
2	White, F.M	Fluid Mechanics	Tata McGraw-Hill, New Delhi.	2008
3	Fox and McDonald	Fluid Mechanics	John Wiley	2006

**WEBSITES**

1. [www.imeche.org](http://www.imeche.org)
2. [openlibrary.org](http://openlibrary.org)
3. [nptel.iitg.ernet.in](http://nptel.iitg.ernet.in)
4. [www.tecquipment.com](http://www.tecquipment.com)

**INTENDED OUTCOMES :**

- To give a comprehensive insight into natural resources, ecosystem and biodiversity.
- To educate the ways and means to protect the environment from various types of pollution.
- To impart some fundamental knowledge on human welfare measures.

**UNIT - I PLANET EARTH**

Environmental segments- Biosphere, Lithosphere, Atmosphere: Structure of atmosphere-Troposphere, Stratosphere and Ionosphere. Air pollution - Sources, effects. Gaseous and particulate air pollutants, Green house effect and global warming, Effect on climates. Ozone depletion-mechanism. Photo chemical smog-mechanism, Acid rain and its effects.

**UNIT - II HYDROSPHERE**

Water-Sources, Ground water and surface water-Water shed and its management-Water conservation-Rain water harvesting. Water Pollution-Water quality-Point and Non-point sources, Classification-Oxygen demanding waste (BOD, COD-Definition and experimental determination of BOD only), Bioamplification, waste water treatment-Preliminary, secondary, Noise pollution and control.

**UNIT - III LITHOSPHERE**

Land - weathering and erosion - types of weathering - types of soil - soil erosion - land slides - deserts - types - desertification - land degradation. Soil Pollution-Effects on modern Agriculture on soil-pesticide-over fertilization-Geochemical cycling-solid waste-sources and disposal by sanitary land filling. Hazardous waste- definition-Types, Chemical waste-sources and effects, Bioclinical waste-Sources and disposal method, Radio active waste-disposal methods.

**UNIT - IV BIOSPHERE**

Ecosystem-Components-functions-Ecological pyramids-energy flow-marine ecosystem-Terrestrial eco system- Biodiversity-Hot spot-Threats to biodiversity, Endemic, Endangered, Extinct species-Factors affecting Biodiversity-Destruction of Biodiversity-conservation of biodiversity.

**UNIT - V ALTERNATE ENERGY SOURCES**

Nuclear energy, Wind energy, Solar energy, Tidal energy-Harnessing methods. Geothermal, Hydro electric power, Sustainability, Green Technology, Microwave technology-Importance-current scenario in India.



**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Ravikrishnan, A	Environmental Science	Sri Krishna Hi tech Publishing Company Private Ltd., Chennai	2008
2.	Anubha kaushik C.P. kaushik	Environmental Science and Engineering	New Age International (p) Ltd., New Delhi.	2008

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Linda D. Williams	Environmental Science Demystified	Tata Mc Graw -Hill Publishing Company Limited, New Delhi.	2005
2.	Tyler Miller G. Jr	Environmental Science	Thomson & Thomson Publishers, New Delhi.	2004
3.	William P.Cunningham	Principles of Environmental Science	Tata Mc Graw -Hill Publishing Company, New Delhi.	2007
4.	Bharucha Erach	Environmental Science Demystified	Mapin Publishing Private Limited, Ahmadabad	2005
5.	Trivedi, R.K. and Goel, P.K	Introduction to Air Pollution	Techno-Science Publications.	2003

**WEBSITES:**

1. [www.clemson.edu/ces/ees](http://www.clemson.edu/ces/ees)
2. [www.ees.lanl.gov/ees11/geophysics/other/mars/marsworkshop.html](http://www.ees.lanl.gov/ees11/geophysics/other/mars/marsworkshop.html)
3. [www.newagepublishers.com/samplechapter/001281.pdf](http://www.newagepublishers.com/samplechapter/001281.pdf)
4. [www.unesco.org/ext/field/beijing/scienceb.htm](http://www.unesco.org/ext/field/beijing/scienceb.htm), [www.infinitepower.org/education.htm](http://www.infinitepower.org/education.htm)

**LIST OF EXPERIMENTS:**

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

**LIST OF EXERCISES:**

1. Exercises in shaper.
2. Exercises in Surface grinding and cylindrical grinding process.
3. Exercises in Tool grinding – single point and multi point tools.
4. Exercise in Milling.
5. Exercise in slotting.
6. Drilling / Tapping / Reaming.
7. Exercise in Capstan and Turret Lathe.

LABORATORY**INTRODUCTION TO GRAPHIC LANGUAGE**

Introduction to graphic language classification of drawing, principle of drawing, BIS specifications - IS codes for machine drawing, lines, scales, section dimensioning, standard abbreviation, Welding symbols, riveted joints, keys, fasteners – sketching of machine elements in orthographic projections, spacing of views.

**FITS AND TOLERANCES**

Fits and tolerance - allocation of fits for various mating parts - Geometric tolerance. Surface roughness, machining symbols, indication of surface roughness, drawing exercises (Manually)

**PRODUCTION DRAWING (Through software only)**

Introduction to developing and reading of production drawing of simple machine elements like helical gear, bevel gear, flange, pinion shaft, connecting rod, crankshaft, belt pulley, piston details etc. Idea about tool drawing.

**ASSEMBLY DRAWING (Through software only)**

Assembly drawing with sectioning and bill of materials from given detailed drawings of assemblies: Lathe Tail stock, Machine vice, Pedestal bearing and Drill jigs and Milling fixture.

**REFERENCES**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Bhatt N. D and Panchal V.M ,	Machine Drawing	Charotar Publishing House, Chennai	2003
2	Sham Tickoo	AutoCAD 2012: A Problem-Solving Approach	Autodesk Press	2011
3	K. Lingaiah	Machine Design Databook	McGraw-Hill Professional	2002
4	Laxmi Narayana and M.L.Mathur	A Text book of Machine Drawing	M/s. Jain Brothers, New Delhi.	1992

**INTENDED OUTCOMES:**

- To hone students' listening skills.
- To help students with intelligible pronunciation and neutral accent
- To guide students to read and comprehend articles from newspapers and magazines.
- To enhance students' professional writing skills.
- To fine tune students' speaking skills in formal and in social

**UNIT - I LISTENING COMPREHENSION**

Listening for general content – listening to fill up information – intensive listening – listening for specific information – note taking based on listening.

**UNIT - II SPEECH PROCESS**

Pronunciation – voice quality – vowels – consonants – diphthongs – stress – pause – intonation – accent.

**UNIT - III PROFESSIONAL SPEAKING**

Distinguishing between formal and informal speech – defining and describing objects and people -- self-introduction – speaking extempore on a given topic -- asking questions politely, disagreeing politely in formal contexts – speaking to a group -- giving oral presentations – group discussion – debates.

**UNIT - IV READING STRATEGIES**

Silent reading – reading comprehension with a variety of activities – cloze, fill ups, true/false questions, and one-line answers, etc. – understanding the meaning of words from the context, grasping the overall message of the text, and drawing conclusions, etc. – skimming and scanning the text – identifying the topic sentence in each paragraph – reading and understanding newspapers, magazines and scientific texts.

**UNIT - V PROFESSIONAL WRITING**

Use of appropriate vocabulary – paragraph writing – coherence and cohesion in writing – narration/description – writing business letters – proposals – summarizing – proof reading – editing.

**TEXT BOOK:**

S.NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	P Kiranmai Dutt, Geetha Rajeevan	A Course in Communication Skills. Cambridge University Press.	Cambridge University Press, New Delhi.	2009

**REFERENCES:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Paul V Anderson,	Technical Communication	Thomson and Wadsworth Publishers.	2010
2	Barun, Mitra K	Effective Technical Communication – A Guide for Scientists and Engineers	Oxford University Press, New Delhi.	2006
3	Seely, John.	The Oxford Guide to Effective Writing and Speaking	Oxford University Press, New Delhi.	2005

**WEBSITES :**

1. [www.learning-development.hr.toolbox.com](http://www.learning-development.hr.toolbox.com)
2. [www.englishclub.com](http://www.englishclub.com)
3. [www.ispeakyouspeak.blogspot.com](http://www.ispeakyouspeak.blogspot.com)
4. [www.teachertube.com](http://www.teachertube.com)
5. [www.Dictionary.com](http://www.Dictionary.com)

**INTENDED OUTCOMES:**

- To gain knowledge in measures of central tendency.
- Acquire skills in handling situations involving more than one random variable and functions of random variables.
- Be introduced to the notion of sampling distributions and have acquired knowledge of statistical techniques useful in making rational decision in management problems.
- Be exposed to statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.

**UNIT- I MEASURES OF CENTRAL TENDENCY AND PROBABILITY**

Measures of central tendency – Mean, Median, Mode and Standard Deviation – SPSS Software Demonstration.

Probability - Random variable - Axioms of probability - Conditional probability - Total probability – Baye's theorem - Probability mass function - Probability density functions.

**UNIT- II STANDARD DISTRIBUTIONS**

Binomial, Poisson, Uniform, Exponential, Gamma, and Normal distributions - Moment generating functions, Characteristic function and their properties - Functions of a random variable.

**UNIT- III TWO DIMENSIONAL RANDOM VARIABLES**

Joint distributions - Marginal and conditional distributions – Covariance - Correlation and Regression - Transformation of random variables - Central limit theorem.

**UNIT- IV TESTING OF HYPOTHESIS**

Sampling distributions – Testing of hypothesis for mean, variance, proportions and differences using Normal, t, Chi-square and F distributions - Tests for independence of attributes and Goodness of fit.

**UNIT- V DESIGN OF EXPERIMENTS**

Analysis of variance – One way classification – CRD - Two – way classification – RBD - Latin square.

*Note: Use of approved statistical tables permitted in the examination.*

**TEXT BOOKS:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Gupta, S.C. and Kapur, V.K	Fundamentals of Mathematical Statistics	Sultan Chand and Sons, New Delhi.	2007
2	Veerarajan, T.	Probability, Statistics and Random process	Tata McGraw-Hill Publications, Second Edition, New Delhi.	2002

**REFERENCES:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Walpole, R.E., Myers, R.H., Myers,R.S.L and Ye, K	Probability and Statistics for Engineers and Scientists	Pearsons Education, Delhi.	2002
2	Ross,S	A first Course in Probability	Pearson Education, Delhi (Chapters 2 to 8). New Delhi	2002
3	Johnson,R.A	Miller & Freund's Probability and Statistics for Engineers	Pearson Education, Delhi (Chapters 7, 8, 9, 12	2000

**WEBSITES :**

1. [www.ece.uoh.edu/course/ee420-500](http://www.ece.uoh.edu/course/ee420-500)
2. [www.tandfonline.com](http://www.tandfonline.com)
3. [www.mathwords.com](http://www.mathwords.com)
4. [www.mhhe.com/engcs/electrical/popoulis](http://www.mhhe.com/engcs/electrical/popoulis)
5. [http://hmdc.harvard.edu/projects/SPSS\\_Tutorial/spsstut.shtml](http://hmdc.harvard.edu/projects/SPSS_Tutorial/spsstut.shtml)

**INTENDED OUTCOMES:**

- To gain knowledge of simple stresses, strains and deformation in components due to external loads.
- To assess stresses and deformations through mathematical models of beams, twisting bars or combinations of both.
- Effect of component dimensions and shape on stresses and deformations are to be understood.

**UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS**

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

**UNIT II BEAMS - LOADS AND STRESSES**

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 – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow.

**UNIT III TORSION**

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 – stresses in helical coil springs under torsion loads

**UNIT IV BEAM DEFLECTION**

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's formula for columns

**UNIT V ANALYSIS OF STRESSES IN TWO DIMENSIONS**

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.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Punmia B.C and Jain A.K,	Strength of Materials and Theory of Structures - Vol.1	Laxmi Publications New Delhi	1992
2	Ramamrutham S and Narayan R	Strength of Materials	Dhanpat Rai and Sons., New Delhi.	2008



**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Jindal U C	Textbook on Strength of Materials	Asian Books Pvt, Ltd, Chennai.	2007
2	Don H Morris, William F Riley and Leroy D Sturges	Mechanics of Materials	John Wiley and Sons Inc.	2001
3	Popov E P	Mechanics of Materials	Prentice Hall Inc., Englewood Cliffs, New Jersey.	1976
4	Bedi D S	Strength of Materials	S Chand and Co. Ltd., New Delhi.	1984

**WEBSITES :**

1. [www.engineersedge.com](http://www.engineersedge.com)
2. <http://en.wikiversity.org>
3. [www.globalsources.com](http://www.globalsources.com)
4. [www.dspace.cusat.ac.in](http://www.dspace.cusat.ac.in)

**INTENDED OUTCOMES:**

- To provide in-depth study of thermodynamic principles, thermodynamics of state, basic thermodynamic relations, Principle of Psychrometry & Properties of pure substances
- To enlighten the basic concepts of vapour power cycles.

**UNIT I BASIC CONCEPTS AND FIRST LAW**

Basic concepts - classical and statistical approaches, scope and limitation - Thermodynamic systems - closed, open, isolated and adiabatic- property, state, process, quasi-static process, cycle, point and path function, work, energy- Zeroth law of thermodynamics – concept of temperature and heat - concept of ideal and real gases - First law of thermodynamics – application to closed and open systems, PMM1, internal energy, specific heat capacities, enthalpy, steady flow energy equation - engineering applications

**UNIT II SECOND LAW AND ENTROPY**

Physical description of the second law - Kelvin-Planck and Clausius statements - equivalence. Reversible processes and cycles. Carnot cycle – corollaries - Absolute temperature scale. Entropy – Entropy of fluids and gases - directional law of nature, Clausius inequality – Third law of thermodynamics

**UNIT III THERMODYNAMIC AVAILABILITY**

Basics – Energy in non-flow processes: Expressions for the energy of a closed system- Equivalence between mechanical energy forms and energy – Flow of energy associated with heat flow – Energy consumption and entropy generation. Energy in steady flow processes : Expressions for energy in steady flow processes – Energy dissipation and entropy generation.

**UNIT IV PROPERTIES OF PURE SUBSTANCE AND IDEAL & REAL GASES**

Pure substance, phase, phase change process, property diagrams, PVT surface-Gas mixtures-properties of ideal and real gases, equation of state, Avagadro's law, Vander Waal's equation of states, compressibility and its chart. Dalton's law of partial pressure, exact differentials-T-D, relations, Maxwell relations, Clausius Clapeyron equations, Joule Thomson Coefficient.

**UNIT V PSYCHROMETRY**

Psychrometry and psychrometric charts, property calculations of air vapour mixtures- Psychrometric process- sensible and latent heat exchange processes-Adiabatic mixing, evaporative cooling - problems.

*(Use of standard Steam table, Mollier diagram and Psychometric chart are permitted in the examination)*

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Nag.P.K	Engineering Thermodynamics	Tata McGraw-Hill, New Delhi.	2008

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Kothandaraman C.P. and Domkundwar S	Engineering Thermodynamics	Dhanpatrai & sons, New Delhi	2004
2	Holman.J.P	Thermodynamics	McGraw-Hill, NewDelhi.	1988
3	Yunus Cengel,Michael Bones	Thermodynamics-An Engineering Approach	Tata McGraw-Hill, New Delhi.	2008

**WEBSITES :**

<ol style="list-style-type: none"><li>1. <a href="http://ocw.MIT.edu">ocw.MIT.edu</a></li><li>2. <a href="http://www.qrg.northwestern.edu">www.qrg.northwestern.edu</a></li><li>3. <a href="http://www.itiomar.it">www.itiomar.it</a></li><li>4. <a href="http://me.cramster.com">me.cramster.com</a></li></ol>
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**INTENDED OUTCOMES:**

- To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching
- To understand the basic concepts of computer numerical control (CNC) machine tool and CNC programming.

**UNIT I THEORY OF METAL CUTTING**

Introduction: material removal processes, types of machine tools – theory of metal cutting: chip formation, orthogonal cutting, oblique cutting, cutting tool materials, tool wear, tool life, surface finish, cutting fluids, heat generation, Merchant circle.

**UNIT II CENTRE LATHE AND SPECIAL PURPOSE LATHES**

Centre lathe, constructional features, cutting tool geometry, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes – automats – single spindle, Swiss type, automatic screw type, multi spindle - Turret Indexing mechanism, Bar feed mechanism.

**UNIT III OTHER MACHINE TOOLS**

Reciprocating machine tools: shaper, planer, slotter - Milling : types, milling cutters, operations - Hole making : drilling - Quill mechanism , Reaming, Boring, Tapping - Sawing machine: hack saw, band saw, circular saw; broaching machines: broach construction – push, pull, surface and continuous broaching machines

**UNIT IV ABRASIVE PROCESSES AND GEAR CUTTING**

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding – honing, lapping, super finishing, polishing and buffing, abrasive jet machining - Gear cutting, forming, generation, shaping, hobbing - Precision and high speed machining

**UNIT V CNC MACHINE TOOLS AND PART PROGRAMMING**

Numerical control (NC) machine tools – CNC: types, constructional details, special features – design considerations of CNC machines for improving machining accuracy – structural members – Part programming fundamentals – manual programming – computer assisted part programming – Macro programming.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Hajra Choudhury	Elements of Workshop Technology Vol- II	Media Promoters Pvt Ltd., Mumbai	2002
2	HMT	Production Technology	Tata McGraw-Hill	2001

**REFERENCE BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	P.C. Sharma	A text book of production technology	S. Chand and Co. Ltd	2008
2	Shrawat N.S. and Narang J.S	CNC Machines	Dhanpat Rai & Co	2002
3	P.N.Rao	CAD/CAM Principles and Applications'	TATA Mc Craw Hill	2007
4	Milton C.Shaw	Metal Cutting Principles Second Edition	Oxford University Press	2005

**WEBSITES :**

1. [www.steelonline.co.in](http://www.steelonline.co.in)
2. <http://mmu.ic.polyu.edu.hk>
3. [www.waterjetindiana.com](http://www.waterjetindiana.com)
4. [www.teskolaser.com](http://www.teskolaser.com)
5. [www.cncinformation.com](http://www.cncinformation.com)
6. [www.cncmachineprogramming.net](http://www.cncmachineprogramming.net)

**INTENDED OUTCOMES:**

- To understand the layout of linkages in the assembly of a system/machine.
- To study the principles involved in assessing the displacement, velocity and acceleration at any point in a link of a mechanism
- To analyse the motion resulting from a specified set of linkages in a mechanism.

**UNIT I BASICS OF MECHANISMS**

Terminology and Definitions-Degree of Freedom - Mobility-Kutzbach criterion-Grashoff's law-Kinematic Inversions of 4-bar chain and slider crank -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**

Displacement, velocity and acceleration - analysis in simple mechanisms - Graphical Method - velocity and acceleration polygons - Kinematic analysis by Complex Algebra methods-Vector Approach, Computer applications in the kinematic analysis of simple mechanisms- Instantaneous center – Coriolis Acceleration.

**UNIT III KINEMATICS OF CAM**

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**

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-Parallel axis gear trains-Epicyclic gear trains-Differentials

**UNIT V FRICTION**

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.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Rattan S.S	Theory of Machines	Tata McGraw-Hill Publishing Company Ltd., New Delhi.	2009
2	Shigley J.E and Uicker J J	Theory of Machines and Mechanisms	McGraw-Hill, Inc, New York.	1995

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Thomas Bevan	Theory of Machines	CBS Publishers and Distributors, New Delhi.	1996
2	Ghosh A and Mallick A.K,	Theory of Mechanisms and Machines	Affiliated East-West Pvt. Ltd., New Delhi.	1988
3	Rao J.S and Dukkupati R.V	Mechanism and Machine Theory	Wiley-Eastern Ltd., New Delhi.	1992
4	John Hannah and Stephens R.C	Mechanics of Machines Viva Low-Prices Student Edition	Wiley-Eastern. Ltd., New Delhi .	1999

**STANDARDS :**

IS 2458 : 2001, Vocabulary of Gear Terms – Definitions Related to Geometry

IS 3756 : 2002, Method of Gear correction – Addendum modification for External Cylindrical Gears with Parallel Axes.

IS 5267 : 2002 Vocabulary of Gear Terms – Definitions Related to Worm Gear Geometry.

IS 12328 : Part 1: 1988 Bevel Gear Systems Part – 1 Straight Bevel Gears.

IS 12328 : Part 2: 1988 Bevel Gear Systems Part – 2 Spiral Bevel Gears

**INTENDED OUTCOMES:**

- To understand the basic concepts of different types of electrical machines and their performance.
- To study the different methods of starting D.C motors and induction motors.
- To study the conventional and solid-state drives.

**UNIT I INTRODUCTION**

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

**UNIT II DRIVE MOTOR CHARACTERISTICS**

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.

**UNIT III STARTING METHODS**

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

**UNIT IV SPEED CONTROL OF D.C.DRIVES**

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications.

**UNIT V SPEED CONTROL OF A.C. DRIVES**

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Vedam Subramaniam	Electric Drives (concepts and applications)	Tata McGraw-Hill, New Delhi.	2001
2	Nagrath I.J. and Kothari D.P,	Electrical Machines	Tata McGraw- Hill, New Delhi	2004

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Pillai.S.K,	A first course on Electric drives	Wiley Eastern Limited, New Delhi.	1998.
2	Singh M.D and Khanchandani K.B,	Power Electronics	Tata McGraw-Hill, New Delhi.	2003



**12BEME411 STRENGTH OF MATERIALS & METALLURGY LABORATORY 0 0 3 2 100**

1. Tensile test on metals-stress strain characteristics
2. Cupping test on metal sheets-load deformation characteristics, cupping load, cupping number.
3. Hardness test on metals-Brinell, Vicker and Rockwell Hardness tests.
4. Impact test on metals-Charpy, Izod impact tests.
5. Shear test on metals-direct shear strength, single shear, double shear.
6. Tests on helical springs-compression, tension springs-load deformation characteristics, stiffness, shear stress, modulus of rigidity, energy.
7. Torsion test on beams-torque and angle of twist characteristics, shear stress, modulus of rigidity, energy.
8. Microscopic examination of i) Hardened samples ii) Hardened and tempered samples.
9. Tempering – Improvement of Mechanical properties –Comparison for i) Unhardened specimen ii) Quenched specimen iii) Quenched and tempered specimen.
10. Study of low carbon steel and medium carbon steel.

**12BEME412 ELECTRICAL DRIVES AND CONTROL LABORATORY 0 0 3 2 100**

**LIST OF EXPERIMENTS:**

1. Load Test on DC Shunt Motor
2. Load Test on DC Series Motor
3. Load Test on DC Compound Motor
4. Speed control of D.C. motor. (Armature and Field control)
5. Speed control of D.C. motor. (Ward-Leonard Method)
6. Speed control of three phase Induction motor. (Voltage Control)
7. Speed control of three phase Induction motor. (Voltage / frequency Control)
8. Load test on single phase Induction Motor.
9. Load test on three phase Induction Motor.
10. Speed control of three phase slip ring Induction Motor.

**INTENDED OUTCOMES:**

- To help students comprehend the role of listening skills in effective communication
- To familiarize students with verbal and non-verbal communication
- To expose students to neutral accent.
- To develop emotional intelligence skills in them for enhancing their self-esteem
- To assist them in setting goals and developing positive attitude.
- To enable students acquire decision making skills, problem solving skills and assertive skills.

**UNIT - I THE ART OF LISTENING**

The art of listening -the importance of listening - the difference between listening and hearing - barriers to listening - remedies for listening problems - listening through English.

**UNIT - II VERBAL AND NON-VERBAL COMMUNICATION**

Non-verbal communication - eye contact - facial expressions - posture - gestures - body language - etiquette.

Verbal communication - importance of voice modulation - accent - diction - functional grammar - sentence construction - effective vocabulary, idioms, phrases, jargons - how to get others to listen.

**UNIT - III INTRAPERSONAL AND INTERPERSONAL SKILLS**

Intrapersonal skills - self-analysis - understanding one's potential and limitations - developing problem solving skills - ability to self-reflect - self-control - thought process - improving self-esteem.

Interpersonal skills - confidence building - resolving conflicts - handling difficult people - valuing diversity - adaptability and flexibility.

**UNIT - IV GOAL SETTING AND POSITIVE ATTITUDE**

Difference between goals and dreams – SMART goal setting – 3 Ds of goal setting- Determination, Discipline and Direction -- developing the right attitude – motivation – intrinsic and extrinsic motivation – dealing with change – dedication – taking responsibilities – decision making.

**UNIT - V MANAGERIAL SKILLS**

Analytical skills – team player – leadership skills – planning/organizing – ability to work independently – professionalism – preparing the résumé – writing the covering letter – communicating via e-mail.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Dhanavel, S.P.	English and Soft Skills	Orient Black Swan Ltd, Hyderabad.	2010

**REFERENCES:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Jagadeesan, G & Santanakrishnan,R.	Soft Skills Development: Training and Evaluation.	The ICFAI University Press, Hyderabad.	2008
2	Sherfield, Robert M., Rhonda J. Montgomery, & Patricia G. Moody	Developing Soft Skills.	Pearson Education, New Delhi.	2005
3	Murthy, G .R. K.	Soft Skills for Success.	The ICFAI University Press, Hyderabad.	2008

**WEBSITES :**

1. [www.englishclub.com](http://www.englishclub.com)
2. [www.ispeakyouspeak.blogspot.com](http://www.ispeakyouspeak.blogspot.com)
3. [www.teachertube.com](http://www.teachertube.com)
4. [www.learning-development.hr.toolbox.com](http://www.learning-development.hr.toolbox.com)
5. [www.Dictionary.com](http://www.Dictionary.com)

**INTENDED OUTCOMES:**

- To make the students acquainted with the basic concepts in numerical methods and their uses.
- To impart the procedure for solving different kinds of problems occur in engineering numerically.

**UNIT- I TYPES OF ERRORS, SOLUTION OF ALGEBRAIC EQUATIONS**

Different types of errors- Newton Raphson method, Modified Newton Raphson method, Method of false position.

**UNIT -II SOLUTION OF ALGEBRAIC SIMULTANEOUS EQUATIONS**

Gauss - Jordan elimination, Cholesky method, Crout's method, Gauss - Jacobi method, Gauss - Seidel method. Matrix Inverse by Gauss - Jordan method.

Eigenvalues and eigenvectors: Power method for finding dominant eigenvalue and inverse power method for finding smallest eigenvalue, Jacobi method for symmetric matrices.

**UNIT- III FINITE DIFFERENCES AND INTERPOLATION**

Finite difference operators  $-E, \Delta, \nabla, \delta, \mu, D$  - Interpolation-Newton-Gregory forward and backward interpolation, Lagrange's interpolation formula, Newton divided difference interpolation formula.

**UNIT- IV DIFFERENTIATION AND INTEGRATION**

Numerical differentiation using Newton-Gregory forward and backward polynomials. Numerical Integration-Gaussian quadrature, Trapezoidal rule and Simpson's one third rule.

Ordinary differential equations: Taylor series method, Euler and Modified Euler method, (Heun's method). Runge-Kutta method, Milne's method, Adams-Moulton method, Solution of boundary value problems of second order by finite difference method.

**UNIT- V PARTIAL DIFFERENTIAL EQUATIONS**

Classification of partial differential equations of second order. Liebmann's method for Laplace equation and Poisson equation, Explicit method and Crank - Nicolson method for parabolic equations. Explicit method for hyperbolic equations.

MATLAB : Matlab – Toolkits – 2D Graph Plotting – 3D Graph Plotting.

**TEXT BOOKS:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Gerald,C.F. and Wheatley,P.O	Applied Numerical Analysis	Pearson Education Asia, New Delhi	2002
2	Balagurusamy.E	Numerical Methods	Tata McGraw Hill Pub.Co.Ltd, New Delhi	2009

**REFERENCES:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Steven C.Chapra and Raymond P.Canale	Numerical Methods for Engineers with Software and Programming Applications	Tata McGraw Hill, New Delhi	2004
2	Kandaswamy, P., Thilagavathy, K. and Gunavathi, K.	Numerical Methods	S. Chand Publishing, New Delhi.	2010

**WEBSITES :**

1. [www.nr.com](http://www.nr.com)
2. [www.numerical-methods.com](http://www.numerical-methods.com)
3. [www.math.ucsb.edu](http://www.math.ucsb.edu)
4. [www.mathworks.com](http://www.mathworks.com)

**INTENDED OUTCOMES:**

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into the analysis of cyclic process.
- To apply the thermodynamic concepts into various thermal applications like Steam turbines, Compressors and Refrigeration and Air conditioning Systems.

**UNIT I      GAS POWER CYCLES**

Stirling, Ericsson, Otto, Diesel, Dual, Lenoir, Atkinson, Brayton cycles - Calculation of mean effective pressure and air standard efficiency - actual and theoretical PV diagrams of four stroke and two stroke engines.

**UNIT II      INTERNAL COMBUSTION ENGINES**

Classification of I.C engines, four stroke and two stroke cycle engines - combustion phenomenon and characteristics - combustion chamber design in SI and CI engine - detonation, knocking, delay period - timing diagrams – super-charging - ignition system and fuel injection system. Engine tests - performance, heat balance, retardation - Morse test.

**UNIT III      NOZZLES, TURBINES & STEAM POWER CYCLES**

Steam nozzles- flow through steam nozzles, effect of friction, critical pressure ratio, super saturated flow - Steam turbines- impulse and reaction turbine, compounding, velocity diagram, condition for maximum efficiency - multi stage turbines, conditional lines, cycles with reheating and regenerating heating - reheat factor, degree of reaction, governing of turbines - Steam power cycle-properties of steam, Rankine Cycle - Determination of Dryness fraction of steam.

**UNIT IV      AIR COMPRESSORS**

Classifications of compressors - Reciprocating air compressor - performance characteristics, effect of clearance volume, free air delivery and displacement, intercooler, after cooler - Rotary compressor - vane type, centrifugal and axial, flow performance characteristics - Screw compressor - performance characteristics

**UNIT V      REFRIGERATION AND AIR CONDITIONING**

Fundamentals of refrigeration – COP - Vapour compression refrigeration system - cycle, p-h chart, Vapour absorption system- comparison, properties of refrigerants. Fundamentals of air conditioning system, cycle, controls, air handling and distribution, simple cooling and heat load estimation

*(Use of standard thermodynamic table, Mollier diagram, Psychometric chart and Refrigeration property table is permitted in the examination)*

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Rajput R.K	Thermal Engineering Sixth edition	Laxmi Publications, New Delhi.	2010
2	Arora C.P	Refrigeration and Air conditioning	Tata McGraw-Hill, New Delhi.	2002

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Kothandaraman C.P, Domkundwar and Domkundwar A.V	A course in Thermal Engineering Fifth Edition	Dhanpat Rai & Sons, Delhi.	2002
2	Ganesan V	Internal Combustion Engines	Tata McGraw-Hill, New Delhi.	2008
3	Cengel	Thermodynamics An Engineering Approach	Third Edition, Tata McGraw Hill, New Delhi.	2008

**WEBSITES :**

1. [www.kruse-ltc.com](http://www.kruse-ltc.com)
2. [www.grc.nasa.gov](http://www.grc.nasa.gov)
3. [www.poweronsite.org](http://www.poweronsite.org)
4. [www.machinerylubrication.com](http://www.machinerylubrication.com)
5. [www.tpub.com](http://www.tpub.com)
6. [www.engineeringtoolbox.com](http://www.engineeringtoolbox.com)
7. [www.scribd.com/](http://www.scribd.com/)

**INTENDED OUTCOMES:**

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components

**UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS**

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – Design of curved beams – crane hook and ‘C’ frame - Factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations.

**UNIT II DESIGN OF SHAFTS AND COUPLINGS**

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways - Design of rigid and flexible couplings – Introduction to gear and shock absorbing couplings - design of knuckle joints.

**UNIT III DESIGN OF FASTNERS AND WELDED JOINTS**

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

**UNIT IV DESIGN OF SPRINGS AND LEVERS**

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

**UNIT V DESIGN OF BEARINGS AND FLYWHEELS**

Selection of bearings – sliding contact and rolling contact types – Cubic mean load – Selection of journal bearings – McKees equation – Lubrication in journal bearings – calculation of bearing dimensions – Design of flywheels involving stresses in rim and arm.

*(Use of standard data books is permitted in the examination)*

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Juvinall R.C and Marshek K.M	Fundamentals of Machine Component Design Third Edition	John Wiley & Sons, New Delhi.	2002
2	Bhandari V.B,	Design of Machine Elements	Tata McGraw-Hill Book Co, New Delhi.	2003



**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Norton R.L	Design of Machinery	Tata McGraw-Hill Book Co., New Delhi.	2004
2	Orthwein W	Machine Component Design	Jaico Publishing Co., New Delhi.	2003
3	Ugural A.C,	Mechanical Design – An Integral Approach	McGraw-Hill Book Co., New York.	2004
4	Spotts M.F, Shoup T.E,	Design and Machine Elements	Pearson Education, New Delhi.	2004

**WEBSITES :**

1. [www.roymech.co.uk](http://www.roymech.co.uk)
2. [www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov)
3. [www.engineersedge.com](http://www.engineersedge.com)
4. [www.bearings.machinedesign.com](http://www.bearings.machinedesign.com)
5. [www.efunda.com](http://www.efunda.com)

**INTENDED OUTCOMES:**

- To make the students to understand the principles of metrology and measurements.
- To expose the students to the methods of measurement and its application in manufacturing industries.
- To enable the students to use LASER technology in measurements.

**UNIT I CONCEPT OF MEASUREMENT**

General concept – generalised measurement system- units and standards-measuring instruments-sensitivity, readability, range of accuracy, precision-static and dynamic response-repeatability-systematic and random errors - correction, calibration, interchangeability.

**UNIT II LINEAR AND ANGULAR MEASUREMENT**

Definition of metrology-Linear measuring instruments: Vernier, micrometer, interval measurement, Slip gauges and classification, interferometry, optical flats, limit gauges- Comparators: Mechanical, pneumatic and electrical types, applications - Angular measurements: -Sine bar, optical bevel protractor, angle Decker – Taper measurements.

**UNIT III FORM MEASUREMENT**

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.

**UNIT IV LASER AND ADVANCES IN METROLOGY**

Precision instruments based on laser-Principles- laser interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection.

**UNIT V MEASUREMENT OF POWER, FLOW AND TEMPERATURE RELATED PROPERTIES**

Force, torque, power:-mechanical, pneumatic, hydraulic and electrical type-Flow measurement: Venturi, orifice, rotameter, pitot tube –Temperature: bimetallic strip, pressure thermometers, thermocouples, electrical resistance thermister.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Jain R.K	Engineering Metrology	Khanna Publishers, Delhi.	2002
2	Alan S. Morris	The Essence of Measurement	Prentice Hall of India, New Delhi.	1997

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Gupta S.C	Engineering Metrology	Dhanpat rai Publications, New Delhi.	2005
2	Tayal A.K,	Instrumentation and Mechanical Measurements	Galgotia Publications, New Delhi.	2000
3	Beckwith T.G and N. Lewis Buck N	Mechanical Measurements	Addison Wesley, New york.	2006
4	Donald D Eckman	Industrial Instrumentation	ASTM Hand Book, Wiley Eastern, New Delhi.	1990

**WEBSITES :**

1. [www.tms.org](http://www.tms.org)
2. [www.arci.res.in/](http://www.arci.res.in/)
3. [www.fbh-berlin.com](http://www.fbh-berlin.com)
4. [www.lasermetrology.com/](http://www.lasermetrology.com/)
5. [www.lasermetrology.com/](http://www.lasermetrology.com/)

**INTENDED OUTCOMES:**

- To make the students to understand the concepts of multi cylinder engines.
- To understand the working of various components, mechanisms suspension and braking systems.

**UNIT I AUTOMOBILE ARCHITECTURE AND PERFORMANCE**

Automotive components, subsystems and their positions - Chassis, frame and body, front, rear and four wheel drives - Operation and performance - Traction force and traction resistance, Power required for automobile-Rolling, air and gradient resistance.

**UNIT II TYPES OF ENGINE**

Types of engine - multi valve engine - in-line engine, vee-engine, Petrol engine-direct - single point and multipoint injection, diesel engine-common rail diesel injection, supercharging and turbo charging - alternate fuels-ethanol and ethanol blend, compressed natural gas, fuel cells, hybrid vehicles.

**UNIT III TRANSMISSION SYSTEMS**

Clutch : Types - coil spring and diaphragm type clutch, single and multi plate clutch, centrifugal clutch, Gear box : Types - constant mesh, sliding mesh and synchromesh gear box, layout of gear box, gear selector and shifting mechanism, overdrive, automatic transmission, Propeller shaft, universal joint, slip joint, differential and real axle arrangement, hydraulic coupling.

**UNIT IV WHEEL AND TYRES AND SUSPENSION SYSTEM**

Types of wheels, construction, wired wheels, Tyres- construction, Radial, bias & belted bias, slip angle, Tread patterns, Tyre retreading cold & hot, Tubeless tyres Types-front and rear suspension, conventional and independent type suspension, leaf springs, coil springs, dampers, torsion bars, stabilizer bars, arms, air suspension systems.

**UNIT V STEERING SYSTEM AND BRAKING SYSTEM**

Types of steering systems, Ackermann principle, Davis steering gear, steering gear boxes, steering linkages, power steering, wheel geometry-caster, camber toe-in, toe out etc., wheel Alignment and balancing. Braking System - Forces on vehicles, tyre grip, load transfer, braking distribution between axles, stopping distance, Types of brakes, Mechanical, Hydraulic, Air brakes, Disc & Drum brakes, Engine brakes anti lock braking system.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Gupta R.B	Automobile Engineering	Satya Prakashan, Laxmi Publications, chennai .	2004
2	Kirpal Singh	Automobile Engineering Vol-I & II	Standard publishers, Delhi.	1997

**REFERENCES:**

<b>S.NO</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Julian Happian Smith	An introduction to modern vehicle design	Butterworth Heinemann, New Delhi.	2002
2	Crouse W H,	Automotive transmissions and power trains	Mc-Graw Hill Book Co., NewDelhi.	1976
3	Heniz Heisler	Vehicle and Engine Technology	Society of Automotive Engineers	1999

**WEBSITES :**

1. [http://en.wikipedia.org/wiki/Automotive\\_engineering](http://en.wikipedia.org/wiki/Automotive_engineering)
2. <http://www.animatedengines.com/>
3. <http://www.automotive-online.com/transmission-system/>
4. <http://www.rqriley.com/suspensn.htm>
5. [http://en.wikipedia.org/wiki/Transmission\\_\(mechanics\)](http://en.wikipedia.org/wiki/Transmission_(mechanics))

**INTENDED OUTCOMES:**

- To understand the force-motion relationship in components subjected to External Forces
- To analyse the force-motion characteristics of standard mechanisms
- To study the undesirable effects of unbalances resulting from prescribed motions in mechanism.

**UNIT I FORCE ANALYSIS**

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**

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 VIBRATION**

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 systems; Natural frequency of two and three rotor systems.

**UNIT IV FORCED VIBRATION**

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

**UNIT V MECHANISMS FOR CONTROL**

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors –Characteristics - Effect of friction - Controlling Force - other Governor mechanisms. Gyroscopes - Gyroscopic forces and Torques - Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Rattan S.S	Theory of Machines	Tata McGraw-Hill Publishing Company Ltd., New Delhi.	2009
2	Shigley J.E. and Uicker J.J	Theory of Machines and Mechanisms	McGraw-Hill, New York.	1995

**REFERENCES:**

<b>S.NO</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Rao J.S. and Dukkipati R.V	Mechanism and Machine Theory	Wiley- Eastern Limited, New Delhi.	2007
2	John Hannah and Stephens R.C	Mechanics of Machines	Viva Books Pvt Ltd.	2005
3	Thomas Bevan	Theory of Machines	CBS Publishers and Distributors, New Delhi.	1996

**WEBSITES :**

- |   |
|---|
| <ol style="list-style-type: none"><li>1. <a href="http://freevideolectures.com/Course/2364/Dynamics-of-Machines">http://freevideolectures.com/Course/2364/Dynamics-of-Machines</a></li><li>2. <a href="http://en.wikipedia.org/wiki/Balancing_of_rotating_masses">http://en.wikipedia.org/wiki/Balancing_of_rotating_masses</a></li><li>3. <a href="http://www.efunda.com/formulae/vibrations/sdof_free_damped.cfm">http://www.efunda.com/formulae/vibrations/sdof_free_damped.cfm</a></li><li>4. <a href="http://www.roymech.co.uk/Useful_Tables/Vibrations/Free_Vibrations.html">http://www.roymech.co.uk/Useful_Tables/Vibrations/Free_Vibrations.html</a></li></ol> |
|---|

**LIST OF EXPERIMENTS OF DYNAMICS**

1. Governors - Determination of sensitivity, effort, etc. for Watt, Porter, Proell, and spring controlled Governors
2. Cam – Determination of jump speed and profile of the cam.
3. Motorized Gyroscope-Verification of laws -Determination of gyroscopic couple.
4. Whirling of shaft-Determination of critical speed of shaft with concentrated loads.
5. Balancing of rotating and reciprocating masses.
6. Determination of moment of inertia by oscillation method for connecting rod and flywheel.
7. Vibrating system - spring mass system - Determination of damping co-efficient of single degree of freedom system
8. Determination of torsional frequencies for compound pendulum and flywheel system with lumped moment of inertia.
9. Transverse vibration –free- Beam. Determination of natural frequency and deflection of beam.
10. Strain gauge measurement system.

**LIST OF EXPERIMENTS OF METROLOGY**

1. Calibration of vernier / Micrometer / Dial gauge
2. Checking dimensions of part using slip gauges
3. Measurement of gear tooth dimensions – addendum, dedendum, pitch circle diameter and tooth thickness
4. Measurement of taper angle using sine bar / tool makers microscope
5. Measurement of straightness and flatness
6. Measurement of thread parameters
7. Checking the limits of dimensional tolerances using comparators (Mechanical / Pneumatic / Electrical)
8. Surface finish measurement



**LIST OF EXPERIMENTS:**

1. Valve Timing and Port Timing Diagrams.
2. Performance Test on 4-stroke Diesel Engine.
3. Heat Balance Test on 4-stroke Diesel Engine.
4. Load test on 4-stroke Diesel Engine.
5. Morse Test on multicylinder Petrol Engine.
6. Retardation Test to find Frictional Power of a Diesel Engine.
7. Determination of Viscosity – Red Wood Viscometer.
8. Determination of Flash Point and Fire Point.
9. Study of Steam Generators and Turbines.
10. Performance and energy balance test on a steam generator

**INTENDED OUTCOMES:**

- To equip the students with effective technical presentation
- To understand the barriers and bridges to communication
- To improve the public speaking capabilities, body language and posture

During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for duration of about 8 to 10 minutes. In a session of three periods per week, 15 students are expected to present the seminar. A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.

Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models.

Students will undergo industrial training for four weeks during the vacation at the end of IV semester and a report with the training completion certificate from the industry will be subsequently submitted to the department with in a week after completion. Viva – Voce exam will be conducted at the end of V semester and 100 marks will be awarded.

**INTENDED OUTCOMES:**

- To know the concepts of Linear programming technique
- To study the applications and use of Assignment, Transportation
- To know the techniques of PERT, CPM and Inventory control

**UNIT – I INTRODUCTION TO OPERATIONS RESEARCH**

Operations research and decision-making - types of mathematical models and constructing the model - Role of computers in operations research -Linear Programming Techniques: Formulation of linear programming problem, applications and limitations, graphical method, simplex method - The Big –M method - the two–phase method, dual problems –Introduction to OR software’s

**UNIT – II TRANSPORTATION PROBLEMS**

Least cost method, North west corner rule, Vogel’s approximation method, modified distribution method, optimization models, unbalance and degeneracy in transportation model.

**UNIT – III ASSIGNMENT MODELS AND SCHEDULING**

Difference between transportation problem and assignment problem, Hungarian algorithm, unbalanced assignment problems maximization case in assignment problems, traveling salesman problem. Scheduling - processing n jobs through two machines, processing n jobs through three machines, processing two jobs through ‘m’ machines, processing n jobs through m machines.

**UNIT – IV INVENTORY CONTROL AND QUEUING THEORY**

Variables in inventory problems, inventory models with penalty, shortage and quantity discount, safety stock, inventory models with probability, lead time, demand, multi item deterministic model.

Queuing Models: Queues – Notation of queues, performance measures, The M/M/1 queue, The M/M/m queue, batch arrival queuing system, queues with breakdowns.

**UNIT – V PROJECT MANAGEMENT, GAME THEORY, REPLACEMENT MODELS**

Basic terminologies, constructing a project network, network computations in CPM and PERT, cost crashing - Game Theory: Theory of games, competitive games, rules for game theory, mixed strategies, two person zero sum game, n person zero sum game - Replacement Models: Replacement of Items due to deterioration with and without time value of Money, Group replacement policy, Staff replacement

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Kanti Swarup, Gupta P.K and Manmohan	Operations Research	Sultan Chand and Sons, New Delhi.	2008

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Viswanathan N and Narahari Y	Performance Modeling of Automated Manufacturing Systems	Prentice Hall Inc, Newyork.	2000
2	Dharani Venkatakrishnan S	Operations Research	Keerthi Publication House, Coimbatore.	2000
3	Prem kumar Gupta and Hira D.S	Operation Research	S Chand and Company Limited, New Delhi.	2004

**WEBSITES :**

<ol style="list-style-type: none"><li>1. <a href="http://www.scienceofbetter.org/what/index.htm">http://www.scienceofbetter.org/what/index.htm</a></li><li>2. <a href="http://www.informs.org/Pubs/OR">http://www.informs.org/Pubs/OR</a></li><li>3. <a href="http://www.me.utexas.edu/~jensen/ORMM/models/unit/network/subunits/special_cases/transportation.html">http://www.me.utexas.edu/~jensen/ORMM/models/unit/network/subunits/special_cases/transportation.html</a></li><li>4. <a href="http://www.projectmanagement.com/">http://www.projectmanagement.com/</a></li></ol>
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**INTENDED OUTCOMES:**

- To gain knowledge on the principles and procedure for the design of power transmission components.
- To understand the standard procedure available for design of transmission systems.
- To learn to use standard data and catalogues

**UNIT I DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS**

Selection of V belts and pulleys - selection of Flat belts and pulleys - Wire ropes and pulleys – Selection of Transmission chains and Sprockets - Design of pulleys and sprockets.

**UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS**

Gear Terminology - Speed ratios and number of teeth-Force analysis - Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials – Module and Face width-power rating calculations based on strength and wear considerations - Parallel axis Helical Gears – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces and stresses - Estimating the size of the helical gears.

**UNIT III BEVEL, WORM AND CROSS HELICAL GEARS**

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

**UNIT IV DESIGN OF GEAR BOXES**

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box -Constant mesh gear box. – Design of multi speed gear box.

**UNIT V DESIGN OF CAM, CLUTCHES AND BRAKES**

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

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Juvinall R. C, Marshak K.M	Fundamentals of Machine component Design	Third Edition, John Wiley & Sons., London	2002
2	Bhandari, V.B,	Design of Machine Elements	Tata McGraw-Hill Publishing Company Ltd, New York.	2008

**REFERENCES:**

<b>S.NO</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Maitra G.M., Prasad L.V	Hand book of Mechanical Design	Tata McGraw-Hill, New Delhi.	2009
2	Shigley J.E and Mischke C.R,	Mechanical Engineering Design	McGraw-Hill International Editions, New Delhi.	2003
3	Prabhu. T.J	Design of Transmission Elements	Mani Offset, Chennai.	2000

**WEBSITES :**

1. <http://en.wikipedia.org/wiki/Gear>
2. <http://www.physicsforums.com/showthread.php?t=292163>
3. <http://www.seminarprojects.com/Thread-design-and-fabrication-of-gearbox-full-report>
4. <http://www.cs.cmu.edu/~rapidproto/mechanisms/chpt6.html>

**INTENDED OUTCOMES:**

- To understand various sensors and transducers
- To understand the various components of automation system
- To understand the concept of monitoring/controlling
- To understand the various applications of mechatronics

**UNIT I MECHATRONICS SENSORS AND TRANSDUCERS**

Introduction to Mechatronics - Systems – Measurement Systems – Control Systems –Traditional design - Microprocessor based Controllers. Introduction to sensors - Performance Terminology – Displacement - Position and Proximity – Velocity and Motion - Fluid Pressure - Temperature Sensors – Light Sensors - Selection of Sensors – Signal processing – Servo systems.

**UNIT II ACTION SYSTEM AND SYSTEM MODELS**

Introduction - Electrical Actuation Systems - Mechanical Switches - Solid State Switches - Solenoids – D.C Motors - A.C Motors - Stepper Motors. Introduction - Building block of Mechanical, Electrical, Fluid and Thermal Systems, Rotational - Transnational Systems, Electromechanical Systems - Hydraulic - Mechanical Systems.

**UNIT III MICROPROCESSORS IN MECHATRONICS**

Introduction - Architecture - pin configuration Instruction set – Programming of Microprocessors using 8085 instructions – Interfacing. Input and output devices - interfacing D/A converters and A/D converters – Application – Temperature control – Stepper motor.

**UNIT IV CONTROLLERS**

Introduction -Continuous and discrete process Controllers - Control Mode - Two - Step mode - Proportional Mode -Derivative Mode - Integral Mode - PID Controllers -Digital Controllers - Adaptive Control - Digital Logic Control - Micro Processors Control. Introduction to PLC - Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters - Data Handling – Analog Input / Output – Selection of a PLC.

**UNIT V DESIGN OF MECHATRONICS SYSTEMS**

Stages in designing Mechatronics Systems - Traditional and Mechatronic Design - Possible Design Solutions - Case Studies of Mechatronics Systems, Pick and place robot - automatic Car Park Systems - Engine Management Systems.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Bolton W	Mechatronics	Pearson Education, Delhi.	2003

**REFERENCES:**

<b>S.NO</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Michael B. Hiland and David G. Alciatore	Introduction to Mechatronics and Measurement Systems	McGraw-Hill International Editions, New York.	2007
2	Bradley D, Dawson A.D, Buru N.C and Loader A.J	Mechatronics	Chapman and Hall, Pearson Education Asia, New Delhi.	2000
3	Ghosh P.K and Sridhar P.R	Introduction to Microprocessors for Engineers and Scientist	Prentice Hall of India, New Delhi.	2004

**WEBSITES :**

1. <a href="http://www.cs.indiana.edu">www.cs.indiana.edu</a>
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**INTENDED OUTCOMES:**

- To understand the application of various experimental heat transfer correlations in engineering applications.
- To learn the thermal analysis and sizing of heat exchangers.
- To understand the basic concepts of mass transfer.

**UNIT I CONDUCTION**

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – General Differential equation of Heat Conduction – Fourier Law of Conduction – Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems – Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Use of Heislers Chart.

**UNIT II CONVECTION**

Basic Concepts – Convective Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – Dimensional Analysis – External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar and Turbulent Flow – Combined Laminar and Turbulent – Flow over Bank of tubes – Free Convection – Dimensional Analysis – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

**UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**

Nusselts theory of condensation-pool boiling, flow boiling, correlations in boiling and condensation. Types of Heat Exchangers – LMTD Method of heat Exchanger Analysis – Effectiveness – NTU method of Heat Exchanger Analysis – Overall Heat Transfer Coefficient – Fouling Factors.

**UNIT IV RADIATION**

Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoff Law –Black Body Radiation – Grey body radiation Shape Factor Algebra – Electrical Analogy – Radiation Shields –Introduction to Gas Radiation.

**UNIT V MASS TRANSFER**

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

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Sachdeva R.C	Fundamentals of Engineering Heat and Mass Transfer	New Age International, New Delhi.	2009



**REFERENCES:**

<b>S.NO</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Frank P. Incropera and David P. DeWitt	Fundamentals of Heat and Mass Transfer	John Wiley and Sons, New Delhi.	2011
2	Ozisik M.N	Heat Transfer	McGraw-Hill Book Co, New Delhi.	1994
3	Kothandaraman C.P	Fundamentals of Heat and Mass Transfer	New Age International, New Delhi	2008

**WEBSITES :**

1. [http://nptel.iitm.ac.in/courses/Webcourse-contents/IISc-BANG/Heat%20and%20Mass%20Transfer/New\\_index1.html](http://nptel.iitm.ac.in/courses/Webcourse-contents/IISc-BANG/Heat%20and%20Mass%20Transfer/New_index1.html)
2. <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv084-Page1.htm>
3. [http://en.wikipedia.org/wiki/Heat\\_transfer](http://en.wikipedia.org/wiki/Heat_transfer)

**MANAGEMENT****INTENDED OUTCOMES:**

- To learn about the basics of economics and cost analysis related to engineering so as to take economically sound decisions.
- To make the students to understand capital market, break even point analysis and depreciation.

**UNIT 1 FUNDAMENTALS OF ENGINEERING ECONOMICS**

Introduction to Engineering Economics – Definition and Scope – Significance of Engineering Economics- Demand and supply analysis-Definition – Law of Demand – Elasticity of Demand – Demand Forecasting - Supply – Law of supply – Elasticity of Supply – Market Mechanism.

**UNIT II FINANCIAL MANAGEMENT**

Objectives: and functions of financial management – financial statements, working capital management – factors influencing working capital requirements – estimation of working capital - Cost analysis -Basic cost concepts – FC, VC, TC, MC – Cost output in the short and long run.

**UNIT III CAPITAL MARKET**

Stock Exchanges – Functions – Listing of Companies – Role of SEBI – Index Numbers – Capital Market Reforms - Money and banking - Money – Functions – Value of Money – Inflation and deflation – Commercial Bank and its functions – Central bank and its functions.

**UNIT IV NEW ECONOMIC ENVIRONMENT**

Economic systems, Economic Liberalization –Privatization – Globalization. - An overview of International Trade – World Trade Organization – Intellectual Property Rights - Capital budgeting - Need for Capital Budgeting – Project Appraisal Methods - Payback Period – ARR – Time Value of Money – DCF Techniques – Feasibility Report.

**UNIT V DEPRECIATION AND BREAK EVEN ANALYSIS**

Meaning – Causes for Depreciation – Methods of Computing Depreciation. Meaning – Break Even Chart – Simple Problems – Managerial uses of BEA.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Ramachandra Aryasri A , and Ramana Murthy V.V	Engineering Economics & Financial Accounting	Tata McGraw Hill, New Delhi.	2004
2	Varshney R. L., and Maheshwari K.L	Managerial Economics	Sultan Chand & Sons, New Delhi.	2001

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Samuelson and Nordhaus	Economics	Tata McGraw Hill, New Delhi.	2002
2	Prasanna Chandra	Fundamentals of Financial Management	Tata McGraw Hill, New Delhi.	-

**INTENDED OUTCOMES:**

- To gain knowledge on integrating computers at various levels of planning and manufacturing.
- To understand the flexible manufacturing system and to handle the product data and various software used for manufacturing

**UNIT – I INTRODUCTION**

The meaning and origin of CIM- the changing manufacturing and management scene - External communication - islands of automation and software-dedicated and open systems-manufacturing automation protocol - product related activities of a company- marketing engineering - production planning - plant operations - physical distribution- business and financial management.

**UNIT – II GROUP TECHNOLOGY, COMPUTER AIDED PROCESS PLANNING AND CNC MACHINES**

Group technology- - part families - Classification and coding - Approaches to computer aided process planning -variant approach and generative approaches – CNC Machines – Types of control system – NC Part Programming – Computer aided part programming – APT Language – Machining centers – Turning centers – CAD/CAM Integration – Part programming method selection.

**UNIT – III SHOP FLOOR CONTROL AND INTRODUCTION OF FMS**

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

**UNIT – IV CIM IMPLEMENTATION AND DATA COMMUNICATION**

CIM and company strategy - system modeling tools -IDEF models - activity cycle diagram - CIM open system architecture (CIMOSA)- manufacturing enterprise wheel-CIM architecture - Product data management-CIM implementation software. Communication fundamentals- local area networks -topology - LAN implementations - network management and installations –ERP concepts

**UNIT – V OPEN SYSTEM AND DATABASE FOR CIM**

Open systems-open system inter connection - manufacturing automations protocol and technical office protocol (MAP /TOP).

Development of databases -database terminology- architecture of database systems-data modeling and data associations -relational data bases - database operators - advantages of data base and relational database.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Mikell.P.Groover	Automation, Production Systems and computer integrated manufacturing	Pearson Education, Delhi.	2001

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Yorem koren	Computer Integrated Manufacturing system	McGraw-Hill, New York.	2005
2	Kant Vajpayee S	Principles of computer integrated manufacturing	Prentice Hall India, New Delhi.	2003
3	Radhakrishnan P, Subramanyan S and Raju V	CAD/CAM/CIM	New Age International (P) Ltd, New Delhi.	2000

**WEBSITES :**

1. <a href="http://en.wikipedia.org/wiki/Computer-integrated_manufacturing">http://en.wikipedia.org/wiki/Computer-integrated_manufacturing</a>
2. <a href="http://www.technologystudent.com/rmprp07/intman1.html">http://www.technologystudent.com/rmprp07/intman1.html</a>
3. <a href="http://www.computerintegratedmanufacturing.com/">http://www.computerintegratedmanufacturing.com/</a>

**LIST OF EXPERIMENTS****HEAT TRANSFER**

1. Heat transfer through a composite wall
2. Thermal conductivity measurement by guarded plate method
3. Natural convection heat transfer from a vertical cylinder
4. Heat transfer from pin-fin (natural & forced convection modes)
5. Effectiveness of Parallel/counter flow heat exchanger
6. Determination of Stefan-Boltzmann constant
7. Determination of emissivity of a grey surface

**REFRIGERATION AND AIR CONDITIONING**

8. Performance test on single/two stage reciprocating air compressor.
9. Determination of COP of a refrigeration system
10. Experiments on air-conditioning system

**12BEME612 COMPUTER AIDED MODELING AND SIMULATION LABORATORY****0 0 3 2 100****A) COMPUTER AIDED DESIGN**

1. 3D modeling of various machine elements using various options like protrusion, cut, sweep, draft, loft, blend, rib.
2. Assembly – creating assembly from parts – assembly constraints
3. Conversion of 3D solid model to 2D drawing - different views, sections, isometric view and dimensioning.
4. Introduction to Surface Modeling.
5. Introduction to File Import, Export – DXF, IGES, STL, STEP

**Note:** Any one of the 3D MODELING software's like Pro/E, IDEAS, CATIA, UNIGRAPHICS, AutoCAD to be used.

**B) COMPUTER AIDED SIMULATION**

1. Transformations algorithm experiment for translation/rotation/scaling: writing program and running it on computer. ( Using C Language)
2. Design problem experiment: writing the program for design of machine element or other systems and running it on computer. ( Using Mat Lab)
3. Optimization problem experiment: writing a program for optimizing a function and running it on computer. ( Using Mat Lab)
4. VBA Applications ( With relevance to Mechanical Engineering)

**LIST OF EXPERIMENTS:**

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. Circuits with multiple cylinder sequences in Electro pneumatic using PLC.
5. Servo controller interfacing for open loop
6. PID controller interfacing
7. Stepper motor interfacing with 8051 Micro controller  
(i) Full step resolution (ii) Half step resolution
8. Modeling and analysis of basic electrical, hydraulic and pneumatic systems using LAB VIEW
9. Computerized data logging system with control for process variables like pressure, flow and temperature

## SEMESTER VII

12BECC701

**PROFESSIONAL ETHICS, PRINCIPLES OF  
MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT**

3 0 0 3 100

### INTENDED OUTCOMES:

- To create an awareness on our Culture
- To create an awareness and practice through Engineering Ethics and Human Values.

### UNIT I HISTORICAL DEVELOPMENT, PLANNING, ORGANISING

Definition of Management – Management and Administration – Development of Management Thought – Contribution of Taylor and Fayol – Functions of Management – Steps involved in Planning – Objectives – Setting Objectives – Process of Managing by Objectives – Strategies, Policies & Planning Premises- Forecasting – Decision-making – Formal and informal organization – Organization Chart -.

### UNIT II DIRECTING AND CONTROLLING

Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment –Process of Communication – System and process of Controlling – Requirements for effective control – Control of Overall Performance – Direct and Preventive Control – Reporting

### UNIT III ENGINEERING ETHICS

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

### UNIT IV FACTORS OF CHANGES

Forces that shape culture, social control – Meaning, Agencies, Institution, Customs, Values, Folkways, Norms and Laws. Social changes – Meaning and nature – Theories.

### UNIT V ENTREPRENEURSHIP AND MOTIVATION

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Entrepreneurship in Economic Growth- Major Motives Influencing an Entrepreneur – Achievement Motivation Training, self Rating, Business Game, Thematic Apperception Test – Stress management, Entrepreneurship Development Programs – Need, Objectives -

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Harold Kooritz & Heinz Weihrich	Essentials of Management	Tata McGraw-Hill, New Delhi.	2008
2	Khanka S.S	Entrepreneurial Development	S.Chand & Co. Ltd. Ram Nagar, NewDelhi.	1999
3	Mike Martin and Roland Schinzinger	Ethics in Engineering	McGraw-Hill, NewYork.	2005

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Tripathy P.C and Reddy P.N,	Principles of Management	Tata McGraw-Hill, New Delhi.	2007
2	Rabindra N Kanungo	Entrepreneurship and innovation	Sage Publications, New Delhi.	1998
3	Charles E Harris, Michael S. Protchard and Michael J Rabins	Engineering Ethics – Concepts and Cases	Wadsworth Thompson Learning, (Indian Reprint now available), New Delhi.	2000

**WEBSITES:**

1.	<a href="http://www.managementstudyguide.com/taylor_fayol.htm">http://www.managementstudyguide.com/taylor_fayol.htm</a>
2.	<a href="http://tutor2u.net/business/gcse/people_motivation_theories.htm">http://tutor2u.net/business/gcse/people_motivation_theories.htm</a>
3.	<a href="http://lfkbb.tripod.com/eng24/gilliganstheory.html">http://lfkbb.tripod.com/eng24/gilliganstheory.html</a>
4.	<a href="http://www.developingeyes.com/five-types-of-entrepreneurs/">http://www.developingeyes.com/five-types-of-entrepreneurs/</a>
5.	<a href="http://helpguide.org/mental/stress_management_relief_coping.htm">http://helpguide.org/mental/stress_management_relief_coping.htm</a>



**INTENDED OUTCOMES:**

- To understand the statistical approach for quality control.
- To create an awareness about the ISO and QS certification process and its need for the industries

**UNIT I ESSENTIALS OF TQM**

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**

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, Performance Measures – Basic Concepts, Strategy, Performance Measure.

**UNIT III TQM TOOLS**

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 - APQP.

**UNIT IV TQM TECHNIQUES**

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 AND ENVIRONMENT SYSTEMS**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Dale H.Besterfiled	Total Quality Management	Pearson Education, Inc.	2003

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Feigenbaum.A.V	Total Quality Control	McGraw Hill, New Delhi	2003
2	Oakland.J.S	Total Quality Management	Butterworth – Heinemann Ltd., Oxford	1993
3	Narayana V. and Sreenivasan N.S	Quality Management – Concepts and Tasks	New Age International Ltd., New Delhi	2005
4	Zairi	Total Quality Management for Engineers	WoodHead Publishers, New Delhi	1996

**WEBSITES :**

1. <http://auciello.tripod.com/14tqm.html>
2. <http://www.fkm.utm.my/~shari/download/toc%20paper%20hilma%20tqm%20dis06.pdf>
3. <http://www.businessgyan.com/node/5409>
4. [http://www.accelper.com/pdfs/SS\\_Measurements\\_Concepts.pdf](http://www.accelper.com/pdfs/SS_Measurements_Concepts.pdf)
5. <http://tutor2u.net/business/strategy/benchmarking.htm>
6. <http://www.trst.com/iso2a.htm>

**INTENDED OUTCOMES:**

- To understand the principles involved in discretization and finite element approach
- To learn to form stiffness matrices and force vectors for simple elements

**UNIT I INTRODUCTION**

Historical background – Matrix approach – Application to the continuum – Discretization – Matrix algebra – Gaussian elimination – Governing equations for continuum – Classical Techniques in FEM – Weighted residual method – Ritz method

**UNIT II ONE DIMENSIONAL PROBLEMS**

Finite element modeling – Coordinates and shape functions- Potential energy approach – Galerkin approach – Assembly of stiffness matrix and load vector – Finite element equations – Quadratic shape functions – Applications to plane trusses

**UNIT III TWO DIMENSIONAL CONTINUUM**

Introduction – Finite element modeling – Scalar valued problem – Poisson equation –Laplace equation – Triangular elements – Element stiffness matrix – Force vector – Galerkin approach - Stress calculation – Temperature effects

**UNIT IV AXISYMMETRIC CONTINUUM**

Axisymmetric formulation – Element stiffness matrix and force vector – Galerkin approach – Body forces and temperature effects – Stress calculations – Boundary conditions – Applications to cylinders under internal or external pressures – Rotating discs

**UNIT V ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL CONTINUUM**

The four node quadrilateral – Shape functions – Element stiffness matrix and force vector – Numerical integration - Stiffness integration – Stress calculations – Four node quadrilateral for axisymmetric problems.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Rao S.S	The Finite Element Method in Engineering	Butter worth Heinemann imprint, USA	2010
2	Logan D.L	A First course in the Finite Element Method	Cengage Learning, Stamford, USA.	2011

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Chandrupatla T.R., and Belegundu A.D	Introduction to Finite Elements in Engineering	Pearson Education, Delhi.	2002
2	David V Hutton	Fundamentals of Finite Element Analysis	McGraw-Hill Int. Ed, New York.	2004

**WEBSITES :**

1. <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/mathematics-2/node18.html>
2. <http://www.me.berkeley.edu/~lwlin/me128/FEMNotes.pdf>
3. <http://www.rose-hulman.edu/~fine/FE2004/Class2/Notes2.pdf>
4. <http://www.asiri.net/courses/meng412/m412sm04ex1sol.pdf>
5. <http://hyperphysics.phy-astr.gsu.edu/hbase/electric/laplace.html>

**INTENDED OUTCOMES:**

- To understand the principles involved in gas dynamics related with energy and momentum
- To learn the underlying theories of rocket and jet propulsion

**UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS**

Energy and momentum equations of compressible fluid flows - Stagnation states, Mach waves and Mach cone -Effect of Mach number on compressibility - Isentropic flow through variable area ducts - Nozzle and Diffusers -area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles. Use of Gas tables.

**UNIT II FLOW THROUGH DUCTS**

Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - Variation of flow properties - Isothermal flow with friction in constant area ducts -Use of tables and charts - Generalised gas dynamics.

**UNIT III NORMAL AND OBLIQUE SHOCKS**

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

**UNIT IV JET PROPULSION**

Theory of jet propulsion - Thrust equation - Thrust power and propulsive efficiency - Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines – Aircraft combustors.

**UNIT V ROCKET PROPULSION**

Types of rocket engines - Propellants - Ignition and combustion - Theory of rocket propulsion – solid and liquid propellants, comparison of different propulsion systems .Performance study - Staging - Terminal and characteristic velocity - Applications - Space flights.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Yahya.S.M	Fundamentals of Compressible flow	New Age International (P) Ltd., New Delhi,	2005
2.	Rathakrishnan.E	Gas Dynamics	Prentice Hall of India, New Delhi,	2001

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Patrich.H.Oosthvizen, Willam E.Carscallen	Compressible fluid flow	McGraw-Hill,	1997
2	Zucker,R.D. and Biblarz,O.	Fundamentals of Gas Dynamics	John Willey,	2002
3	Ganesan .V.	Gas Turbines	Tata McGraw-Hill, New Delhi,	2010
4	P.Hill and C. Peterson	Mechanics and Thermodynamics of Propulsion	Addison - Wesley Publishing Company	1992
5	Zucrow, M.J. and Anderson, J.D.	Elements of gas dynamics	McGraw-Hill Book Co., New York	1989
6	N.J. Zucrow	Principles of Jet Propulsion and Gas Turbines	John Wiley, New York	1970

**WEBSITES :**

- |  |
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| <ol style="list-style-type: none"> <li>1. <a href="http://www.adl.gatech.edu/classes/ae3021/ae3021_f06_6.pdf">http://www.adl.gatech.edu/classes/ae3021/ae3021_f06_6.pdf</a></li> <li>2. <a href="http://www.grc.nasa.gov/WWW/k-12/airplane/isndrv.html">http://www.grc.nasa.gov/WWW/k-12/airplane/isndrv.html</a></li> <li>3. <a href="http://panoramix.ift.uni.wroc.pl/~maq/papers/PM_Correct_Matyka.pdf">http://panoramix.ift.uni.wroc.pl/~maq/papers/PM_Correct_Matyka.pdf</a></li> <li>4. <a href="http://soliton.ae.gatech.edu/people/jseitzma/classes/ae3450/StudyProblems.pdf">http://soliton.ae.gatech.edu/people/jseitzma/classes/ae3450/StudyProblems.pdf</a></li> <li>5. <a href="http://www.sil.si.edu/smithsoniancontributions/AnnalsofFlight/pdf_lo/SAOF-0001.4.pdf">http://www.sil.si.edu/smithsoniancontributions/AnnalsofFlight/pdf_lo/SAOF-0001.4.pdf</a></li> </ol> |
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**12BEME7E\_\_ ELECTIVE I****3 0 0 3 100****12BEME7E\_\_ ELECTIVE II****3 0 0 3 100**

**COMPUTER AIDED ENGINEERING (Simple Analysis using ANSYS Tool)**

- ❖ Stress analysis of rectangular L bracket
- ❖ Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
- ❖ Mode frequency analysis of beams (Cantilever, Simply supported, Fixed ends)
- ❖ Harmonic analysis of a 2D component
- ❖ Thermal stress analysis of a 2D component
- ❖ Modeling a 3D component. ( Single point cutting tool, I beams, etc.,)

**COMPUTER AIDED MANUFACTURING (CAM)****MANUAL PART PROGRAMMING (Using G and M Codes) in CNC Machine.**

- ❖ Part programming for Linear, Circular interpolation, and Contour motions.
- ❖ Part programming using standard canned cycles for Thread cutting, Drilling, Peck drilling, and Boring.

**SIMULATION AND NC CODE GENERATION**

NC code generation using CAD / CAM software's - Post processing for standard CNC Controls like FANUC, Hiedenhain etc.

**INTENDED OUTCOMES:**

- To Understand and apply the principles of science, technology, engineering, and math to solve industry-related problems.
- Contribute to the profitable growth of industrial economic sectors by using IE analytical tools, effective computational approaches, and systems thinking methodologies.

**UNIT I INTRODUCTION TO INDUSTRIAL ENGINEERING**

Facilities requirement, need for layout study - types of layout. Plant location analysis - factors, costs, location decisions - simple problems in single facility location models, network location problems.

**UNIT II LAYOUT DESIGN**

Design cycle - SLP procedure manpower, machinery requirements - computer algorithms - ALDEP, CORELAP, CRAFT

**UNIT III QUANTITATIVE METHODS AND MATERIALS HANDLING**

Group technology - Production Flow analysis (PFA), ROC (Rank Order Clustering) - Line balancing. Principles, unit load concept, material handling system design, handling equipment types, selection and specification, containers and packaging.

**UNIT IV OPERATIONS ANALYSIS AND WORK MEASUREMENT**

Productivity and living standards, Productivity measurement, work design and Productivity – process planning – types. Total time for a job or operation, total work content and ineffective time, methods and motions, graphic tools. Stop watch time study – time study through video graphy, Standard data, methods time measurement (MTM), Development of Production Standards, learning effect.

**UNIT V HUMAN FACTORS IN WORK SYSTEM DESIGN**

Human factors Engineering/Ergonomics, human performance in physical work, anthropometry, design of work station, design of displays and controls.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	O.P. Khanna	Industrial Engineering And Management	Dhanpat rai & Co, Seventeenth Reprint	2012
2.	M.Mahajan	Industrial Engineering and Production Management	Dhanpat rai & Co	2008



**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Tompkins .J.A. and J.A. White	Facilities planning	John Wiley	2003
2	James Apple,M.Plant	Material Handling	John Wiley	1977
3	Barnes,R.M	Motion and Time study	John Wiley	1980
4	Bridger R.S	Introduction to Ergonomics	McGraw Hill	1995

**WEBSITES:**

1. <a href="http://www.websukat.com/PAOM-plant-layout.htm">http://www.websukat.com/PAOM-plant-layout.htm</a>
2. <a href="http://www.du.ac.in/fileadmin/DU/Academics/course_material/EP_07.pdf">http://www.du.ac.in/fileadmin/DU/Academics/course_material/EP_07.pdf</a>
3. <a href="http://www.scribd.com/doc/60109160/8/Rank-Order-Clustering-Method">http://www.scribd.com/doc/60109160/8/Rank-Order-Clustering-Method</a>
4. <a href="http://www.zalzala.info/IKMA/LinkedDocuments/GAManufacturing/sld006.htm">http://www.zalzala.info/IKMA/LinkedDocuments/GAManufacturing/sld006.htm</a>
5. <a href="http://www.wrebv.nl/l6.pdf">http://www.wrebv.nl/l6.pdf</a>

**12BEME8E\_\_ ELECTIVE III****3 0 0 3 100****08BEME8E\_\_ ELECTIVE IV****3 0 0 3 100**

**INTENDED OUTCOMES:**

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

Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be typewritten form as specified in the guidelines.

The continuous assessment shall be made as prescribed in the regulations.

**INTENDED OUTCOMES:**

- |   |
|---|
| <ul style="list-style-type: none"> <li>• To understand the basic concepts of nontraditional machining techniques</li> <li>• To know the factors influencing the processes and their applications</li> </ul> |
|---|

**UNIT I INTRODUCTION**

Unconventional machining Processes – Need – classification – Brief overview of all techniques.

**UNIT II MECHANICAL ENERGY BASED PROCESSES**

Abrasive Jet Machining – Water Jet Machining – Ultrasonic Machining. (AJM, WJM and USM). Working Principles – equipment used – Process parameters – MRR-Variation in techniques used – Applications.

**UNIT III ELECTRICAL ENERGY BASED PROCESSES**

Electric Discharge Machining (EDM) - working Principles-equipments-Process Parameters-MRR-electrode / Tool – Power Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.

**UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES**

Chemical machining and Electr-Chemical machining (CHM and ECM)-Etchants-maskant-techniques of applying maskants-Process Parameters – MRR-Applications. Principles of ECM-equipments-MRR-Electrical circuit-Process Parameters-ECG and ECH Applications.

**UNIT V THERMAL ENERGY BASED PROCESSES**

Laser Beam machining (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles-Equipment-Types-Beam control techniques – Applications.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Vijay.K. Jain,	Advanced Machining Processes	Allied Publishers Pvt. Ltd., New Delhi, ISBN 81-7764-294-4.	2002

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Benedict. G.F	Nontraditional Manufacturing Processes	Marcel Dekker Inc., New York.	1987
2	Pandey P.C. and Shah H.S	Modern Machining Processes	Tata McGraw-Hill Education, New Delhi.	1980
3	Mc Geough	Advanced Methods of Machining	Chapman and Hall, London.	1988

**WEBSITES:**

1.	<a href="http://www.newagepublishers.com/samplechapter/001566.pdf">http://www.newagepublishers.com/samplechapter/001566.pdf</a>
2.	<a href="http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Manuf%20Proc%20II/pdf/LM-36.pdf">http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Manuf%20Proc%20II/pdf/LM-36.pdf</a>
3.	<a href="http://www.enotes.com/topic/Electron_beam_machining">http://www.enotes.com/topic/Electron_beam_machining</a>
4.	<a href="http://webtools.delmarlearning.com/sample_chapters/Ch08_rev_CP.pdf">http://webtools.delmarlearning.com/sample_chapters/Ch08_rev_CP.pdf</a>
5.	<a href="http://www.archivesmse.org/vol28_8/28810.pdf">http://www.archivesmse.org/vol28_8/28810.pdf</a>

**INTENDED OUTCOMES:**

- To understand the various processes involved in Marketing and its Philosophy.
- To learn the Psychology of consumers.
- To formulate strategies for advertising, pricing and selling

**UNIT I      MARKETING PROCESS**

Definition, Marketing process, dynamics, needs, wants and demands, marketing concepts, environment, mix, types. Philosophies, selling versus marketing, organizations, industrial versus consumer marketing, consumer goods, industrial goods, product hierarchy

**UNIT II      BUYING BEHAVIOUR AND MARKET SEGMENTATION**

Cultural, demographic factors, motives, types, buying decisions, segmentation factors - demographic -Psycho graphic and geographic segmentation, process, patterns.

**UNIT III      PRODUCT PRICING AND MARKETING RESEARCH**

pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.

**UNIT IV      MARKETING PLANNING AND STRATEGY FORMULATION**

Components of marketing plan-strategy formulations and the marketing process, implementations, portfolio analysis, BCG, GEC grids.

**UNIT V      ADVERTISING, SALES PROMOTION AND DISTRIBUTION**

Characteristics, impact, goals, types, and sales promotions- point of purchase- unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trends in retailing.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Ramasamy and Nama kumari	Marketing Environment: Planning, implementation and control (Global perspective & Indian context)	Macmillan India, New Delhi	2002
2	Govindarajan. M	Industrial marketing management	Vikas Publishing Pvt. Ltd, New Delhi.	2003

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Philip Kotler	Marketing Management	Pearson Education, New Delhi.	2001
2	Green Paul E and Donald Tull	Research for marketing decisions	Prentice Hall of India, New Delhi.	1975
3	Philip Kotler and Gary Armstrong	Principles of Marketing	Prentice Hall of India, New Delhi.	2000

**WEBSITES :**

1. <http://www.netmba.com/marketing/process/>
2. <http://www.themarketingprocessco.com/marketing/>
3. <http://www.helium.com/>
4. <http://www.quickmba.com/marketing/market-segmentation/>
5. <http://www.marketstreetresearch.com/capabilities/>

**INTENDED OUTCOMES:**

- To integrate the thermodynamic concepts into the analysis of refrigeration cycles.
- To give awareness to students on parameter to be considered for designing Refrigeration & Air Conditioning.
- To enable the student to design air conditioning system for building.

**UNIT I REFRIGERATION CYCLE**

Review of thermodynamic principles of refrigeration. Concept of refrigeration system. Vapour compression refrigeration cycle - use of P-H charts - multistage and multiple evaporator systems - cascade system - COP comparison. Vapor absorption refrigeration system. Ammonia water and Lithium Bromide water systems. Steam jet refrigeration system

**UNIT II REFRIGERANTS, SYSTEM COMPONENTS AND BALANCING**

Compressors - reciprocating & rotary (elementary treatment.) - Condensers - evaporators - cooling towers. Refrigerants - properties - selection of refrigerants, Alternate Refrigerants, Refrigeration plant controls - testing and charging of refrigeration units. Balancing of system components. Applications to refrigeration systems - ice plant - food storage plants - milk -chilling plants – refrigerated cargo ships.

**UNIT III PSYCHROMETRY**

Psychrometric processes- use of psychrometric charts - - Grand and Room Sensible Heat Factors - bypass factor - requirements of comfort air conditioning - comfort charts - factors governing optimum effective temperature, recommended design conditions and ventilation standards

**UNIT IV COOLING LOAD CALCULATIONS**

Types of load - design of space cooling load - heat transmission through building. Solar radiation - infiltration - internal heat sources (sensible and latent) - outside air and fresh air load - estimation of total load - Domestic, commercial and industrial systems - central air conditioning systems.

**UNIT V AIRCONDITIONING**

Air conditioning equipments – air cleaning and air filters - humidifiers - dehumidifiers - air washers - condenser – cooling tower and spray ponds - elementary treatment of duct design - air distribution system. Thermal insulation of air conditioning systems. - Applications: car, industry, stores, and public buildings

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Manohar Prasad	Refrigeration and Air Conditioning	New Age International Ltd, New Delhi.	2002
2	Arora. C.P.	Refrigeration and Air Conditioning	Tata McGraw-Hill, New Delhi.	2000

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Roy.J Dossat	Principles of Refrigeration	Pearson Education, New Delhi.	1997
2	Jordon and Prister	Refrigeration and Air Conditioning	Prentice Hall of India PVT Ltd., New Delhi.	1948
3	Stoecker N.F and Jerold W.Jones	Refrigeration and Air Conditioning	McGraw Hill, New Delhi.	1986

**WEBSITES :**

1. [http://nptel.iitg.ernet.in/Mech\\_Engg/IIT%20Kharagpur/Refrigeration%20and%20Air%20Conditioning.htm](http://nptel.iitg.ernet.in/Mech_Engg/IIT%20Kharagpur/Refrigeration%20and%20Air%20Conditioning.htm)
2. <http://www.ashrae.org/>
3. [http://en.wikipedia.org/wiki/Thermal\\_comfort](http://en.wikipedia.org/wiki/Thermal_comfort)



**INTENDED OUTCOMES:**

- To understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components

**UNIT I BASICS OF VIBRATION**

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

**UNIT II BASICS OF NOISE**

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**

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**

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**

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

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Singiresu S.Rao	Mechanical Vibrations	Pearson Education,	2004
2	Kewal Pujara	Vibrations and Noise for Engineers	Dhanpat Rai & Sons, New Delhi.	1977

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Bernard Challen and Rodica Baranescu	Diesel Engine Reference Book	Butterworth- Heinemann, New Delhi	1999
2	Julian Happian- Smith,	An Introduction to Modern Vehicle Design	Butterworth- Heinemann, New Delhi	2004
3	John Fenton	Handbook of Automotive body Construction and Design Analysis	Professional Engineering	1998

**WEBSITES :**

<ol style="list-style-type: none"><li>1. <a href="http://www.sae.org">http://www.sae.org</a></li><li>2. <a href="http://cedb.asce.org/cgi/wwwdisplay.cgi?0405520">http://cedb.asce.org/cgi/wwwdisplay.cgi?0405520</a></li><li>3. <a href="http://www.viacoustics.com/systems.html">http://www.viacoustics.com/systems.html</a></li><li>4. <a href="http://www.diracdelta.co.uk/science/source/a/e/aerodynamic%20noise/source.html">www.diracdelta.co.uk/science/source/a/e/aerodynamic%20noise/source.html</a></li><li>5. <a href="http://www.vibrationiso.com/">http://www.vibrationiso.com/</a></li></ol>
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**INTENDED OUTCOMES:**

- To enable the students to understand the principle of working and the components of different non-conventional sources of energy and their utilization.
- To get an exposure on the power plants working with non conventional energy

**UNIT I ENERGY AND ENVIRONMENT**

Primary energy sources - world energy resources-Indian energy scenario-energy cycle of the earth – environmental aspects of energy utilisation, CO<sub>2</sub> emissions and Global warming–renewable energy resources and their importance. Potential impacts of harnessing the different renewable energy resources.

**UNIT II SOLAR ENERGY**

Principles of solar energy collection -.solar radiation - measurements - instruments - data and estimation- types of collectors - characteristics and design principles of different type of collectors - performance of collectors - testing of collectors. Solar thermal applications - water heaters and air heaters - performance and applications - simple calculations - solar cooling - solar drying - solar ponds - solar tower concept - solar furnace.

**UNIT III WIND, TIDAL AND GEO THERMAL ENERGY**

Energy from the wind - general theory of windmills - types of windmills - design aspects of horizontal axis windmills - applications. Energy from tides and waves – working principles of tidal plants and ocean thermal energy conversion plants - power from geothermal energy - principle of working of geothermal power plants.

**UNIT IV BIO ENERGY**

Energy from bio mass & bio gas plants -various types - design principles of biogas plants - applications. Energy from wastes - waste burning power plants - utilization of industrial and municipal wastes - energy from the agricultural wastes.

**UNIT V OTHER RENEWABLE ENERGY SOURCES**

Direct energy conversion (Description, principle of working and basic design aspects only) – Magneto hydrodynamic systems (MHD) - thermoelectric generators – thermionic generators - fuel cells - solar cells - types, Emf generated, power output, losses and efficiency and applications. Hydrogen conversion and storage systems

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Rai G.D	Non conventional Energy sources	Khanna Publishers, New Delhi.	2011
2	Duffie and Beckmann	Solar Energy Thermal Processes	John Wiley, London.	2006

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Sukhatme S.P	Solar Energy	Tata McGraw Hill, New Delhi.	2003
3	Garg. H. P and Prakash J	Solar Energy - Fundamentals and applications	Tata McGrawHill, New Delhi.	1997
4	Ashok V Desai	Non-conventional Energy	Wiley Eastern Ltd, New Delhi.	1990

**WEBSITES :**

1. [http://www.apricus.com/html/solar\\_typesofsolar.htm](http://www.apricus.com/html/solar_typesofsolar.htm)
2. <http://www.solarserver.de/wissen/sonnenkollektoren-e.html>
3. <http://earthsci.org/mineral/energy/wind/wind.html>
4. <http://www.biomassgasification.com/>

**INTENDED OUTCOMES:**

- To introduce the concept of SQC
- To understand process control and acceptance sampling procedure and their application.
- To learn the concept of reliability

**UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES**

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost-Variation in process- factors – process capability – process capability studies and simple problems – Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and  $\sigma$  chart.

**UNIT II PROCESS CONTROL FOR ATTRIBUTES**

Control chart for attributes –control chart for proportion or fraction defectives – p chart and np chart – control chart for defects – C and U charts, State of control and process out of control identification in charts.

**UNIT III ACCEPTANCE SAMPLING**

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts- standard sampling plans for AQL and LTPD- uses of standard sampling plans.

**UNIT IV LIFE TESTING - RELIABILITY**

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

**UNIT V QUALITY AND RELIABILITY**

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

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

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Grant, Eugene .L	Statistical Quality Control	McGraw-Hill, New Delhi.	2008
2	Srinath L.S	Reliability Engineering	Affiliated East west press New Delhi	1991

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Manohar Mahajan	Statistical Quality Control	Dhanpat Rai & Sons, New Delhi.	2001
2	Besterfield D.H.	Quality Control	Prentice Hall, New Delhi.	1993
3	Danny Samson	Manufacturing & Operations Strategy	Prentice Hall, New Delhi.	1991
4	Connor P.D.T.O	Practical Reliability Engineering	John Wiley, New Delhi.	1993

**WEBSITES :**

1. <http://www.statsoft.com/textbook/stquacon.html>
2. <http://www.isixsigma.com/library/content/c010806a.asp>
3. [http://www.statgraphics.com/control\\_charts.htm](http://www.statgraphics.com/control_charts.htm)
4. <http://www.sqconline.com/sampling-plans.html>
5. [http://reliability.sandia.gov/Maintenance/Data\\_Failure\\_Analysis/data\\_failure\\_analysis.html](http://reliability.sandia.gov/Maintenance/Data_Failure_Analysis/data_failure_analysis.html)
6. <http://www.designinindia.net/everywhere/disciplines/product-design/index.html>

**INTENDED OUTCOMES:**

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

**UNIT I WORK STUDY AND ERGONOMICS**

Method study – Definition – Objective - Motion economy- Principles – Tools and Techniques- Applications – Work measurements- purpose – use – procedure – tools and techniques- Standard time –Ergonomics – principles – applications.

**UNIT II PROCESS PLANNING**

Definition – Objective – Scope – 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.

**UNIT III INTRODUCTION TO COST ESTIMATION**

Objective of cost estimation- costing – cost accounting- classification of cost- Elements of cost.

**UNIT IV COST ESTIMATION**

Types of estimates – methods of estimates – data requirements and sources- collection of cost-allowances in estimation.

**UNIT V PRODUCTION COST ESTIMATION**

Estimation of material cost, labour cost and over heads, allocation of overheads – Estimation for different types of jobs.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Sinha.B.P Q	Mechanical Estimating and Costing	Tata McGraw-Hill, Publishing Co., New Delhi.	2001

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Phillip.F Ostwalal and Jairo Munez	Manufacturing Processes and systems”	John Wiley, London.	1998
2	Russell.R.S and TailorB.W	Operations Management	PHI, New Delhi	2003

**WEBSITES :**

1. [webstyleguide.com/process/plan.html](http://webstyleguide.com/process/plan.html)
2. [www.npd-solutions.com/capp.html](http://www.npd-solutions.com/capp.html)

**METHODS AND ENERGY AUDIT****INTENDED OUTCOMES:**

- To understand the basic concepts of mass transfer conservation methods.
- To understand the application of Energy Audit methods.

**UNIT I ENERGY SCENARIO**

Present status, rate of growth, energy utilization (sector wise), concept of energy conservation, energy economics.

COMBUSTION: Fuel analysis, combustion calculations, air requirements, theoretical and excess air requirements, excess air control, flue gas analysis and measurement, types of draught, draught calculations, chimney size calculations. F.D and I.D fan draught requirements and power requirements, furnace pressure requirements.

**UNIT II INDUSTRIAL BOILERS**

Types and characteristics of industrial boilers, heat balance in boilers, efficiency trials in boilers, energy conservation opportunities in boilers operation and maintenance, water treatment requirements, soot blowing requirements, super heaters and superheat controls, waste heat recovery systems.

STEAM: Distribution requirements of steam and streamlines, efficient utilization of steam, steam trapping and air venting, flash steam recovery, condensate recovery, thermal insulation for systems including HVAC, steam balance calculations.

**UNIT III INDUSTRIAL FURNACES**

Furnace types and characteristics, heat balance in furnaces, furnace efficiency calculations, energy conservation opportunities in furnaces, refractories types and properties, waste heat recovery system, insulating refractories, ceramic fibers, heat loss reduction calculations, wall and stored heat loss reduction.

**UNIT IV DRYING**

Principle of drying and types of driers, mass and heat balance in driers, energy conservation opportunities in drying operations.

EVAPORATION: Principle of evaporation and types of evaporations, mass and heat balance, single and multiple effect evaporation, capacity and steam economy calculations, vapour recompression system.

**UNIT V ENERGY AUDIT AND APPLICATIONS**

Types, methodology, questionnaire development, specific energy consumption (unitwise/section wise), identification of energy conservation measures/ technologies, economic and cost benefit analysis, case studies.



**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Trinks M.H, W.Mawhinney	Industrial Furnaces	John Wiley Publications, London.	2004
2	Prabir Basu, Cen Kefa, Louis Jestin	Boilers and Burners Design and Theory	Springer Publications, New Delhi.	1999
3	Lyle O	Efficient use of Steam Heritage, Oyvkusgersm. 1954,” Efficient use of Fuel”,	Her Majesty’s Stationary Office, UK.	1963

**WEBSITES :**

1. [www.energyconservation.co.in](http://www.energyconservation.co.in)
2. [www.energymanagertraining.com](http://www.energymanagertraining.com)
3. [www.nrel.gov](http://www.nrel.gov)
4. [www.aerfindia.org](http://www.aerfindia.org)
5. [www.gvepinternational.org](http://www.gvepinternational.org)

**INTENDED OUTCOMES:**

- To understand the principles, functions and design practices of Jigs, Fixtures and dies for press working
- To understand the Principles of jigs and fixtures design, locating principles, locating elements and clamping Devices.

**UNIT I PURPOSE TYPES AND FUNCTIONS OF JIGS AND FIXTURES**

Tool design objective - Production devices - Inspection devices - Materials used in Jigs and Fixtures – Types of Jigs - Types of Fixtures-Mechanical actuation-pneumatic and hydraulic actuation-Analysis of clamping force-Tolerance and error analysis.

**UNIT II JIGS**

Drill bushes –different types of jigs-plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs-Automatic drill jigs-Rack and pinion operated. Air operated Jigs components. Design and development of Jigs for given components.

**UNIT III FIXTURES**

General principles of boring, lathe, milling and broaching fixtures- Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures- Modular fixtures. Design and development of fixtures for given component.

**UNIT IV PRESS WORKING TERMINOLOGIES AND ELEMENTS OF DIES AND STRIP LAY OUT**

Press working terminology-Presses and press accessories-Computation of capacities and tonnage requirements. Elements of progressive combination and compound dies:Die block-die shoe. Bolster plate-punch plate-punch holder-guide pins and bushes – strippers – knockouts-stops –pilots-Selection of standard die sets strip lay out-strip lay out calculations

**UNIT V DESIGN AND DEVELOPMENT OF DIES**

Design and development of progressive and compound dies for Blanking and piercing operations. Bending dies – development of bending dies-forming and drawing dies-Development of drawing dies. Design considerations in forging, extrusion, casting and plastic dies.

**TEXT BOOKS:**

S.NO	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Edward G Hoffman	Jigs & Fixture Design	Thomson – Delmar Learning, Singapore.	2004
2	Donaldson C	Tool Design	Tata McGraw-Hill, New Delhi	2000

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Kempster	Jigs & Fixtures Design	The English Language Book Society, Tata McGraw-Hill Publishing, New Delhi.	1978
2	Joshi P.H	Jigs & Fixtures Second Edition	Tata McGraw-Hill Publishing Company Limited, New Delhi.	2004
3	Hiram E Grant	Jigs and Fixture	Tata McGraw-Hill, New Delhi.	2003

**WEBSITES :**

<ol style="list-style-type: none"><li>1. <a href="http://www.wisetool.com">www.wisetool.com</a></li><li>2. <a href="http://www.invert-a-bolt.com">www.invert-a-bolt.com</a></li><li>3. <a href="http://www.diemech.com">www.diemech.com</a></li><li>4. <a href="http://www.schaeferertools.com">www.schaeferertools.com</a></li><li>5. <a href="http://www.steelsmith.com">www.steelsmith.com</a></li></ol>
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**INTENDED OUTCOMES:**

- To introduce the basic concepts, parts of robots and types of robots
- To make the students familiar with the various drive systems for robot, sensors and their applications in robots, programming of robots
- To discuss about the various applications of robots, justification, implementation and safety of robot.

**UNIT I FUNDAMENTALS OF ROBOT**

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

**UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS**

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of all these Drives

End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations

**UNIT III SENSORS AND MACHINE VISION**

Requirements of a sensor, Principles and Applications of the following types of sensors – Position sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors, (Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors

Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis – Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms. Applications – Inspection, Identification, Visual Servicing and Navigation.

**UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING**

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 effector commands, and Simple programs

**UNIT V IMPLEMENTATION AND ROBOT ECONOMICS**

RGV, AGV; Implementation of Robots in Industries – Various Steps; Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Groover M.P.	Industrial Robotics – Technology Programming and Applications	McGraw-Hill, New Delhi	2001

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Fu.K.S., Gonzalez.R.C. and Lee C.S.G	Robotics Control, Sensing, Vision and Intelligence	McGraw-Hill Book Co., New Delhi.	1988
2	Yoram Koren	Robotics for Engineers	McGraw-Hill Book Co., New Delhi.	1992
3	Janakiraman. P.A	Robotics and Image Processing	Tata McGraw-Hill, New Delhi.	1995

**WEBSITES :**

1. <a href="http://www.learnaboutrobots.com/industrial.htm">www.learnaboutrobots.com/industrial.htm</a>
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**INTENDED OUTCOMES:**

- To provide an overview of the integrated design process with a practical bias.
- To understand and develop a design process leading to a realizable product with an appreciation of the economics, environmental concerns, manufacturability and product life cycle management.

**UNIT I PRODUCT DESIGN PROCESS**

Importance of product design-Design process - Design considerations-Morphology of design - Marketing Organisation for design - Computer aided engineering-Codes and standards-Design review-Technological innovation and design process-Product and process cycles-Societal considerations in design.

**UNIT II CONCEPT GENERATION, SELECTION AND TESTING**

Activity of concept generation, Clarification of problem-External and internal searches-Concept exploration-Result analysis-Overview of selection methodologies-Concept screening-Concept scoring-Concept testing-Choice of survey population-Survey formats-measurement of customer response-Interpretation and analysis of results.

**UNIT III CONCEPT GENERATION-INNOVATION THROUGH TRIZ TOOL**

**TRIZ** – Theory to Resolve Inventive Problem Solving – Historical development – Essence of TRIZ; 36 Contradiction parameters – Contradiction matrix – 40 Inventive principles – 76 Standard solutions – ARIZ – Algorithm to solve inventive problem – Case studies

**UNIT IV PRODUCT ARCHITECTURE, INDUSTRIAL DESIGN, DESIGN FOR MANUFACTURE AND PROTOTYPING**

Product architecture-implications-establishment-platform planning-system level design-Need for industrial design and its impact-The Industrial design process and its management-Assessment of quality-Overview of Design for Manufacture process-Steps in DFM-Basics principles of prototyping-Prototyping technologies-Planning for prototypes.

**UNIT V ROBUST DESIGN AND PRODUCT DEVELOPMENT ECONOMICS AND INTELLECTUAL PROPERTY RIGHTS**

Design of experiments-Steps in the robust design process-Elements of economic analysis-Steps in economic analysis process-Overview of patents-Utility patents-Steps in preparing disclosure.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Ulrich KT. and Eppinger S.D	Product Design and Development	McGraw-Hill Book Company, New Delhi.	2003

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Dieter G.E	Engineering Design	McGraw-Hill Book Company, Singapore.	2000
2	Ullman D.G	The Mechanical Design Process Third Edition	McGraw-Hill Book Co, Singapore.	2003
3	Otto K.N and Wood K.L	Product Design- Techniques in Reverse Engineering and New product Development	First Indian Reprint, Pearson Education, Delhi.	2004
4	Yousef Haik	Engineering Design Process	Vikas Publishing House, Uttar Pradesh, India.	1999

**WEBSITES :**

<ol style="list-style-type: none"><li>1. <a href="http://www.engineersedge">http://www.engineersedge</a></li><li>2. <a href="http://www.technologystudent.com">http://www.technologystudent.com</a></li><li>3. <a href="http://www.onesmartclick.com">http://www.onesmartclick.com</a></li><li>4. <a href="http://www.nptel.iitg.ernet.in">http://www.nptel.iitg.ernet.in</a></li><li>5. <a href="http://www.nptel.iitm.ac.in">http://www.nptel.iitm.ac.in</a></li></ol>
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**INTENDED OUTCOMES:**

- To gain some fundamental knowledge about nuclear physics, nuclear reactor, nuclear fuels, reactors and safe disposal of nuclear wastes.

**UNIT I NUCLEAR PHYSICS**

Nuclear model of an atom-Equivalence of mass and energy-binding- radio activity-half life-neutron interactions-cross sections.

**UNIT II NUCLEAR REACTIONS AND REACTION MATERIALS**

Mechanism of nuclear fission and fusion- radio activity- chain reactions-critical mass and composition-nuclear fuel cycles and its characteristics-uranium production and purification-Zirconium, thorium, beryllium.

**UNIT III REPROCESSING**

Reprocessing: nuclear fuel cycles-spent fuel characteristics-role of solvent extraction in reprocessing-solvent extraction equipment.

**UNIT IV NUCLEAR REACTOR**

Nuclear reactors: types of fast breeding reactors-design and construction of fast breeding reactors-heat transfer techniques in nuclear reactors- reactor shielding. Fusion reactors.

**UNIT V SAFETY AND DISPOSAL**

Safety and disposal: Nuclear plant safety-safety systems-changes and consequences of accident-criteria for safety-nuclear waste-types of waste and its disposal-radiation hazards and their prevention-weapons proliferation.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Thomas J.Cannoly	Fundamentals of nuclear Engineering	John Wiley and Sons, New York.	1993



**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	J.G Collier J.G and Hewitt G.F	Introduction to Nuclear power	HemispherePublishing, New York.	1987
2	Wakil M.M.El	Power Plant Technology	McGraw-Hill International, NewDelhi.	1984

**WEBSITES :**

1. [www.nuclearcanada.ca](http://www.nuclearcanada.ca).
2. <http://hyperphysics.phy-astr.gsu.edu/hbase/nucene/fasbre.html>
3. [http://library.thinkquest.org/3471/nuclear\\_waste\\_body.html](http://library.thinkquest.org/3471/nuclear_waste_body.html)
4. [http://www.classzone.com/books/earth\\_science/terc/content/investigations/es0501/es0501page03.cfm](http://www.classzone.com/books/earth_science/terc/content/investigations/es0501/es0501page03.cfm)

**INTENDED OUTCOMES:**

- To introduce numerical modeling and its role in the field of heat transfer and fluid flow.
- To enable the students to understand the various discretization methods and solving methodologies.
- To create confidence to solve complex problems in the field of heat transfer and fluid dynamics by using high speed computers

**UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS**

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 - Turbulence -Kinetic -Energy Equations – mathematical behavior of PDEs on CFD: Elliptic, Parabolic and Hyperbolic equations.

**UNIT II DISCRETIZATION AND SOLUTION METHODOLOGIES**

Methods of Deriving the Discretization Equations - Taylor Series formulation – Finite difference method – Control volume Formulation – Spectral method.

Solution methodologies: Direct and iterative methods, Thomas algorithm, Relaxation method, Alternating Direction Implicit method.

**UNIT III HEAT CONDUCTION**

Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems

**UNIT IV CONVECTION AND DIFFUSION**

Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power-law schemes - Discretization equations for two dimensional convection and diffusion.

**UNIT V CALCULATION OF FLOW FIELD**

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- $\epsilon$ ) models.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Versteeg H.K, and Malalasekera.W	An Introduction to Computational Fluid Dynamics	Pearson education ltd, UK	2008
2	Ghoshdastidar P.S	Computer Simulation of flow and heat transfer	Tata McGraw-Hill Publishing Company Ltd., New Delhi.	1998

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Patankar S.V	Numerical Heat Transfer and Fluid Flow	McGraw-Hill book company, New Delhi.	1980
2	Muralidhar K and Sundarajan T	Computational Fluid Flow and Heat Transfer	Narosa Publishing House, New Delhi.	1995
3	Bose T.K	Narosa publishing House, New Delhi.	Numerical Fluid Dynamics	1997
4	Muralidhar K, and Biswas	Advanced Engineering Fluid Mechanics	Narosa Publishing House, New Delhi.	1996

**WEBSITES :**

1. <http://www.ams.org/mcom//.pdf>
2. <http://www.cham.co.uk/website/new/cfdintro.htm>
3. <http://www.mechartes.com/>
4. <http://www.technologystudent.com>
5. [http://web.njit.edu/topics/Prog\\_Lang\\_Docs/html/FLUENT/fluent/fluent5/ug/html/node594.htm](http://web.njit.edu/topics/Prog_Lang_Docs/html/FLUENT/fluent/fluent5/ug/html/node594.htm)

**INTENDED OUTCOMES:**

- To know the advantages and applications of Fluid Power Engineering and Power Transmission System.
- To learn the Applications of Fluid Power System in automation of Machine Tools and others Equipments.

**UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS**

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids – Fluid power symbols. Basics of Hydraulics-Applications of Pascals Law- Laminar and Turbulent flow – Reynold's number – Darcy's equation – Losses in pipe, valves and fittings.

**UNIT II HYDRAULIC SYSTEM & COMPONENTS**

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tanden, Rodless, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston motors.

**UNIT III DESIGN OF HYDRAULIC CIRCUITS**

Construction of Control Components : Direction 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 – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram. Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit.

**UNIT IV PNEUMATIC SYSTEMS AND COMPONENTS**

Pneumatic Components: Properties of air – Compressors – Filter, Regulator and Lubricator Unit – Air control valves, Quick exhaust valves, pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Penumo hydraulic circuit, Sequential circuit design for simple applications using cascade method.

**UNIT V DESIGN OF PNEUMATIC CIRCUITS**

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Anthony Esposito	Fluid Power with Applications	Pearson Education, New Delhi.	2003
2	Majumdar S.R,	Oil Hydraulics	Tata McGraw-Hill, New Delhi.	2000

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Majumdar S.R,	Pneumatic systems – Principles and maintenance	Tata McGraw Hill, New Delhi.	2006
2	Anthony Lal	Oil hydraulics in the service of industry	Allied publishers, New Delhi.	1982
3	Michael J, Princes and AshbyJ.G	Power Hydraulics	Prentice Hall of India, New Delhi.	1989

**WEBSITES :**

1. [http://www.g-w.com/PDF/SampChap/60525\\_0816\\_Ch02.pdf](http://www.g-w.com/PDF/SampChap/60525_0816_Ch02.pdf)
2. [http://www.engineeringtoolbox.com/classification-pumps-d\\_55.html](http://www.engineeringtoolbox.com/classification-pumps-d_55.html)
3. <http://www.omega.com/auto/pdf/SimpValvesguide.pdf>
4. [http://www.arca53.dsl.pipex.com/index\\_files/propair.htm](http://www.arca53.dsl.pipex.com/index_files/propair.htm)
5. <http://www.control-systems-principles.co.uk/whitepapers/servo-control-systems1.pdf>

**INTENDED OUTCOMES:**

- To gain the fundamental knowledge about the design variations of thermal turbo machines.
- To perform the design of the thermal turbo machines.

**UNIT I INTRODUCTION TO TURBO MACHINES**

Turbines, Pumps, Compressors, Fans and Blowers – Stages of Turbo machines – Energy transfer between fluid and rotor – Stage velocity triangles Thermal Turbo machines – Classification – General energy equation – Modified to turbo machines – compression and expansion process – Velocity triangles – Work – T-S and H-S diagram, Total – to – Total and Total – to – Static efficiencies. Dimensional analysis – Non dimensional parameters of compressible flow Turbo machines – Similarity laws, applications and limitations.

**UNIT II CENTRIFUGAL FANS AND BLOWERS**

Definition, selection and classifications –Types of blading design-velocity triangles - Stage Parameters – Flow analysis in impeller blades –Design parameter- Volute and Diffusers – Efficiencies and Losses – Fan noises – Causes and remedial measures. Centrifugal Compressors: - Constructional details – Stage velocity triangles — Stage work – Stage pressure rise – Stage efficiency – Degree of reaction – Slip factor – H-S diagram – Efficiencies – Performance characteristics.

**UNIT III AXIAL FANS AND PROPELLERS**

Definition and classifications – Stage parameters – Types of fan stages-performance characteristics. Cascade of blades – Cascade tunnel - Blade geometry-Cascade variables-Energy transfer and loss in terms of lift and drag - Axial Flow Compressors: definition and classifications – Constructional details – Stage velocity triangles – Stage work – Stage pressure rise – H-S diagram – Stage efficiencies and losses- Degree of reaction – Radial equilibrium-Surging and Stalling – Performance characteristics.

**UNIT IV AXIAL FLOW TURBINES**

Construction details –90° IFR turbine- Stage work – Stage Velocity triangles – Stage pressure rise – Impulse and reaction stage – Effect of degree of reaction – H-S diagram – Efficiencies and Losses – Performance characteristics.

**UNIT V RADIAL FLOW TURBINES AND WIND TURBINES**

Constructional details — Stage velocity triangles – H-S diagram – Stage efficiencies and losses – Performance characteristics.

Wind turbines: definition and classifications – Constructional details –Horizontal axis wind turbine- Power developed – Axial thrust – Efficiency.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Yahya S.M	Turbines, Compressors and Fans	Tata McGraw-Hill Publishing Company, New Delhi.	2010
2	Dixon S.L	Fluid Mechanics, Thermodynamics of Turbomachines Second Edition	Pergamon press, Oxford, U.K.	2010

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Kadambi V and Manohar Prasad	An Introduction to energy conversion Vol. III	New Age Int (p) Ltd	2005
2	Shepherd D.H	Principles of Turbomachinery	The Macmillan Company, New York.	2007

**WEBSITES :**

1. <http://en.wikipedia.org/wiki/Turbomachinery>
2. <http://ekwestrel.com/diffuser-versus-volute/diffuser-versus-volute>
3. <http://mit.edu/16.unified/www/FALL/thermodynamics/notes/node93.html>
4. [http://www.codecogs.com/reference/engineering/fluid\\_mechanics/turbines/axial\\_flow\\_turbines.php](http://www.codecogs.com/reference/engineering/fluid_mechanics/turbines/axial_flow_turbines.php)

**INTENDED OUTCOMES:**

- To introduce the students, the different types of composite materials, their properties and applications.

**UNIT I INTRODUCTION TO COMPOSITES**

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

**UNIT II POLYMER MATRIX COMPOSITES**

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

**UNIT III METAL MATRIX COMPOSITES**

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

**UNIT IV CERAMIC MATRIX COMPOSITES**

Engineering ceramic materials – properties – advantages – limitations – Monolithic ceramics - Need for CMC – Ceramic matrix - Various types of Ceramic Matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold Isostatic Pressing (CIPing) – Hot Isostatic Pressing (HIPing).

**UNIT V ADVANCES IN COMPOSITES**

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

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Mathews F.L and Rawlings R.D	Composite materials Engineering and Science	Wood head publishing Ltd, England	2006
2	Chawla K.K	Composite materials	Springer – Verlag, , New York.	1998



**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Clyne T.W and Withers P.J	Introduction to Metal Matrix Composites	Cambridge University Press, New York.	1995
2	Strong A.B	Fundamentals of Composite Manufacturing	Society of Manufacturing Engineering	2008
3	Sharma S.C	Composite materials	Narosa Publications, New Delhi.	2000

**WEBSITES :**

<ol style="list-style-type: none"><li>1. <a href="http://www.metu.edu.tr/~ckaynak/METE%20470.htm">http://www.metu.edu.tr/~ckaynak/METE%20470.htm</a></li><li>2. <a href="http://www.springerlink.com/content/978-1-4020-8771-4">http://www.springerlink.com/content/978-1-4020-8771-4</a></li><li>3. <a href="http://www.virginia.edu/bohr/mse209/chapter17.htm">http://www.virginia.edu/bohr/mse209/chapter17.htm</a></li><li>4. <a href="http://www.virginia.edu/bohr/mse209/chapter10.htm">http://www.virginia.edu/bohr/mse209/chapter10.htm</a></li><li>5. <a href="http://www.mse.mtu.edu/~drjohn/my4150/">http://www.mse.mtu.edu/~drjohn/my4150/</a></li><li>6. <a href="http://www.msm.cam.ac.uk/Teaching/PtIIAB/C16/index.html">http://www.msm.cam.ac.uk/Teaching/PtIIAB/C16/index.html</a></li></ol>
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**INTENDED OUTCOMES:**

- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

**UNIT I INTRODUCTION**

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

**UNIT II WORK STUDY**

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

**UNIT III PRODUCT PLANNING AND PROCESS PLANNING**

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

**UNIT IV PRODUCTION SCHEDULING**

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

**UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC**

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures.

Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size-ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems-elements of JIT Systems-Fundamentals of MRP and ERP.

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Martand Telsang	Industrial Engineering and Production Management	S.Chand and Company, New Delhi.	2000

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Samson Eilon	Elements of production planning and control	Macmillan, India.	1962
2	Elwood S.Buffa, and Rakesh K.Sarin	Modern Production Operations Management”, 8 <sup>th</sup> Edition	John Wiley and Sons, New Delhi.	2000
3	Jain C.K and Aggarwal L.N	Production Planning Control and Industrial Management	Khanna Publishers, New Delhi.	1990

**WEBSITES :**

<ol style="list-style-type: none"><li>1. <a href="http://envfor.nic.in/divisions/iwsu/iwsu.html">http:// envfor.nic.in/divisions/iwsu/iwsu.html</a></li><li>2. <a href="http://src.edu/work-study">http://src.edu/work-study</a></li><li>3. <a href="http://thequalityportal.com/articles/value.htm">http://thequalityportal.com/articles/value.htm</a></li><li>4. <a href="http://wendt.library.wisc.edu/miles/milesbook.html">http://wendt.library.wisc.edu/miles/milesbook.html</a></li><li>5. <a href="http://en.wikipedia.org/wiki/Kanban">http://en.wikipedia.org/wiki/Kanban</a></li><li>6. <a href="http://en.wikipedia.org/wiki/Inventory_control_system">http://en.wikipedia.org/wiki/Inventory_control_system</a></li><li>7. <a href="http://waspbarcode.com/inventory_control">http://waspbarcode.com/inventory_control</a></li><li>8. <a href="http://lib.washington.edu/business/guides/jit">http://lib.washington.edu/business/guides/jit</a>.</li></ol>
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**INTENDED OUTCOMES:**

- To analysis the stresses and deformations through advanced mathematical models.
- To estimate the design strength of various industrial equipments.

**UNIT I ANALYSIS OF PLATES**

Mathematical modeling of plates with normal loads – Point and Distributed Loads – Support conditions – Rectangular plates - Stresses along coordinate axes – Plate deformations – Axisymmetric plates – Radial and tangential stresses – plate deflections.

**UNIT II THICK CYLINDERS AND SPHERES**

Equilibrium and compatibility conditions - Lamé's Theorem – Boundary conditions – distribution of radial and tangential stresses – compound cylinders – Interference fits - Stresses due to temperature distributions.

**UNIT III ROTATING DISCS**

Lame-Clayperon Theorem – radial and tangential stresses in discs due to centrifugal effects – boundary conditions – solid and hollow discs – Interference fit on shafts –Strengthening of the hub – residual stresses – Autofrettege – Discs of variable thickness – Disc profile for uniform strength.

**UNIT IV BEAMS ON ELASTIC FOUNDATION**

Infinite beam subjected to concentrated load – Boundary Conditions – Infinite beam subjected to a distributed load segment – Triangular load – Semi infinite beam subjected to loads at the ends and concentrated load near the ends – Short beams.

**UNIT V CURVED BEAMS AND CONTACT STRESSES**

Analysis of stresses in beams with large curvature – Stress distribution in curved beams – Stresses in crane hooks and C clamps – Contact Stresses – Hertz equation for contact stresses – applications to rolling contact elements.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Boresi A.P, Schmidt R.J	Advanced Mechanics of Materials”, Sixth edition	John Wiley and Sons, London.	2003
2	Dally J.W and Riley W.F	Experimental Stress Analysis	John Wiley and Sons, London.	2003

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Burr A.H , CheathAm J.B	Mechanical Analysis and Design	Prentice Hall of India, New Delhi.	2001
2	Den-Hartog J.P	Strength of Materials	Dovers publishers, India.	1961

**WEBSITES :**

<ol style="list-style-type: none"><li>1. <a href="http://www.rwc.uc.edu/koehler/biophys/2f.html">http://www.rwc.uc.edu/koehler/biophys/2f.html</a></li><li>2. <a href="http://wiki.answers.com/Q/What_is_torsion">http://wiki.answers.com/Q/What_is_torsion</a></li><li>3. <a href="http://www.engin.umich.edu/students/ELRC/me211/beamdef.html">www.engin.umich.edu/students/ELRC/me211/beamdef.html</a></li><li>4. <a href="http://www.mech.uwa.edu.au/DANotes/cylinders/thin/thin.html">http://www.mech.uwa.edu.au/DANotes/cylinders/thin/thin.html</a></li><li>5. <a href="http://en.wikipedia.org/wiki/shear_stress">http://en.wikipedia.org/wiki/shear_stress</a></li></ol>
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**INTENDED OUTCOMES:**

- To enable the student to understand the several aspects of the design process and to apply them in practice.
- To train the student in the concept of product costing and other manufacturing economics in optimization of product design

**UNIT I PRODUCT DESIGN AND DEVELOPMENT**

Principles of creativity in design- integrated product development and concurrent engineering – Product analysis – Criteria for product design – Market research – Design for customer and design for manufacture – Product life cycle.

**UNIT II ECONOMICS OF DESIGN**

Breaks even point - Selection of optimal materials and processes – Material layout planning – Value analysis – Re-engineering and its impact on product development.

**UNIT III PRODUCT MODELING**

Product modeling – Definition of concept - fundamental issues – Role and basic requirement of process chains and product models –Types of product models – model standardization efforts – types of process chains – industrial demands.

**UNIT IV PRODUCT COSTING**

Bill of materials – Outline Process charts – Concepts of operational standard time - Work measurement by analytical estimation and synthesis of time – Budgets times – Labor cost and material cost at every stage of manufacture – W.I.P. costing

**UNIT V RECENT ADVANCES AND CONCEPTS IN PRODUCT DESIGN**

Fundamentals of FEM and its significance to product design – Product life cycle management – Intelligent information system – Concept of Knowledge based product and process design.

**TEXT BOOKS**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Sameul Eilon	Elements of Production Planning and Control	McMillan and Company., New York.	1962
2	Jones S.W	Product Dosing and Process Selection	Butterworth Publications,	1973
3	Karl T. Ulrich and Stephen Eppinger D	Product Design and Development	McGraw Hill,Newyork	1994

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Harry Nystrom	Creativity and Innovation	John Wiley & Sons, London.	1979
2	George E Dieter	Engineering Design – Materials and process approach	McGraw-Hill Higher Education, New Delhi.	2008
3	Donald E Carter	Concurrent Engineering	Addison Wesley, London.	1992

**WEBSITES :**

1. <http://marketingteacher.com/lesson-store/lesson-plc.html>
2. <http://www.ielm.ust.hk/dfaculty/ajay/courses/ieem513/Layout/lecLayout.html>
3. <http://www.soton.ac.uk/~jps7/Lecture%20notes/Lecture%209%20Concurrent%20Engineering.pdf>
4. [http://www.research.kobe-u.ac.jp/eng-mech-design/taura/img/taura\\_pub/POET.pdf](http://www.research.kobe-u.ac.jp/eng-mech-design/taura/img/taura_pub/POET.pdf)
5. <http://classes.bus.oregonstate.edu/fall-07/ba321/Caplan/Cost%20Accounting%20-%20Chapter%2014%20-%202007.htm>

**INTENDED OUTCOMES:**

- To implement the various maintenance policies repair methods for machine elements

**UNIT I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING**

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

**UNIT II MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE**

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

**UNIT III CONDITION MONITORING**

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

**UNIT IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS**

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

**UNIT V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT**

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

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Srivastava S.K	Industrial Maintenance Management	S.Chand and Co.,New Delhi	1981
2	Bhattacharya S.N	Installation, Servicing and Maintenance	S.Chand and Co., New Delhi.	1995



**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Garg M.R	Industrial Maintenance	S.Chand & Co., New Delhi.	1987
2	R. Keith Mobley, Lindley R. Higgins, Darrin J. Wikoff	Maintenance Engineering Hand book	McGraw Hill, New Delhi	2008
3	Armstrong	Condition Monitoring	BSIRSA ,Frankfurt.	1988

**WEB REFERENCES**

1. <http://www.maintenanceonline.org/maintenanceonline/>
2. [http://www.weibull.com/SystemRelWeb/preventive\\_maintenance.htm](http://www.weibull.com/SystemRelWeb/preventive_maintenance.htm)
3. <http://www.reliabilityweb.com/fa/pdm.htm>
4. <http://www.maintenanceresources.com/products/showcase/productlisting/mechanicalpage.htm>
5. <http://www.globalsecurity.org/military/systems/ground/mhe.htm>

**INTENDED OUTCOMES:**

- To implement the various design process for various material.
- To determine the failure analysis tools

**UNIT I MATERIALS AND DESIGN PROCESS**

Factors affecting the behavior of materials in components, effect of component geometry and shape factors, design for static strength, stiffness, designing with high strength and low toughness materials, designing for hostile environments, material processing and design, processes and their influence on design, process attributes, systematic process selection, screening, process selection diagrams, ranking, process cost.

**UNIT II FRACTURE MECHANICS**

Ductile fracture, brittle fracture, Cleavage-fractography, ductile-brittle transition-Fracture mechanics approach to design-energy criterion, stress intensity approach, time dependent crack growth and damage

LINEAR ELASTIC FRACTURE MECHANICS: Griffith theory, Energy release rate, instability and R-curve, stress analysis of cracks-stress intensity factor, K-threshold, crack growth instability analysis, crack tip stress analysis.

**UNIT III ELASTIC PLASTIC FRACTURE MECHANICS**

Crack tip opening displacement (CTOD), J integral, relationship between J and CTOD, DYNAMIC AND TIME-DEPENDENT FRACTURE: Dynamic fracture, rapid loading of a stationary crack, rapid crack propagation, dynamic contour integral, Creep crack growth-C Integral, Visco elastic fracture mechanics, viscoelastic J integral

**UNIT IV DETERMINATION OF FRACTURE TOUGHNESS VALUES**

Experimental determination of plane strain fracture toughness, K- R curve testing, J measurement, CTOD testing, effect of temperature, strain rate on fracture toughness.

**UNIT V FAILURE ANALYSIS TOOLS**

Reliability concept and hazard function, life prediction, life extension, application of poisson, exponential and Weibull distribution for reliability, bath tub curve, parallel and series system, MTBF, MTTR, FMEA definition-Design FMEA, Process FMEA, analysis causes of failure, modes, ranks of failure modes, fault tree analysis, industrial case studies/projects on FMEA.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	John M Barsoom and Stanley T Rolte	Fracture and Fatigue Control in Structures	Prentice Hall, New Delhi.	1999
2	Michael F Ashby	Material Selection in Mechanical Design	Butterworth-Heinemann, New Delhi.	2010

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Shigley and Mische	Mechanical Engineering Design	McGraw Hill, Singapore.	2003
2	Mahmoud M Farag	Material Selection for Engineering Design	Prentice Hall, New Delhi.	2008
3	William T. Becker, Roch J. Shipley	ASM Handbook: Failure analysis and prevention	ASM Metals Park, Ohio, USA.	2002

**WEB REFERENCES**

1. [www.weibull.com](http://www.weibull.com)

**INTENDED OUTCOMES:**

- To study the various factors influencing the manufacturability of components and the use of tolerances in manufacturing.

**UNIT I DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY**

DFM approach, DFM guidelines, standardisation, group technology, value engineering, comparison of materials on cost basis, design for assembly, DFA index, Poka - Yoke principle;  $6\sigma$  concept; design creativity.

Tolerance Analysis: Process capability, process capability metrics,  $C_p$ ,  $C_{pk}$ , cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law.

**UNIT II SELECTIVE ASSEMBLY**

Interchangeable and selective assembly, deciding the number of groups, Model-I: group tolerances of mating parts equal; Model-II: total and group tolerances of shaft, control of axial play-introducing secondary machining operations, laminated shims, examples.

Datum Systems: Degrees of freedom, grouped datum systems-different types, two and three mutually perpendicular grouped datum planes, grouped datum system with spigot and recess, pin and hole, grouped datum system with spigot and recess pair and tongue-slot pair, computation of translational and rotational accuracy, geometric analysis and applications.

**UNIT III TRUE POSITION TOLERANCING THEORY**

Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples.

**UNIT IV FORM DESIGN OF CASTINGS AND WELDMENTS**

Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, use of welding symbols – design considerations for plastic component manufacturing.

**UNIT V TOLERANCE CHARTING**

Tolerance Charting Technique: Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples, design features to facilitate machining, datum features - functional and manufacturing, component design-machining considerations, redesign for manufacture, examples.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Harry Peck	Designing for Manufacture	Pitman Publications, London.	1983
2	Matousek R	Engineering Design - A Systematic Approach	Blackie and Son Ltd., London.	1974

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Spotts M F	Dimensioning and Tolerance for Quantity Production	Prentice Hall Inc., New Jersey, USA.	1983
2	Oliver R Wade	Tolerance Control in Design and Manufacturing	Industrial press Inc., New York.	1967
3	James G Bralla	Hand Book of Product Design for Manufacturing	McGraw Hill Publications, New Delhi.	1986
4	Creveling C M	Tolerance Design - A Hand Book for Developing Optimal Specifications	Addison Wesley Longman Inc., USA.	1997

**WEB REFERENCES**

1. [www.dfma.com](http://www.dfma.com)
2. [www.design4manufacturability.com](http://www.design4manufacturability.com)

**INTENDED OUTCOMES:**

- |   |
|---|
| <ul style="list-style-type: none"> <li>To impart the different types of composite materials, their properties and applications</li> </ul> |
|---|

**UNIT I INTRODUCTION**

Modern materials in design, types, metals, polymers, ceramics, composites. Polymers-Classification, properties of thermo plastics, properties of thermo setting plastics, applications, merits and demerits. Classification of composites, Honey comb composites, advantages, applications. Matrix and their role, principal types of fibre and matrix materials.

**UNIT II PROCESS AND CHARACTERISTICS OF COMPOSITES**

Manufacture of polymer matrix composites-Lay up and curing, open and closed mould processes, bag moulding, filament winding, pultrusion, pulforming, thermoforming, advantages and limitations of different processes. Manufacture of metal matrix and ceramic matrix composites. Advantages, limitations and characteristics of ceramic and metal matrix composites.

**UNIT III CONCEPTS OF SOLID MECHANICS**

Stress and strain, Strain Energy, Plane stress and plane strain, Generalized Hook's Law for different types of materials, material symmetry, Engineering constants, coordinate transformation, thermal effects and moisture effects,

**UNIT IV MICRO MECHANICAL BEHAVIOUR OF A LAMINA**

Volume and mass fractions, density and void content, evaluation of elastic moduli, ultimate strengths of a unidirectional lamina, coefficients of thermal and moisture expansion.

**UNIT V MACRO MECHANICAL BEHAVIOUR OF A LAMINA**

Hook's Law for a two dimensional unidirectional lamina and angular lamina, evaluation of elastic moduli for unidirectional and angle lamina, engineering constants of unidirectional and angle lamina, strength failure theories.

Macro Mechanical Behaviour Of A Laminate: Laminate code, stress - strain behaviour in a laminate, Resultant forces and moments in a laminate, interlaminar stresses in laminates.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Autar K Kaw	Mechanics of Composite Materials	CRC Press, New York	2006
2	Agarwal B.D. and Broutman L.J	Analysis and Performance of Fibre Composites	John Wiley and Sons Inc, London.	2006

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Ronald F Gibson	Principles of Composite Material Mechanics	McGraw Hill Book Co., Newyork.	2011
2	Robert M Jones	Mechanics of Composite Materials	McGraw Hill Book Co.,Newyork.	1999
3	Kalyanmoy Deb	Optimization for engineering design	Prentice-Hall,India (Pvt) Ltd., New Delhi	2000
4	Sanjay K Mazumdar	Composites Manufacturing - Materials, Product, and Process Engineering	CRC Press, New York.	2003

**WEB REFERENCES**

1. <a href="http://www.springer.com">www.springer.com</a>
2. <a href="http://www.ossamashaar.4t.com">www.ossamashaar.4t.com</a>

**INTENDED OUTCOMES:**

- |   |
|---|
| <ul style="list-style-type: none"> <li>To gain knowledge in production, gear material selection.</li> </ul> |
|---|

**UNIT I INTRODUCTION TO GEARS**

Types of gears-classification, application of gears, gearboxes, drawings for gears, gear production method an overview, types of blanks and blank preparation. Production Of Cylindrical Gears: Procedure of cutting gears and obtainable quality in hobbing and gear shaping, cutter selection and work holding methods, setting calculations. Rack type gear shaping machine description and application. Internal gear cutting methods, CNC gear hobbing and gear shaping machines.

**UNIT II PRODUCTION OF CONICAL GEARS**

Production of straight bevel gears by bevel gear generator, duplex rotary cutter method, Gleason Reva cycle method, spiral and hybrid bevel gear generation. Description of machine, cutter and machine setting.

**UNIT III GEAR MATERIAL SELECTION AND HARDENING METHODS**

Properties of gear materials-non-metallic, non-ferrous and plastic gears, selection of material for power transmission, high speed application. Selection of material for worm and wheel. Hardening by through hardening, case hardening, induction hardening, flame hardening, nitriding and tuftriding, hardening defects.

**UNIT IV GEAR FINISHING METHODS**

Gear finishing advantages, finishing of gears by grinding, shaving, lapping and honing methods, cold rolling of gears - description of process, machine, cutters and process parameters setting. Gear Inspection: Type of gear errors-gear quality standards and allowable limits-tooth thickness, base tangent length measurement, pitch error, radial run out, involute profile error measurements methods and analysis, composite error measurement, computerized gear inspection, gear failure reasons and remedies.

**UNIT V MODERN GEAR PRODUCTION METHODS**

Gear production by stamping, die casting, powder metal process, injection and compression moulding of plastic gears, cold and hot rolling. Mass production methods, shear speed shaping, gear broaching, Gleason G-TRAC – gear generation methods. Economical and Quality Production Of Gears: Gear production systems – batch production, gear production cells, lean and agile production practices, automobile gear and gear boxes, heavy engineering gear production, gear for instruments and appliances, process and cutter selection for quantity, cost and quality criteria.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Watson. H. J	Modern Gear Production	Persman Press, Oxford.	1984
2	HMT,	Production Technology	Tata McGraw Hill Co., New Delhi	1992



**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	-	Gear Design Manufacturing Inspection Manual	Society of Automotive Engineers	1990
2	Weck .M,	Hand Book of Machine Tools Technology and Sun Gear Technology	Magazine – Back Volumes.	1984

**WEBSITES :**

1. [www.geartechnology.com](http://www.geartechnology.com)
2. [www.gearsolutions.com](http://www.gearsolutions.com)

**INTENDED OUTCOMES:**

- The basics of precision engineering
- The various techniques of precision engineering like Nano technology etc.
- The accuracy, influence of static stiffness, vibration accuracy etc.

**UNIT I      ACCURACY**

Concept of accuracy – accuracy of numeric control systems, acceptance test for machine tools.

Factors Affecting Accuracy: Static stiffness and its influence on machining accuracy, inaccuracies due to thermal effects, influence of forced vibrations on accuracy, dimensional wear of cutting tools and its influence on accuracy.

**UNIT II      MICRO FINISHING PROCESS**

Surface roughness, bearing area curves, surface texture measurement, methods of improving accuracy and surface finish, finish boring, finish grinding, precision cylindrical grinding, micro machining, precision micro drilling.

**UNIT III      UNCONVENTIONAL MACHINING**

Precision, cut in wire, EDM machining, electro mechanical grinding, electron beam machining, laser beam machining.

**UNIT IV      MICRO ELECTRO MECHANICAL SYSTEMS**

Introduction to silicon processing, wafer cleaning, diffusion and ion implantation, oxidation, photolithography, photo resist, resist strip, electron beam and X-ray lithography, thin film deposition, evaporation, sputtering, molecular beam epitaxy, chemical vapour deposition, electro plating.

**UNIT V      BULK MICRO MACHINING AND NANO TECHNOLOGY**

Wet etching, isotropic etching, anisotropic etching, dry etching, physical etching, reactive ion etching, Nano Technology, nano-grating system, nano-lithography, fabrication of CCDs, nano processing of materials for super high density ICs, nano-mechanical parts.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Murthy. R L,	Precision Engineering in Manufacturing	New Age International Publishers, New Delhi.	2005
2	Mark J Madou	Fundamentals of Micro Fabrication	CRC Press , Florida.	2002
3	Nano Tanigudi	Nanotechnology	Oxford University Press, New York.	2003

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Davidson	Handbook of Precision Engineering, Vol. 1	McMillan, Chennai	1972
2	Jaeger.R.C	Introduction to Micro Electronics Fabrication	Addison Wesley, England.	1988
3	Chang C.V and Sze S.M	VLSI Technology	Tata McGraw Hill, New Delhi	2003
4	Bhart Bhusshan	Handbook of Nano Technology	Springer, Germany	2004

**WEBSITES :**

<ol style="list-style-type: none"><li>1. <a href="http://www.scientific.net">www.scientific.net</a></li><li>2. <a href="http://www.nist.gov">www.nist.gov</a>.</li></ol>
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**INTENDED OUTCOMES:**

- To know the various tools and methodologies of lean manufacturing.
- To know the cost of wastes in manufacturing systems.
- To study the requirements of customer satisfaction in terms of quality.

**UNIT I INTRODUCTION**

Objectives of lean manufacturing-key principles and implications of lean manufacturing- Traditional Vs lean manufacturing – Lean benefits - Case studies

**UNIT II LEAN MANUFACTURING CONCEPTS**

Value creation and waste elimination- Major kinds of waste- pull production-different models of pull production-continuous flow-continuous improvement / Kaizen- Worker involvement.

**UNIT III MANUFACTURING FLOW ELEMENT**

Product/quantity analysis - process mapping - routing analysis - takt time calculations, line balancing and one-piece flow - Various types of layouts – Process - Product and cellular layouts - Manufacturing cell design criteria.

**UNIT IV PROCESS CONTROL ELEMENT**

Single minute exchange of dies (SMED) - total productive maintenance (TPM) - Poka-yoke - 5S - visual controls - graphic work instructions - Lean Sixsigma Concepts and tools - Sixsigma measurements - Case studies.

**UNIT V VALUE STREAM MAPPING**

The as-is diagram-the current state and future state map-application to the factory simulation scenario - overall equipment effectiveness(OEE)- measurements and case studies.

Just in Time manufacturing: Introduction - elements of JIT - Kanban system - Kanban sizing - Case studies

IMPLEMENTING LEAN: Road map-senior management Involvement - best practices.

INTEGRATING LEAN WITH OTHER SYSTEMS: Toyota production system-lean six sigma-lean and ERP-lean with ISO9001: 2000)

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Askin R.G. and Goldberg J.B	Design and Analysis of Lean Production Systems	John Wiley and Sons Inc.,New Jercey.	2003
2	Micheal Wader	Lean Tools: A Pocket guide to Implementing Lean Practices	Productivity and Quality Publishing Pvt Ltd., New Delhi	2002

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Joseph A.D Feo , William W Bearnard,	Juran Institute's Six Sigma Break Through and Beyond	Tata McGraw-Hill Edition, New Delhi	2004
2	Richard B Chase, Robert Jacobs F and Nicholas J Aquilano	Operations Management for Competitive Advantage Tenth Edition	McGraw- Hill, Newyork	2003
3	Poka – Yoke	Improving Product Quality by Preventing Defects	Productivity Press, Chennai	1992
4	Alan Robinson	Continuous Improvement in Operations	Productivity Press, Portland, Oregon	1991

**WEBSITES :**

1. [www.leanmanufacturingconcepts.com](http://www.leanmanufacturingconcepts.com)
2. [www.learnleanblog.com](http://www.learnleanblog.com)

**INTENDED OUTCOMES:**

- To understand the role of logistics and the phases of supply chain
- To understand the models and activities of SC

**UNIT I INTRODUCTION TO SUPPLY CHAIN MANAGEMENT**

Definition, global optimization, Objectives of SCM. Logistics networks- data collection, model and data elevation, solution techniques.

**UNIT II INVENTORY MANAGEMENT**

Introduction, single warehouse, Inventory examples, economic lot size model, effect of demand uncertainty. Risk pooling, centralized and decentralized system, managing inventory in the supply chain, forecasting.

**UNIT III VALUE OF INFORMATION**

Bullwhip effect, information and supply chain technology. Supply chain integration- push, pull and push-pull system. Demand driven strategies, impact of internet on SCM, distribution strategies.

**UNIT IV STRATEGIC ALLIANCES**

Framework for strategic alliance, third party logistics, retailer, supplies partnership, distributor-integration, procurement and out servicing strategies.

**UNIT V INTERNATIONAL ISSUES IN SCM**

Introduction, risks and advantages- design for logistics, supplies integration into to new product development, mass customization. Issues in customer value.

Information Technology For Scm: Goals, standardization, infrastructure, DSS for supply chain management.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Simchi – Levi Davi, Kaminsky Philip and Simchi-Levi Edith	Designing and Managing the Supply Chain	Tata M.Graw- Hill Publishing Company Ltd, New Delhi	2003
2	Sunil Chopra and Peter Meindl	Supply Chain Management – Strategy, Planning and Operation	Prentice Hall, New Delhi	2006

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Ayers J.B	Hand book of Supply Chain Management	The St. Lencie press, New Delhi.	2001
2	Raghuram G and Rangaraj N	Logistics and Supply Chain Management: Cases and Concepts	Macmillan, New Delhi	2000
3	Scharj P.B, Lasen T.S	Managing the global supply chain	Viva Books, New Delhi	2000
4	Thomas E Vollman, Clay Whybark D	Manufacturing Planning and Control for Supply Chain Management	Tata McGraw-Hill, New Delhi	2005

**WEBSITES :**

1. <http://www.supplychainmanagement.in/>
2. [www.supplychainseminars.com](http://www.supplychainseminars.com)
3. <http://www.training-management.info/>
4. <http://www.erpfans.com/erpfans/erpdefinition/erp002.html>
5. [http://www.ascet.com/documents.asp?grID=197&d\\_ID=981](http://www.ascet.com/documents.asp?grID=197&d_ID=981)

**INTENDED OUTCOMES:**

- To understand the components and operations of steam power plants and hydel power plants
- To understand the components and operations of Nuclear power plant and Gas turbine plants

**UNIT I INTRODUCTION TO POWER PLANTS & BOILERS**

Layout of Steam, Hydel, Diesel, MHD, Nuclear and Gas Turbine Power Plants - Combined Power Cycles – Comparison and Selection, Load Duration Curves.

Steam Boilers and Cycles – High Pressure and Super Critical Boilers – Fluidised Bed Boilers

**UNIT II STEAM POWER PLANT**

Fuel and Ash Handling, Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precipitator, Draught – different types, Surface Condenser Types, Cooling Towers

**UNIT III NUCLEAR AND HYDEL POWER PLANTS**

Nuclear Energy – Fission, Fusion Reaction, Types of Reactors, pressurized water reactor, Boiling Water Reactor, Waste Disposal and safety.

Hydel Power Plant – Essential Elements, Selection of Turbines, Governing of Turbines- Micro Hydel developments.

**UNIT IV DIESEL AND GAS TURBINE POWER PLANT**

Types of Diesel Plants, Components, Selection of Engine Type, Applications Gas Turbine Power Plant – Fuels - Gas Turbine Material – Open and Closed Cycles – Reheating – Regeneration and Intercooling – Combined Cycle.

**UNIT V OTHER POWER PLANTS AND ECONOMICS OF POWER PLANTS**

Geo thermal –OTEC – Tidel - Pumped storage - Solar thermal central receiver system.

Cost of Electric Energy – Fixed and operating Costs – Energy Rates – Types of Tariffs – Economics of load sharing, comparison of economics of various power plants.

**TEXT BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Arora S.C and Domkundwar S	A course in Power Plant Engineering	Dhanpatrai Publishers, New Delhi.	1984



**REFERENCES:**

<b>S.NO</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Nag P.K	Power plant Engineering	Tata McGraw-Hill, New Delhi.	2007
2	Rajput R.K	Power Plant Engineering	Laxmi Publications, Chennai.	2005
3	Morse Frederick T	Power Plant Engineering	Prentice Hall of India, New Delhi.	1998

**WEBSITES :**

1. [www.igcar.gov.in](http://www.igcar.gov.in)
2. [ga.water.usgs.gov](http://ga.water.usgs.gov)
3. [www.mapsofindia.com](http://www.mapsofindia.com)
4. [www.solarpaces.org](http://www.solarpaces.org)

## LIST OF VALUE ADDED COURSE

### **1. ROBOTICS & AUTOMATION**

**2 0 0 2 100**

#### **INTENDED OUTCOMES:**

- To introduce the basic concepts, parts of robots and types of robots
- To make the students familiar with the various drive systems for robot, sensors and their applications.
- To discuss about the robot cell design and safety of robot.

#### **UNIT I FUNDAMENTALS OF ROBOT**

Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Their Functions – Need for Robots – Different Applications. Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features. End Effectors – Grippers. Requirements of a sensor, Principles and Applications of sensors – Position of sensors, Proximity Sensors, Touch Sensors - Camera, Frame Grabber, Sensing and Digitizing Image.

#### **UNIT II ROBOT CELL DESIGN**

Robot cell design – simulation software (Robo Wave). Robot cell layouts – Multiple robots and machine interference – robot cell planning – robot cycle time analysis for assembly, welding and painting shop.

Safety Considerations for Robot Operations, Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.

**INTENDED OUTCOMES**

To enable the student to get a detailed knowledge of all the hardware components that make up a computer and to understand the different interfaces required for connecting these hardware devices.

- To introduce issues related to CPU and memory.
- To understand the components on the motherboard
- To understand different storage media
- To introduce the features of different I/O peripheral devices and their interfaces.

**UNIT I CPU**

CPU essentials – processor modes – modern CPU concepts – Architectural performance features – the Intel’s CPU – CPU over clocking – over clocking requirements – over clocking the system – over clocking the Intel processors – Essential memory concepts – memory organizations – memory packages – modules – logical memory organizations – memory considerations – memory types – memory techniques – selecting and installing memory.

Active motherboards – sockets and slots – Intel D850GB – Pentium4 mother board – expansion slots – form factor – upgrading a mother board – chipsets – north bridge – south bridge – CMOS – CMOS optimization tactics – configuring the standard CMOS setup – motherboard BIOS – POST – BIOS features – BIOS and Boot sequences – BIOS shortcomings and compatibility issues – power supplies and power management – concepts of switching regulation – potential power problems – power management.

**UNIT II INTERFACE**

Parallel port – signals and timing diagram – IEEE1284 modes – asynchronous communication - serial port signals – video adapters – graphic accelerators – 3D graphics accelerator issues – DirectX – mice – modems – keyboards – sound boards – audio bench marks.

**TEXT BOOK:**

<b>S.NO</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Stephen J. Bigelow	Trouble Shooting, maintaining and Repairing PCs	Tata McGraw-Hill, New Delhi.	2009

**INTENDED OUTCOMES**

- To understand the working principles of pumps
- To understand the working principles and motors
- Selection of pumps and motors

**UNIT I SINGLE PHASE INDUCTION MOTOR**

Constructional details of single phase induction motor – Principle of operation – Types – Losses and Efficiency - Performance analysis – Starting methods of single-phase induction motors. - Design aspects of motors for usage in submersible pumps– Motors Rating and selection criteria.

**UNIT II THREE PHASE INDUCTION MOTOR**

Constructional details – Types of rotors – Principle of operation - Need for starters – Types of starters – DOL, Stator resistance and reactance, rotor resistance, autotransformer and star-delta starters – Speed control – Change of voltage, torque, number of poles and slip – Losses and Efficiency - Performance analysis – Design aspects of motors for usage in submersible pumps – Motors Rating and selection criteria.

**UNIT III PUMPS**

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: working principles of gear and vane pumps

**TEXT BOOKS**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Kothari, D. P., and Nagrath, I. J	Electric Machines	Tata McGraw Hill Publishing Company Ltd., New Delhi	2002
2	Bimbhra, P. S	Electrical Machinery	Khanna Publishers, New Delhi	2003

**INTENDED OUTCOMES**

- To understand the concepts of geometrical dimensioning & Tolerancing
- To study the physical importance of them in industrial point of view
- To know the various types of Tolerancing, its measurement and design.

**UNIT I INTRODUCTION TO GD & T**

Introduction to Geometric dimensioning & Tolerancing - working of geometric system - Terms and definitions - Common symbols & Terminology - Fundamental Rules (Drawing)- Feature definition - With Size and Without Size - Material Condition (Maximum, Least, Regard of Material Condition)- Limit Tolerancing - Dimension Origin -Limits of Size, Rule 1 or Envelope Principle - Go- No Go Gauges.

**UNIT II FORM & ORIENTATION TOLERANCE**

Datum Reference Frame (DRF) theory and application - DRF qualification measurement and design - Datum targets - Form tolerance specification and design considerations - Flatness and Circularity measurement concepts - Orientation tolerance specification and application design.

**UNIT III POSITION & RUNOUT TOLERANCE**

Profile of surface and line tolerance design and application - Location tolerance, Position, applied and material condition consideration - Coaxial controls and design - Concentricity, Symmetry - Measurement and application - Design considerations - Position, Composite tolerance concept, design and Measurement - Runout, Total Runout tolerances - Measurement and considerations.

**INTENDED OUTCOMES:**

- To introduce the basic concepts, parts of CNC machines and types
- To make the students familiar with the CNC Programming
- To know about the inspection and maintenance of CNC machines.

**UNIT I INTRODUCTION TO CNC**

CNC Definition – history of CNC – CNC Control Systems – Types of CNC Machines – Basic components of CNC machines - CNC Lathe, Milling Machine – Advantages, limitations of CNC machines

**UNIT II CNC PROGRAMMING (CNC LATHE & MILLING MACHINE)**

CNC Programming – Programming methods – Absolute method, Incremental method - G Codes & M codes – Address Characters – Codes for Miscellaneous Functions, Preparatory functions, Speed functions, Feed function, Tool function – Axes control and Direction control – cycles in programming - Tool offset and work offset – Tool nose radius compensation

- ❖ Part programming for Linear, Circular interpolation, and Contour motions.
- ❖ Part programming using standard canned cycles for Thread cutting, Drilling, Peck drilling, and Boring.

**UNIT III INSPECTION AND MAINTENANCE**

Importance of maintenance – types of maintenance – daily, weekly, monthly, half yearly, annual & periodic inspection and maintenance