



MANGALORE INSTITUTE OF TECHNOLOGY AND ENGINEERING
(An ISO 9001:2015 Certified Institution)

1.3.2. Average percentage of courses that include experiential learning through project work/field work/internship during last five years

ACADEMIC YEAR 2016-17

MECHANICAL ENGINEERING

Documents contains list and syllabus of courses that includes experiential learning through project works, internships and field work for the department.

Documents Enclosed

Sl. No	Particulars	Page Nos
1.	List of course that include experiential learning through project works, internships and field work	1-2
2.	Syllabus of the courses mapped	3-118

Subjects List of 2016-2017 Mapped Project/ Internship/Industrial Visit

10WSL16	Workshop Practice
10PHY12	Engineering Physics
10MAT11	Engineering Maths I
10ELE15	Basic Electrical Engg
10CIV13	Elements of Civil Engg and Engineering Mechanics
10CIP18	Constitution of India and Professional Ethics Syllabus
10EME14	Elements of Mechanical Engg
10CCP13	Computer Concepts and C Programming
10CHE12	Engineering Chemistry
10CIV18	Environmental Studies
10ELN15	Basic Electronics
10MAT11	Engineering Maths I
10MAT31	Engg. Maths - III
10ME32A	Material Sc. & Metallurgy
10ME33	Basic Thermodynamics
10ME34	Mechanics of Materials
10ME35	Manufacturing Process I
10ME36B	Fluid Mechanics
10MEL37B	Mech. Measurements & Metrology Lab
10MEL38A	Foundry & Forging lab
10ME42B	Mechanical Measurements & Metrology
10ME43	Applied Thermodynamics
10ME44	Kinematics of Machines
10ME45	Manufacturing Process II
10ME46A	Computer Aided Machine Drawing
10MEL47A	Metallography & Material Testing Lab
10MEL48B	Machine Shop
10ME51	Management and Entrepreneurship
10ME52	Design of Machine Elements I
10ME53	Energy Engineering

10ME54	Dynamics of Machines
10ME55	Manufacturing Process III
10ME56	Turbo Machines
10MEL57	Fluid Mechanics & Machines Lab
10MEL58	Energy Conversion Engg. Lab
10ME61	Computer Integrated Manufacturing
10ME62	Design of Machine Elements II
10ME63	Heat & Mass Transfer
10ME64	Finite Element Methods
10ME65	Mechatronics & DP
10MEL67	Heat & Mass Transfer Lab
10MEL68	CAMA Lab
10ME665	Non-Traditional Machining
10ME667	Project Management
10ME71	Engineering Economics
10ME72	Mechanical Vibrations
10ME73	Hydraulics and Pneumatics
10ME74	Operations Research
10MEL77	Design Lab
10MEL78	CIM and Automation Lab
10ME758	Total Quality Management
10ME81	Operations Management
10ME82	Control Engineering
10ME85L	Project Work

ENGINEERING MATHEMATICS – I

Sub Code	:	10MAT11	IA Marks	:	25
Hrs/ Week	:	04	Exam Hours	:	03
Total Hrs.	:	52	Exam Marks	:	100

PART-A

UNIT – 1

Differential Calculus - 1

Determination of n^{th} derivative of standard functions-illustrative examples*. Leibnitz's theorem (without proof) and problems.

Rolle's Theorem – Geometrical interpretation. Lagrange's and Cauchy's mean value theorems. Taylor's and Maclaurin's series expansions of function of one variable (without proof).

6 Hours

UNIT – 2

Differential Calculus - 2

Indeterminate forms – L'Hospital's rule (without proof), Polar curves: Angle between polar curves, Pedal equation for polar curves. Derivative of arc length – concept and formulae without proof. Radius of curvature - Cartesian, parametric, polar and pedal forms.

7 Hours

UNIT – 3

Differential Calculus - 3

Partial differentiation: Partial derivatives, total derivative and chain rule, Jacobians-direct evaluation.

Taylor's expansion of a function of two variables-illustrative examples*. Maxima and Minima for function of two variables. Applications – Errors and approximations.

6 Hours

UNIT – 4

Vector Calculus

Scalar and vector point functions – Gradient, Divergence, Curl, Laplacian, Solenoidal and Irrotational vectors.

Vector Identities: $\text{div}(\phi A)$, $\text{Curl}(\phi A)$, $\text{Curl}(\text{grad } \phi)$, $\text{div}(\text{Curl} A)$, $\text{div}(A \times B)$ & $\text{Curl}(\text{Curl } A)$.

Orthogonal Curvilinear Coordinates – Definition, unit vectors, scale factors, orthogonality of Cylindrical and Spherical Systems. Expression for Gradient, Divergence, Curl, Laplacian in an orthogonal system and also in Cartesian, Cylindrical and Spherical System as particular cases – No problems

7 Hours

PART-B

UNIT – V

Integral Calculus

Differentiation under the integral sign – simple problems with constant limits. Reduction formulae for the integrals of $\sin^n x$, $\cos^n x$, $\sin^m x \cos^n x$ and evaluation of these integrals with standard limits - Problems.

Tracing of curves in Cartesian, Parametric and polar forms – illustrative examples*. Applications – Area, Perimeter, surface area and volume.

Computation of these in respect of the curves – (i) Astroid: $x^{2/3} + y^{2/3} = a^{2/3}$
(ii) Cycloid: $x = a(\theta - \sin \theta)$, $y = a(1 - \cos \theta)$ and (iii) Cardioid:
 $r = a(1 + \cos \theta)$

6 Hours

UNIT – VI

Differential Equations

Solution of first order and first degree equations: Recapitulation of the method of separation of variables with illustrative examples*. Homogeneous, Exact, Linear equations and reducible to these forms. Applications - orthogonal trajectories.

7 Hours

UNIT – VII

Linear Algebra-1

Recapitulation of Matrix theory. Elementary transformations, Reduction of the given matrix to echelon and normal forms, Rank of a matrix, consistency of a system of linear equations and solution. Solution of a system of linear homogeneous equations (trivial and non-trivial solutions). Solution of a system of non-homogeneous equations by Gauss elimination and Gauss – Jordan methods.

6 Hours

UNIT – VIII:

Linear Algebra -2

Linear transformations, Eigen values and eigen vectors of a square matrix, Similarity of matrices, Reduction to diagonal form, Quadratic forms, Reduction of quadratic form into canonical form, Nature of quadratic forms

7 Hours

Note: * In the case of illustrative examples, questions are not to be set.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Latest edition, Khanna Publishers
2. Erwin Kreyszig, Advanced Engineering Mathematics, Latest edition, Wiley Publications.

Reference Books:

1. B.V. Ramana, Higher Engineering Mathematics, Latest edition, Tata Mc. Graw Hill Publications.
2. Peter V. O'Neil, Engineering Mathematics, CENGAGE Learning India Pvt Ltd.Publishers

ENGINEERING PHYSICS

Sub Code	: 10PHY12/10PHY22	IA Marks	: 25
Hrs/ Week	: 04	Exam Hours	: 03
Total Hrs.	: 52	Exam Marks	: 100

PART – A

UNIT-1

Modern Physics

Introduction to Blackbody radiation spectrum, Photo-electric effect, Compton effect. Wave particle Dualism. de Broglie hypothesis – de Broglie wavelength, extension to electron particle. – Davisson and Germer Experiment.

Matter waves and their Characteristic properties. Phase velocity, group velocity and Particle velocity. Relation between phase velocity and group velocity. Relation between group velocity and particle velocity. Expression for deBroglie wavelength using group velocity.

7 Hours

UNIT-2

Quantum Mechanics

Heisenberg's uncertainty principle and its physical significance. Application of uncertainty principle (Non-existence of electron in the nucleus, Explanation for β -decay and kinetic energy of electron in an atom). Wave function. Properties and Physical significance of a wave function. Probability density and Normalisation of wave function. Setting up of a one dimensional, time independent Schrödinger wave equation. Eigen values and Eigen functions. Application of Schrödinger wave equation – Energy Eigen values for a free particle. Energy Eigen values of a particle in a potential well of infinite depth.

6 Hours

UNIT-3

Electrical Conductivity in Metals

Free-electron concept. Classical free-electron theory - Assumptions. Drift velocity. Mean collision time and mean free path. Relaxation time. Expression for drift velocity. Expression for electrical conductivity in metals. Effect of impurity and temperature on electrical resistivity of metals. Failures of classical free-electron theory.

Quantum free-electron theory - Assumptions. Fermi - Dirac Statistics. Fermi-energy – Fermi factor. Density of states (No derivation). Expression for electrical resistivity / conductivity. Temperature dependence of resistivity of metals. Merits of Quantum free – electron theory.

7 Hours

UNIT-4

Dielectric & Magnetic Properties of Materials

Dielectric constant and polarisation of dielectric materials. Types of polarisation. Equation for internal field in liquids and solids (one dimensional). Clausius – Mossotti equation. Ferro and Piezo – electricity (qualitative). Frequency dependence of dielectric constant. Important applications of dielectric materials. Classification of dia, para and ferromagnetic materials. Hysteresis in ferromagnetic materials. Soft and Hard magnetic materials. Applications.

7 Hours

PART – B

UNIT - 5

Lasers

Principle and production. Einstein's coefficients (expression for energy density). Requisites of a Laser system. Condition for Laser action. Principle, Construction and working of He-Ne and semiconductor Laser. Applications of Laser – Laser welding, cutting and drilling. Measurement of atmospheric pollutants. Holography – Principle of Recording and reconstruction of 3-D images. Selected applications of holography.

6 Hours

UNIT-6

Optical Fibers & Superconductivity

Propagation mechanism in optical fibers. Angle of acceptance. Numerical aperture. Types of optical fibers and modes of propagation. Attenuation. Applications – block diagram discussion of point to point communication.

Temperature dependence of resistivity in superconducting materials. Effect of magnetic field (Meissner effect). Type I and Type II superconductors - Temperature dependence of critical field. BCS theory (qualitative). High temperature superconductors. Applications of superconductors– Superconducting magnets, Maglev vehicles and squids

7 Hours

UNIT-7

Crystal Structure

Space lattice, Bravais lattice - unit cell, primitive cell. Lattice parameters. Crystal systems. Direction and planes in a crystal. Miller indices. Expression for inter-planar spacing. Co-ordination number. Atomic packing factor. Bragg's Law. Determination of crystal structure by Bragg's x-ray spectrometer. Crystal structures of NaCl, and diamond.

6 Hours

UNIT-8**Material Science**

Introduction to Nanoscience and Nanotechnology. Nanomaterials: Shapes of nanomaterials, Methods of preparation of nanomaterials, Wonders of nanotechnology: Discovery of Fullerene and carbon nanotubes, Applications. Ultrasonic non-destructive testing of materials. Measurements of velocity in solids and liquids, Elastic constants.

6 Hours**Text Books**

	Title		Author/s / Editor		Publishers
1	Solid State Physics – Sixth Edition	-	S.O. Pillai	-	New Age International
2	Engineering Physics	-	V. Rajendran	-	Tata Mc-Graw Hill Company Ltd., New Delhi

Reference Books

	Title		Author/s / Editor		Publishers
1	Nanosystems- Molecular Machinery, Manufacturing and Computation	-	K.Eric Drexler	-	John Wiley & Sons 2005 Ed.
2	Fundamentals and Applications of Ultrasonic Waves	-	J David N Cheeke and Cheeke N Cheeke	-	CRC Press
3	Nano Materials	-	Vishwanathan	-	Narosa Publications
4	Engineering Physics	-	G.K Shivakumar	-	Prism Books Pvt. Ltd.

ENGINEERING CHEMISTRY

Sub Code	: 10CHE12/ 10CHE 22	IA Marks	: 25
Hrs/ Week	: 04	Exam Hours	: 03
Total Hrs.	: 52	Exam Marks	: 100

PART – A

UNIT – 1

Electrode Potential and Cells

Introduction, Differences between galvanic and electrolytic cells, Construction of galvanic cell, EMF of a cell, Origin of single electrode potential, Sign convention and cell notation, Standard electrode potential, Derivation of Nernst equation for single electrode potential.

Types of electrodes: Reference electrodes – Primary and secondary, Limitations of standard hydrogen electrode, Construction and working of calomel electrode and Ag – AgCl electrode, Measurement of single electrode potential, Numerical problems on electrode potential and EMF of a cell, Ion selective electrode: Glass electrode – Construction, Determination of pH of a solution using glass electrode, concentration cells, numerical problems.

7 Hours

UNIT - 2

Batteries and Fuel Cells

Basic concepts, Battery characteristics – primary, secondary and reserve batteries with examples, super capacitors

Classical batteries: Construction, working and applications of Zn – MnO₂, Lead acid storage and Ni – Cd batteries.

Modern batteries: Construction, working and applications of Zn – air, Ni – metal hydride and Li – MnO₂ batteries.

Fuel cells – Differences between battery and fuel cell, construction and working of H₂ – O₂ and CH₃OH– O₂ fuel cells.

6 Hours

UNIT - 3

Corrosion and its control

Electrochemical theory of corrosion, Galvanic series, Types of corrosion- Differential metal corrosion, Differential aeration corrosion (Pitting and water line corrosion), Stress corrosion (caustic embrittlement in boilers), Factors affecting the rate of corrosion

Corrosion control: Inorganic coatings – Anodizing and phosphating, Metal coatings – Galvanizing and Tinning, Corrosion inhibitors, cathodic protection.

7 Hours

UNIT - 4

Metal Finishing

Technological importance, Significance of Polarization, Decomposition potential and Overvoltage in electroplating, Theory of electroplating. Effect of plating variables on the nature of electrodeposit- Electroplating process, Electroplating of gold and Chromium.

Distinction between electroplating and electrolessplating, Electrolessplating of copper and nickel.

6 Hours

PART – B

UNIT – 5

Chemical fuels and Photovoltaic cells

Introduction, Classification of chemical fuels Calorific value – High and Low calorific values, Determination of calorific value –solid or liquid fuel using Bomb calorimeter - numerical problems .

Petroleum – Cracking by fluidized catalytic cracking process, Reformation of petrol, Octane and Cetane numbers. Knocking – mechanism and harmful effects. Antiknocking agents – TEL, Catalytic converters – Principle and working, Unleaded petrol, Power alcohol and Biodiesel.

Photovoltaic cells – Production of solar grade silicon, Doping of silicon, Construction and working of photovoltaic cell, Advantages.

7 Hours

UNIT – 6

The Phase rule and Instrumental methods of analysis

Statement of Gibb's phase rule and explanation of the terms involved, Phase diagram of one component system – water system, Condensed phase rule , Phase diagram of two component system- Eutectic Pb – Ag system and Fe – C system. Application – Desilverization of lead.

Instrumental methods of analysis- Theory , Instrumentation and applications of Colorimetry, Potentiometry , Conductometry and Flame photometry.

6 Hours

UNIT - 7

Polymers

Types of polymerization – Addition and Condensation, Mechanism of polymerization – Free radical mechanism taking ethylene as example. Glass transition temperature (T_g) , Structure – property relationship. Types of plastics – Thermosetting and thermoplastics. Manufacture of plastics by compression ,injection and extrusion moulding.

Synthesis and applications of Teflon, PMMA, Polyurethane and Phenol – formaldehyde resins.

Elastomers: Deficiencies of natural rubber, Vulcanization of rubber. Synthesis and applications of Neoprene and Butyl rubber, Silicone rubbers. Adhesives: Synthesis and applications of epoxy resins. Polymer composites - Synthesis and applications of Kevlar and Carbon fibers. Conducting polymers – Definition, Mechanism of conduction in Polyacetylene, applications.

7 Hours

UNIT - 8

Water Chemistry

Impurities in water ,Water analysis – Determination of different constituents in water – Hardness, alkalinity, chloride , fluoride , nitrate , sulphate and dissolved oxygen. Numerical problems on hardness and alkalinity. Sewage – BOD and COD, Numerical problems, Sewage treatment. Desalination of water – Reverse Osmosis and Electrodialysis

6 Hours

Text Books:

1. Chemistry for Engineering students by B.S. Jai Prakash, R.Venugopal, Sivakumaraiah and Pushpa Iyengar
2. Engineering Chemistry by O.G. Palanna, Tata McGraw Hill Publishing Pvt.Ltd. New Delhi 2009

Reference Books:

1. Principles of Physical Chemistry B.R. Puri , L.R.Sharma & M.S. Pathania, S. Nagin chand and Co.
2. A text book of Engineering Chemistry P.C. Jain and Monica Jain Dhanpatrai Publications , New Delhi.
- 1 Corrosion Engineering M.G. Fontana Mc. Graw Hill Publications.
- 2 Chemistry in Engineering and Technology (Vol. 1 &2) J.C. Kuriacose and J. Rajaram.
- 3 Polymer Science V.R. Gowariker , Wiley Eastern Ltd.

**ELEMENTS OF CIVIL ENGINEERING & ENGINEERING
MECHANICS**

Sub Code	: 10CIV13/10CIV23	IA Marks	: 25
Hrs/ Week	: 04	Exam Hours	: 03
Total Hrs.	: 52	Exam Marks	: 100

PART - A

UNIT-1

1. Introduction to Civil Engineering, Scope of different fields of Civil Engineering - Surveying, Building Materials, Construction Technology, Geotechnical Engineering, Structural Engineering, Hydraulics, Water Resources and Irrigation Engineering, Transportation Engineering, Environmental Engineering.

Infrastructure: Types of infrastructure, Role of Civil Engineer in the Infrastructural Development, Effect of the infrastructural facilities on socio-economic development of a country.

4 Hours

2. Roads: Type of roads, Components and their functions.

2 Hours

3. Bridges and Dams: Different types with simple sketches.

1 Hour

UNIT -2

4. Introduction to Engineering mechanics: Basic idealisations - Particle, Continuum and Rigid body; Force and its characteristics, types of forces, Classification of force systems; Principle of physical independence of forces, Principle of superposition of forces, Principle of transmissibility of forces; Newton's laws of motion, Introduction to SI units, Moment of a force, couple, moment of a couple, characteristics of couple, Equivalent force - couple system; Resolution of forces, composition of forces; Numerical problems on moment of forces and couples, on equivalent force - couple system.

7 Hours

UNIT -3

5. Composition of forces - Definition of Resultant; Composition of coplanar - concurrent force system, Principle of resolved parts; Numerical problems on composition of coplanar concurrent force systems.

3 Hours

6. Composition of coplanar - non-concurrent force system, Varignon's principle of moments; Numerical problems on composition of coplanar non-concurrent force systems.

5 Hours

UNIT -4

7. Centroid of plane figures; Locating the centroid of triangle, semicircle, quadrant of a circle and sector of a circle using method of integration, Centroid of simple built up sections; Numerical problems.

6 Hours

PART - B

UNIT -5

8. Equilibrium of forces - Definition of Equilibrant; Conditions of static equilibrium for different force systems, Lami's theorem; Numerical problems on equilibrium of coplanar – concurrent and non concurrent force systems.

6 Hours

UNIT -6

9. Types of supports, statically determinate beams, Numerical problems on support reactions for statically determinate beams and analysis of simple trusses (Method of joints and method of sections).

6 Hours

UNIT -7

10. Friction - Types of friction, Laws of static friction, Limiting friction, Angle of friction, angle of repose; Impending motion on horizontal and inclined planes; Wedge friction; Ladder friction; Numerical problems.

6 Hours

UNIT -8

11. Moment of inertia of an area, polar moment of inertia, Radius of gyration, Perpendicular axis theorem and Parallel axis theorem; Moment of Inertia of rectangular, circular and triangular areas from method of integration; Moment of inertia of composite areas; Numerical problems.

6 Hours

Text Books:

1. Engineering Mechanics by S.Timoshenko,D.H.Young, and J.V.Rao TATA McGraw-Hill Book Company, New Delhi
2. Elements of Civil Engineering (IV Edition) by S.S. Bhavikatti, New Age International Publisher, New Delhi, 3rd edition 2009.
3. Elements of Civil Engineering and Engineering Mechanics by M.N.Sheshaprakash and G.B.Mogaveer PHI Learning (2009)

Reference Books:

1. Engineering Mechanics B.Bhattacharyya, Oxford University Press 2008
2. Engineering Mechanics by K.L. Kumar, Tata McGraw-Hill Publishing Company, New Delhi.
3. Engineering Mechanics by MVS Rao and D.R.Durgaiah. University Press (2005)
4. Engineering Mechanics by Nelson, Tata McGraw Hill Edn. India Pvt Ltd.
5. Fundamentals of Engineering Mechanics Ali Hassan and Khan , Acme Learning Pvt Ltd.

COMPUTER CONCEPTS AND C PROGRAMMING

Subject Code	: 10CCP13/10CCP23	IA Marks	: 25
Hrs/Week	: 04	Exam Hours	: 03
Total Hrs.	: 52	Exam Marks	: 100

PART – A

UNIT-1

Introduction to Computer Systems, Interacting with the Computer, Computer Organization

The Computer defined, Early history, Basic parts and structure of a computer, Categorizing Computers, Information Processing life cycle, Essential computer hardware, Essential computer software.

Keyboard, Mouse, Inputting data in other ways: Pen-based systems, Data scanning devices, Game controllers, Voice recognition devices, Microphone, Visual input devices, Video and sound, Monitors, Printers, Plotters, Data projectors, Sound systems. Number systems, ASCII, BCD, CPU, Buses, Mother Board, Chip sets, Microprocessors.

7 Hours

UNIT-2

Storage Device Concepts, Operating Systems, Networking

Storage media, Floppy drive, Hard disks, Optical media, CD-ROM, CD-R, CD-RW, DVD-ROM, Recordable DVD.

Software, Custom-made Software, Shrunken-wrapped software, Types of operating systems, Computer processing techniques, Functions of Operating Systems, Management of processor, Memory, Virtual storage, devices, and information.

Networking, Convergence of computing with communications, Networking basics, Need for networking, Basic components of a network.

7 Hours

UNIT-3

Fundamentals of Problem Solving, Introduction to C Language

Creating and running programs, System development, Software Engineering. Introduction to C Language: Background, C Programs, Identifiers, Types, Variables, Constants, Input / Output, Programming example, Software Engineering, Tips and common programming errors.

6 Hours

UNIT-4

Structure of a C Program

Expressions, Precedence and associativity, Side effects, Evaluating expressions, Type conversion, Statements, Programming examples, Software Engineering, Tips and common programming errors.

6 Hours

PART - B

UNIT-5

Functions

Designing structured programs, Functions in C, User-defined Functions, Inter-function communication, Standard functions, Scope, Programming examples, Software Engineering, Tips and common programming errors.

6 Hours

UNIT-6

Selection – Making Decisions, Repetition

Logical data and operators, Two-way selection, Multiway-selection, Concept of a loop, pre-test and post-test loops, Initialization and updating, Event controlled and count controlled loops, Loops in C, Other statements related to looping, looping applications, Recursion, Programming examples, Software Engineering, Tips and common programming errors.

7 Hours

UNIT-7

Arrays, Strings

Concepts, Using arrays in C, Inter-function communication, Array applications, Bubble Sort, Binary search, Two-dimensional Arrays, Multi-dimensional arrays, String concepts, C strings, String input/output, Programming examples, Software Engineering, Tips and common programming errors.

7 Hours

UNIT-8

Basic Concepts of Parallel Programming

Motivating parallelism, Scope for parallel computing, Thread basics, Why threads? OpenMP: A standard for directive – based parallel programming, The OpenMP programming model, Specifying concurrent tasks in OpenMP, Synchronization constructs in OpenMP, Data handling in OpenMP, OpenMP library functions, Environment variables in OpenMP.

6 Hours

Text Books:

1. Vikas Gupta: Computer Concepts and C Programming, Dreamtech Press/Wiley India, 2009.
2. Behrouz A. Forouzan, Richard F. Gilberg: Computer Science - A Structured Approach Using C, 3rd Edition, Cengage Learning, 2007.
3. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar: Introduction to Parallel Computing, 2nd Edition, Pearson Education, 2003.

Reference Books:

1. Peter Norton: Introduction to Computers, 7th Edition, Tata McGraw Hill, 2010.
2. E. Balagurusamy: Programming in ANSI C, 4th Edition, Tata McGraw Hill, 2008.
3. Brian W. Kernighan and Dennis Ritchie: The C Programming Language, 2nd Edition, PHI, 1998.

Web Reference: <http://elearning.vtu.ac.in>

ELEMENTS OF MECHANICAL ENGINEERING

Sub Code	: 10EME14 / 10EME24	IA Marks	:	25
Hrs/ Week	: 04	Exam Hours	:	03
Total Hrs.	: 52	Exam Marks	:	100

PART – A

UNIT-1

Energy and Steam

Forms, Sources and Classification of energy. Utilization of energy with simple block diagrams. Steam formation. Types of steam. Steam properties – Specific Volume, Enthalpy and Internal energy. (simple numerical problems) Steam boilers – classification, Lancashire boiler, Babcock and Wilcox boiler, Boiler mountings, Accessories, their locations and applications. (No sketches for mountings and accessories)

7 Hours

UNIT-2

Turbines

Steam turbines – Classification, Principle of operation of Impulse and reaction. Delaval's turbine, Parson's turbine. Compounding of Impulse turbines.

Gas turbines – Classification, Working principles and Operations of Open cycle and Closed cycle gas turbines.

Water turbines – Classification, Principles and operations of Pelton wheel, Francis turbine and Kaplan turbine

7 Hours

UNIT-3

Internal Combustion Engines

Classification, I.C. Engines parts, 2/4 – Stroke Petrol and 4-stroke diesel engines. P-V diagrams of Otto and Diesel cycles. Simple problems on indicated power, Brake power, Indicated thermal efficiency, Brake thermal efficiency, Mechanical efficiency and specific fuel consumption.

6 Hours

UNIT-4

Refrigeration and Air conditioning

Refrigerants, Properties of refrigerants, List of commonly used refrigerants. Refrigeration - Definitions - Refrigerating effect, Ton of Refrigeration, Ice making capacity, COP, Relative COP, Unit of Refrigeration. Principle and working of vapor compression refrigeration and vapor absorption refrigeration. Principles and applications of air conditioners, Room air conditioner.

6 Hours

PART – B

UNIT-5

Lathe and Drilling Machines

Lathe - Principle of working of a centre lathe. Parts of a lathe. Operations on lathe - Turning, Facing, Knurling, Thread Cutting, Drilling, Taper turning by Tailstock offset method and Compound slide swiveling method, Specification of Lathe.

Drilling Machine – Principle of working and classification of drilling machines. bench drilling Machine, Radial drilling machine. Operations on drilling machine -Drilling, Boring, Reaming, Tapping, Counter sinking, Counter boring and Spot facing. Specification of radial drilling machine.

7 Hours

UNIT-6

Milling and Grinding Machines

Milling Machine – Principle of milling, Types of milling machines. Principle & working of horizontal and vertical milling machines. Milling Processes - Plane milling, End milling, Slot milling, Angular milling, Form milling, Straddle milling and Gang milling. Specification of universal milling machine.

Grinding Machine – Principle and classification of Grinding Machines. Abrasives- Definition, Types and applications. Bonding materials. Type of Grinding machines, Principle and working of surface grinding, Cylindrical grinding and Centerless grinding.

7 Hours

UNIT-7

Joining Processes, Lubrication and Bearings

Soldering, Brazing and Welding

Definitions. Classification and method of Soldering, Brazing and welding and differences. Brief description of arc welding and Oxy-Acetylene welding

Lubrication and Bearings

Lubricants-Classification and properties. Screwcap, Tell-Tale, Drop feed, Wick feed and Needle lubricators. Ring, Splash and Full pressure lubrication. Classification of bearings, Bushed bearing, Pedestal bearing, Pivot bearing, Collar bearings and Antifriction bearings.

6 Hours

UNIT-8

Power Transmission

Belt Drives - Classification and applications, Derivations on length of belt.

Definitions - Velocity ratio, Creep and slip, Idler pulley, stepped pulley and fast & loose pulley.

Gears - Definitions, Terminology, Types and uses. Gear drives and

Gear Trains – Definitions and classifications, Simple problems.

6 Hours

Text Books:

1. A Text Book of Elements of Mechanical Engineering - S. Trymbaka Murthy, 3rd revised edition 2006, I .K. International Publishing House Pvt. Ltd., New Delhi.

Reference Books:

1. A Text Book of Elements of Mechanical Engineering – K.R. Gopalkrishna, Subhash Publishers, Bangalore.
2. The Elements of Workshop Technology - Vol I & II , SKH Chowdhary, AKH Chowdhary , Nirjhar Roy, 11th edition 2001, Media Promotors and Publishers, Mumbai.
3. Elements of Mechanical Engineering –Dr.A.S.Ravindra, Best Publications, 7th edition 2009.

COMPUTER AIDED ENGINEERING DRAWING

Sub Code	: 10CED14 / 10CED24	IA Marks	: 25
Hrs/ Week	: 06 (Instruction 2 hr. + Sketching & Practice 4 hr.)	Exam Hours	: 03
Total Hrs.	: 84 (Instruction 28 hr. +Sketching & Practice 56 hr.)	Exam Marks	: 100

1. Introduction to Computer Aided Sketching

Introduction, Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning and free hand practicing.

Computer screen, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP & LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz. tangency, parallelism, inclination and perpendicularity. Dimensioning, line conventions, material conventions and lettering.

12 Hours

2. Orthographic Projections

Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes (No application problems).

12 Hours

3. Orthographic Projections of Plane Surfaces (First Angle Projection Only)

Introduction, Definitions–projections of plane surfaces–triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only (No problems on punched plates and composite plates).

12 Hours

4. Projections of Solids

(First angle Projection only)

Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions (No problems on octahedrons and combination solid).

24 Hours

5. Sections And Development of Lateral Surfaces of Solids

Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP. (No problems on sections of solids)

Development of lateral surfaces of above solids, their frustums and truncations. (No problems on lateral surfaces of trays, tetrahedrons, spheres and transition pieces).

12 Hours

6. Isometric Projection (Using Isometric Scale Only)

Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projection of tetrahedron, hexahedron(cube), right regular prisms, pyramids, cylinders, cones, spheres, cut spheres and combination of solids (Maximum of three solids).

12 Hours

Text Books:

1. **Engineering Drawing** - N.D. Bhatt & V.M. Panchal, 48th edition, 2005-Charotar Publishing House, Gujarat.
2. **A Primer on Computer Aided Engineering Drawing-2006**, Published by VTU, Belgaum.

Reference Books:

1. **Computer Aided Engineering Drawing** - S. Trymbaka Murthy, - I.K. International Publishing House Pvt. Ltd., New Delhi, 3rd revised edition- 2006.
2. **Engineering Graphics** - K.R. Gopalakrishna, 32nd edition, 2005-Subash Publishers Bangalore.
3. **Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production-** Luzadder Warren J., Duff John M., Eastern Economy Edition, 2005-Prentice-Hall of India Pvt. Ltd., New Delhi.
4. **Computer Aided Engineering drawing-** Prof. M. H. Annaiah, New Age International Publisher, New Delhi. 2009.

Conducting classes

Classes may be conducted in two slots/ week of 3 hours each (Instruction 1 hr. +Sketching & Practice 2 hr.)

Scheme of Evaluation for Internal Assessment (25 Marks)

1. 15 Marks for Class work (Sketching & Computer Aided Engineering drawing printouts in A4 size sheets).
2. 10 Marks for test in the same pattern as that of the main examination.(Better of the two Tests).

All the solutions must be valued on the spot by examining the sketches, display and the hard copies. All the sketches including the computer printouts must be submitted and they must be preserved for one year.

Scheme of Examination

- Chapter 1 is only for practice and Internal Assessment and not for examination.
- Separate Question paper must be set for each batch of students, jointly by the Internal & External examiners.
- A maximum of **THREE** questions must be set as per the following pattern (*No mixing of questions from different Chapters*).

Q. No.	From Chapters	Marks Allotted
1	Chapter 2 or Chapter 3	30
2	Chapter 4	40
3	Chapter 5 or Chapter 6	30
Total		100

Scheme of Evaluation

Q. No.	Solutions & Sketching on graph book	Computer display & printout	Total Marks
1	10 Marks	20 Marks	30
2	15 Marks	25 Marks	40
3	15 Marks	15 Marks	30
Total	40 Marks	60 Marks	100

Students have to submit the computer printouts and the sketches drawn on the graph sheets at the end of the examination. Both Internal & External examiners have to jointly evaluate the solutions (sketches) and computer display & printouts of each student for 100 marks (40 marks for solutions & sketches + 60 marks for computer display and printouts) and submit the marks list along with the solution (sketches) on graph sheets & computer printouts in separate covers.

- Each batch must consist of a minimum of 10 students and a maximum of 12 students.
- Examination can be conducted in parallel batches, if necessary.

BASIC ELECTRICAL ENGINEERING

Sub Code	:	10ELE15/ 10ELE25	IA Marks	:	25
Hrs/ Week	:	04	Exam Hours	:	03
Total Hrs.	:	52	Exam Marks	:	100

PART – A

UNIT-1

1-a) D. C. Circuits: Ohm's Law and Kirchoff's Laws, analysis of series, parallel and series- parallel circuits excited by independent voltage sources. Power and Energy. Illustrative examples.

4Hours

1-b) Electromagnetism: Faradays Laws, Lenz's Law, Fleming's Rules, Statically and dynamically induced emf's. Concept of self inductance, mutual inductance and coefficient of coupling. Energy stored in magnetic field. Illustrative examples.

3Hours

UNIT-2

2.Single-phase A.C. Circuits: Generation of sinusoidal voltage, definition of average value, root mean square value, form factor and peak factor of sinusoidally varying voltage and current, phasor representation of alternating quantities. Analysis, with phasor diagrams, of R, L, C, R-L, R-C and R-L-C circuits, real power, reactive power, apparent power and power factor. Illustrative examples involving series, parallel and series- parallel circuits.

7 Hours

UNIT-3

3 Three Phase Circuits: Necessity and advantages of three phase systems, generation of three phase power, definition of Phase sequence, balanced supply and balanced load. Relationship between line and phase values of balanced star and delta connections. Power in balanced three-phase circuits, measurement of power by two-wattmeter method. Illustrative examples.

6 Hours

UNIT-4

4-a) Measuring Instruments: Construction and Principle of operation of dynamometer type wattmeter and single-phase induction type energy meter (problems excluded).

3 Hours

4-b) Domestic Wiring: Service mains, meter board and distribution board. Brief discussion on Cleat, Casing & Capping and conduit (concealed) wiring. Two-way and three-way control of a lamp. Elementary discussion on fuse and Miniature Circuit Breaker (MCB's). Electric shock, precautions against shock –Earthing: Pipe and Plate.

3 Hours

PART – B

UNIT-5

5.DC Machines: Working principle of DC machine as a generator and a motor. Types and constructional features. emf equation of generator, relation between emf induced and terminal voltage enumerating the brush drop and drop due to armature reaction. Illustrative examples. DC motor working principle, Back emf and its significance, torque equation. Types of D.C. motors, characteristics and applications. Necessity of a starter for DC motor. Illustrative examples on back emf and torque.

7 Hours

UNIT-6

6. Transformers: Principle of operation and construction of single-phase transformers (core and shell types). emf equation, losses, efficiency and voltage regulation (Open Circuit and Short circuit tests, equivalent circuit and phasor diagrams are excluded). Illustrative problems on emf equation and efficiency only.

7 Hours

UNIT-7

7. Synchronous Generators: Principle of operation. Types and constructional features. emf equation. Concept of winding factor (excluding derivation of distribution and pitch factors). Illustrative examples on emf equation.

6 Hours

UNIT-8

8. Three Phase Induction Motors: Concept of rotating magnetic field. Principle of operation. Types and Constructional features. Slip and its significance. Applications of squirrel - cage and slip - ring motors. Necessity of a starter, star-delta starter. Illustrative examples on slip calculations.

6 Hours

Text Books:

1. "Basic Electrical Engineering", D C Kulshreshtha, ,TMH,2009 Edition.
2. "Fundamentals of Electrical Engineering", Rajendra Prasad, PHI, Second Edition, 2009.

Reference Books:

- 1 "Electrical Technology", E. Hughes International Students 9th Edition, Pearson, 2005.
- 2 "Basic Electrical Engineering", Abhijit Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, TMH, First reprint 2009.
- 3 Problems in Electrical Engineering, Parker Smith, CBS Publishers and Distributors, 9th Edition, 2003.

BASIC ELECTRONICS

Sub Code	: 10ELN15 / 10ELN25	IA Marks	: 25
Hrs/ Week	: 04	Exam Hours	: 03
Total Hrs.	: 52	Exam Marks	: 100

PART - A

UNIT-1

SEMICONDUCTOR DIODES AND APPLICATIONS: p-n junction diode, Characteristics and Parameters, Diode approximations, DC load line, Temperature dependence of p-n characteristics, AC equivalent circuits, Zener diodes Half-wave diode rectifier, Ripple factor, Full-wave diode rectifier, Other full-wave circuits, Shunt capacitor filter - Approximate analysis of capacitor filters, Power supply performance, Zener diode voltage regulators, Numerical examples as applicable.

7 Hours

UNIT-2

TRANSISTORS: Bipolar Junction transistor, Transistor Voltages and currents, amplification, Common Base, Common Emitter and Common Collector Characteristics, DC Load line and Bias Point.

6 Hours

UNIT-3

BIASING METHODS: Base Bias, Collector to Base Bias, Voltage divider Bias, Comparison of basic bias circuits, Bias circuit design, Thermal Stability of Bias Circuits (Qualitative discussions only).

6 Hours

UNIT-4

OTHER DEVICES: Silicon Controlled Rectifier (S.C.R), SCR Control Circuits, More S.C.R applications; Unijunction transistor, UJT applications, Junction Field effect Transistors(Exclude Fabrication and Packaging), JFET Characteristics, FET Amplifications, Numerical examples as applicable.

7 Hours

PART - B

UNIT-5

AMPLIFIERS & OSCILLATORS: Decibels and Half power points, Single Stage CE Amplifier and Capacitor coupled two stage CE amplifier(Qualitative discussions only), Series voltage negative feedback and Additional effects of Negative feed back(Qualitative discussions only), The Barkhausen Criterion for Oscillations, BJT RC phase shift oscillator, Hartley, Colpitts and crystal oscillator (Qualitative discussions only) Numerical problems as applicable.

6 Hours

UNIT-6

INTRODUCTION TO OPERATIONAL AMPLIFIERS: Ideal OPAMP, Saturable property of an OP AMP, Inverting and Non Inverting OPAMP circuits, Need for OPAMP, Characteristics and applications - voltage follower, addition, subtraction, integration, differentiation; Numerical examples as applicable Cathode Ray Oscilloscope (CRO).

6 Hours

UNIT-7

COMMUNICATION SYSTEMS: Block diagram, Modulation, Radio Systems, Superhetrodyne Receivers, Numerical examples as applicable

NUMBER SYSTEMS: Introduction, decimal system, Binary, Octal and Hexadecimal number systems, addition and subtraction, fractional number, Binary Coded Decimal numbers.

7 Hours

UNIT-8

DIGITAL LOGIC:, Boolean algebra, Logic gates, Half-adder, Full-adder, Parallel Binary adder.

7 Hours

Text Books:

1. Electronic Devices and Circuits: David. A. Bell; Oxford University Press, 5th Edn., 2008.

Reference Books:

1. Electronic Devices and Circuits: Jacob Millman, Christos C. Halkias TMH, 1991 Reprint 2001.
2. Electronic Communication Systems, George Kennedy, TMH 4th Edition.
3. Digital Logic and Computer Design, Morris Mano, PHI, EEE.
4. Basic Eelctronics, RD Sudhaker Samuel, U B Mahadevaswamy, V. Nattarsu, Saguine-Pearson, 2007.

WORKSHOP PRACTICE

Sub Code	: 10WSL16/ 10WSL26	IA Marks	: 25
Hrs/ Week	: 03	Exam Hours	: 03
Total Hrs.	: 42	Exam Marks	: 50

1. Fitting

- i. Study of fitting tools
- ii. Study of fitting operations & joints
- iii. Minimum 5 models involving rectangular, triangular, semi circular and dovetail joints.

2. Welding

- iv. Study of electric arc welding tools & equipments
- v. Minimum 4 Models- electric arc welding-Butt joint, Lap joint, T-joint & L-joint.

3. Study and demonstration of Sheet metal and soldering work.

4. Study & demonstration of power Tools in Mechanical Engineering

Scheme of Examination:

Fitting	30 Marks
Welding	10 Marks
Viva Voce	10 marks

Reference Book:

1. The Elements of Workshop Technology -, Vol 1 & 2, S.K.H. Choudhury, A.K.H.Choudhury, Nirjhar Roy, 11th edition, 2001, Media Promoters and Publishers, Mumbai.

COMPUTER PROGRAMMING LABORATORY

Subject Code	: 10CPL16 / 10CPL26	IA Marks	: 25
Hrs/Week	: 03	Exam Hours	: 03
Total Hrs.	: 42	Exam Marks	: 50

PART – A

1. Design, develop and execute a program in C to find and output all the roots of a given quadratic equation, for non-zero coefficients.
2. Design, develop and execute a program in C to implement Euclid's algorithm to find the GCD and LCM of two integers and to output the results along with the given integers.
3. Design, develop and execute a program in C to reverse a given four digit integer number and check whether it is a palindrome or not. Output the given number with suitable message.
4. Design, develop and execute a program in C to evaluate the given polynomial $f(x) = a_4x^4 + a_3x^3 + a_2x^2 + a_1x + a_0$ for given value of x and the coefficients using Horner's method.
5. Design, develop and execute a program in C to copy its input to its output, replacing each string of one or more blanks by a single blank.
6. Design, develop and execute a program in C to input N integer numbers in ascending order into a single dimensional array and perform a binary search for a given key integer number and report success or failure in the form of a suitable message.
7. Design, develop and execute a program in C to input N integer numbers into a single dimensional array, sort them in ascending order using bubble sort technique and print both the given array and the sorted array with suitable headings.
8. Design, develop and execute a program in C to compute and print the word length on the host machine.

PART – B

9. Design, develop and execute a program in C to calculate the approximate value of $\exp(0.5)$ using the Taylor Series expansion for the exponential function. Use the terms in the expansion until the last term is less than the machine epsilon defined FLT_EPSILON in the header file <float.h>. Also print the value returned by the Mathematical function $\exp()$.
10. Design, develop and execute a program in C to read two matrices A (M x N) and B (P x Q) and compute the product of A and B if the matrices are compatible for multiplication. The program must print the input matrices and

the resultant matrix with suitable headings and format if the matrices are compatible for multiplication, otherwise the program must print a suitable message. (For the purpose of demonstration, the array sizes M, N, P, and Q can all be less than or equal to 3)

11. Design, develop and execute a parallel program in C to add, element-wise, two one-dimensional arrays A and B of N integer elements and store the result in another one-dimensional array C of N integer elements.

12. Design and develop a function `rightrot(x, n)` in C that returns the value of the integer x rotated to the right by n bit positions as an unsigned integer. Invoke the function from the main with different values for x and n and print the results with suitable headings.

13. Design and develop a function `isprime(x)` that accepts an integer argument and returns 1 if the argument is prime and 0 otherwise. The function must use plain division checking approach to determine if a given number is prime. Invoke this function from the main with different values obtained from the user and print appropriate messages.

14. Design, develop and execute a parallel program in C to determine and print the prime numbers which are less than 100 making use of algorithm of the Sieve of Eratosthenes.

15. Design and develop a function `reverses(s)` in C to reverse the string s in place. Invoke this function from the main for different strings and print the original and reversed strings.

16. Design and develop a function `match any(s1,s2)` which returns the first location in the string s1 where any character from the string s2 occurs, or - 1 if s1 contains no character from s2. Do not use the standard library function which does a similar job! Invoke the function `match any(s1, s2)` from the main for different strings and print both the strings and the return value from the function `match any(s1,s2)`.

Note: In the practical examination, the student has to answer two questions. One question from Part A and one question from Part B will be selected by the student by lots. All the questions listed in the syllabus have to be included in the lots. The change of question (Part A only / Part B only / Both Part A & Part B) has to be considered, provided the request is made for the same, within half an hour from the start of the examination. The allotment of marks is as detailed below:

Sl. No.	Activity		Max. Marks
1.	Procedure Writing program & procedure for the assigned problems along with algorithms / flowchart	Part A	5*
		Part B	5*
2.	Conduction Execution of the program and	Part A	10

	showing the results in proper format	Part B	20
3.	Viva-voce**		10
Total Max. Marks			50
Minimum passing Marks (40% of Max. Marks)			20

* To be considered as zero if student has been allowed change of question.

LABORATORY EXPERIMENTS IN ENGINEERING PHYSICS

Sub Code	: 10PHYL17/10PHYL27	IA Marks	: 25
Hrs/ Week	: 03	Exam Hours	: 03
Total Hrs.	: 10 (To be completed)	Exam Marks	: 50

EXPERIMENTS :

1. Series & Parallel LCR Circuits.(Determination of resonant frequency & quality factor)
2. I-V Characteristics of Zener Diode.(determination of knee voltage, zener voltage & forward resistance)
3. Characteristics of a Transistor.(Study of Input & Output characteristics and calculation of input resistance, output resistance & amplification factor)
4. Photo Diode Characteristics.(Study of I-V characteristics in reverse bias and variation of photocurrent as a function of reverse voltage & intensity)
5. Ultrasonic Interferometer (Measurement of velocity of sounds in solids/liquids).
6. Dielectric constant (Measurement of dielectric constant).
7. Magnetic properties (Study of retentivity and coercivity by B-H graph method).
8. Diffraction (Measurement of wavelength of laser / Hg source using diffraction grating).
9. Planck's constant (Using the principle of photoelectric effect/LED's).
10. Electrical Resistivity (Determination of resistivity in semiconductor by Four probe method).
11. Verification of Stefan's law.
12. Determination of Fermi energy.(Measurement of Fermi energy in copper)
13. Uniform Bending Experiment.(Determination of Youngs modulus of material bar)
14. Newtons Rings.(Determination of radius of curvature of planoconvex lens)

ENGINEERING CHEMISTRY LABORATORY

Sub Code	: 10CHEL17/10CHEL27	IA Marks	: 25
Hrs/ Week	: 03	Exam Hours	: 03
Total Hrs.	: 42	Exam Marks	: 50

PART – A

1. Potentiometric estimation of FAS using standard $K_2Cr_2O_7$ solution
2. Colorimetric estimation of Copper
3. Conductometric estimation of an Acid mixture using standard NaOH solution
4. Flame Photometric estimation of Sodium and Potassium in the given sample of Water
5. Determination of pKa of a weak acid using pH Meter
6. Determination of Viscosity co-efficient of a given liquid using Ostwald's Viscometer.

PART – B

1. Determination of Total Hardness of a sample of Water using Disodium salt of EDTA.
2. Determination of CaO in the given sample of Cement by Rapid EDTA method.
3. Determination of Percentage of Copper in Brass using standard Sodium thiosulphate solution.
4. Determination of Iron in the given sample of Haematite ore solution using Potassium dichromate Crystals by external indicator method.
5. Determination of COD of the given Industrial Waste water sample.
6. Determination of Total Alkalinity of a given Water Sample using standard Hydrochloric acid.

References Books:

- 1) Laboratory manual in Engineering Chemistry Sudharani, Dhanpatrai Publishing Company.
- 2) Vogel's Text Book of Quantitative Chemical Analysis revised by G.H.Jeffery, J. Bassett, J. Mendham and R.C Denney.

Scheme of Examination:

One experiment from Part- A and another from Part - B shall be set. Different experiments may be set from Part- A and a common experiment from Part – B.

CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS

Sub Code	: 10CIP18/10CIP28	IA Marks	:	25
Hrs/ Week	: 02	Exam Hours	:	02
Total Hrs.	: 26	Exam Marks	:	50

- 1 Preamble to the constitution of India. Fundamental rights under Part – III – details of Exercise of rights, Limitations & Important cases. **4 Hours**
- 2 Relevance of Directive principles of State Policy under Part – IV. Fundamental duties & their significance. **3 Hours**
- 3 Union Executive – President, Prime Minister, Parliament & the Supreme Court of India. **3 Hours**
- 4 State executive – Governors, Chief Minister, State Legislator and High Courts. **3 Hours**
- 5 Constitutional Provisions for Scheduled Castes & Tribes, Women & Children & Backward classes. Emergency Provisions. **4 Hours**
- 6 Electoral process, Amendment procedure, 42nd, 44th, 74th, 76th, 86th and 91st Constitutional amendments. **3 Hours**
- 7 Scope & aims of engineering Ethics. Responsibility of Engineers. Impediments to responsibility. **3 Hours**
- 8 Honesty, Integrity and reliability, risks, safety & liability in engineering. **3 Hours**

Text Books:

1. Durga Das Basu: “Introduction to the Constitution of India” (Students Edn.) Prentice – Hall EEE, 19th/20th Edn., 2001.
2. “Engineering Ethics” by Charles E.Haries, Michael. S.Pritchard and Michael J.Robins Thompson Asia, 2003-08-05.

Reference Books:

1. “An Introduction to Constitution of India” by M.V.Pylee, Vikas Publishing, 2002.
2. “Engineering Ethics” by M. Govindarajan, S.Natarajan, V.S. Senthilkumar., Prentice – Hall of India Pvt. Ltd. New Delhi, 2004.

Scheme of examination:

Question paper is of objective type. Students have to pass this subject compulsorily. However, marks will not be considered for awarding class/rank.

ENVIRONMENTAL STUDIES

Sub Code	:	10CIV18/10CIV28	IA Marks	:	25
Hrs/ Week	:	02	Exam Hours	:	02
Total Hrs.	:	26	Exam Marks	:	50

PART – A

UNIT-1

Environment -_ Definition, Eco system -- Balanced ecosystem, Human activities - Food, Shelter, Economic and Social Security

3 Hours

UNIT-2

Effects of human activities on environment - Agriculture, Housing, Industry, Mining, and Transportation activities, Environmental Impact Assessment. Sustainable Development.

3 Hours

UNIT-3

Natural Resources - Water resources - Availability and Quality aspects. Water borne diseases, Water induced diseases, Fluoride problem in drinking water. Mineral Resources, Forest Wealth, Material Cycles - Carbon, Nitrogen and Sulphur Cycles.

4 Hours

UNIT-4

Energy - Different types of energy, Electro-magnetic radiation. Conventional and Non - Conventional sources - Hydro Electric, Fossil fuel based, Nuclear, Solar, Biomass and Bio-gas. Hydrogen as an alternative future source of Energy.

4 Hours

PART – B

UNIT-5

Environmental Pollution and their effects. Water pollution. Land pollution . Noise pollution . Public Health aspects.

3 Hours

UNIT-6

Current Environmental issues of importance:
Population Growth, Climate change and Global warming - Effects, Urbanization, Automobile pollution

3 Hours

UNIT-7

Acid Rain, Ozone layer depletion, Animal Husbandry

3 Hours

UNIT-8

Environmental Protection - Role of Government, Legal aspects, Initiatives by Non - Governmental Organizations (NGO), Environmental Education, Women Education.

3 Hours

Question paper is of objective type for 50 marks (**Fifty questions have to be set with 4 multiple choice answers**). Students have to pass the subject compulsorily. However, marks will not be considered for awarding class/rank.

Text Books:

- 1) Benny Joseph (2005), "Environmental Studies", Tata McGraw - Hill Publishing Company Limited
- 2) Ranjit Daniels R.J. and Jagdish Kirshnaswamy, (2009), "Environmental Studies", Wiley India Private Ltd., New Delhi
- 3) Rajagopalan R. (2005), "Environmental Studies – From Crisis to Cure", Oxford University Press

Reference Books:

- 1) Raman Sivakumar, (2005), "Principles of Environmental Science and Engineering", Second Edition, Cengage learning, Singapore
- 2) Meenakshi P. (2006), "Elements of Environmental Science and Engineering", Prentice Hall of India Private Limited, New Delhi
- 3) Prakash S.M. (2007), "Environmental Studies", Elite Publishers, Mangalore
- 4) Erach Bharucha (2005), "Text Book of Environmental Studies", for UGC, University Press
- 5) Tyler Miller Jr. G. (2004), "Environmental Science – Working with the Earth", Tenth Edition, Thomson Brooks/Cole
- 6) Tyler Miller Jr. G. (2006), "Environmental Science – Working with the Earth", Eleventh Edition, Thomson Brooks/Cole
- 7) "Text Book of Environmental and Ecology" by Dr. Pratibha Sing, Dr. Anoop Singh and Dr. Piyush Malaviya. Acme Learning Pvt. Ltd., New Delhi.

ENGINEERING MATHEMATICS – II

Sub Code	:	10MAT21	IA Marks	:	25
Hrs/ Week	:	04	Exam Hours	:	03
Total Hrs.	:	52	Exam Marks	:	100

PART-A

UNIT-1

Differential Equations - 1

Equations of first order and higher degree (p-y-x equations), Equations solvable for p-y-x. General and singular solutions, Clairaut's equation. Applications of differential equations of first order–illustrative examples*.

6 Hours

UNIT-2

Differential Equations – 2

Linear differential equations: Solution of second and higher order equations with constant coefficients by inverse differential operator method. Simultaneous differential equations of first order – Applications.

7 Hours

UNIT-3

Differential Equations – 3

Method of variation of parameters, Solutions of Cauchy's and Legendre's linear equations, Series solution of equations of second order, Frobenius method – simple problems.

6 Hours

UNIT-4

Partial Differential Equations (PDE)

Formation of Partial differential equations (PDE) by elimination of arbitrary constants/ functions. Solution of non-homogeneous PDE by direct integration. Solution homogeneous PDE involving derivative with respect to one independent variable only. Solution of Lagrange's linear PDE. Solution of PDE by the Method of separation of variables (first and second order equations)

7 Hours

PART-B

UNIT-5

Integral Calculus

Multiple Integrals – Evaluation of Double integrals and triple integrals. Evaluation of double integrals over a given region, by change of order of integration, by change of variables. Applications to area and volume – illustrative examples*.

Beta and Gamma Functions - Properties and problems

6 Hours

UNIT-6**Vector Integration**

Line integrals – definition and problems, Surface and volume integrals- definition. Green's theorem in a plane, Stoke's and Gauss divergence theorem (statements only).

6 Hours

UNIT-7**Laplace Transforms-1**

Definition, transforms of elementary functions, properties, Periodic function, Unit step function and unit impulse function.

7 Hours

UNIT-8**Laplace Transforms-2**

Inverse Laplace Transforms, Convolution theorem, solution of linear differential equations using Laplace transforms. Applications – illustrative examples*.

7 Hours

Note: * In the case of illustrative examples, questions are not to be set.

Text Books:

- 1) B.S. Grewal, Higher Engineering Mathematics, Latest edition, Khanna Publishers.
- 2) Erwin Kreyszig, Advanced Engineering Mathematics, Latest edition, Wiley Publications.

Reference Book:

- 1) B.V. Ramana, Higher Engineering Mathematics, Latest edition, Tata Mc. Graw Hill Publications.
- 2) Peter V. O'Neil, Engineering Mathematics, CENGAGE Learning India Pvt Ltd. Publishers.

Elective 'D'		Elective 'E'	
10ME831 Tribology	10ME832 Fracture Mechanics	10ME841 Machine Tool Design	10ME842 Industrial Engineering & Ergonomics
10ME833 Power Plant Engineering	10ME834 Nano Technology	10ME843 Bio Mass Energy Systems	10ME844 Automotive Engineering
10ME835 Organisational Behaviour and Professional Communication	10ME836 Computer Graphics	10ME845 Database Management System	10ME846 Artificial Intelligence
10ME837 Rapid Prototyping	10ME838 Foundry Technology	10ME847 Design of Experiments	10ME848 Design for Manufacture & Assembly

III Semester
MATERIAL SCIENCE AND METALLURGY

Sub Code	: 10ME 32A /42A	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT - 1

Crystal Structure: BCC, FCC and HCP Structures, coordination number and atomic packing factors, crystal imperfections -point line and surface imperfections. Atomic Diffusion: Phenomenon, Fick's laws of diffusion, factors affecting diffusion.

06 Hours

UNIT - 2

Mechanical Behaviour: Stress-strain diagram showing ductile and brittle behaviour of materials, linear and non linear elastic behaviour and properties, mechanical properties in plastic range, yield strength offset yield strength, ductility, ultimate tensile strength, toughness. Plastic deformation of single crystal by slip and twinning.

06 Hours

UNIT - 3

Fracture: Type I, Type II and Type III.

Creep: Description of the phenomenon with examples. three stages of creep, creep properties, stress relaxation.

Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and S-N diagram.

07 Hours

UNIT - 4

Solidification: Mechanism of solidification, Homogenous and Heterogeneous nucleation, crystal growth, cast metal structures.

Phase Diagram I: Solid solutions Hume Rothery rule substitutional, and interstitial solid solutions, intermediate phases, Gibbs phase rule.

07 Hours

PART - B

UNIT - 5

Phase Diagram II: Construction of equilibrium diagrams involving complete and partial solubility, lever rule. Iron carbon equilibrium diagram description of phases, solidification of steels and cast irons, invariant reactions.

06 Hours

UNIT - 6

Heat treating of metals: TTT curves, continuous cooling curves, annealing and its types. normalizing, hardening, tempering, martempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flame hardening and induction hardening, age hardening of aluminium-copper alloys.

07 Hours

UNIT - 7

Ferrous and non ferrous materials: Properties, Composition and uses of

- Grey cast iron, malleable iron, SG iron and steel
- Copper alloys-brasses and bronzes.
Aluminium alloys-Al-Cu,Al-Si,Al-Zn alloys.

06 Hours

UNIT - 8

Composite Materials: Definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP' sand MMC's advantages and application of composites.

07 Hours

TEXT BOOKS:

1. **Foundations of Materials Science and Engineering**, Smith, 4th Edition McGraw Hill, 2009
2. **Materials Science, Shackelford., & M. K. Muralidhara**, Pearson Publication – 2007.

REFERENCE BOOKS:

1. **An Introduction to Metallurgy; Alan Cottrell**, University Press India Oriental Longman Pvt. Ltd., 1974.
2. **Engineering Materials Science**, W.C.Richards, PHI, 1965
3. **Physical Metallurgy**; Lakhtin, Mir Publications
4. **Materials Science and Engineering**, V.Raghavan , PHI, 2002
5. **Elements of Materials Science and Engineering**, H. VanVlack, Addison-Wesley Edn., 1998
6. **Materials Science and Engineering**,William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001.
7. **The Science and Engineering of Materials**, Donald R. Asklund and Pradeep.P. Phule, Cengage Learning, 4th Ed., 2003.

MECHANICAL MEASUREMENTS AND METROLOGY

Sub Code	: 10ME 32B / 42B	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks:	100

PART- A

UNIT-1:

Standards of measurement: Definition and Objectives of metrology, Standards of length-International prototype meter, Imperial standard yard, Wave length standard, subdivision of standards, line and end standard, calibration of end bars (Numerical), Slip gauges, Wringing phenomena, Indian Standards (M-81, M-12), Numerical problems on building of slip gauges.

06 Hours

UNIT-2:

System of Limits, Fits, Tolerance and Gauging: Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly limits of size, Indian standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS 919-1963), geometrical tolerance, positional-tolerances, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials.

07 Hours

UNIT-3:

Comparators and Angular measurement: Introduction to comparators, characteristics, classification of comparators, mechanical comparators-Johnson Mikrokator, sigma comparators, dial indicator, optical comparators-principles, Zeiss ultra optimeter, electric and electronic comparators-principles, LVDT, pneumatic comparators, back pressure gauges, solex comparators. Angular measurements, bevel protractor, sine principle and use of sine bars, sine centre, use of angle gauges (numericals on building of angles), clinometers.

07 Hours

UNIT-4:

Interferometer and screw thread, gear measurement: Interferometer, interferometry, autocollimator. Optical flats. Terminology of screw threads, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods, best size wire. Tool maker's microscope, gear tooth terminology, use of gear tooth vernier caliper and micrometer.

06 Hours

PART-B

UNIT-5:

Measurements and measurement systems: Definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-times delay. Errors in measurement, classification of errors. Transducers, transfer efficiency, primary and secondary transducers, electrical, mechanical, electronic transducers, advantages of each type transducers. **07 Hours**

UNIT-6:

Intermediate modifying and terminating devices: Mechanical systems, inherent problems, electrical intermediate modifying devices, input circuitry, ballast circuit, electronic amplifiers and telemetry. Terminating devices, mechanical, cathode ray oscilloscope, oscillographs, X-Y plotters. **06 Hours**

UNIT-7:

Measurement of force, torque and pressure: Principle, analytical balance, platform balance, proving ring. Torque measurement, Prony brake, hydraulic dynamometer. Pressure measurements, principle, use of elastic members, Bridgeman gauge, McLeod gauge, Pirani gauge. **06 Hours**

UNIT-8:

Temperature and strain measurement: Resistance thermometers, thermocouple, law of thermo couple, materials used for construction, pyrometer, optical pyrometer. Strain measurements, strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement. **07 Hours**

TEXT BOOKS:

1. **Mechanical Measurements**, Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. **Engineering Metrology**, R.K. Jain, Khanna Publishers, 1994.

REFERENCE BOOKS:

1. **Engineering Metrology**, I.C. Gupta, Dhanpat Rai Publications, Delhi.
2. **Mechanical Measurements**, R.K. Jain Khanna Publishers, 1994
3. **Industrial Instrumentation**, Alsutko, Jerry. D. Faulk, Cengage Asia Pvt. Ltd. 2002.
4. **Measurement Systems Applications and Design**, Ernest O. Doebelin, 5th Ed., McGraw Hill Book Co.
5. **Metrology & Measurement**, Anand K. Bewoor & Vinay A.

BASIC THERMODYNAMICS

(Common to ME/IP/AU/IM/MA)

Sub Code	: 10ME33	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART-A

UNIT - 1

Fndamental Concepts & Definitions: Thermodynamics definition and scope, Microscopic and Macroscopic approaches. Some practical applications of engineering thermodynamic Systems, Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive and extensive properties. Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic processes; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium, Zeroth law of thermodynamics, Temperature; concepts, scales, fixed points and measurements.

06 Hours

UNIT - 2

Work and Heat: Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; as a part of a system boundary, as a whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat; definition, units and sign convention.

06 Hours

UNIT - 3

First Law of Thermodynamics: Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, modes of energy, pure substance; definition, two-property rule, Specific heat at constant volume, enthalpy, specific heat constant pressure. Extension of the First law to control volume; steady state-steady flow energy equation, important applications, analysis of unsteady processes such as film and evacuation of vessels with and without heat transfer.

07 Hours

UNIT - 4

Second Law of Thermodynamics: Devices converting heat to work; (a) in a thermodynamic cycle, (b) in a mechanical cycle. Thermal reservoir. Direct heat

engine; schematic representation and efficiency. Devices converting work to heat in a thermodynamic cycle; reversed heat engine, schematic representation, coefficients of performance. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Equivalence of the two statements; Reversible and irreversible processes; factors that make a process irreversible, reversible heat engines, Carnot cycle, Carnot principles.

07 Hours

PART-B

UNIT - 5

Entropy: Clausius inequality; Statement, proof, application to a reversible cycle. Entropy; definition, a property, change of entropy, principle of increase in entropy, entropy as a quantitative test for irreversibility, calculation of entropy using Tds relations, entropy as a coordinate. Available and unavailable energy.

06 Hours

UNIT - 6

Pure Substances: P-T and P-V diagrams, triple point and critical points. Subcooled liquid, saturated liquid, mixture of saturated liquid and vapour, saturated vapour and superheated vapour states of pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness fraction (quality), T-S and H-S diagrams, representation of various processes on these diagrams. Steam tables and its use. Throttling calorimeter, separating and throttling calorimeter.

07 Hours

UNIT - 7

Thermodynamic relations: Maxwell relation, Clausius Clapeyron's equation. Ideal gas; equation of state, internal energy and enthalpy as functions of temperature only, universal and particular gas constants, specific heats, perfect and semi-perfect gases. Evaluation of heat, work, change in internal energy, enthalpy and entropy in various quasi-static processes.

07 Hours

UNIT - 8

Ideal gas mixture : Ideal gas mixture; Dalton's laws of partial pressures, Amagat's law of additive volumes, evaluation of properties, Analysis of various processes. Real Gases: Introduction. Van-der Waal's Equation of state, Van-der Waal's constants in terms of critical properties, Law of corresponding states, compressibility factor; compressibility chart

06 Hours

Data Handbooks :

1. **Thermodynamic data hand book**, B.T. Nijaguna.
2. **Properties of Refrigerant & Psychrometric** (tables & Charts in SI Units), Dr. S.S. Banwait, Dr. S.C. Laroia, Birla Pub. Pvt. Ltd., Delhi, 2008

Back to Index

TEXT BOOKS:

1. **Basic Engineering Thermodynamics**, A.Venkatesh, University Press, 2008
2. **Basic and Applied Thermodynamics**, P.K.Nag, 2nd Ed., Tata McGraw Hill Pub. 2002

REFERENCE BOOKS:

1. **Thermodynamics**, An Engineering Approach, Yunus A.Cengel and Michael A.Boles, Tata McGraw Hill publications, 2002
2. **Engineering Thermodynamics**, J.B.Jones and G.A.Hawkins, John Wiley and Sons..
3. **Fundamentals of Classical Thermodynamics**, G.J.Van Wylen and R.E.Sonntag, Wiley Eastern.
4. **An Introduction to Thermodynamics**, Y.V.C.Rao, Wiley Eastern, 1993,
5. **B.K Venkanna, Swati B. Wadavadagi “Basic Thermodynamics**, PHI, New Delhi, 2010

MECHANICS OF MATERIALS

Sub Code	: 10ME34	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks:	100

PART-A

UNIT 1:

Simple Stress and Strain: Introduction, Stress, strain, mechanical properties of materials, Linear elasticity, Hooke's Law and Poisson's ratio, Stress-Strain relation - behaviour in tension for Mild steel, cast iron and non ferrous metals. Extension / Shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections (circular and rectangular), Elongation due to self weight, Principle of super position.

07 Hours

UNIT 2:

Stress in Composite Section: Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shear strain, temperature stresses (including compound bars).

06 Hours

UNIT 3:

Compound Stresses: Introduction, Plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress.

07 Hours

UNIT 4:

Energy Methods: Work and strain energy, Strain energy in bar/beams, Castigliano's theorem, Energy methods.

Thick and Thin Cylinder Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume). Thick cylinders Lamé's equation (compound cylinders not included).

06 Hours

PART-B

UNIT 5:

Bending Moment and Shear Force in Beams: Introduction, Types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments. Shear force and bending moment diagrams for different beams subjected to concentrated loads, uniformly distributed load, (UDL) uniformly varying load (UVL) and couple for different types of beams.

07 Hours

UNIT 6:

Bending and Shear Stresses in Beams: Introduction, Theory of simple bending, assumptions in simple bending. Bending stress equation, relationship between bending stress, radius of curvature, relationship between bending moment and radius of curvature. Moment carrying capacity of a section. Shearing stresses in beams, shear stress across rectangular, circular, symmetrical I and T sections. (composite / notched beams not included).

07 Hours

UNIT 7:

Deflection of Beams: Introduction, Differential equation for deflection. Equations for deflection, slope and bending moment. Double integration method for cantilever and simply supported beams for point load, UDL, UVL and Couple. Macaulay's method

06 Hours

UNIT 8:

Torsion of Circular Shafts and Elastic Stability of Columns:

Introduction. Pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts. Power transmitted by solid and hollow circular shafts

Columns: Euler's theory for axially loaded elastic long columns. Derivation of Euler's load for various end conditions, limitations of Euler's theory, Rankine's formula.

06 Hours

TEXT BOOKS:

1. "**Mechanics of Materials**", by R.C.Hibbeler, Prentice Hall. Pearson Edu., 2005
2. "**Mechanics of materials**", James.M.Gere, Thomson, Fifth edition 2004.
3. "**Mechanics of materials**", in SI Units, Ferdinand Beer & Russell Johnston, 5th Ed., TATA McGraw Hill- 2003.

REFERENCE BOOKS:

1. "**Strength of Materials**", S.S. Rattan, Tata McGraw Hill, 2009
2. "**Strength of Materials**", S.S.Bhavikatti, Vikas publications House -1 Pvt. Ltd., 2nd Ed., 2006.
3. "**Mechanics of Materials**", K.V. Rao, G.C. Raju, First Edition, 2007
4. "**Engineering Mechanics of Solids**", Egor.P. Popov, Pearson Edu. India, 2nd, Edison, 1998.
5. "**Strength of Materials**", W.A. Nash, 5th Ed., Sehaum's Outline Series, Fourth Edition-2007.

MANUFACTURING PROCESS – I

(FUNDAMENTALS OF FOUNDRY & WELDING)

Sub Code	: 10ME35	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART – A

CASTING PROCESS

UNIT 1

Introduction: Concept of Manufacturing process, its importance. Classification of Manufacturing processes. Introduction to Casting process & steps involved. Varieties of components produced by casting process. Advantages & Limitations of casting process.

Patterns: Definition, functions, Materials used for pattern, various pattern allowances and their importance. Classification of patterns, BIS color coding of Patterns.

Binder: Definition, Types of binder used in moulding sand.
Additives: Need, Types of additives used and their properties..

06 Hours

UNIT 2

Sand Moulding : Types of base sand, requirement of base sand. Moulding sand mixture ingredients for different sand mixtures. Method used for sand moulding, such as Green sand, dry sand and skin dried moulds.

Cores: Definition, Need, Types. Method of making cores, Binders used, core sand moulding.

Concept of Gating & Risers. Principle and types.

Fettling and cleaning of castings. Basic steps, Casting defects, Causes, features and remedies.

Moulding Machines : Jolt type, Squeeze type, Jolt & Squeeze type and Sand slinger.

07 Hours

UNIT 3

Special moulding Process: Study of important moulding processes, No bake moulds, Flaskless moulds, Sweep mould, CO₂ mould, Shell mould, Investment mould.

Metal moulds: Gravity die-casting, Pressure die casting, Centrifugal casting, Squeeze Casting, Slush casting, Thixo-casting and Continuous Casting Processes.

07 Hours

UNIT 4

Melting Furnaces: Classification of furnaces. Constructional features & working principle of coke fired, oil fired and Gas fired pit furnace, Resistance furnace, Coreless Induction furnace, Electric Arc Furnace, Cupola furnace.

06 Hours

PART – B

WELDING

UNIT 5

Welding process: Definition, Principles, Classification, Application, Advantages & limitations of welding.

Arc Welding: Principle, Metal Arc welding (**MAW**), Flux Shielded Metal Arc Welding (**FSMAW**), Inert Gas Welding (**TIG & MIG**) Submerged Arc Welding (**SAW**) and Atomic Hydrogen Welding processes. (**AHW**)

Gas Welding: Principle, Oxy – Acetylene welding, Chemical Reaction in Gas welding, Flame characteristics. Gas torch construction & working. Forward and backward welding.

07 Hours

UNIT 6

Special types of welding: Resistance welding - principles, Seam welding, Butt welding, Spot welding and projection welding.

Friction welding, Explosive welding, Thermit welding, Laser welding and Electron beam welding.

07 Hours

UNIT 7

Metallurgical aspect, in welding : Structure of welds, Formation of different zones during welding. Heat affected zone (**HAZ**). Parameters affecting **HAZ**. Effect of carbon content on structure and properties of steel. Shrinkage in welds & Residual stresses.

Concept of electrodes, Filler rod and fluxes. Welding defects – Detection causes & remedy.

06 Hours

UNIT 8

Principles of soldering & brazing: Parameters involved & Mechanism. Different Types of Soldering & Brazing Methods.

Inspection Methods – Methods used for Inspection of casting and welding. Visual, Magnetic particle, Fluorescent particle, Ultrasonic, Radiography, Eddy current, Holography methods of Inspection.

06 Hours

TEXT BOOKS:

1. “**Manufacturing Process-I**”, Dr.K.Radhakrishna, Sapna Book House, 5th Revised Edition 2009.
2. “**Manufacturing & Technology: Foundry Forming and Welding**”, P.N.Rao, 3rd Ed., Tata McGraw Hill, 2003.

REFERENCE BOOKS:

1. “**Process and Materials of Manufacturing**”, Roy A Lindberg, 4th Ed. Pearson Edu. 2006.
2. “**Manufacturing Technology**”, Serope Kalpakjain, Steuen. R. Sechmid, Pearson Education Asia, 5th Ed. 2006.

COMPUTER AIDED MACHINE DRAWING

Sub Code	: 10ME36A / 10ME46A	IA Marks	: 25
Hrs/week	: 04(1 Hrs. Theory & 2 Hrs Practical)	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

Introduction:

Review of graphic interface of the software. Review of basic sketching commands and navigational commands. Starting a new drawing sheet. Sheet sizes. Naming a drawing, Drawing units, grid and snap.

02 Hours

PART-A

UNIT 1:

Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on, axis inclinations, spheres and hollow solids). True shape of sections.

Orthographic Views: Conversion of pictorial views into orthographic projections. of simple machine parts with or without section. (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions. Precedence of lines.

08 Hours

UNIT 2:

Thread Forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread.

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.

08 Hours

PART-B

UNIT 3:

Keys & Joints :

Parallel key, Taper key, Feather key, Gibhead key and Woodruff key

Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets). cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.

08 Hours

UNIT 4:

Couplings:

Split Muff coupling, Protected type flanged coupling, pin (bush) type flexible coupling, Oldham's coupling and universal coupling (Hooks' Joint)

08 Hours

PART - C

Assembly Drawings

(Part drawings should be given)

1. Plummer block (Pedestal Bearing)
2. Rams Bottom Safety Valve
3. I.C. Engine connecting rod
4. Screw jack (Bottle type)
5. Tailstock of lathe
6. Machine vice
7. Tool Head of a shaper

18 Hours

TEXT BOOKS:

1. 'A Primer on Computer Aided Machine Drawing-2007', Published by VTU, Belgaum.
2. 'Machine Drawing', N.D.Bhat & V.M.Panchal

REFERENCE BOOKS:

1. 'A Text Book of Computer Aided Machine Drawing', S. Trymbaka Murthy, CBS Publishers, New Delhi, 2007
2. 'Machine Drawing', K.R. Gopala Krishna, Subhash Publication.
3. 'Machine Drawing with Auto CAD', Goutam Pohit & Goutham Ghosh, 1st Indian print Pearson Education, 2005
4. 'Auto CAD 2006, for engineers and designers', Sham Tickoo. Dream tech 2005
5. 'Machine Drawing', N. Siddeshwar, P. Kanniah, V.V.S. Sastri, published by Tata McGraw Hill,2006

NOTE:

Internal assessment: 25 Marks

All the sheets should be drawn in the class using software. Sheet sizes should be A3/A4. All sheets must be submitted at the end of the class by taking printouts.

Scheme of Examination:

Two questions to be set from each Part-A, Part-B and Part-C
Student has to answer one question each from Part-A and Part-B for 20 marks each. And one question from Part-C for 60 marks.

i.e.	PART-A 1 x 20 = 20 Marks
	PART-B 1 x 20 = 20 Marks
	PART-C 1 x 60 = 60 Marks
	<hr/>
Total	= 100 Marks

FLUID MECHANICS

Sub Code	: 10ME 36B / 46B	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART – A

UNIT-1

Properties of Fluids: Introduction, Types of fluid, Properties of fluids, viscosity, thermodynamic properties, surface tension, capillarity, vapour pressure and cavitation

06 Hours

UNIT-2

Fluid Statics : Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmospheric and vacuum pressures, simple manometers and differential manometers. Total pressure and center of pressure on submerged plane surfaces; horizontal, vertical and inclined plane surfaces, curved surface submerged in liquid.

07 Hours

UNIT-3

Buoyancy and Fluid Kinematics:

Buoyancy, center of buoyancy, metacentre and metacentric height, conditions of equilibrium of floating and submerged bodies, determination of Metacentric height experimentally and theoretically.

Kinematics: Types of fluid flow, continuity equation in 2D and 3D (Cartesian Co-ordinates only, velocity and acceleration, velocity potential function and stream function.

07 Hours

UNIT-4

Fluid Dynamics: Introduction equation of motion, Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation.

06 Hours

PART-B

UNIT-5

Fluid Flow Measurements : Venturimeter, orificemeter, pitot-tube, vertical orifice, V-Notch and rectangular notches.

Dimensional Analysis : Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham π theorem, dimensionless numbers, similitude, types of similitudes.

07 Hours

UNIT-6

Flow through pipes : Minor losses through pipes. Darcy's and Chezy's equation for loss of head due to friction in pipes. HGL and TEL.

06 Hours

UNIT-7

Laminar flow and viscous effects : Reynold's number, critical Reynold's number, laminar flow through circular pipe-Hagen Poiseuille's equation, laminar flow between parallel and stationary plates.

06 Hours

UNIT-8

Flow past immersed bodies : Drag, Lift, expression for lift and drag, boundary layer concept, displacement, momentum and energy thickness.

Introduction to compressible flow : Velocity of sound in a fluid, Mach number, Mach cone, propagation of pressure waves in a compressible fluid.

07 Hours

TEXT BOOKS:

1. **Fluid Mechanics**, Ojush.K.Kundu, IRAM COCHEN, ELSEVIER, 3rd Ed. 2005.
2. **Fluid Mechanics**, Dr. Bansal, R.K.Lakshmi Publications, 2004.

REFERENCE BOOKS:

1. **Fluid Mechanics and hydraulics**, Dr.Jagadishlal: Metropolitan Book Co-Ltd., 1997.
2. **Fluid Mechanics (SI Units)**, Yunus A. Cengel John M.Oimbala, 2nd Ed., Tata McGraw Hill, 2006.

3. **Fluid Mechanics**, John F.Douglas, Janul and M.Gasiosek and John A.Swaffield, Pearson Education Asia, 5th ed., 2006
4. **Fluid Mechanics and Fluid Power Engineering**, Kumar.D.S, Kataria and Sons., 2004
5. **Fluid Mechanics** -. Merle C. Potter, Elaine P.Scott. Cengage learning

METALLOGRAPHY AND MATERIAL TESTING LABORATORY

Sub Code	: 10MEL 37A / 47A	IA Marks	: 25
Hrs/week	: 03	Exam Hours	: 03
Total Lecture Hrs	: 48	Exam Marks	: 50

PART – A

1. Preparation of specimen for Metallographic examination of different engineering materials. Identification of microstructures of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze & composites.
2. Heat treatment: Annealing, normalizing, hardening and tempering of steel. Hardness studies of heat-treated samples.
3. To study the wear characteristics of ferrous, non-ferrous and composite materials for different parameters.
4. Non-destructive test experiments like,
 - (a). Ultrasonic flaw detection
 - (b). Magnetic crack detection
 - (c). Dye penetration testing. To study the defects of Cast and Welded specimens

PART – B

1. Tensile, shear and compression tests of metallic and non metallic specimens using Universal Testing Machine
2. Torsion Test
3. Bending Test on metallic and nonmetallic specimens.
4. Izod and Charpy Tests on M.S, C.I Specimen.
5. Brinell, Rockwell and Vickers's Hardness test.
6. Fatigue Test.

Scheme of Examination:

ONE question from part -A: 20 Marks

ONE question from part -B: 20 Marks

Viva -Voice: 10 Marks

Total : 50 Marks

MECHANICAL MEASUREMENTS AND METROLOGY LABORATORY

Sub Code	: 10MEL 37B / 47B	IA Marks	: 25
Hrs/week	: 03	Exam Hours	: 03
Total Lecture Hrs	: 48	Exam Marks	: 50

PART-A: MECHANICAL MEASUREMENTS

1. Calibration of Pressure Gauge
2. Calibration of Thermocouple
3. Calibration of LVDT
4. Calibration of Load cell
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.

PART-B: METROLOGY

1. Measurements using Optical Projector / Toolmaker Microscope.
2. Measurement of angle using Sine Center / Sine bar / bevel protractor
3. Measurement of alignment using Autocollimator / Roller set
4. Measurement of cutting tool forces using
 - a) Lathe tool Dynamometer
 - b) Drill tool Dynamometer.
5. Measurement of Screw thread Parameters using Two wire or Three-wire method.
6. Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator
7. Measurement of gear tooth profile using gear tooth vernier /Gear tooth micrometer
8. Calibration of Micrometer using slip gauges
9. Measurement using Optical Flats

Scheme of Examination:

ONE question from part -A: 20 Marks

ONE question from part -B: 20 Marks

Viva -Voice: 10 Marks

Total : 50 Marks

FOUNDRY AND FORGING LABORATORY

Sub Code	: 10MEL 38A / 48A	IA Marks	: 25
Hrs/week	: 03	Exam Hours	: 03
Total Lecture Hrs	: 48	Exam Marks	: 50

PART – A

1. Testing of Moulding sand and Core sand

Preparation of sand specimens and conduction of the following tests:

- 1 Compression, Shear and Tensile tests on Universal Sand Testing Machine.
- 2 Permeability test
- 3 Core hardness & Mould hardness tests.
- 4 Sieve Analysis to find Grain Finest number of Base Sand
- 5 Clay content determination in Base Sand

PART – B

2. Foundry Practice

Use of foundry tools and other equipments.

Preparation of moulds using two moulding boxes using patterns or without patterns. (Split pattern, Match plate pattern and Core boxes).

Preparation of one casting (Aluminum or cast iron-Demonstration only)

PART – C

3. Forging Operations :

- Calculation of length of the raw material required to do the model.

- Preparing minimum three forged models involving upsetting, drawing and bending operations.
- Out of these three models, at least one model is to be prepared by using Power Hammer.

Scheme of Examination:

One question is to be set from Part-A: 10 marks

One question is to be set from either

Part-B or Part-C: 30 marks

Calculation part in case of forging is made compulsory

Calculation (Forging)	+ Foundry Model	= 05 +25 = 30 Marks
Calculation (Forging)	+ Forging Model	= 05 +25 = 30 Marks

Viva-Voce : 10 marks.

Total : 50 Marks.

MACHINE SHOP

Sub Code	: 10MEL 38A / 48A	IA Marks	: 25
Hrs/week	: 03	Exam Hours	: 03
Total Lecture Hrs	: 48	Exam Marks	: 50

PART – A

Preparation of three models on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning.

PART – B

Cutting of V Groove/ dovetail / Rectangular groove using a shaper.
Cutting of Gear Teeth using Milling Machine.

Scheme of Examination:

ONE question from part -A: 30 Marks

ONE question from part -B: 10 Marks

Viva -Voice: 10 Marks

Total : 50 Marks

APPLIED THERMODYNAMICS

Sub Code	: 10ME43	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks:	100

PART-A

Unit 1:

Combustion thermodynamics: Theoretical (Stoichiometric) air and excess air for combustion of fuels. Mass balance, actual combustion. Exhaust gas analysis. A./ F ratio, Energy balance for a chemical reaction, enthalpy of formation, enthalpy and internal energy of combustion, Combustion efficiency, adiabatic flow temperature.

07 Hours

Unit 2:

Gas power cycle: Air Standard cycles: Carnot, Otto, Diesel, Dual and Stirling cycles, P-V and T-S diagrams, description, efficiencies and mean effective pressures, Comparison of Otto, Diesel and dual cycles.

06 Hours

Unit 3:

I.C. Engine: Testing of two stroke and four stroke SI and CI engines for performance Related numerical problems, heat balance, Motoring Method, Willian's line method, swinging field dynamometer, Morse test.

06 Hours

Unit 4:

Vapour Power Cycles: Carnot vapour power cycles, drawbacks as a reference cycle, Simple Rankine cycle, description, T- S diagram, analysis for performance , comparison of Carnot and Rankine cycles. Effects of pressure and temperature on Rankine cycle performance. Actual vapour power cycles. Ideal and practical regenerative Rankine cycle, open and closed feed water heaters, Reheat Rankine cycle.

07 Hours

PART-B

Unit 5:

Reciprocating Compressors: Operation of a single stage reciprocating compressors, work input through P-V diagram and steady state steady flow analysis. Effect of clearance and volumetric efficiency. Adiabatic, isothermal and mechanical efficiencies. Multistage compressor, saving in work,

optimum intermediate pressure, inter- cooling, minimum work for compression.

06 Hours

Unit 6:

Gas turbine and Jet propulsion: Classification of Gas turbines, Analysis of open cycle gas turbine cycle. Advantages and disadvantages of closed cycle. Methods to improve thermal efficiency, Jet propulsion and Rocket propulsion.

07 Hours

Unit 7

Refrigeration: Vapour compression refrigeration system ; description, analysis, refrigerating effect, capacity , power required, units of refrigeration, COP , Refrigerants and their desirable properties. Air cycle refrigeration; reversed Carnot cycle, reversed Brayton cycle, Vapour absorption refrigeration system, steam jet refrigeration.

06 Hours

Unit 8

Psychrometry: Atmospheric air and psychrometric properties; Dry bulb temperature, wet bulb temperature, dew point temperature; partial pressures, specific and relative humidities and the relation between the two enthalpy and adiabatic saturation temperature. Construction and use of psychrometric chart . Analysis of various processes; heating, cooling , dehumidifying and humidifying. Adiabatic mixing of moist air. Summer and winter air conditioning.

07 Hours

Data Hand Book :

1. **Thermodynamic data hand book**, B.T. Nijaguna.
2. **Properties of Refrigerant & Psychrometric** (tables & Charts in SI Units), Dr. S.S. Banwait, Dr. S.C. Laroia, Birla Pub. Pvt. Ltd., Delhi, 2008

TEXT BOOK

1. **Basic and applied Thermodynamics**, P.K. Nag, 2nd Ed., Tata McGraw Hill Pub.Co,2002
2. **Applied Thermodynamics**, Rajput, Laxmi Publication
3. **Applied Thermodynamics**, B.K. Venkanna, Swati B. Wadavadagi, PHI, New Delhi, 2010

REFERENCE BOOKS

1. **Thermodynamics , An engineering approach**, Yunus, A. Cengel and Michael A.Boies, 6th Ed., Tata McGraw Hill pub. Co., 2002,

2. **Fundamental of Classical Thermodynamics**, G.J. Van Wylen and R.E. Sontang Wiley eastern.

KINEMATICS OF MACHINES

Sub Code	: 10ME44	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT 1:

Introduction: Definitions Link or element, kinematic pairs, Degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, Structure, Mobility of Mechanism, Inversion, Machine.

Kinematic Chains and Inversions: Inversions of Four bar chain; Single slider crank chain and Double slider crank chain.

07 Hours

UNIT 2:

Mechanisms: Quick return motion mechanisms-Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism.

Straight line motion mechanisms Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms -Geneva wheel mechanism and Ratchet and Pawl mechanism. Toggle mechanism, Pantograph, Ackerman steering gear mechanism.

06 Hours

UNIT 3:

Velocity and Acceleration Analysis of Mechanisms (Graphical Methods)

Velocity and acceleration analysis of Four Bar mechanism, slider crank mechanism and Simple Mechanisms by vector polygons: Relative velocity and acceleration of particles in a common link, relative velocity and accelerations of coincident Particles on separate links- Coriolis component of acceleration. Angular velocity and angular acceleration of links, velocity of rubbing.

07 Hours

UNIT 4:

Velocity Analysis by Instantaneous Center Method: Definition, Kennedy's Theorem, Determination of linear and angular velocity using instantaneous center method

Klein's Construction: Analysis of velocity and acceleration of single slider crank mechanism.

06 Hours

PART - B

UNIT 5:

Velocity and Acceleration Analysis of Mechanisms (Analytical Methods):

Analysis of four bar chain and slider crank chain using analytical expressions. (Use of complex algebra and vector algebra)

06 Hours

UNIT 6:

Spur Gears: Gear terminology, law of gearing, Characteristics of involute action, Path of contact. Arc of contact, Contact ratio of spur, helical, bevel and worm gears, Interference in involute gears. Methods of avoiding interference, Back lash. Comparison of involute and cycloidal teeth. Profile Modification.

07 Hours

UNIT 7:

Gear Trains: Simple gear trains, Compound gear trains for large speed. reduction, Epicyclic gear trains, Algebraic and tabular methods of finding velocity ratio of epicyclic gear trains. Tooth load and torque calculations in epicyclic gear trains.

07 Hours

UNIT 8:

Cams: Types of cams, Types of followers. Displacement, Velocity and Acceleration time curves for cam profiles. Disc cam with reciprocating follower having knife-edge, roller and flat-face follower, Disc cam with oscillating roller follower. Follower motions including SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion.

06 Hours

TEXT BOOKS:

1. "Theory of Machines", Rattan S.S, Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 3rd edition -2009.
2. "Theory of Machines", Sadhu Singh, Pearson Education (Singapore) Pvt. Ltd, Indian Branch New Delhi, 2nd Edi. 2006

REFERENCE BOOKS:

1. "Theory of Machines & Mechanisms", J.J. Uicker, , G.R. Pennock, J.E. Shigley. OXFORD 3rd Ed. 2009.
2. **Mechanism and Machine theory**, Ambekar, PHI, 2007

Graphical Solutions may be obtained either on the Graph Sheets or on the Answer Book itself.

MANUFACTURING PROCESS – II
(Metal Removing Process)

Sub Code	: 10ME45	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART – A

UNIT - 1

Theory of Metal Cutting: Single point cutting tool nomenclature, geometry. Mechanics of Chip Formation, Types of Chips. Merchant's circle diagram and analysis, Ernst Merchant's solution, shear angle relationship, problems of Merchant's analysis. Tool Wear and Tool failure, tool life. Effects of cutting parameters on tool life. Tool Failure Criteria, Taylor's Tool Life equation. Problems on tool life evaluation.

07 Hours

UNIT - 2

Cutting Tool Materials: Desired properties and types of cutting tool materials – HSS, carbides coated carbides, ceramics. Cutting fluids. Desired properties, types and selection. Heat generation in metal cutting, factors affecting heat generation. Heat distribution in tool and work piece and chip. Measurement of tool tip temperature.

07 Hours

UNIT - 3

Turning (Lathe), Shaping and Planing Machines: Classification, constructional features of Turret and Capstan Lathe. Tool Layout, shaping Machine, Planing Machine, Driving mechanisms of lathe, shaping and planing machines, Different operations on lathe, shaping machine and planing machine. Simple problems on machining time calculations

07 Hours

UNIT - 4

Drilling machines: Classification, constructional features, drilling & related operations. Types of drill & drill bit nomenclature, drill materials. Introduction to CNC machines- Principles of operation. Axes of NC machine-Coordinate systems. Basics of Manual part programming methods.

06 Hours

PART – B

UNIT - 5

Milling machines: Classification, constructional features, milling cutters nomenclature, milling operations, up milling and down milling concepts. Various milling operations.

Indexing: Simple, compound, differential and angular indexing calculations. Simple problems on simple and compound indexing.

06 Hours

UNIT - 6

Grinding machines: Types of abrasives, Grain size, bonding process, grade and structure of grinding wheels, grinding wheel types. Classification, constructional features of grinding machines (Centerless, cylindrical and surface grinding). Selection of grinding wheel. Grinding process parameters. Dressing and truing of grinding wheels.

07 Hours

UNIT - 7:

Broaching process - Principle of broaching. Details of a broach. Types of broaching machines-constructional details. Applications. Advantages and Limitations.

Finishing and other Processes Lapping and Honing operations – Principles, arrangement of set up and application. Super finishing process, polishing, buffing operation and application.

06 Hours

UNIT - 8

Non-traditional machining processes: Need for non traditional machining, Principle, equipment & operation of Laser Beam, Plasma Arc Machining, Electro Chemical Machining, Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining, Electron Discharge Machining and Plasma Arc Machining.

06 Hours

Text Books:

1. **Workshop Technology**, Hazara Choudhry, Vol-II, Media Promoters & Publishers Pvt. Ltd. 2004
2. **Production Technology**, R.K.Jain, Khanna Publications, 2003.
3. **Production Technology**, HMT, Tata Mc Graw Hill, 2001.

Reference Books:

1. **Manufacturing Science**, Amitabha Ghosh and Mallik, affiliated East West Press, 2003.
2. **Fundamentals of Metal Machining and Machine Tools**, G. Boothroyd, McGraw Hill, 2000.

MANAGEMENT AND ENTREPRENEURSHIP

Sub Code	: 10AL 51	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART – A

MANAGEMENT

UNIT - 1

MANAGEMENT: Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as a science, art of profession - Management & Administration - Roles of Management, Levels of Management, Development of Management Thought - early management approaches - Modern management approaches.

7 Hours

UNIT - 2

PLANNING: Nature, importance and purpose of planning process - Objectives - Types of plans (Meaning Only) - Decision making Importance of planning - steps in planning & planning premises - Hierarchy of plans.

6 Hours

UNIT - 3

ORGANIZING AND STAFFING: Nature and purpose of organization - Principles of organization - Types of organization - Departmentation - Committees- Centralization Vs Decentralization of authority. and responsibility - Span of control - MBO and MBE (Meaning Only) Nature and importance of staffing--:Process of Selection & Recruitment (in brief).

6 Hours

UNIT - 4

DIRECTING & CONTROLLING: Meaning and nature of directing - Leadership styles, Motivation Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of Co - Ordination. Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control (in brief):

7 Hours

PART-B

ENTREPRENEURSHIP

UNIT - 5

ENTREPRENEUR: Meaning of Entrepreneur; Evolution of .the Concept; Functions of an Entrepreneur, Types of Entrepreneur, Entrepreneur - an emerging. Class. Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship - its Barriers.

6 Hours

UNIT – 6

SMALL SCALE INDUSTRIES: Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI Steps to start and SSI - Government policy towards SSI; Different Policies of SSI; Government Support for SSI during 5 year plans. Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GA TT Supporting Agencies of Government for SSI, Meaning, Nature of support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry (Definition Only)

7 Hours

UNIT - 7

INSTITUTIONAL SUPPORT: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC.

7 Hours

UNIT - 8

PREPARATION OF PROJECT: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; Formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal. Identification of business opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

7 Hours

TEXT BOOKS:

1. **Principles of Management** – P. C.Tripathi, P.N. Reddy – Tata McGraw Hill,
2. **Dynamics of Entrepreneurial Development & Management** Vasant Desai - Himalaya Publishing House
3. **Entrepreneurship Development** – Poornima. M. Charantimath Small Business Enterprises - Pearson Education - 2006 (2 & 4).

REFERENCE BOOKS:

1. **Management Fundamentals** - Concepts, Application, Skill Development - Robers Lusier - Thomson
2. **Entrepreneurship Development** - S.S.Khanka - S.Chand & Co.
3. **Management** - Stephen Robbins - Pearson Education/PHI - 17th Edition, 2003.

DESIGN OF MACHINE ELEMENTS-I

Sub Code	: 10ME 52	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT- 1

Introduction: Definitions: normal, shear, biaxial and tri axial stresses, Stress tensor, Principal Stresses. Engineering Materials and their mechanical properties, Stress-Strain diagrams, Stress Analysis, Design considerations: Codes and Standards.

05 Hours

UNIT- 2

Design For Static & Impact Strength:

Static Strength: Static loads and factor of safety, Theories of failure: Maximum normal stress theory, Maximum shear stress theory, Maximum strain theory, Strain energy theory, Distortion energy theory. Failure of brittle and ductile materials, Stress concentration, Determination of Stress concentration factor.

Impact Strength: Introduction, Impact stresses due to axial, bending and torsional loads, effect of inertia.

07 Hours

UNIT - 3

Design For Fatigue Strength: Introduction- S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit, Modifying factors: size effect, surface effect, Stress concentration effects, Fluctuating stresses, Goodman and Soderberg relationship, stresses due to combined loading, cumulative fatigue damage.

08 Hours

UNIT - 4

Threaded Fasteners: Stresses in threaded fasteners, Effect of initial tension, Design of threaded fasteners under static, dynamic and impact loads, Design of eccentrically loaded bolted joints.

06 Hours

PART - B

UNIT - 5

Design Of Shafts: Torsion of shafts, design for strength and rigidity with steady loading, ASME codes for power transmission shafting, shafts under fluctuating loads and combined loads.

07 Hours

UNIT - 6

Cotter And Knuckle Joints, Keys And Couplings: Design of Cotter and Knuckle joints, Keys: Types of keys, Design of keys, Couplings: Rigid and

flexible couplings, Flange coupling, Bush and Pin type coupling and Oldham's coupling.

07 Hours

UNIT - 7

Riveted and Welded Joints – Types, rivet materials, failures of riveted joints, Joint Efficiency, Boiler Joints, Lozanze Joints, Riveted Brackets. Welded Joints – Types, Strength of butt and fillet welds, eccentrically loaded welded joints.

07 Hours

UNIT - 8

Power Screws: Mechanics of power screw, Stresses in power screws, efficiency and self-locking, Design of Power Screw, Design of Screw Jack: (Complete Design).

05 Hours

TEXT BOOKS

1. **Mechanical Engineering Design**, Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition 2009.
2. **Design of Machine Elements**, V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007.

DESIGN DATA HANDBOOK

1. **Design Data Hand Book**, K. Lingaiah, McGraw Hill, 2nd Ed.
2. **Data Hand Book**, K. Mahadevan and Balaveera Reddy, CBS Publication
3. **Design Data Hand Book**, H.G. Patil, I. K. International Publisher, 2010.

REFERENCE BOOKS

1. **Machine Design**, Robert L. Norton, Pearson Education Asia, 2001.
2. **Design of Machine Elements**, M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, Pearson Education, 2006.
3. **Machine Design**, Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008.
4. **Fundamentals of Machine Component Design**, Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007.

ENERGY ENGINEERING

Sub Code	: 10ME 53	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT - 1

Steam Power Plant: Different Types of Fuels used for steam generation, Equipment for burning coal in lump form, stokers, different types, Oil burners, Advantages and Disadvantages of using pulverized fuel, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace, Coal and ash handling, Generation of steam using forced circulation, high and supercritical pressures.

07 Hours

UNIT - 2

A Brief Account Of Benson, Velox Schmidt Steam Generators. Chimneys: Natural, forced, induced and balanced draft, Calculations and numericals involving height of chimney to produce a given draft. Cooling towers and Ponds. Accessories for the Steam generators such as Superheaters, De-superheater, control of superheaters, Economizers, Air pre-heaters and re-heaters.

07 Hours

UNIT - 3

Diesel Engine Power Plant: Applications of Diesel Engines in Power field. Method of starting Diesel engines. Auxiliaries like cooling and lubrication system, filters, centrifuges, Oil heaters, intake and exhaust system, Layout of diesel power plant.

06 Hours

UNIT - 4

Hydro-Electric Plants: Hydrographs, flow duration and mass curves, unit hydrograph and numericals. Storage and pondage, pumped storage plants, low, medium and high head plants, Penstock, water hammer, surge tanks, gates and valves. General layout of hydel power plants.

06 Hours

PART - B

UNIT - 5

Nuclear Power Plant: Principles of release of nuclear energy; Fusion and fission reactions. Nuclear fuels used in the reactors. Multiplication and thermal utilization factors. Elements of the nuclear reactor; moderator, control rod, fuel rods, coolants. Brief description of reactors of the following types-Pressurized water reactor, Boiling water reactor, Sodium graphite reactor, Fast Breeder reactor, Homogeneous graphite reactor and gas cooled reactor, Radiation hazards, Shieldings, Radio active waste disposal.

06 Hours

[Back to Index](#)

UNIT - 6

Solar Energy: Solar Extra terrestrial radiation and radiation at the earth surface, radiation-measuring instruments, working principles of solar flat plate collectors, solar pond and photovoltaic conversion (Numerical Examples).

Wind Energy: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, wind machines; Types of wind machines and their characteristics, horizontal and vertical axis wind mills, coefficient of performance of a wind mill rotor (Numerical Examples).

08 Hours**UNIT - 7**

Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, limitations.

Ocean Thermal Energy Conversion: Principle of working, Rankine cycle, problems associated with OTEC.

Geothermal Energy Conversion: Principle of working, types of geothermal station with schematic diagram, problems associated with geothermal conversion, scope of geothermal energy.

06 Hours**UNIT - 8**

Energy From Bio Mass: Photosynthesis, photosynthetic oxygen production, energy plantation.

Bio Chemical Route: Biogas production from organic wastes by anaerobic fermentation, classification of bio gas plants, factors affecting bio gas generation.

Thermo Chemical Route: Thermo chemical conversion on bio mass, types of gasifiers.

06 Hours**TEXT BOOKS:**

1. **Power Plant Engineering**, P. K. Nag Tata McGraw Hill 2nd edn 2001.
2. **Power Plant Engineering**, Domakundawar, Dhanpath Rai sons. 2003

REFERENCE BOOKS:

1. **Power Plant Engineering**, R. K. Rajput, Laxmi publication, New Delhi.
2. **Principles of Energy conversion**, A. W. Culp Jr., McGraw Hill. 1996

3. **Non conventional Energy sources**, G D Rai Khanna Publishers.
4. **Non conventional resources**, B H Khan TMH - 2007

DYNAMICS OF MACHINES

Sub Code	: 10ME 54	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT 1: Static Force Analysis: Introduction: Static equilibrium. Equilibrium of two and three force members. Members with two forces and torque. Free body diagrams. Principle of virtual work. Static force analysis of four bar mechanism and slider-crank mechanism with and without friction.

06 Hours

UNIT 2: Dynamic Force Analysis: D'Alembert's principle, Inertia force, inertia torque. Dynamic force analysis of four-bar mechanism and slider crank mechanism. Dynamically equivalent systems. Turning moment diagrams and flywheels. Fluctuation of Energy. Determination of size of flywheels.

08 Hours

UNIT 3: Friction and Belt Drives: Definitions: Types of friction: laws of friction, Friction in pivot and collar bearings. Belt drives: Flat belt drives. ratio of belt tensions, centrifugal tension, power transmitted.

06 Hours

UNIT 4: Balancing of Rotating Masses: Static and dynamic balancing. Balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes.

06 Hours

PART - B

UNIT 5: Balancing of Reciprocating Masses: Inertia effect of crank and connecting rod, single cylinder engine, balancing in multi cylinder-inline engine (primary & secondary forces), V-type engine; Radial engine – Direct and reverse crank method.

08 Hours

UNIT 6: Governors: Types of governors; force analysis of Porter and Hartnell governors. Controlling force. stability, sensitiveness. Isochronism, effort and power,

06 Hours

UNIT 7: Gyroscope: Vectorial representation of angular motion. Gyroscopic couple. Effect of gyroscopic couple on ship, plane disc, aeroplane, stability of two wheelers and four wheelers.

06 Hours

UNIT 8: Analysis of Cams: Analysis of Tangent cam with roller follower and Circular arc cam operating flat faced and roller followers. Undercutting in Cams

06 Hours

TEXT BOOKS:

1. **Theory of Machines**, Sadhu Singh, Pearson Education. 2nd edition. 2007.
2. **Theory of Machines**, Rattan S.S. Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2009.

REFERENCE BOOKS:

1. **“Theory of Machines & Mechanisms”**, J.J. Uicker, , G.R. Pennock, J.E. Shigley. OXFORD 3rd Ed. 2009
2. **Mechanism and Machine Theory**, A.G.Ambekar PHI, 2007

MANUFACTURING PROCESS – III

(METAL FORMING PROCESS)

Sub Code	: 10ME 55	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT - 1

Introduction And Concepts: Classification of metal working processes, characteristics of wrought products, advantages and limitations of metal working processes. Concepts of true stress, true strain, triaxial & biaxial stresses. Determination of flow stress. Principal stresses, Tresca & Von-Mises yield criteria, concepts of plane stress & plane strain.

07 Hours

UNIT - 2

Effects Of Parameters: Temperature, strain rate, friction and lubrication, hydrostatic pressure in metalworking, Deformation zone geometry, workability of materials, Residual stresses in wrought products.

06 Hours

UNIT - 3

Forging: Classification of forging processes. Forging machines & equipment. Expressions for forging pressures & load in open die forging and closed die forging by slab analysis, concepts of friction hill and factors affecting it. Die-design parameters. Material flow lines in forging. Forging defects, Residual stresses in forging. Simple problems.

07 Hours**UNIT - 4**

Rolling: Classification of Rolling processes. Types of rolling mills, expression for Rolling load. Roll separating force. Frictional losses in bearing, power required in rolling, Effects of front & back tensions, friction, friction hill. Maximum possible reduction. Defects in rolled products. Rolling variables, simple problems.

06 Hours**PART - B****UNIT - 5**

Drawing: Drawing equipment & dies, expression for drawing load by slab analysis, power requirement. Redundant work and its estimation, optimal cone angle & dead zone formation, drawing variables, Tube drawing, classification of tube drawing, simple problems.

07 Hours**UNIT - 6**

Extrusion: Types of extrusion processes, extrusion equipment & dies, deformation, lubrication & defects in extrusion. Extrusion dies, Extrusion of seamless tubes. Extrusion variables, simple problem

06 Hours**UNIT - 7**

Sheet & Metal Forming: Forming methods, dies & punches, progressive die, compound die, combination die. Rubber forming. Open back inclinable press (OBI press), piercing, blanking, bending, deep drawing, LDR in drawing, Forming limit criterion, defects of drawn products, stretch forming. Roll bending & contouring, Simple problems

06 Hours**UNIT - 8**

High Energy Rate Forming Methods: Principles, advantages and applications, explosive forming, electro hydraulic forming, Electromagnetic forming.

Powder Metallurgy: Basic steps in Powder metallurgy brief description of methods of production of metal powders, conditioning and blending powders, compaction and sintering application of powder metallurgy components, advantages and limitations.

07 Hours**TEXT BOOKS:**[Back to Index](#)

1. **Mechanical metallurgy (SI units)**, G.E. Dieter, Mc Graw Hill pub.2001
2. **Manufacturing Process – III**, Dr. K.Radhakrishna, Sapna Book House, 2009.

REFERENCE BOOKS:

1. **Materials and Processes in Manufacturing**, E.paul, Degramo, J.T. Black, Ronald, A.K. Prentice -hall of India 2002
2. **Principles of Industrial metal working process**, G.W. Rowe, CBSpub. 2002
3. **Manufacturing Science**, Amitabha Ghosh & A.K. Malik - East - Westpress 2001
4. **Technology of Metal Forming Process**, Surendra kumar, PHI – 2008

TURBO MACHINES

Sub Code	: 10ME 56	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART- A

UNIT -1

Introduction: Definition of turbomachine, parts of turbomachines, Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance, Effect of Reynold's number, Unit and specific quantities, model studies. Application of first and second law's of thermodynamics to turbomachines, Efficiencies of turbomachines. Problems.

07 Hours

UNIT – 2

Thermodynamics of fluid flow: Static and Stagnation states-Incompressible fluids and perfect gases, Overall isentropic efficiency, stage efficiency (their comparison) and polytropic efficiency for both compression and expansion processes. Reheat factor for expansion process.

07 Hours

UNIT – 3

Energy exchange in Turbomachines: Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction,

utilization factor, Relation between degree of reaction and Utilization factor, Problems.

06 Hours

UNIT – 4

General Analysis of Turbomachines: Radial flow compressors and pumps – general analysis, Expression for degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Effect of blade discharge angle on performance, Theoretical head – capacity relationship, General analysis of axial flow pumps and compressors, degree of reaction, velocity triangles, Problems.

06 Hours

PART - B

UNIT – 5

Steam Turbines: Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor, Reaction turbine – Parsons's turbine, condition for maximum utilization factor, reaction staging, Problems.

07 Hours

UNIT – 6

Hydraulic Turbines: Classification, Different efficiencies, Pelton turbine – velocity triangles, design parameters, Maximum efficiency. Francis turbine - velocity triangles, design parameters, runner shapes for different blade speeds. Draft tubes- Types and functions. Kaplan and Propeller turbines - velocity triangles, design parameters. Problems.

07 Hours

UNIT – 7

Centrifugal Pumps: Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel. Problems.

06 Hours

UNIT – 8

Centrifugal Compressors: Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging and problems.

Axial flow Compressors: Expression for pressure ratio developed in a stage, work done factor, efficiencies and stalling. Problems.

06 Hours

(**Note:** Since dimensional analysis is covered in Fluid Mechanics subject, questions on dimensional analysis may not be given. However, dimensional parameters and model studies may be given more weightage.)

TEXT BOOKS:

1. **An Introduction to Energy Conversion**, Volume III, Turbo machinery, V. Kadambi and Manohar Prasad, New Age International Publishers, reprint 2008.
2. **Turbines, Compressors & Fans**, S. M. Yahya, Tata McGraw Hill Co. Ltd., 2nd edition, 2002

REFERENCE BOOKS:

1. **Principals of Turbomachines**, D. G. Shepherd, The Macmillan Company (1964).
2. **Fluid Mechanics & Thermodynamics of Turbomachines**, S. L. Dixon, Elsevier (2005).
3. **Turbomachine**, B.K.Venkanna PHI, New Delhi 2009.
4. **Text Book of Turbomachines**, M. S. Govindgouda and A. M. Nagaraj, M. M. Publications, 4Th Ed, 2008.

FLUID MECHANICS AND MACHINES LABORATORY

Sub Code	: 10MEL 57	IA Marks	: 25
Hrs/week	: 03	Exam Hours	: 03
Total Lecture Hrs	: 42	Exam Marks	: 50

PART - A

1. Determination of coefficient of friction of flow in a pipe.
2. Determination of minor losses in flow through pipes.
3. Determination of force developed by impact of jets on vanes.
4. Calibration of flow measuring devices
 - a. Orifice Plate meter
 - b. Nozzle
 - c. Venturimeter
 - d. V-notch

18 Hours

PART - B

5. Performance testing of Turbines
 - a. Pelton wheel
 - b. Francis Turbine
 - c. Kaplan Turbines
6. Performance testing of Pumps
 - a. Single stage / Multi stage centrifugal pumps
 - b. Reciprocating pump
7. Performance test of a two stage Reciprocating Air Compressor
8. Performance test on an Air Blower

24 Hours**Scheme for Examination:**

One Question from Part A	-	15 Marks (05 Writeup + 10)
One Question from Part B	-	25 Marks (05 Writeup + 20)
Viva-Voce	-	10 Marks

Total		50 Marks

ENERGY CONVERSION ENGINEERING LABORATORY

Sub Code	: 10MEL 58	IA Marks	: 25
Hrs/week	: 03	Exam Hours	: 03
Total Lecture Hrs	: 42	Exam Marks	: 50

PART - A

1. Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Marten's (closed) / Cleavland's (Open Cup) Apparatus.
2. Determination of Calorific value of solid, liquid and gaseous fuels.
3. Determination of Viscosity of a lubricating oil using Redwoods, Saybolt and Torsion Viscometers.

4. Valve Timing/port opening diagram of an I.C. engine (4 stroke/2 stroke).
5. Use of planimeter

21 Hours**PART - B**

1. Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiencies, Volumetric efficiency, Mechanical efficiency, SFC, FP, A:F Ratio heat balance sheet for
 - (a) Four stroke Diesel Engine
 - (b) Four stroke Petrol Engine
 - (c) Multi Cylinder Diesel/Petrol Engine, (Morse test)
 - (d) Two stroke Petrol Engine
 - (e) Variable Compression Ratio I.C. Engine.

21 Hours**Scheme for Examination:**

One Question from Part A	-	15 Marks (05 Writeup+10)
One Question from Part B	-	25 Marks (05 Writeup+20)
Viva-Voce	-	10 Marks

Total		50 Marks

COMPUTER INTEGRATED MANUFACTURING

Sub Code	: 10ME 61	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART-A

UNIT - 1

Computer Integrated Manufacturing Systems: Introduction, Automation definition, Types of automation, CIM, processing in manufacturing, Production concepts, Mathematical Models-Manufacturing lead time, production rate, components of operation time, capacity, Utilization and availability, Work-in-process, WIP ratio, TIP ratio, Problems using mathematical model equations.

8 Hours

UNIT - 2

High Volume Production System: Introduction Automated flow line-symbols, objectives, Work part transport-continuous, Intermittent, synchronous, Pallet fixtures, Transfer Mechanism-Linear-Walking beam, roller chain drive, Rotary-rack and pinion, Ratchet & Pawl, Geneva wheel, Buffer storage, control functions-sequence, safety, Quality, Automation for machining operation.

6 Hours

UNIT - 3

Analysis Of Automated Flow Line & Line Balancing: General terminology and analysis, Analysis of Transfer Line without storage upper bound approach, lower bound approach and problems, Analysis of Transfer lines with storage buffer, Effect of storage, buffer capacity with simple problem, Partial automation-with numerical problems, flow lines with more than two stages, Manual Assembly lines, line balancing problem.

6 Hours

UNIT - 4

Minimum Rational Work Element: Work station process time, Cycle time, precedence constraints. Precedence diagram, Balance delay methods of line balancing-largest Candidate rule, Kilbridge and Westers method, Ranked positional weight method, Numerical problems covering L above methods and computerized line balancing.

6 Hours

PART-B

UNIT - 5

Automated Assembly Systems: Design for automated assembly systems, types of automated assembly system, Parts feeding devices-elements of parts delivery system-hopper, part feeder, Selectors, feed back, escapement and placement analysis of Multistation Assembly Machine analysis of single station assembly. **Automated Guided Vehicle System:** Introduction,

Vehicle guidance and routing, System management, Quantitative analysis of AGV's with numerical problems and application.

8 Hours

UNIT - 6

Computerized Manufacturing Planning System: Introduction, Computer Aided Process Planning, Retrieval types of process planning, Generative type of process planning, Material requirement planning, Fundamental concepts of MRP inputs to MRP, Capacity planning.

6 Hours

UNIT - 7

Cnc Machining Centers: Introduction to CNC, elements of CNC, CNC machining centers, part programming, fundamental steps involved in development of part programming for milling and turning.

6 Hours

UNIT - 8

Robotics: Introduction to Robot configuration, Robot motion, programming of Robots end effectors, Robot sensors and Robot applications.

6 Hours

TEXT BOOKS:

2. **Automation, Production system & Computer Integrated manufacturing**, M. P. Groover Person India, 2007 2nd edition.
3. **Principles of Computer Integrated Manufacturing**, S. Kant Vajpayee, Prentice Hall India.

REFERENCE BOOKS:

1. **Computer Integrated Manufacturing**, J. A. Rehg & Henry. W. Kraebber.
2. **CAD/CAM** by Zeid, Tata McGraw Hill.

DESIGN OF MACHINE ELEMENTS – II

Sub Code	: 10ME 62	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT - 1

Curved Beams: Stresses in curved beams of standard cross sections used in crane hook, punching presses & clamps, closed rings and links
Cylinders & Cylinder Heads: Review of Lame's Equations; compound cylinders, stresses due to different types of fits, cylinder heads, flats.

08 Hours

UNIT - 2

Belts Ropes and Chains: Flat belts: Length & cross section, Selection of V-belts, ropes and chains for different applications.

05 Hours**UNIT - 3**

Springs: Types of springs - stresses in Helical coil springs of circular and non-circular cross sections. Tension and compression springs, springs under fluctuating loads, Leaf Springs: Stresses in leaf springs. Equalized stresses, Energy stored in springs, Torsion, Belleville and Rubber springs.

08 Hours**UNIT - 4**

Spur & Helical Gears: Spur Gears: Definitions, stresses in gear tooth: Lewis equation and form factor, Design for strength, Dynamic load and wear load. Helical Gears: Definitions, formative number of teeth, Design based on strength, dynamic and wear loads.

07 Hours**PART - B****UNIT - 5**

Bevel and Worm Gears: Bevel Gears: Definitions, formative number of teeth, Design based on strength, dynamic and wear loads. Worm Gears: Definitions, Design based on strength, dynamic, wear loads and efficiency of worm gear drives.

07 Hours**UNIT - 6**

Clutches & Brakes: Design of Clutches: Single plate, multi plate and cone clutches. Design of Brakes: Block and Band brakes: Self locking of brakes: Heat generation in Brakes.

05 Hours**UNIT - 7**

Lubrication and Bearings: Lubricants and their properties, Mechanisms of Lubrication bearing modulus, coefficient of friction, minimum oil film thickness, Heat Generated, Heat dissipated, Bearing Materials, Examples of journal bearing and thrust bearing design.

07 Hours**UNIT - 8**

IC Engine Parts: Design of piston, connecting rod and crank shaft.

05 Hours**DESIGN DATA HANDBOOK**

1. **Design Data Hand Book** , K. Lingaiah, McGraw Hill, 2nd Ed.
2. **Data Hand Book**, K. Mahadevan and Balaveera Reddy, CBS Publication

3. **Design Data Hand Book**, H.G. Patil, I. K. International Publisher, 2010.

TEXT BOOKS

1. **Mechanical Engineering Design**, Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition 2003.
2. **Design of Machine Elements**, V. B Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007

REFERNCE BOOKS

1. **Machine Design**, Robert L. Norton, Pearson Education Asia, 2001.
2. **Design of Machine Elements**, M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, Pearson Education, 2006.
3. **Machine Design**, Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008.
4. **Machine Design**, A CAD Approach: Andrew D DIMAROGONAS, John Wiley Sons, Inc, 2001.

HEAT AND MASS TRANSFER

Sub Code	: 10ME 63	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT - 1

Introductory Concepts And Definitions: Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; radiation heat transfer; combined heat transfer mechanism. Boundry conditions of 1st, 2nd and 3rd Kind

Conduction: Derivation of general three dimensional conduction equation in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems (No derivation). One dimensional conduction equations in rectangular, cylindrical and spherical coordinates for plane and composite walls. Overall heat transfer coefficient. Thermal contact resistance.

07 Hours

UNIT - 2

Variable Thermal Conductivity: Derivation for heat flow and temperature distribution in plane wall. Critical thickness of insulation without heat generation, Thermal resistance concept & its importance. Heat transfer in extended surfaces of uniform cross-section without heat generation, Long fin, short fin with insulated tip and without insulated tip and fin connected between two heat sources. Fin efficiency and effectiveness. Numerical problems.

06 Hours**UNIT - 3**

One-Dimensional Transient Conduction: Conduction in solids with negligible internal temperature gradient (Lumped system analysis), Use of Transient temperature charts (Heisler's charts) for transient conduction in slab, long cylinder and sphere; use of transient temperature charts for transient conduction in semi-infinite solids. Numerical Problems.

06 Hours**UNIT - 4**

Concepts And Basic Relations In Boundary Layers: Flow over a body velocity boundary layer; critical Reynolds number; general expressions for drag coefficient and drag force; thermal boundary layer; general expression for local heat transfer coefficient; Average heat transfer coefficient; Nusselt number. Flow inside a duct- velocity boundary layer, hydrodynamic entrance length and hydro dynamically developed flow; flow through tubes (internal flow discussion only). Numericals based on empirical relation given in data handbook.

Free Or Natural Convection: Application of dimensional analysis for free convection- physical significance of Grashoff number; use of correlations of free convection in vertical, horizontal and inclined flat plates, vertical and horizontal cylinders and spheres, Numerical problems.

07 Hours**PART - B****UNIT - 5**

Forced Convections: Applications of dimensional analysis for forced convection. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydro dynamically and thermally developed flows inside a duct, use of correlations for flow over a flat plate, over a cylinder and sphere. Numerical problems.

06 Hours**UNIT - 6**

Heat Exchangers: Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD, Effectiveness-NTU methods of analysis of heat exchangers. Numerical problems.

06 Hours

UNIT - 7

Condensation And Boiling: Types of condensation (discussion only) Nusselt's theory for laminar condensation on a vertical flat surface; use of correlations for condensation on vertical flat surfaces, horizontal tube and horizontal tube banks; Reynolds number for condensate flow; regimes of pool boiling, pool boiling correlations. Numerical problems. Mass transfer definition and terms used in mass transfer analysis, Ficks First law of diffusion (no numericals).

07 Hours**UNIT - 8**

Radiation Heat Transfer: Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's law and Wein's displacement law. Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces; effect of radiation shield; intensity of radiation and solid angle; Lambert's law; radiation heat exchange between two finite surfaces-configuration factor or view factor. Numerical problems.

07 Hours**TEXT BOOKS:**

1. **Heat & Mass transfer**, Tirumaleshwar, Pearson education 2006
2. **Heat transfer-A basic approach**, Ozisik, Tata McGraw Hill 2002

REFERENCE BOOKS:

1. **Heat transfer, a practical approach**, Yunus A- Cengel Tata Mc Graw Hill
2. **Principles of heat transfer**, Kreith Thomas Learning 2001
3. **Fundamentals of heat and mass transfer**, Frenk P. Incropera and David P. Dewitt, John Wiley and son's.
4. **Heat transfer**, P.K. Nag, Tata McGraw Hill 2002.

FINITE ELEMENT METHODS

Sub Code	: 10ME 64	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART-A

UNIT-1

Introduction: Equilibrium equations in elasticity subjected to body force, traction forces, and stress-strain relations for plane stress and plane strains. General description of Finite Element Method, Application and limitations. Types of elements based on geometry. Node numbering, Half band width.

07 Hrs

UNIT-2

Basic Procedure: Euler - Lagrange equation for bar, beam (cantilever / simply supported fixed) Principle of virtual work, principle of minimum potential energy, Raleigh's Ritz method. Direct approach for stiffness matrix formulation of bar element. Galerkin's method.

07 Hrs

UNIT-3

Interpolation Models: Interpolation polynomials- Linear, quadratic and cubic. Simplex complex and multiplex elements. 2D PASCAL's triangle. CST elements-Shape functions and Nodal load vector, Strain displacement matrix and Jacobian for triangular and rectangular element.

07 Hrs

UNIT-4

Solution of 1-D Bars: Solutions of bars and stepped bars for displacements, reactions and stresses by using penalty approach and elimination approach. Gauss-elimination technique.

06 Hrs

PART-B

UNIT-5

Higher Order Elements: Langrange's interpolation, Higher order one dimensional elements-Quadratic and cubic element and their shape functions. Shape function of 2-D quadrilateral element-linear, quadric element Iso-parametric, Sub parametric and Super parametric elements. numerical integration : 1, 2 and 3 gauge point for 1D and 2D cases.

06 Hrs

UNIT-6

Trusses: Stiffness matrix of Truss element. Numerical problems.

06 Hrs

UNIT-7

Beams: Hermite shape functions for beam element, Derivation of stiffness matrix. Numerical problems of beams carrying concentrated, UDL and linearly varying loads.

06 Hrs

UNIT-8

Heat Transfer: Steady state heat transfer, 1D heat conduction governing equations. Functional approach for heat conduction. Galerkin's approach for heat conduction. 1D heat transfer in thin fins.

07 Hrs**TEXT BOOKS:**

1. **Finite Elements in Engineering**, T.R.Chandrupatla, A.D Belegunde, 3rd Ed PHI.
2. **Finite Element Method in Engineering**, S.S. Rao, 4th Edition, Elsevier, 2006.

REFERENCE BOOKS:

1. **"Finite Element Methods for Engineers"** U.S. Dixit, Cengage Learning, 2009
2. **Concepts and applications of Finite Element Analysis**, R.D. Cook D.S Maltus, M.E Plesha, R.J.Witt, Wiley 4th Ed, 2009
3. **Finite Element Methods**, Daryl. L. Logon, Thomson Learning 3rd edition, 2001.
4. **Finite Element Method**, J.N.Reddy, McGraw -Hill International Edition.

MECHATRONICS & MICROPROCESSOR

Sub Code	: 10ME 65	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A**UNIT - 1**

Introduction to Mechatronic Systems: Measurement and control systems Their elements and functions, Microprocessor based controllers.

06 Hours**UNIT - 2**

Review of Transducers and Sensors: Definition and classification of transducers. Definition and classification of sensors. Principle of working and applications of light sensors, proximity sensors and Hall effect sensors.

07 Hours

UNIT 3

Electrical Actuation Systems: Electrical systems, Mechanical switches, solid-state switches, solenoids, DC & AC motors, Stepper motors and their merits and demerits.

06 Hours**UNIT - 4**

Signal Conditioning: Introduction to signal conditioning. The operational amplifier, Protection, Filtering, Wheatstone bridge, Digital signals Multiplexers, Data acquisition, Introduction to Digital system. Processing Pulse-modulation.

07 Hours**PART - B****UNIT - 5**

Introduction to Microprocessors: Evolution of Microprocessor, Organization of Microprocessors (Preliminary concepts), basic concepts of programming of microprocessors.

Review of concepts - Boolean algebra, Logic Gates and Gate Networks, Binary & Decimal number systems, memory representation of positive and negative integers, maximum and minimum integers. Conversion of real, numbers, floating point notation, representation of floating point numbers, accuracy and range in floating point representation, overflow and underflow, addition of floating point numbers, character representation.

07 Hours**UNIT - 6**

Logic Function: Data word representation. Basic elements of control systems 808SA processor architecture terminology such as CPU, memory and address, ALU, assembler data registers, Fetch cycle, write cycle, state, bus, interrupts. Micro Controllers. Difference between microprocessor and micro controllers. Requirements for control and their implementation in microcontrollers. Classification of micro controllers.

07 Hours**UNIT - 7**

Organization & Programming of Microprocessors: Introduction to organization of INTEL 808S-Data and Address buses, Instruction set of 8085, programming the 8085, assembly language programming.

06 Hours**UNIT - 8**

Central Processing Unit of Microprocessors: Introduction, timing and control unit basic concepts, Instruction and data flow, system timing, examples of INTEL 8085 and INTEL 4004 register organization.

06 Hours

TEXT BOOKS:

1. **Mechatronics**, W.Bolton, Longman, 2Ed, Pearson Publications, 2007.
2. **Microprocessor Architecture, Programming And Applications With 8085/8085A**, R.S. Ganokar, Wiley Eastern.

REFERENCE BOOKS:

1. **Mechatronics and Microprocessors**, K.P.Ramchandran, G.K.Vijayraghavan, M.S.Balasundran, Wiley, 1st Ed, 2009
2. **Mechatronics - Principles, Concepts and applications** – Nitaigour and Premchand Mahilik - Tata McGraw Hill- 2003.
3. **Mechatronics Principles & applications**, Godfrey C. Onwubolu, Elsevier..
4. **Introduction Mechatronics & Measurement systems**, David.G. Aliciatore & Michael. B. Bihistaned, Tata McGraw Hill, 2000.

HEAT & MASS TRANSFER LABORATORY

Sub Code	: 10MEL 67	IA Marks	: 25
Hrs/week	: 03	Exam Hours	: 03
Total Lecture Hrs	: 42	Exam Marks	: 50

PART - A

1. Determination of Thermal Conductivity of a Metal Rod.
2. Determination of Overall Heat Transfer Coefficient of a Composite wall.
3. Determination of Effectiveness on a Metallic fin.
4. Determination of Heat Transfer Coefficient in a free Convection on a vertical tube.
5. Determination of Heat Transfer Coefficient in a Forced Convection Flow through a Pipe.
6. Determination of Emissivity of a Surface.

21 Hours**PART - B**

1. Determination of Stefan Boltzman Constant.
2. Determination of LMDT and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers
3. Experiments on Boiling of Liquid and Condensation of Vapour

4. Performance Test on a Vapour Compression Refrigeration.
5. Performance Test on a Vapour Compression Air - Conditioner
6. Experiment on Transient Conduction Heat Transfer

21 Hours**Scheme for Examination:**

One Question from Part A	-	20 Marks (05 Write up +15)
One Question from Part B	-	20 Marks (05 Write up +15)
Viva-Voce	-	10 Marks

Total		50 Marks

COMPUTER AIDED MODELING AND ANALYSIS LABORATORY

Sub Code	: 10MEL 68	IA Marks	: 25
Hrs/week	: 03	Exam Hours	: 03
Total Lecture Hrs	: 42	Exam Marks	: 50

PART - A**Study of a FEA package and modeling stress analysis of**

- a. Bars of constant cross section area, tapered cross section area and stepped bar **6 Hours**
- b. Trusses – (Minimum 2 exercises) **3 Hours**
- c. Beams – Simply supported, cantilever, beams with UDL, beams with varying load etc (Minimum 6 exercises) **12 Hours**

PART - B

- a) Stress analysis of a rectangular plate with a circular hole **3 Hours**
- b) Thermal Analysis – 1D & 2D problem with conduction and convection boundary conditions (Minimum 4 exercises) **9 Hours**

edge load – method of Fourier analysis – pin ended beam under uniform pressure.

7 Hours

UNIT - 4

General Equations In Cylindrical Co-Ordinates: Thick cylinder under uniform internal and / or external pressure, shrink and force fit, stress concentration.

6 Hours

PART - B

UNIT - 5

Stresses In An Infinite Plate (with a circular hole) subjected to uniaxial and biaxial loads, stress concentration, stresses in rotating discs and cylinders.

7 Hours

UNIT - 6

Torsion Of Circular, Elliptical And Triangular Bars: membrane analogy, torsion of thin open sections and thin tubes.

6 Hours

UNIT - 7

Thermal Stresses: Thermo elastic stress strain relationship, Equations of equilibrium Thermal stresses in thin circular discs and in long circular cylinder, sphere.

7 Hours

UNIT - 8

Uniqueness Theorem: Principle of super position, reciprocal theorem, saint venant principle.

6 Hours

TEXT BOOKS:

1. **Advanced Mechanics of solids**, L. S. Srinath, Tata Mc. Graw Hill, 2003
2. **Theory of Elasticity**, S. P. Timoshenko and J. N Gordier, Mc.Graw Hill International, 3rd edition, 1972

REFERENCES BOOKS:

1. **Theory of Elasticity**, Dr. Sadhu Singh, Khanna Publications, 1988
2. **Elasticity, Theory, Applications & Numericals**, Martin H Sadd, Elsevier. 2005
3. **Applied Elasticity**, Seetharamu & Govindaraju, Interline Publishing
4. **Applied Elasticity**, C.T. WANG Sc. D. McGraw Hill Book Co.1953

NON-TRADITIONAL MACHINING

Sub Code	: 10ME 665	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT - 1

Introduction: History, Classification, comparison between conventional and Non-conventional machining process selection.

05 Hours

UNIT - 2

Ultrasonic Machining (Usm): Introduction, equipment, tool materials & tool size, abrasive slurry, cutting tool system design:- Effect of parameter: Effect of amplitude and frequency and vibration, Effect of abrasive grain diameter, effect of applied static load, effect of slurry, tool & work material, USM process characteristics: Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM.

08 Hours

UNIT - 3

Abrasive Jet Machining (Ajm): Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean number. abrasive particles per unit volume of the carrier gas, work material, stand off distance (SOD), nozzle design, shape of cut. Process characteristics-Material removal rate, Nozzle wear, Accuracy & surface finish. Applications, advantages & Disadvantages of AJM. Water Jet Machining: Principal, Equipment, Operation, Application, Advantages and limitations of water Jet machinery

07 Hours

UNIT - 4

Electrochemical Machining (Ecm): Introduction, study of ECM machine, elements of ECM process : Cathode tool, Anode work piece, source of DC power, Electrolyte, chemistry of the process, ECM Process characteristics – Material removal rate, Accuracy, surface finish, ECM Tooling: ECM tooling technique & example, Tool & insulation materials, Tool size Electrolyte flow arrangement, Handling of slug, Economics of ECM, Applications such as Electrochemical turning, Electrochemical Grinding, Electrochemical Honing, deburring, Advantages, Limitations.

06 Hours

PART - B**UNIT - 5**

Chemical Machining (Chm): Introduction, elements of process, chemical blanking process : Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking, applications of chemical blanking, chemical milling (contour machining): process steps –masking, Etching, process characteristics of CHM: material removal rate, accuracy, surface finish, Hydrogen embrittlement, advantages & application of CHM.

06 Hours**UNIT - 6**

Electrical Discharge Machining (Edm): Introduction, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, Electrode manufacture, Electrode wear, EDM tool design, choice of machining operation, electrode material selection, under sizing and length of electrode, machining time. Flushing; pressure flushing, suction flushing, side flushing, pulsed flushing synchronized with electrode movement, EDM process characteristics: metal removal rate, accuracy, surface finish, Heat Affected Zone. Machine tool selection, Application, EDM accessories / applications, electrical discharge grinding, Traveling wire EDM.

08 Hours**UNIT - 7**

Plasma Arc Machining (Pam): Introduction, equipment, non-thermal generation of plasma, selection of gas, Mechanism of metal removal, PAM parameters, process characteristics. Safety precautions, Applications, Advantages and limitations.

05 Hours**UNIT - 8**

Laser Beam Machining (Lbm): Introduction, equipment of LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages & limitations.

Electron Beam Machining (Ebm): Principles, equipment, operations, applications, advantages and limitation of EBM.

07 Hours**TEXT BOOKS:**

1. **Modern machining process**, Pandey and Shan, Tata McGraw Hill 2000
2. **New Technology**, Bhattacharya 2000

REFERENCE BOOKS:

1. **Production Technology**, HMT Tata McGraw Hill. 2001

PROJECT MANAGEMENT

Sub Code	: 10ME 667	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT 1

Introduction: Definition of project, characteristics of projects, understand projects, types of projects, scalability of project tools, project roles,

04 Hours

UNIT 2

Project Selection And Prioritization – Strategic planning process, Strategic analysis, strategic objectives, portfolio alignment – identifying potential projects, methods of selecting projects, financial mode / scoring models to select projects, prioritizing projects, securing and negotiating projects.

05 Hours

UNIT 3

Planning Projects: Introduction, developing the project management plan, understanding stake holders, communication planning, project meeting management, communication needs of global and virtual project teams, communication technologies, Constructing Work Breakdown Structures – scope planning, scope definition, work breakdown structures (WBS), Using Microsoft project for work breakdown structures.

08 Hours

UNIT 4

Scheduling Projects: purpose of a project schedule, historical development, how project schedules are limited and created, develop project schedules, uncertainty in project schedules, Gantt Chart, Using Microsoft Project for critical path schedules.

08 Hours

PART - B

UNIT 5

Resourcing Projects: Abilities needed when resourcing projects, estimate resource needs, creating staffing management plant, project team composition issues, assign resource to each activity, resource overloads, critical chain project management (CCPM), compress the project schedule, Using Microsoft Project for resource allocation.

Budgeting Projects: Cost planning, cost estimating, cost budgeting, establishing cost control, using Microsoft Project for Project Budgets,

08 hours

UNIT 6

Project Risk Planning: Risk Management Planning, risk identification, risk analysis, risk response planning, Project Quality Planning and Project Kickoff: Development of quality concepts, project quality management plan, project quality tools, kickoff project, baseline and communicate project management plan, using Microsoft Project for project baselines.

06 Hours**UNIT 7**

Performing Projects: Project supply chain management: - Plan purchasing and acquisitions, plan contracting, contact types, project partnering and collaborations, project supply chain management, Leading and Managing Project Teams – Acquiring, developing, managing and leading the project team, managing stakeholders, managing project conflicts.

07 Hours**UNIT 8**

Determining Project Progress and Results: Project Balanced Scorecard Approach, Internal project, customer, financial issues, Using Microsoft Project to monitor and control projects. Finishing the project: Terminate project early, finish projects on time, secure customer feedback and approval, knowledge management, perform administrative and contract closure, celebrate success and reward participant, provide ongoing support.

06 Hours**TEXT BOOK:**

1. **Project Management**, Timothy J Kloppenborg, Cengage Learning, Edition 2009.
2. **Project Management**, A systems approach to planning scheduling and controlling by Harold Kerzner, CBS publication.

REFERENCE:

1. **Project Management Refer**, Pennington Lawrence, Mc Graw hill
2. **Project Management**, A Moder Joseph and Phillips New York Van Nostrand, Reinhold.
3. **Project Management**, Bhavesh M. Patal, Vikas publishing House,

ENGINEERING ECONOMY

Sub Code	: 10ME 71	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT - 1

Introduction: Engineering Decision-Makers, Engineering and Economics, Problem solving and Decision making, Intuition and Analysis, Tactics and Strategy. Engineering Economic Decision, Maze. Law of demand and supply, Law of returns, Interest and Interest factors: Interest rate, Simple interest, Compound interest, Cash - flow diagrams, Personal loans and EMI Payment, Exercises and Discussion.

08 Hours

UNIT - 2

Present-Worth Comparisons: Conditions for present worth comparisons, Basic Present worth comparisons, Present-worth equivalence, Net Present-worth, Assets with unequal lives, infinite lives, Future-worth comparison, Pay-back comparison, Exercises, Discussions and problems.

06 Hours

UNIT - 3

Equivalent Annual-Worth Comparisons: Equivalent Annual-Worth Comparison methods, Situations for Equivalent Annual-Worth Comparisons, Consideration of asset life, Comparison of assets with equal and unequal lives, Use of shrinking fund method, Annuity contract for guaranteed income, Exercises, Problems.

06 Hours

UNIT - 4

Rate-Of-Return Calculations And Depreciation: Rate of return, Minimum acceptable rate of return, IRR, IRR misconceptions, Cost of capital concepts. Causes of Depreciation, Basic methods of computing depreciation charges, Tax concepts, corporate income tax.

06 Hours

PART - B

UNIT - 5

Estimating and Costing: Components of costs such as Direct Material Costs, Direct Labor Costs, Fixed Over-Heads, Factory cost, Administrative Over-Heads, First cost, Marginal cost, Selling price, Estimation for simple components.

05 Hours

UNIT - 6

Introduction, Scope Of Finance, Finance Functions: Statements of Financial Information: Introduction, Source of financial information, Financial statements, Balance sheet, Profit and Loss account, relation between Balance sheet and Profit and Loss account. Simple Numericals

08 Hours

UNIT - 7

Financial Ratio Analysis: Introduction, Nature of ratio analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Evaluation of a firm's earning power. Comparative statements analysis. Simple numericals

06 Hours

UNIT - 8

Financial And Profit Planning: Introduction, Financial planning, Profit planning, Objectives of profit planning, Essentials of profit planning, Budget administration, type of budgets, preparation of budgets, advantages, problems and dangers of budgeting. Introduction to Bench Marking of Manufacturing Operation.

07 Hours

TEXT BOOKS:

1. **Engineering Economy**, Riggs J.L., 4TH ed. , McGraw Hill, 2002
2. **Engineering Economy**, Thuesen H.G. PHI , 2002

REFERENCE BOOKS:

1. **Engineering Economy**, Tarachand, 2000.
2. **Industrial Engineering and Management**, OP Khanna, Dhanpat Rai & Sons. 2000
3. **Financial Mangement**, Prasanna Chandra, 7th Ed., TMH, 2004
4. **Finacial Management**, IM PANDEY, Vikas Pub. House, 2002

MECHANICAL VIBRATIONS

Sub Code	: 10ME 72	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART- A

UNIT - 1

Introduction: Types of vibrations, Definitions, Simple Harmonic Motion (S.H.M.), Work done by harmonic force, Principle of super position applied to SHM, Beats, Fourier theorem and problems.

06 Hours

UNIT -2

Undamped (Single Degree of Freedom) Free Vibrations: Derivations for spring mass systems, Methods of Analysis, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations, Effect of mass of spring and Problems.

07 Hours

UNIT - 3

Damped free vibrations (1DOF): Types of damping, Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement and Problems.

06 Hours

UNIT - 4

Forced Vibrations (1DOF): Introduction, Analysis of forced vibration with constant harmonic excitation - magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, Energy dissipated due to damping and Problems.

07 Hours

PART – B

UNIT – 5

Vibration Measuring Instruments and Whirling of shafts: Seismic Instruments – Vibrometers, Accelerometer, Frequency measuring instruments and Problems. Whirling of shafts with and without damping, discussion of speeds above and below critical speeds and Problems.

06 Hours

UNIT – 6

Systems with two degrees of Freedom: Principle modes of vibrations, Normal mode and natural frequencies of systems (without damping) – Simple spring mass systems, masses on tightly stretched strings, double pendulum, torsional systems, combined rectilinear and angular systems, geared systems and Problems. Undamped dynamic vibration absorber and Problems.

06 Hours

UNIT - 7

Numerical Methods for multi degree freedom of systems: Introduction, Maxwell's reciprocal theorem, Influence coefficients, Rayleigh's method, Dunkerley's method, Stodola method, Holzer's method, Orthogonality of principal modes, method of matrix iteration and Problems.

09 Hours

UNIT – 8

Modal analysis and Condition Monitoring: Signal analysis, dynamic testing of machines and structures, Experimental modal analysis, Machine condition monitoring and diagnosis.

05 Hours

TEXT BOOKS:

1. **Mechanical Vibrations**, S. S. Rao, Pearson Education Inc, 4th edition, 2003.
2. **Mechanical Vibrations**, V. P. Singh, Dhanpat Rai & Company, 3rd edition, 2006.

REFERENCE BOOKS:

1. **Theory of Vibration with Applications**, W. T. Thomson, M. D. Dahleh and C. Padmanabhan, Pearson Education Inc, 5th edition, 2008.
2. **Mechanical Vibrations:** S. Graham Kelly, Schaum's outline Series, Tata McGraw Hill, Special Indian Edition, 2007.
3. **Theory and Practice of Mechanical Vibrations:** J. S. Rao & K. Gupta, New Age International Publications, New Delhi, 2001.
4. **Mechanical Vibrations**, G. K.Grover, Nem Chand and Bros, 6th edition, 1996.

HYDRAULICS AND PNEUMATICS

Sub Code	: 10ME 73	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT -1

Introduction to Hydraulic Power: Definition of hydraulic system, advantages, limitations, applications, Pascal's law, structure of hydraulic control system, problems on Pascal's law.

The source of Hydraulic Power: Pumps Classification pumps, Pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump Selection factors, problems on pumps.

07 Hours

UNIT -2

Hydraulic Actuators and Motors: Classification cylinder and hydraulic motors, Linear Hydraulic Actuators [cylinders], single and double acting cylinder, Mechanics of Hydraulic Cylinder Loading, mounting arrangements, cushioning, special types of cylinders, problems on cylinders, construction and working of rotary actuators such as gear, vane, piston motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance, problems, symbolic representation of hydraulic actuators (cylinders and motors).

06 Hours

UNIT - 3

Control Components in Hydraulic Systems: Classification of control valves, Directional Control Valves- Symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, check valves, Pressure control valves - types, direct operated types and pilot operated types. Flow Control Valves - compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation.

07 Hours

UNIT - 4

Hydraulic Circuit Design And Analysis: Control of Single and Double - Acting Hydraulic Cylinder, Regenerative circuit, Pump Unloading Circuit, Double Pump Hydraulic System, Counter balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Automatic cylinder reciprocating system, Locked Cylinder using Pilot check Valve, Cylinder synchronizing circuit using different methods, factors affecting synchronization, Hydraulic circuit for force multiplication, Speed Control of Hydraulic Cylinder, Speed Control of Hydraulic Motors, Safety circuit, Accumulators, types, construction and applications with circuits.

06 Hours

PART – B

UNIT - 5

Maintenance of Hydraulic System: Hydraulic Oils - Desirable properties, general type of Fluids, Sealing Devices, Reservoir System, Filters and Strainers, wear of Moving Parts due to solid -particle Contamination, temperature control (heat exchangers), Pressure switches, trouble shooting.

06 Hours

UNIT - 6

Introduction to Pneumatic Control: Definition of pneumatic system, advantages, limitations, applications, Choice of working medium. Characteristic of compressed air. Structure of Pneumatic control System, fluid conditioners and FRL unit.

Pneumatic Actuators: Linear cylinder - Types, Conventional type of cylinder- working, End position cushioning, seals, mounting arrangements- Applications. Rod - Less cylinders types, working, advantages, Rotary cylinders- types construction and application, symbols.

07 Hours

UNIT-7

Pneumatic Control Valves: DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols. 3Hrs Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and Exhaust air throttling and Exhaust air throttling.

Signal Processing Elements: Use of Logic gates - OR and AND gates in pneumatic applications. Practical Examples involving the use of logic gates, Pressure dependant controls- types - construction - practical applications, Time dependent controls principle. Construction, practical applications.

07 Hours

UNIT-8

Multi- Cylinder Application: Coordinated and sequential motion control, Motion and control diagrams. Signal elimination methods, Cascading method- principle, Practical application examples (up to two cylinders) using cascading method (using reversing valves).

Electro- Pneumatic Control: Principles - signal input and out put, pilot assisted solenoid control of directional control valves, Use of relay and contactors. Control circuitry for simple signal cylinder application.

Compressed Air: Production of compressed air- Compressors Preparation of compressed air-Driers, Filters, Regulators, Lubricators, Distribution of compressed air Piping layout.

06 Hours

TEXT BOOKS:

1. **"Fluid Power with Applications"**, Anthony Esposito, Sixth edition, Pearson Education, Inc, 2000.
2. **'Pneumatics and Hydraulics'**, Andrew Parr, Jaico Publishing Co

REFERENCE BOOKS:

1. **'Oil Hydraulic systems', Principles and Maintenance** S. R. Majurr, Tata McGraw Hill Publishing Company Ltd. - 2001
2. **'Industrial Hydraulics', Pippenger, Hicks"** McGraw Hill, New York
3. **'Hydraulic & Pneumatic Power for Production'**, Harry L. Stewart
4. **'Pneumatic Systems'**, S. R. Majumdar, Tata McGraw Hill Publish 1995
5. **Power Hydraulics'** Michael J Pinches & John G Ashby, Prentice Hall

OPERATION RESEARCH

Sub Code	: 10ME 74	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART- A

UNIT -1

Introduction: Evolution of OR, definition of OR, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, linear programming (LP) problem-formulation and solution by graphical method.

04 Hours

UNIT -2

Solution Of Linear Programming Problems: The simplex method-canonical and standard form of an LP problem, slack, surplus and artificial variables, big M method and concept of duality, dual simplex method.

08 Hours

UNIT -3

Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using different methods, optimal solution by MODI method, degeneracy in transportation problems, application of transportation problem concept for maximization cases. Assignment Problem-formulation, types, application to maximization cases and travelling salesman problem.

08 Hours

UNIT -4

Integer Programming: Pure and mixed integer programming problems, solution of Integer programming problems-Gomory's all integer cutting plane method and mixed integer method, branch and bound method, Zero-One programming.

06 Hours

PART- B

UNIT -5

Pert-CPM Techniques: Introduction, network construction - rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects.

08 Hours

UNIT -6

Queuing Theory: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), empirical queuing models – M/M/1 and M/M/C models and their steady state performance analysis.

06 Hours

UNIT -7

Game Theory: Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games.

06 Hours

UNIT -8

Sequencing: Basic assumptions, sequencing ‘n’ jobs on single machine using priority rules, sequencing using Johnson’s rule-‘n’ jobs on 2 machines, ‘n’ jobs on 3 machines, ‘n’ jobs on ‘m’ machines. Sequencing 2 jobs on ‘m’ machines using graphical method.

06 Hours

TEXT BOOKS

1. **Operations Research**, P K Gupta and D S Hira, Chand Publications, New Delhi - 2007
2. **Operations Research**, Taha H A, Pearson Education

REFERNCE BOOKS

1. **Operations Research**, A P Verma, S K Kataria & Sons, 2008
2. **Operations Research**, Paneerselvan, PHI
3. **Operations Research**, A M Natarajan, P Balasubramani, Pearson Education, 2005
4. **Introduction to Operations Research**, Hillier and Liberman, 8th Ed., McGraw Hill
5. **Operations Research** S.D. Sharma, Ledarnath Ramanath & Co, 2002

DESIGN LABORATORY

Sub Code	: 10MEL 77	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 42	Exam Marks	: 50

PART - A

1. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional)
2. Balancing of rotating masses.
3. Determination of critical speed of a rotating shaft.
4. Determination of Fringe constant of Photoelastic material using.
 - a) Circular disc subjected to diametral compression.
 - b) Pure bending specimen (four point bending)
5. Determination of stress concentration using Photoelasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression, 2D Crane hook.

PART - B

6. Determination of equilibrium speed, sensitiveness, power and effort of Porter/Prowel /Hartnel Governor. (only one or more)
7. Determination of Pressure distribution in Journal bearing.
8. Determination of Principal Stresses and strains in a member subjected to combined loading using Strain rosettes.
9. Determination of stresses in Curved beam using strain gauge.
10. Experiments on Gyroscope (Demonstration only)

Scheme of Examination:

One question from Part A -	20 Marks (05 Write up +15)
One question from Part B -	20 Marks (05 Write up +15)
Viva - Voce -	10 Marks

Total: 50 Marks

CIM & AUTOMATION LAB

Sub Code	: 10MEL 78	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 42	Exam Marks	: 50

PART - A

CNC part programming using CAM packages. Simulation of Turning, Drilling, Milling operations. 3 typical simulations to be carried out using simulation packages like Master- CAM, or any equivalent software.

PART - B

(Only for Demo/Viva voce)

1. FMS (Flexible Manufacturing System): Programming of Automatic storage and Retrieval system (ASRS) and linear shuttle conveyor Interfacing CNC lathe, milling with loading unloading arm and ASRS to be carried out on simple components.
2. Robot programming: Using Teach Pendent & Offline programming to perform pick and place, stacking of objects, 2 programs.

PART - C

(Only for Demo/Viva voce)

Pneumatics and Hydraulics, Electro-Pneumatics: 3 typical experiments on Basics of these topics to be conducted.

Scheme of Examination:

Two questions from Part A - 40 Marks (20 Write up +20)

Viva - Voce - 10 Marks

Total: 50 Marks

TOTAL QUALITY MANAGEMENT

Sub Code	: 10ME 758	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT - 1

Principles and Practice: Definition, basic approach, gurus of TQM, TQM Framework, awareness, defining quality, historical review, obstacles, benefits of TQM.

06 Hours

UNIT - 2

Leadership: Definition, characteristics of quality leaders, leadership concept, characteristics of effective people, ethics, the Deming philosophy, role of TQM leaders, implementation, core values, concepts and framework, strategic planning communication, decision making,

06 Hours

UNIT - 3

Customer Satisfaction and Customer Involvement:

Customer Satisfaction : customer and customer perception of quality, feedback, using customer complaints, service quality, translating needs into requirements, customer retention, Case studies.

Employee Involvement – Motivation, employee surveys, empowerment, teams, suggestion system, recognition and reward, gain sharing, performance appraisal, unions and employee involvement, case studies.

07 Hours

UNIT - 4

Continuous Process Improvement: process, the Juran trilogy, improvement strategies, types of problems, the PDSA Cycle, problem-solving methods, Kaizen, reengineering, six sigma, case studies.

Tools and Techniques: Benchmarking, information technology, quality management systems, environmental management system, quality function deployment, quality by design, failure mode and effect analysis, product liability, total productive maintenance.

07 Hours

PART - B

UNIT - 5

Quality Management Tools : Why Why, forced field analysis, nominal group technique, affinity diagram, interrelationship digraph, tree diagram, matrix diagram, prioritization matrices, process decision program chart, activity network diagram.

07 hours

UNIT - 6

Statistical Process Control : Pareto diagram, process flow diagram, cause-and-effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams, case studies.

06 Hours

UNIT - 7

Building and Sustaining Performance Excellence in Organizations : Making the commitment to total quality, organizational culture and total quality, change management, sustaining the quality organization, self-assessment processes, implementing ISO 9000, Bald ridge, and sis sigma, a view toward the future.

07 Hours

UNIT - 8

Design for Six Sigma: Tools for concept development, tools for design development, tools for design optimization, tools for design verification, problems.

06 Hours

TEXT BOOKS:

1. **Total Quality Management:** Dale H. Bester field, Publisher - Pearson Education India, ISBN: 8129702606, Edition 03/e Paperback (Special Indian Edition)
2. **Total Quality Management for Engineers:** M. Zairi, ISBN: 1855730243, Publisher: Wood head Publishing

REFERENCE BOOKS:

1. **A New American TQM, four revolutions in management,** Shoji Shiba, Alan Graham, David Walden, Productivity press, Oregon, 1990
2. **100 Methods for Total Quality Management:** Gopal K. Kanji and Mike Asher, ISBN: 0803977476, Publisher: Sage Publications, Inc.; Edition – 1
3. **Organisational Excellence through TQM,** H. Lal, New age pub, 2008

UNIT - 7

Corporate Knowledge Management In Agile Manufacturing: Strategies, strategic options in Agile manufacturing, Role of standards.

06 Hours

UNIT - 8

Design Of Skill & Knowledge: Enhancing technology for Machine tool system, Resumption of design requirement geometry, definition, methods, decision support for selection of cutting parameters, design enhancements, parametric approach only.

06 Hours

TEXT BOOKS:

1. ‘**Agile Manufacturing-** Forging New Frontiers’, **Poul T Kidd**, Amagow Co. UK, ISBN-0-201-63163-6, 1994
2. “**Agile Manufacturing**”, A Gunasekharan, the 21st Century Competitive strategy, ISBN -13 978-0-08-04 3567-1, Elsevier Press, India

REFERENCE BOOKS:

1. **O Levine Transitions to Agile Manufacturing**, Joseph C Moutigomery and Lawrurence – Staying Flexible for competitive advantage, ASQC quality press, Milwaukee. Wisconsin, USA 1996
2. **Agile Development for Mass Customization**, David M Andeson and B Joseph Pine, Irwin Professional Publishing, Chicago USA 1997

ROBOTICS

Sub Code	: 10ME 766	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT - 1

Introduction and Mathematical Representation of Robots: History of Robots, Types of Robots, Notation, Position and Orientation of a Rigid Body, Some Properties of Rotation Matrices, Successive Rotations, Euler Angles For fixed frames X- Y -Z and moving frame ZYZ. Transformation between coordinate system, Homogeneous coordinates, Properties of A/BT, Types of

Joints: Rotary, Prismatic joint, Cylindrical joint, Spherical joint, Representation of Links using Denavit - Hartenberg Parameters: Link parameters for intermediate, first and last links, Link transformation matrices, Transformation matrices of 3R manipulator, PUMA560 manipulator, SCARA manipulator

07 Hours

UNIT - 2

Kinematics of Serial Manipulators: Direct kinematics of 2R, 3R, RRP, RPR manipulator, puma560 manipulator, SCARA manipulator, Stanford arm, Inverse kinematics of 2R, 3R manipulator, puma560 manipulator.

06 Hours

UNIT - 3

Velocity and Static's of Manipulators: Differential relationships, Jacobian, Differential motions of a frame (translation and rotation), Linear and angular velocity of a rigid body, Linear and angular velocities of links in serial manipulators, 2R, 3R manipulators, Jacobian of serial manipulator, Velocity ellipse of 2R manipulator, Singularities of 2R manipulators, Statics of serial manipulators, Static force and torque analysis of 3R manipulator, Singularity in force domain.

07 Hours

UNIT - 4

Dynamics of Manipulators: Kinetic energy, Potential energy, Equation of motion using Lagrangian, Equation of motions of one and two degree freedom spring mass damper systems using Lagrangian formulation, Inertia of a link, Recursive formulation of Dynamics using Newton Euler equation, Equation of motion of 2R manipulator using Lagrangian Newton-Euler formulation.

06 Hours

PART-B

UNIT - 5

Trajectory Planning: Joint space schemes, cubic trajectory, Joint space schemes with via points, Cubic trajectory with a via point, Third order polynomial trajectory planning, Linear segments with parabolic blends, Cartesian space schemes, Cartesian straight line and circular motion planning

07 Hours

UNIT - 6

Control: Feedback control of a single link manipulator- first order, second order system, PID control, PID control of multi link manipulator, Force control of manipulator, force control of single mass, Partitioning a task for force and position control- lever, peg in hole Hybrid force and position controller.

08 Hours

UNIT - 7

Actuators: Types, Characteristics of actuating system: weight, power-to-weight ratio, operating pressure, stiffness vs. compliance, Use of reduction gears, comparison of hydraulic, electric, pneumatic actuators, Hydraulic actuators, proportional feedback control, Electric motors: DC motors, Reversible AC motors, Brushless DC motors, Stepper motors- structure and principle of operation, stepper motor speed-torque characteristics

06 Hours

UNIT - 8

Sensors: Sensor characteristics, Position sensors- potentiometers, Encoders, LVDT, Resolvers, Displacement sensor, Velocity sensor-encoders, tachometers, Acceleration sensors, Force and Pressure sensors piezoelectric, force sensing resistor, Torque sensors, Touch and tactile sensor, Proximity sensors-magnetic, optical, ultrasonic, inductive, capacitive, eddy-current proximity sensors.

05 Hours

TEXT BOOKS:

1. **Fundamental Concepts and Analysis**, Ghosal A., Robotics, Oxford, 2006
2. **Introduction to Robotics Analysis, Systems, Applications**, Niku, S. B., Pearson Education, 2008

REFERENCE BOOKS:

1. **Introduction to Robotics: Mechanics and Control**, Craig, J. J., 2nd Edition, Addison-Wesley, 1989.
2. **Fundamentals of Robotics, Analysis and Control**, Schilling R. J., PHI, 2006

3. **Microsystems Design**, S. D. Senturia, 2001, Kluwer Academic Publishers, Boston, USA. ISBN 0-7923-7246-8.
4. **Analysis and Design Principles of MEMS Devices**, Minhang Bao, Elsevier, Amsterdam, The Netherlands, ISBN 0-444-51616-6.
5. **Design and Development Methodologies**, Smart Material Systems and MEMS: V. Varadan, K. J. Vinoy, S. Gopalakrishnan, Wiley.
6. **MEMS-** Nitaigour Premchand Mahalik, TMH 2007

OPERATION MANAGEMENT

Sub Code	: 10ME 81	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART – A

UNIT 1

Production and Operations Management: Introduction, Functions within business organizations, the operation management function, Classification of production systems, Productivity, factors affecting productivity, contemporary issues and development

06 Hours

UNIT 2

Decision Making: The decision process, characteristics of operations decisions, use of models, decision making environments, graphical linear programming, analysis and trade-offs.

06 Hours

UNIT 3

Forecasting: Steps in forecasting process, approaches to forecasting, forecasts based on judgment and opinion, analysis of time series data, accuracy and control of forecasts, choosing a forecasting technique, elements of a good forecast,

07 Hours

UNIT 4

Capacity & Location Planning: Importance of capacity decisions, defining and measuring capacity, determinants of effective capacity, determining capacity requirement, developing capacity alternatives, evaluating alternatives, Need for location decisions, nature of locations decisions, general procedure for making locations decisions, evaluating locations decisions, facilities layout – need for layout decisions, types of processing.

07 Hours

PART – B

UNIT 5

Aggregate Planning & Master Scheduling: Aggregate planning – Nature and scope of aggregate planning, strategies of aggregate planning, techniques for aggregate planning – graphical and charting techniques, mathematical techniques. The master production schedule, Master scheduling process, Master scheduling methods.

08 hours

UNIT 6

Inventory Management: Types of Inventories, independent and dependent demand, reasons for holding inventory, objectives of inventory control, requirements for effective inventory management – information, cost, priority system. Inventory control and economic-order-quantity models.

06 Hours

UNIT 7

Material Requirement Planning (MRP): Dependent versus independent demand, an overview of MRP – MRP inputs and outputs, MRP processing, An overview of MRP-II and ERP capacity requirement planning, benefits and limitations of MRP.

07 Hours

UNIT 8

Purchasing and Supply Chain Management (SCM): Introduction, Importance of purchasing and SCM, The procurement process, Concept of tenders, Approaches to SCM, Vendor development, Measures of purchasing and SCM, Make or buy decision, Types of buying, E-procurement.

06 Hours

TEXT BOOK:

1. **Production and Operations Management**, William J Stevenson, 9th Ed., Tata McGraw Hill.
2. **Operations Management-Theory and Practice**, B Mahadevan, Pearson Education, 2007.

REFERENCES:

1. **Production and Operations Management**, Norman Gaither & Greg Frazier,
2. **Operations Management for Competitive Advantage**, R.B.Chase, N.J.Aquilino, F. Roberts Jacob; McGraw Hill Companies Inc., Ninth Edition.
3. **Production & Operations Management**, Everett E.Adams, Ronald J.Ebert, Prentice Hall of India Publications, Fourth Edition.

4. **Production / Operations Management**, Joseph G Monks, McGraw Hill Books

CONTROL ENGINEERING

Sub Code	: 10ME 82	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT - 1

Introduction: Concept of automatic controls, Open loop and closed loop systems, Concepts of feedback, requirements of an ideal control system, Types of controllers- Proportional, Integral Proportional Integral, Proportional Integral Differential controllers.

07 Hrs

UNIT- 2

Mathematical Models: Transfer function models, models of mechanical systems, models of electrical circuits, DC and AC motors in control systems, models of thermal systems, models of hydraulic systems, pneumatic system, Analogous systems: Force voltage, Force current.

06 Hrs

UNIT - 3

Block Diagrams and Signal Flow Graphs: Transfer Functions definition, function, block representation of systems elements, reduction of block diagrams, Signal flow graphs: Mason's gain formula.

07 Hrs

UNIT- 4

Transient and Steady State Response Analysis: Introduction, first order and second order system response to step, ramp and impulse inputs, concepts of time constant and its importance in speed of response. System stability: Routh's-Hurwitz Criterion.

06 Hrs

PART -B

UNIT - 5

Frequency Response Analysis: Polar plots, Nyquist stability criterion, Stability analysis, Relative stability concepts, Gain margin and phase margin, M&N circles.

06 Hrs

UNIT - 6

Frequency Response Analysis Using Bode Plots: Bode attenuation diagrams, Stability analysis using Bode plots, Simplified Bode Diagrams.

07 Hrs

UNIT - 7

Root Locus Plots: Definition of root loci, General rules for constructing root loci, Analysis using root locus plots.

06 Hrs

UNIT 8

System Compensation and State Variable Characteristics of Linear Systems: Series and feedback compensation, Introduction to state concepts, state equation of linear continuous data system. Matrix representation of state equations, controllability and observability, Kalman and Gilberts test.

07 Hrs

TEXT BOOKS :

1. **Modern Control Engineering**, Katsuhiko Ogatta, Pearson Education,2004.
2. **Control Systems Principles and Design**, M.Gopal, 3rd Ed., TMH,2000.

REFERENCE BOOKS :

1. **Modern Control Systems**, Richard.C.Dorf and Robert.H.Bishop, Addison Wesley,1999
2. **System dynamics & control**, Eronini-Umez, Thomson Asia pte Ltd. singapore, 2002.
3. **Feedback Control System**, Schaum's series. 2001.

ELECTIVE-II (GROUP - D)

TRIBOLOGY

Sub Code	: 10ME 831	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

PART - A

UNIT - 1

Introduction To Tribology: Properties of oils and equation of flow: Viscosity, Newton's Law of viscosity, Hagen-Poiseuille Law, Flow between