DESIGN OF MACHINE ELEMENTS-I

Subject Code: 10ME52   IA Marks: 25

No. of Lecture Hours/Week: 04   Exam Hours: 03

Total No. of Lecture Hours: 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, Shri Shashi Prakashan, Belgaum.

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. **Fundamentals of Machine Component Design,** Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007.

ENERGY ENGINEERING

Subject Code	:	**10ME53**	IA Marks	:	25
No. of Lecture Hrs./ Week	:	04	Exam Hours	:	03
Total No. of 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, strokers, 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, Desuperheater, 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

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	: 10ME54	**IA Marks**	: 25
Hrs/Week	: 04	**Exam Hrs**	: 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

TURBO MACHINES

Subject Code	: 10ME55	**I.A. Marks**	: 25
No. of Lecture Hrs./ Week	: 04	**Exam Hrs.**	: 03
Total No. of Lecture Hrs.	: 52	**Exam Marks**	: 100

PART- A

Unit -1
Introduction: Definition of turbomachine, parts of turbomachines, Comparison with positive displacement machines, Classification, Static and Stagnation states- Incompressible fluids and perfect gases, Application of first and second law's of thermodynamics to turbomachines, Efficiencies of turbomachines. Problems.

07 Hours

Unit – 2
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 – 3
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

Unit – 4
Dimensionless analysis and thermodynamics of fluid flow: Dimensionless parameters and their significance, Effect of Reynold's number, Unit and specific quantities, model studies. Overall isentropic efficiency, stage efficiency (their comparison) and polytropic efficiency for both compression and expansion processes. Reheat factor for expansion process.

07 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.)

<u>**TEXT BOOKS:**</u>

1. **An Introduction to Energy Conversion**, Volume III, Turbomachinery, **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

<u>**REFERENCE BOOKS:**</u>

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, 2007

MANUFACTURING PROCESS – III

(METAL FORMING PROCESS)

Subject Code	**: 10ME56**	**I.A. Marks**	**: 25**
No. of Lecture Hrs./ Week	**: 04**	**Exam Hrs.**	**: 03**
Total No. of 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 RoIling 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:

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

FLUID MECHANICS AND MACHINES LABORATORY

Subject Code	:	**10MEL57**	IA Marks	:	25
No. of Practical Hrs./ Week	:	03	Exam Hours	:	03
Total No. of Practical 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

Subject Code	:	**10MEL58**	IA Marks	:	25
No. of Practical Hrs./ Week	:	03	Exam Hours	:	03
Total No. of Practical Hrs.	:	42	Exam Marks	:	50

PART - A

1. Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Martin (closed) / Cleavland (Open Cup) Apparatus.

2. Determination of Calorific value of solid, liquid and gaseous fuels.

3. Determination of Viscosity of a lubricating oil using Redwoods, Saybolts 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, SFC, FP, 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

<u>**Scheme for Examination:**</u>

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**

DESIGN OF MACHINE ELEMENTS – II

Subject Code:10ME61   IA Marks: 25
No. of Lecture Hours/Week: 04   Exam Hours: 03
Total No. of Lecture Hours: 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, Shri Shashi Prakashan, Belgaum.

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

Subject Code	: **10ME63**	IA Marks	:	25
No. of Lecture Hrs./ Week	: 04	Exam Hours	:	03
Total No. of 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 Mc Graw 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 Mc Graw Hill 2002.

FINITE ELEMENT METHODS

Subject Code	**: 10ME64**	**l A Marks**	**: 25**
No. of Lecture Hrs./ Week	**: 04**	**Exam Hours :**	**03**
Total No. of 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 - Lagrauge 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. Guass-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

Subject Code	: 10ME65	**l A Marks**	: 25
No. of Lecture Hrs./ Week	: 04	**Exam Hours**	: 03
Total No. of 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

Subject Code	:	**10MEL67**	IA Marks	:	25
No. of Practical Hrs./ Week	:	03	Exam Hours	:	03
Total No. of Practical 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 Convention 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	-	20Marks (05 Write up +15)
One Question from Part B	-	20Marks (05 Write up +15)
Viva-Voce	-	10 Marks

Total		**50 Marks**

COMPUTER AIDED MODELING AND ANALYSIS LABORATORY

Subject Code	:	**10MEL68**	IA Marks	:	25
No. of Practical Hrs./ Week	:	03	Exam Hours	:	03
Total No. of Practical 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 boundry conditions(Minimum 4 exercises)

9 Hours

   c) Dynamic Analysis
       1) Fixed – fixed beam for natural frequency determination
       2) Bar subjected to forcing function
       3) Fixed – fixed beam subjected to forcing function

9 Hours

REFERENCE BOOKS:
   1. **A first course in the Finite element method,** Daryl L Logan, Thomason, Third Edition
   2. **Fundaments of FEM,** Hutton – McGraw Hill, 2004
   3. **Finite Element Analysis,** George R. Buchanan, Schaum Series

Scheme for Examination:

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

Total		**50 Marks**

ELECTIVE-II (GROUP - A)

THEORY OF ELASTICITY

Subject Code	:	**10ME661**	IA Marks	:	25
No. of Lecture Hrs./ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hrs.	:	52	Exam Marks	:	100

PART - A

UNIT - 1
DEFINITION AND NOTATION: Stress, Stress at a Point, Equilibrium Equations, Principal Stresses, Mohr's Diagram, Maximum Shear Stress, Boundary Conditions.   **6 Hours**

UNIT - 2
STRAIN AT A POINT: Compatibility Equations, Principal Strains, Generalised Hooke's law, Methods of Solution of Elasticity Problems – Plane Stress-Plane Strain Problems.
7 Hours

UNIT - 3
TWO DIMENSIONAL PROBLEMS: Cartesian co-ordinates – Airy's stress functions – Investigation of Airy's Stress function for simple beam problems – Bending of a narrow cantilever beam of rectangular cross section under 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. Mc. Graw Hill Book Co.1953

MECHANICS OF COMPOSITE MATERIALS

Subject Code	:	**10ME662**	IA Marks	:	25
No. of Lecture Hrs./ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hrs.	:	52	Exam Marks	:	100

PART - A

UNIT - 1
INTRODUCTION TO COMPOSITE MATERIALS: Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites. **APPLICATIONS :**Automobile, Aircrafts. missiles. Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites.

06 Hours

UNIT - 2
FIBER REINFORCED PLASTIC PROCESSING: Lay up and curing, fabricating process, open and closed mould process, hand lay up techniques;structural laminate bag molding, production procedures for bag molding;filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding.

07 Hours

UNIT - 3 **Micro Mechanical Analysis of a Lamina:** Introduction, Evaluation of the four elastic moduli by Rule of mixture, Numerical problems. **Macro Mechanics of a Lamina:** Hooke's law for different types of materials, Number of elastic constants, Two - dimensional relationship of compliance and stiffness matrix.

07 **Hours**

UNIT – 4. Macro Mechanics of a Lamina Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems.

06 Hours

PART - B

UNIT – 5
Biaxial Strength Theories: Maximum stress theory, Maximum strain theory, Tsai-Hill theory, Tsai, Wu tensor theory, Numerical problems.

06 Hours

UNIT – 6
Macro Mechanical Analysis of Laminate: Introduction, code, Kirchoff hypothesis, CL T, A, B, and D matrices (Detailed derivation) ,Special cases of laminates, Numerical problems**.**

06 Hours

UNIT - 7
METAL MATRIX COMPOSITES: Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC's and its application. **FABRICATION PROCESS FOR MMC'S:** Powder metallurgy technique,liquid metallurgy technique and secondary processing, special fabrication techniques.

07 Hours

UNIT - 8
STUDY PROPERTIES OF MMC'S: Physical Mechanical, Wear, machinability and Other Properties. Effect of size, shape and distribution of particulate on properties.

07 Hours

TEXT BOOKS:

    1. **Composite Science and Engineering,** K. K. Chawla Springer Verlag 1998.

    2. **Mechanics of composite materials,** Autar K. Kaw CRC Press New York.

REFERENCE BOOKS:

    1. **Fiber Reinforced Composites,** P. K. Mallick, Marcel Dekker,Inc

    2. **Mechanics of Composite Materials**, Robert M. Jones, McGraw Hill Kogakusha Ltd.1998

    3. **Composite materials hand book,** Meing Schwaitz," McGraw Hill book company.1984

    4. **Principles of composite Material mechanics,** Ronald F. Gibron. McGraw Hill international, 1994.

    5. **Mechanics of Composite Materials and Structures**, Madhujit Mukhopadhyay , University Press 2009

REFRIGERATION AND AIR CONDITIONING

Subject Code	:	**10ME663**	IA Marks	:	25
No. of Lecture Hrs./ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hrs.	:	52	Exam Marks	:	100

Note: pre requisite Applied thermodynamics

PART - A

UNIT - 1

METHODS OF REFRIGERATION: Ice refrigeration, evaporative refrigeration, air refrigeration, vapour refrigeration, dry ice refrigeration, thermo electric refrigeration, pulse tube refrigeration, thermoacoustic refrigeration.

06 Hours

UNIT – 2

GAS CYCLE REFRIGERATION:
Introduction , reverse Carnot cycle, Bell Coleman cycle, advantages & dis-advtanges of gas refrigeration system. Applications to aircraft refrigeration, Analysis of gas refrigeration and Numericals.

06 Hours

UNIT – 3

MULTI PRESSURE VAPOUR COMPRESSION SYSTEMS: Multi stage compression, Multi evaporator systems, Cascade systems, calculation, production of solid carbon dioxide, System practices for multistage system.

07 Hours

UNIT - 4

REFRIGERANTS: Types of Refrigerants, Comparative study of Ethane and Methane derivatives, selection of Refrigerants, Requirements of Refrigerants, Effects of lubricants in Refrigerants, substitutes of CFC Refrigerants, Mixture Refrigerants-azeotropic mixtures

07 Hours

PART - B

UNIT – 5

EQUIPMENTS USED IN VAPOUR COMPRESSION REFRIGERATION SYSTEM: Compressors: Principle, types of compressors, capacity control. Condensers: Types and construction, Expansion devices: Types- Automatic expansion valve, Thermostatic expansion valves, capillary tube. Sizing Evaporator: Types & construction.

06 Hours

UNIT - 6

VAPOUR ABSORPTION SYSTEM: Common refrigerant absorbent combinations, Binary mixtures, Ammonia Water Absorption system, Actual vapour absorption cycle and its representation on enthalpy. composition diagram, calculations. Triple fluid vapour absorption refrigeration system. Water - Lithium Bromide absorption chiller.

07 Hours

UNIT - 7

DESIGN CONDITIONS: Outside design conditions, choice of inside conditions, comfort chart. Choice of supply design condition.

06 Hours

UNIT - 8

LOAD CALCULATIONS AND APPLIED PSYCHOMETRICS: Internal heat gains, system heat gains, break up of ventilation load and effective sensible heat factor, Bypass factor, cooling load estimate. Psychometric calculations for cooling. Selection of Air conditioning apparatus for cooling and dehumidification, evaporative cooling.

07 Hours

UNIT - 8
TRANSMISSION AND DISTRIBUTION OF AIR: Room Air Distribution, Friction loss in ducts, dynamic losses in ducts, Air flow through simple Duct system, Duct design.
CONTROLS IN REFRIGERATION AND AIR CONDITIONING EQUIPMENTS: High pressure and low pressure cut out, thermostats, pilot operated solenoid valve, motor controls, bypass control-Damper motor. VAV controls.

06 Hours

TEXT BOOKS:
1. '**Refrigeration and Air-Conditioning'** C. P. Arora, Tata McGraw Hill Publication, 2nd edition, 2001.
2. '**Refrigeration and Air-Conditioning'** W. F. Stoecker, Tata McGraw Hill Publication, 2nd edition, 1982.

REFERENCE BOOKS:
1. '**Principles of Refrigeration'** Dossat, Pearson-2006.
2. **'Heating, Ventilation and Air Conditioning',** McQuistion, Wiley Students edition, 5th edition 2000.
3. **'Air conditioning'** PITA, 4th edition, pearson-2005
4. '**Refrigeration and Air-Conditioning'** Manohar prasad
5. '**Refrigeration and Air-Conditioning'** S C Arora & S Domkundwar, Dhanpat Rai Publication

DESIGN OF HEAT EXCHANGER

Subject Code	:	**10ME664**	IA Marks	:	25
No. of Lecture Hrs./ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hrs.	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION TO HEAT EXCHANGER DESIGN: Types of heat exchangers and their applications. Flow arrangements and temperature distributions in transfer type of heat exchangers. Overall heat transfer coefficient;- Clean overall heat transfer coefficient, dirt factor dirt overall heat transfer coefficient, dirt factors for various process services. Basic design equation. Mean temperature difference Concept: - LMTD for parallel flow and counter flow arrangement, correction factor for LMTD for cross flow and multi – pass heat exchangers.

06 Hours

UNIT - 2

SHELL AND TUBE HEAT EXCHANGERS: Constructional features. Applications. Effectiveness-NTU method for heat exchanger design/ analysis. Rating and sizing problem. Correlations for tube side pressure drop and heat transfer coefficients. Pressure drop and heat transfer coefficient correlations for shell side flow.

06 Hours

UNIT - 3

EFFECT OF BY – PASS AND LEAKAGE CALCULATION PROCEDURE FOR SHELL AND TUBE HEAT EXCHANGER: Heat balance equations: LMTD: reference temperature calculations: evaluation of fluid properties: flow assignments: tube side flow area calculations; viscosity correction factor, shell side equivalent diameter, calculation of shell side heat transfer coefficient, evaluation for wall temperature, evaluation of overall heat transfer coefficient, Calculation of surface area. Calculations of tube side and shell side pressure drops.

08 Hours

UNIT - 4

STEAM CONDENSERS: Specifications of other details as per TEMA standards. Flow arrangement for increased heat recovery: - lack of heat recovery in 1-2 exchangers true temperature difference in a 2-4 exchanger. Calculation procedure for steam condensers.

06 Hours

PART - B

UNIT - 5

DOUBLE PIPE HEAT EXCHANGERS: Constructional features. Applications. Design parameters :- tube side and shell side film coefficients cut and twist factor, fin efficiency, overall heat transfer coefficient, mean temperature difference, available surface area, fin geometry fin height, number of fins, tube side and shell side pressure drop. Calculation procedure for the design/ analysis of double pipe heat exchanger.

06 Hours

UNIT - 6

COMPACT HEAT EXCHANGERS: Introduction; definition of Geometric Terms: plate fin surface geometries and surface performance data; correlation of heat transfer and friction data; Goodness factor comparisons; specification of rating and sizing problems; calculation procedure for a rating problem.

06 Hours

UNIT - 7
AIR-COOLED HEAT EXCHANGERS: Air as coolant for industrial processes; custom-built units; fin-tube systems for air coolers; fin-tube bundles; thermal rating; tube side flow arrangements; cooling air supply by fans; cooling air supply in natural draft towers.

06 Hours

UNIT - 8
FURNACES AND COMBUSTION CHAMBERS: Introduction; process heaters and boiler; heat transfer in furnaces: - Heat source; Heat sink; refractory surfaces; heat transfer to the sink; Design methods: - Method of Lobo and Evans: Method of Wilson, Lobo and Hottel; The Orrok-Hudson equation; Wallenberg simplified method.

08 Hours

TEXT BOOKS:

1. **Process Heat Transfer**: Donald Q. Kern, Tata McGraw –Hill Edition (1997)

2. **Compact Heat Exchangers:** W. M. Kays & A. L. London, Mcgraw –Hill co. (1997)

REFERENCE BOOKS:

1. **Heat Transfer – A Basic Approach:** Necati Ozsisik, McGraw – Hill International edition (1985).

2. **Heat Exchanger Design Hand Book:** Volumes 2 and 3, edited by Ernst U schlunder. et. al Hemisphere Publishing Co. (1983)

3. **Heat exchanger-** Kokac Thermal- hydraulic and design analysis.

NON-TRADITIONAL MACHINING

Subject Code	:	**10ME665**	IA Marks :	25
No. of Lecture Hrs./ Week	:	04	Exam Hours :	03
Total No. of 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
2. **Modern Machining Process,** Aditya. 2002
3. **Non-Conventional Machining,** P.K.Mishra, The Institution of Engineers (India) Test book series, Narosa Publishing House – 2005.
4. **Metals Handbook: Machining Volume 16,** Joseph R. Davis (Editor), American Society of Metals (ASM)

KNOWLEDGE MANAGEMENT

Subject Code	:	**10ME666**	IA Marks	:	25
No. of Lecture Hrs./ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hrs.	:	52	Exam Marks	:	100

PART - A

Will be sent latter

PROJECT MANAGEMENT

Subject Code: 10ME667   IA Marks: 25
No. of Lecture Hours/Week: 04   Exam Hours: 03
Total No. of Lecture Hours: 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 ream 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 schuduing 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 Yark Van Nostrand, Reinhold.

3. **Project Management,** Bhavesh M. Patal, Vikas publishing House,

STATISTICAL QUALITY CONTROL

Subject Code	:	**10ME668**	IA Marks	:	25
No. of Lecture Hrs./ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hrs.	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs, legal aspects of quality implementing, quality improvement).

06 Hours

UNIT - 2

MODELING PROCESS QUALITY: Mean, Median, Mode, Standard deviation, Calculating area, The Deming funnel experiment, Normal distribution tables, Finding the Z score, Central limit theorem.

06 Hours

UNIT - 3

METHODS AND PHILOSOPHY OF STATISTICAL PROCESS CONTROL: Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length**-**ARL)

06 Hours

UNIT - 4

CONTROL CHARTS FOR VARIABLES: Control Charts for X-Bar and R- Charts, Type I and Type II errors, the probability of Type II error. Simple Numerical Problems

08 Hours

PART - B

UNIT - 5

PROCESS CAPABILITY: The foundation of process capability, Natural Tolerance limits, c_p – process capability index, c_{pk}, p_p – process performance index, summary of process measures. Numerical problems

06 Hours

UNIT 6: Control Charts For Attributes: Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non conformities per unit. Numerical problems

07 Hours

UNIT - 7

LOT-BY-LOT ACCEPTANCE SAMPLING FOR ATTRIBUTES: The acceptance sampling problem, single sampling plan for attributes, Double, Multiple, and Sequential sampling, AOQL, LTPD, OC curves, Military Standard 105E, the Dodge-Romig sampling plans. Numerical problems

07 Hours

UNIT - 8

CUMULATIVE-SUM (CUSUM) & EXPONENTIALLY WEIGHTED MOVING AVERAGE (EWMA) CONTROL CHARTS: CUSUM Control Chart (basic principles of the chart for monitoring the process mean); EWMA control chart (EWMA control chart for monitoring process mean), design of an EWMA control chart.

06 Hours

TEXT BOOKS:

1. **Statistical Quality Control,** E.L. Grant and R.S. Leavenworth, 7th edition, McGraw-Hill publisher.
2. **Statistical Quality Control,** RC Gupta, Khanna Publishers, New Delhi, 2005

REFERENCE BOOKS:

1. **Statistical Process Control and Quality Improvement,** Gerald M. Smith, Pearson Prentice Hall. ISBN 0 – 13-049036-9.
2. **Statistical Quality Control for Manufacturing Managers,** W S Messina, Wiley & Sons, Inc. New York, 1987
3. **Statistical Quality Control,** Montgomery, Douglas, 5th Edition, John Wiley & Sons, Inc. 2005, Hoboken, NJ (ISBN 0-471-65631-3).
4. **Principles of Quality Control,** Jerry Banks, Wiley & Sons, Inc. New York.