

VII SEMESTER

ENGINEERING ECONOMY

Subject Code	: 10ME71	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 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

Subject Code	: 10ME72	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 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

Subject Code	: 10ME73	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 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 of 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. 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

Subject Code	: 10ME74	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 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

REFERENCE 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

Subject Code	: 10MEL77	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 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

Subject Code	: 10MEL78	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 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 Pendant & 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

ELECTIVE-II (GROUP B)

MECHANISM DESIGN

Subject Code	: 10ME751	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 52	Exam Marks	: 100

PART - A

UNIT-1

Planar Mechanisms and Geometry of Motion: Definitions and basic concepts, Classification of links, Classification of pairs, Mechanism and machine, Inversions, Grashoff's law, Transmission of torque and force in

mechanisms, Mobility, Degree of freedom permitted by joints other than turning and sliding, Equivalent mechanisms, Unique mechanisms.

07 Hours

UNIT-2

Number Synthesis: Effect of even or odd number of links on degree of freedom, Minimum number of binary links in a mechanism, Minimum possible number of turning pairs, Enumeration of kinematic chain, Degree of freedom of special mechanisms.

06 Hours

UNIT-3

Synthesis of Linkages: Type, Number and dimensional synthesis, Function generation, Path generation and body guidance, Precision positions, Structural error, Chebychev spacing, Two position synthesis of slider crank mechanisms, Crank-rocker mechanisms with optimum transmission angle.

07 Hours

UNIT-4

Motion Generation: Poles and relative poles, Relative poles of 4-bar mechanism, Relative poles of slider crank mechanism.

06 Hours

PART – B

UNIT-5

Graphical Methods of Dimensional Synthesis: Two position synthesis of crank and rocker mechanisms, Three position synthesis, Four position synthesis (point position reduction), Overlay method.

06 Hours

UNIT-6

Coupler Curves: Equation of coupler curves, Synthesis for path generation, Graphical synthesis for path generation, Robert-Chebyshev theorem (cognate linkages), Coupler curves from 5-bar mechanisms, Examples.

07 Hours

UNIT-7

Analytical Methods of Dimensional Synthesis: Freudenstein's equation for 4-bar mechanism and slider crank mechanism, Examples, Bloch's method of synthesis.

06 Hours

UNIT-8

Cams: Introduction, Pressure angle, Parameters affecting pressure angle, Effect of offset follower motion, Radius of curvature and undercutting, Cams with specified contours.

07 Hours

TEXT BOOKS:

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

REFERENCE BOOKS:

1. 'Kinematics, Dynamics & Design of Machinery', K. J. Waldron, G. L. Kinzel, Wiley India, 2007.
2. 'Advanced Mechanism Design', Erdman Sandoor, Vol-I PHI, 2006,
3. "Kinematics & Dynamics of Machinery" H.H. Mabie, F.W. Ocvirk, John Wiley & Sons, New York, 3rd Ed.

THEORY OF PLASTICITY

Subject Code	: 10ME752	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 52	Exam Marks	: 100

PART – A

UNIT - 1

Fundamental Of Elasticity: Concept of stress, stress transformation laws, spherical and deviator stress tensors, equilibrium equations, octahedral stresses, concept of strain, deviator and spherical strain tensors, strain

transformation laws, octahedral strains, generalized Hooke's law, elastic strain energy, compatibility equations, theories of strength. problems.

07 Hours

UNIT - 2

Plastic Deformation Of Metals: Crystalline structure in metals, mechanism of plastic deformation, factors affecting plastic deformation, strain hardening, recovery, recrystallization and grain growth, flow figures or Luder's cubes.

06 Hours

UNIT - 3

Cubical Dilation, True Stress And Strain: Strain tensor, principal strain, plane strain, spherical and deviator strain, octahedral strain and representative strain, problems.

07 Hours

UNIT - 4

Stress Strain Relations: Introduction, types of materials, empirical equations, theories of plastic flow, experimental verification of St. Venant's theory of plastic flow, the concept of plastic potential, the maximum work hypothesis, mechanical work for deforming a plastic substance.

06 Hours

PART – B

UNIT - 5

Yield Criteria: Introduction, yield or plasticity conditions, Von Mises and Tresca criteria, Geometrical representation, yield surface, yield locus (two dimensional stress space), experimental evidence for yield criteria, energy required to change the shape with basic principle problems

07 Hours

UNIT - 6

Slip Line Field Theory: Introduction, basic equations for incompressible two dimensional flow, continuity equations, stresses in conditions of plain strain, convention for slip lines, solutions of plastic deformation problem, Geometry of slip line field, Properties of the slip lines, construction of slip line nets

07 Hours

UNIT - 7

Bending Of Beams: Analysis for stresses, Non linear stress strain curve, shear stress distribution, residual stresses in plastic bending, problems.

06 Hours

UNIT - 8

Torsion Of Bars: Introduction, plastic torsion of a circular bar, elastic perfectly plastic material, elastic work hardening of material, residual stresses and problems

06 Hours

TEXT BOOKS:

1. 'Theory of Plasticity', Chakraborty 3rd Edition Elsevier.
2. 'Engineering Plasticity', W. Johnson and P. B. Mellor D Van N.O Strand Co. Ltd 2000

REFERENCE BOOKS:

1. **Basic Engineering Plasticity**, DWA Rees 1st Edition Elsevier.
2. **Theory of Plasticity**, L. S. Srinath TMH,
3. **Theory of Plasticity**, Sadhu Singh, Kanna publisher

ENGINEERING DESIGN

Subject Code	: 10ME753	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 52	Exam Marks	: 100

PART – A

UNIT-1

Identifying Customer Needs, Gather raw data from customers, Interpret raw data in terms of customer needs, Organize the needs into a hierarchy, Establish the relative importance of the needs, Reflect on the results and the process.

06 Hours

UNIT -2

The Design Process: Introduction, The design process, The design process steps, A detailed morphology of design, Further considerations in design, Spectrum of engineering activities, Organization of the engineering function,

The product life cycle, Technological forecasting and innovation, Market identification, Competitive benchmarking ,Human factors in design

07 Hours

UNIT-3

Design Methods: Introduction, Creativity and problem solving, Creativity methods, The problem statement, Product design specifications, Concept selection technique, Methods of conceptual design, Design principles, Decision theory, Evaluating alternatives, Decision trees.

07 Hours

UNIT-4

Modeling and Simulation: Role of models in design, Mathematical modeling, Similitude and scale models, Simulation, Geometric modeling.

06 Hours

PART – B

UNIT-5

Human Engineering Consideration: Introduction, Human being as applicator of forces, Anthropometry, The design of controls, Design of displays, Man/Machine information exchange.

07 Hours

UNIT-6

Risk and Reliability: Probabilistic approach to design, Reliability theory, Design for reliability, Hazard analysis, Bath tub curve, Mean life, MTTF and MTBF, Exponential and Weibull distribution, series and parallel configuration, Combination of series and parallel configuration Fault tree analysis.

07 Hours

UNIT-7

Material Selection: Performance characteristics of materials, Material selection process, Sources of information on materials, Economics of materials, Methods of material selection, cost verses performance relations, weighted property index, Value analysis.

06 Hours

UNIT-8

Robust Design: What is robust design, Identify control factors, Noise factors, Formulate an objective function, Develop the experimental plan, Run the experimental plan, Conduct the analysis, Select and confirm factor set points, Reflect and repeat.

06 Hours

TEXT BOOKS:

1. **Engineering Design : A Materials and Processing Approach**, George E. Dieter, 4th Ed., Mc. Graw Hill Company, Newyork
2. **Product Design and Development**. T. Ulrich. and S. D. Eppinger, Tata Mc Graw Hill -2003

REFERENCE BOOKS:

1. **The Mechanical Design Process**, D., G. Ullman. 4th Ed., International Edition, 1992.
2. **Product Design and Manufacturing**, A. K. Chitale, R. C. Gupta, PHI, 2nd Ed – 2002.

NON-CONVENTIONAL ENERGY SOURCES

Subject Code	: 10ME754	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 52	Exam Marks	: 100

PART A

UNIT – 1

Introduction : Energy source, India's production and reserves of commercial energy sources, need for non-conventional energy sources, energy alternatives, solar, thermal, photovoltaic. Water power, wind biomass, ocean temperature difference, tidal and waves, geothermal, tarsands and oil shale, nuclear (Brief descriptions); advantages and disadvantages, comparison (Qualitative and Quantitative).

6 Hours

UNIT – 2

Solar Radiation : Extra-Terrestrial radiation, spectral distribution of extra terrestrial radiation, solar constant, solar radiation at the earth's surface, beam, diffuse and global radiation, solar radiation data.

Measurement of Solar Radiation : Pyrometer, shading ring pyrliometer, sunshine recorder, schematic diagrams and principle of working.

Solar Radiation Geometry : Flux on a plane surface, latitude, declination angle, surface azimuth angle, hour angle, zenith angle, solar altitude angle expression for the angle between the incident beam and the normal to a plane surface (No derivation) local apparent time. Apparent motion of sun, day length, numerical examples.

9 Hours

UNIT – 3

Radiation Flux on a Tilted Surface : Beam, diffuse and reflected radiation, expression for flux on a tilted surface (no derivations) numerical examples.

Solar Thermal Conversion : Collection and storage, thermal collection devices, liquid flat plate collectors, solar air heaters concentrating collectors (cylindrical, parabolic, paraboloid) (Quantitative analysis); sensible heat storage, latent heat storage, application of solar energy water heating. Space heating and cooling, active and passive systems, power generation, refrigeration. Distillation (Qualitative analysis) solar pond, principle of working, operational problems.

9 Hours

UNIT – 4

Performance Analysis of Liquid Flat Plate Collectors : General description, collector geometry, selective surface (qualitative discussion) basic energy-balance equation, stagnation temperature, transmissivity of the cover system, transmissivity – absorptivity product, numerical examples. The overall loss coefficient, correlation for the top loss coefficient, bottom and side loss coefficient, problems (all correlations to be provided). Temperature distribution between the collector tubes, collector heat removal factor, collector efficiency factor and collector flow factor, mean plate temperature, instantaneous efficiency (all expressions to be provided). Effect of various parameters on the collector performance; collector orientation, selective surface, fluid inlet temperature, number covers, dust.

4 Hours

PART B

UNIT – 5

Photovoltaic Conversion : Description, principle of working and characteristics, applications.

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, elementary design principles; coefficient of performance of a wind mill rotor, aerodynamic considerations of wind mill design, numerical examples.

8 Hours

UNIT – 6

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, OTEC power stations in the world, problems associated with OTEC.

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

7 Hours

UNIT – 7

Energy from Bio Mass : Photosynthesis, photosynthetic oxygen production, energy plantation, bio gas production from organic wastes by anaerobic fermentation, description of bio-gas plants, transportation of bio-gas, problems involved with bio-gas production, application of bio-gas, application of bio-gas in engines, advantages.

4 Hours

UNIT – 8

Hydrogen Energy : Properties of Hydrogen with respected to its utilization as a renewable form of energy, sources of hydrogen, production of hydrogen, electrolysis of water, thermal decomposition of water, thermo chemical production bio-chemical production.

Storage & Transportation Methods : Gaseous, cryogenic and metal hydrides, application of hydrogen, domestic and industrial safe burning of hydrogen.

5 Hours

TEXT BOOKS:

1. Non-Conventional Energy Sources by *G.D Rai K*, Khanna Publishers, 2003.
2. Solar energy, by *Subhas P Sukhatme* – Tata McGraw Hill, 2nd Edition, 1996.

REFERENCE BOOKS:

1. Renewable Energy Sources and Conversion Technology by *N.K.Bansal, Manfred Kleeman & Michael Meliss*, Tata McGraw Hill, 2001.
2. Renewable Energy Resources, *John W.Twidell Anthony D. Weir El*, BG 2001.
3. Solar Power Engineering, *P.K.Nag*, Tata McGraw Hill, 2003.

GAS DYNAMICS

Subject Code	: 10ME755	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 52	Exam Marks	: 100

PART – A

UNIT - 1

Fundamental Equations Of Steady Flow: Continuity and momentum equations, The thrust function, The dynamic equation and Euler's Equation. Bernoulli's Equation. Steady flow energy equation.

08 Hours

UNIT - 2

Isentropic Flow: Acoustic velocity, Mach number, Mach cone and Mach angle. Flow parameters, stagnation temperature, pressure, and density.

06 Hours

UNIT - 3

Adiabatic Flow: Stagnation temperature change. Rayleigh line, Pressure ratio and temperature ratio, Entropy considerations, maximum heat transfer.

06 Hours

UNIT - 4

Flow With Friction: The fanning equation, Friction factor and friction parameter, Fanno line, Fanno equations.

06 Hours

PART – B

UNIT - 5

Wave Phenomena: Classification of wave phenomena, analysis of shock phenomena, Hugoniot equation. Weak waves, compression waves, Normal shock waves, oblique shock waves, Entropy considerations, Rayleigh Pilot equations, detonation and deflagration.

06 Hours

UNIT - 6

Variable Area Flow: Velocity variation with Isentropic flow, Criteria for acceleration and deceleration. Effect of pressure ratio on Nozzle operation. Convergent nozzle and convergent divergent nozzle. Effect of back pressure on nozzle flow. Isothermal flow functions. Comparison of flow in nozzle. Generalized one dimensional flow.

07 Hours

UNIT - 7

Applications of dimensional analysis and similitude to gas dynamic problems.

06 Hours

UNIT - 8

Introduction To Flames And Combustion: Flame propagation, diffusion flames, premixed flames, flame velocity, theories of flame propagation, ignition for combustible mixture, flame stabilization.

07 Hours

TEXT BOOKS:

1. **Fundamentals of Compressible flow:** Yahya, 2nd Edn. 1991; Wiley Eastern.
2. **Gas Dynamics,** E Radhakrishnan PHI-2006

REFERENCE BOOKS:

1. **Introduction to Gas Dynamics:** Roly, Wiley 1998
2. **Elements of Gas Dynamics:** Liepmann and Roshko, Wiley 1994.
3. **The dynamics and thermodynamics of compressible fluid flow:** Shapiro Ronold press. 1994.
4. **Compressible Fluid Flow,** J. F. Anderson

MANAGEMENT INFORMATION SYSTEM

Subject Code	: 10ME756	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 52	Exam Marks	: 100

PART – A**UNIT - 1**

The Information Age: An Overview: The purpose, data, information, and information systems and their types, ethical and societal issues, information systems in business functions, web empowered enterprises.

05 Hours

UNIT - 2

Strategic Uses of Information Systems: Strategies and Strategic moves, Achieving a competitive advantage, creating and maintaining strategic information systems, Business Functions and Supply Chains – effectiveness and efficiency, accounting, finance, engineering, supply chain management, Human resource management, Enterprise resource planning.

05 Hours

UNIT - 3

Information Technology: Business Hardware – components, classification of computers, output devices, storage media, and purchasing,, Business Software – programming languages and software development tools, language translation, compilers and interpreters, system software, open source software, software licensing, ethical issues,

08 Hours

UNIT - 4

Business Networks and Telecommunication: Telecommunication in Business and Daily Use, Bandwidths and Media, networks, protocols, internet networking services, Telecommuting – pros and cons, Future of Networking Technologies.

08 Hours

PART – B

UNIT - 5

Web Enabled Commerce: Web enabled enterprises – web business and technologies, web enabled business, Challenges of Global Information Systems – Multinational organizations, international commerce, ethical issues.

07 hours

UNIT - 6

Decision Support and Business intelligence: Decision support and expert systems – decision support and decision making process, structured and unstructured problems, decision support systems, expert systems, geographical systems, Business Intelligence and Knowledge Management – Data Mining and online analysis, knowledge management,

06 Hours

UNIT - 7

Planning, Acquisition, and Control: Systems Planning and Development – Planning Information systems, systems development life cycle, agile methods, systems integration, ethical issues – IS professionals certification.

07 Hours

UNIT - 8

Choices in Systems Acquisition: Options and Priorities, outsourcing, licensing applications, software as a service, user application development, ethical issues- computer use policies for employees.

06 Hours

TEXT BOOKS:

1. **Management Information Systems**, Effy Oz, Cengage Learning, INDIA EDITION, 2009.
2. **Management Information Systems**, James A O'Brien, Irwin, 9th Ed., McGraw Hill.

REFERENCE BOOKS:

1. **Management Information Systems**, Laudon & Laudon, PHI 1998 Ed. ISBN 81-203-1282-1
2. **Management Information systems**, S.Sadagopan, Prentice Hall of India, 1998 Ed. ISBN 81-203-1180-9
3. **Information systems for Modern management** G.R.Murdick PHI 2002.

AUTOMATION IN MANUFACTURING

Subject Code	: 10ME757	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 52	Exam Marks	: 100

PART – A

UNIT - 1

Introduction: Production System Facilities, Manufacturing Support systems, Automation in Production systems, Automation principles & Strategies

05 Hours

UNIT - 2

Manufacturing Operations: Manufacturing Operations, Product/Production Relationship, Production concepts and Mathematical Models & Costs of Manufacturing Operations

07 Hours

UNIT - 3

Industrial Control System: Basic Elements of an Automated System, Advanced Automation Functions & Levels of Automation, Continuous versus Discrete control, Computer Process control, Forms of Computer Process Control.

07 Hours

UNIT - 4

Automated Manufacturing Systems: Components of a Manufacturing systems, Classification of Manufacturing Systems, overview of Classification Scheme, Single Station Manned Workstations and Single Station Automated Cells.

07 Hours

PART – B

UNIT - 5

Group Technology & Flexible Manufacturing Systems: Part Families, Parts Classification and coding, Production Flow Analysis, Cellular Manufacturing, Flexible Manufacturing Systems: What is an FMS, FMS Components, FMS Applications & Benefits, and FMS Planning & Implementation Issues.

08 Hours

UNIT - 6

Quality Control Systems: Traditional and Modern Quality Control Methods, Taguchi Methods in Quality Engineering. Introduction to SQC Tools.

04 Hours

UNIT - 7

Inspection Technologies: Automated Inspection, Coordinate Measuring Machines Construction, operation & Programming, Software, Application & Benefits, Flexible Inspection System, Inspection Probes on Machine Tools, Machine Vision, Optical Inspection Techniques & Non-contact Non-optical Inspection Technologies

06 Hours

UNIT - 8

Manufacturing Support System: Process Planning, Computer Aided Process Planning, Concurrent Engineering & Design for Manufacturing, Advanced Manufacturing Planning, Just-in Time Production System, Basic concepts of lean and Agile manufacturing.

08 Hours

TEXT BOOKS:

1. **Automation, Production Systems and Computer Integrated Manufacturing**, M. P. Groover, Pearson education. Third Edition, 2008
2. **Principles of CIM**, Vajpayee, PHI.

REFERENCE BOOKS:

1. **Anatomy of Automation**, Amber G.H & P. S. Amber, Prentice Hall.
2. **Performance Modeling of Automated Manufacturing Systems**, Viswanandham, PHI
3. **Computer Based Industrial Control**, Krishna Kant, EEE-PHI

TOTAL QUALITY MANAGEMENT

Subject Code	: 10ME758	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 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 PDCA 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 six 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

ELECTIVE-III (GROUP C)

EXPERIMENTAL STRESS ANALYSIS

Subject Code	: 10ME761	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 52	Exam Marks	: 100

PART – A

UNIT-1

Electrical Resistance Strain Gages: Strain sensitivity in metallic alloys, Gage construction, Adhesives and mounting techniques, Gage sensitivity and gage factor, Performance Characteristics, Environmental effects, Strain Gage circuits. Potentiometer, Wheatstone's bridges, Constant current circuits.

06 Hours

UNIT-2

Strain Analysis Methods: Two element, three element rectangular and delta rosettes, Correction for transverse strain effects, Stress gage, Plane shear gage, Stress intensity factor gage.

06 Hours

UNIT-3

Photo-elasticity: Nature of light, Wave theory of light - optical interference , Stress optic law – effect of stressed model in plane and circular polariscopes, Isoclinics & Isochromatics, Fringe order determination Fringe multiplication techniques, Calibration photoelastic model materials

08 Hours

UNIT-4

Two Dimensional Photo-elasticity: Separation methods: Shear difference method, Analytical separation methods, Model to prototype scaling, Properties of 2D photo-elastic model materials, Materials for 2D photo-elasticity

06 Hours

PART –B

UNIT-5

Three Dimensional Photo elasticity: Stress freezing method, Scattered light photo-elasticity, Scattered light as an interior analyzer and polarizer, Scattered light polariscope and stress data Analyses.

06 Hours

UNIT-6

Photoelastic (Birefringent) Coatings : Birefringence coating stresses, Effects of coating thickness: Reinforcing effects, Poisson's, Stress separation techniques: Oblique incidence, Strip coatings.

08 Hours

UNIT-7

Brittle Coatings: Coatings stresses, Crack patterns, Refrigeration techniques, Load relaxation techniques, Crack detection methods, Types of brittle coatings, Calibration of coating. Advantages and brittle coating applications.

06 Hours

UNIT-8

Moire Methods: Moire fringes produced by mechanical interference .Geometrical approach, Displacement field approach to Moire fringe analysis ,Out of plane displacement measurements, Out of plane slope measurements .Applications and advantages

06 Hours

TEXT BOOKS:

1. **"Experimental Stress Analysis"**, Dally and Riley, McGraw Hill.
2. **"Experimental Stress Analysis"**. Sadhu Singh, Khanna publisher.
3. **Experimental stress Analysis**, Srinath L.S tata McGraw Hill.

REFERENCES BOOKS :

1. **"Photoelasticity Vol I and Vol II**, M.M.Frocht, John Wiley & sons.
2. **"Strain Gauge Primer"**, Perry and Lissner,
3. **"Photo Elastic Stress Analysis"**, Kuske, Albrecht & Robertson John Wiley & Sons.
4. **"Motion Measurement and Stress Analysis"**, Dave and Adams,

TOOL DESIGN

Subject Code	: 10ME762	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 52	Exam Marks	: 100

PART – A

UNIT - 1

Introduction to tool design: Tooling, requirements of a tool designer, general tool design procedure.

Design of Single point Cutting Tools: Design of single point lathe tool: Design of shank dimension using strength and rigidity considerations for rectangular, square and round cross section and selection of tool geometry. Solid type tool, brazed tip tool, long index able insert, throwaway index able insert types and chip breakers.

06 Hours

UNIT - 2

Design of Multi Point Cutting Tool: Drill bit design of elements like back taper, web thickness, land width, margin, flute length and cross section and selection of tool geometry. Design of milling cutter: Design of elements like number of teeth and height circular pitch, body thickness, chamfer width, fillet radius and selection of tool geometry.

04 Hours

UNIT - 3

Design of Jigs : Functions and differences between jigs and fixtures, advantages in mass production, design principles, economics of jigs and fixtures. Principles of location -3-2-1 and 4-1-1 types of locations, different types of locating elements. Clamping – Principles of clamping, types of clamping including power clamping devices. Drill jigs- Types, Drill bushes, simple exercises of designing jigs for given components.

05 Hours

UNIT - 4

Design of Fixtures: Fixture Design Turning fixtures, milling fixtures, grinding and broaching fixtures, indexing fixtures. Design of fixtures for simple components.

05 Hours

PART – B

UNIT - 5

Design of Sheet Metal: Working of a power press and classification of presses. Components of a simple die, press tool operation, die accessories, shearing action in punch & die, clearance, shear on punch and die, Centre of pressure and problems, scrap strip layout. Simple, progressive, compound, combination and inverted dies. Design problems on blanking and piercing dies for simple components.

05 Hours

UNIT - 6

Bending & Drawing: Bending dies – Introduction, bend allowance, spring back, edge bending die design. Drawing dies – Single action, double action and triple action dies, factors affecting drawing, drawing die design.

05 Hours

UNIT - 7

Die Casting Dies : Terminology: Core, cavity, sprue, slug, fixed and movable cores, finger cams, draft, ejector pins ejector plates, gate, goose-nozzle, over-flow, platten, plunger, runner, vent, water-line etc. Types of Dies: Single cavity, multicavity dies, combination dies, unit dies, advantages and disadvantages of types of dies. Die casting dies, unit dies. advantages and disadvantages of types of dies. Die casting alloys, defects in die casting, finishing trimming and inspection of die casting components, safety, modern trends in die casting dies.

05 Hours

UNIT - 8

Injection Molding: Injection moulding machine and its elements, general configuration of a mould. 2 plate and 3 plate mould. Introduction, to gate, runner, parting surface, ejection system. Core and cooling system.

Introduction to compression, transfer, blow moulding, extrusion, forming and calendaring.

05 Hours

TEXT BOOKS:

1. **Tool Design**, C. Donaldson, G.H.Le Cain V.C. Goold, Tata McGraw Hill pub.1976.
2. **Metal cutting theory & cutting tool design**, V. Arshinow and G. Alfseev Mir pub. Mascow Edu 1976:

REFERENCE BOOKS:

1. **Introduction to jigs and fixture design**, M H A Kempster, Elbs, Edn. 1974.
2. **Tool engineering and design**, Nagpal Khanna pub.Edn. 1998.
3. **Fundamentals of tool design**, ASTM Prentice Hall India.2000
4. **Metal cutting and tool design**, DR,B,J, Ranga, Vikas Pub. Edn. 1993.
5. **Manufacturing technology (foundry forming and welding)** P.N. Rao, Tata McGraw Hill Pub, Edn.1996
6. **Die Casting Die Design**, Burton 2000
7. **Injection Moulding Design**, RGW Pye, john.1998
8. **Injection Moulding Handbook**, Dominick V. Rosato & Donald V. Rosato, 1996, CBS Publishers

Scheme of Examination:

1. Eight questions to be set selecting FOUR questions from each Part
2. Each question carries 20 marks.
3. Five questions to be solved selecting at least two question from each Part

CRYOGENICS

Subject Code	: 10ME763	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 52	Exam Marks	: 100

PART – A

UNIT - 1

Introduction To Cryogenic Systems: Applications Areas of Cryogenic Engineering

Low temperature properties of engineering materials – Mechanical properties, Thermal properties, Electrical properties.

Introduction The Thermodynamically Ideal system Production of low temperatures – Joule Thompson Effect, Adiabatic expansion.

06 Hours

UNIT - 2

Gas Liquefaction Systems: Liquefaction systems for Air Simple Linde – Hampson System, Claude System, Heylndt System, Dual pressure, Claude. Liquefaction cycle Kapitza System. Comparison of Liquefaction Cycles Liquefaction cycle for hydrogen, helium and Neon, Critical components of liquefaction systems.

07 Hours

UNIT - 3

Gas Cycle Cryogenic Refrigeration Systems: Classification of Cryo coolers Stirling cycle Cryo – refrigerators, Ideal cycle – working principle. Schmidt's analysis of Stirling cycle Various configurations of Stirling cycle refrigerators Integral piston Stirling cryo-cooler, Free displacer split type Stirling Cryo coolers, Gifford McMahon Cryo- refrigerator, Pulse tube refrigerator, Solvay cycle refrigerator, Vuillimier refrigerator, Cryogenic regenerators.

06 Hours

UNIT - 4

Gas Separation And Gas Purification Systems: Thermodynamic ideal separation system, Properties of mixtures, Principles of gas separation, Linde single column air separation. Linde double column air separation, Argon and Neon separation systems. Adsorption Process, PSA systems.

07 Hours

PART – B

UNIT - 5

Ultra Low Temperature Cryo – Refrigerators: Magneto Caloric Refrigerator ^3He - ^4He Dilution refrigerator. Pomeranchuk cooling.

Measurement systems for low temperatures, Temperature measurement at low temperatures, Resistance thermometers, Thermocouples, Thermistors, Gas Thermometry. Liquid level sensors.

06 Hours

UNIT - 6

Vacuum Technology: Fundamental principles. Production of high vacuum, Mechanical vacuum pumps, Diffusion pumps, Cryo-pumping, Measurement of high vacuum level.

Cryogenic Insulation: Heat transfer due to conduction, Evacuated porous insulation Powder & Fibers Opacified powder insulation, Gas filled powders & Fibrous materials Multilayer super-insulation, Composite insulation.

07 Hours

UNIT - 7

Cryogenic Fluid Storage And Transfer Systems: Design of cryogenic fluid storage vessels, Inner vessel, Outer Insulation, Suspension system, Fill and drain lines. Cryogenic fluid transfer, External pressurization, Self pressurization, Transfer pump.

07 Hours

UNIT - 8

Application Of Cryogenic Systems: Cryogenic application for food preservation – Instant Quick Freezing techniques 11.2 Super conductive devices, Cryogenic applications for space technology.

06 Hours

TEXT BOOKS:

1. **Cryogenic Systems**, Randall Barron – Oxford Press, 1985
2. **Cryogenic Engineering**, Thomas M. Flynn, Marcel Dekker, Inc N.Y. Basal 1997

REFERENCE BOOK:

1. **Cryogenic Process Engineering**, Klaus D. Timmerhaus & Thomas M. Flynn, Plenum Press, New York & London 1989.

SMART MATERIALS

Subject Code	: 10ME764	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 52	Exam Marks	: 100

PART - A**UNIT - 1**

Introduction: Characteristics of composites and ceramics materials, Dynamics and controls, concepts, Electro-magnetic materials and shape memory alloys-processing and characteristics

06 Hours

UNIT - 2

Sensing And Actuation: Principles of electromagnetic, acoustics, chemical and mechanical sensing and actuation, Types of sensors and their applications, their compatibility with conventional and advanced materials, signal processing, principles and characterization.

07 Hours

UNIT - 3

Control Design: Design of shape memory alloys, Types of MR fluids, Characteristics and application, principles of MR fluid valve designs, Magnetic circuit design, MR Dampers, Design issues.

06 Hours

UNIT - 4

Optics And Electromagnetic: Principles of optical fiber technology, characteristics of active and adaptive optical system and components, design and manufacturing principles.

07 Hours

PART – B

UNIT - 5

Structures: Principles of drag and turbulence control through smart skins, applications in environment such as aerospace and transportation vehicles, manufacturing, repair and maintainability aspects.

07 Hours

UNIT - 6

Controls: Principles of structural acoustic control, distributed, analog and digital feed back controls, Dimensional implications for structural control.

06 Hours

UNIT - 7

Principles Of Vibration And Modal Analysis: PZT Actuators, MEMS, Magnetic shape Memory Alloys, Characteristics and Applications.

07 Hours

UNIT - 8

Information Processing: Neural Network, Data Processing, Data Visualisation and Reliability – Principles and Application domains.

06 Hours

TEXT BOOKS:

1. **Analysis and Design**, A. V. Srinivasan, 'Smart Structures – Cambridge Universities Press, New York, 2001, (ISBN : 0521650267)
2. **'Smart Materials and Structures'**, M V Gandhi and B S Thompson Chapman & Hall, London, 1992 (ISBN : 0412370107)

REFERENCE BOOKS:

1. **'Smart Materials and Structures'**, Banks HT, RC Smith, Y Wang, Massow S A, Paris 1996
2. **G P Gibss' Adaptive Structures'**, Clark R L, W R Saunolers, Jhon Wiles and Sons, New York, 1998
3. **An introduction for scientists and Engineers'**, Esic Udd, Optic Sensors : Jhon Wiley & Sons, New York, 1991 (ISBN : 0471830070)

AGILE MANUFACTURING

Subject Code	: 10ME765	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 52	Exam Marks	: 100

PART – A**UNIT - 1**

Agile Manufacturing: Definition, business need, conceptual frame work, characteristics, generic features.

06 Hours

UNIT - 2

Developing Agile Manufacturing: Enterprise, Strategies, integration of organization, workforce and technology, reference models, examples.

07 Hours

UNIT - 3

Integration Of Product /Process Development: Principles, Robust design approach, Approaches to enhance ability in manufacturing, Role of QFD, Managing people in Agile organization, Approaches.

06 Hours

UNIT - 4

Application Of It/Is Concepts In Agile Manufacturing: Strategies, Management of complexities and information. flow, approaches,

applications of multimedia to improve agility in manufacturing, system concepts.

07 Hours

PART – B

UNIT - 5

Agile Supply Chain Management: Principles, IT/IS concepts in supply chain management, enterprise integration and management in agile manufacturing, concepts, Agility, Adaptability and learners – comparison of concepts.

07 Hours

UNIT - 6

Computer Control Of Agile Manufacturing: CAPP for Agile Manufacturing, Aggregate capacity planning and production line design / redesign in Agile manufacturing, Cellular manufacturing, concepts, examples.

07 Hours

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

Subject Code	: 10ME766	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 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 Denvit - 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

FINANCE MANAGEMENT

Subject Code	: 10ME767	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 52	Exam Marks	: 100

PART – A

UNIT - 1

Introduction To Financial Management: Forms of organization, direct and indirect taxes. Statutory Registration- excise Duty, central sales tax, VAT, service tax, international fund availability.

06 Hours

UNIT - 2

Risk And Required Return: Risk and return relationship, methods of measuring the risk, Business risk, financial risk, calculation of expected rate of return to the portfolio, numerical problems.

06 Hours

UNIT - 3

Working Capital Management: Definition, need and factors influencing the working capital requirement. Determination of operating cycle, cash cycle and operating cycle analysis. Calculation of gross working capital and net working capital requirement.

07 Hours

UNIT - 4

Long Term Financing: Raising of finance from primary and secondary markets. Valuation of securities, features of convertible securities and warrants. Features of debt, types of debt instruments, return on investment(ROI) and credit rating of units. Shares, debentures.

07 Hours

PART – B

UNIT - 5

Introduction: Book keeping – systems of book keeping, journal and ledger posting. Financial Statement, Preparation of Trial balance, profit and Loss Account, Balance Sheet with adjustments.

07 Hours

UNIT - 6

Ratio Analysis / Accounting Ratio: Liquidity ratio – Current ratio, quick ratio, turnover ratio, capital structure ratio- Debt – equity ratio, Coverage ratio, Profitability ratio, Profit margin, Return on assets, Activity ratios – Inventory turnover ratio, Debtors Turnover ratio. Preparation of the balance sheet from various ratios. Analysis of any one published balanced sheet.

07 Hours

UNIT - 7

Costing: Classification of cost, preparation of cost sheet, absorption and variable costing, job costing, process costing. Classification of the variances analysis – material, labour and overhead variances.

06 Hours

UNIT - 8

Budgeting: Types of budgets – Flexible budgets, preparation of cash budgets, purchase and production budgets and master budget, Budgetary control, advantages & limitations of budgeting.

06 Hours

TEXT BOOKS:

1. **Financial Management**, Khan & Jain, text & problems, 5th Ed., TMH ISBN 0-07-460208-A. 20001
2. **Financial Accounting, Costing and Management Accounting**, S. M. Maheshwari, 2000

REFERENCE BOOKS:

1. **Financial Management**, I. M. Pandey, Vikas Publication House ISBN 0-7069-5435-1. 2002
2. **Financial Management**, Abrish Gupta, Pearson.
3. **Financial Decision Making**, Humpton. 2000
4. **Financial Management**, Theory and Practice, Prasanna Chandra TMH ISGN -07-462047-9, 3rd edition 2002

MICRO AND SMART SYSTEMS TECHNOLOGY

Subject Code	: 10ME768	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 52	Exam Marks	: 100

PART – A**UNIT - 1****Introduction To Micro And Smart Systems:**

- a) What are smart-material systems? Evolution of smart materials, structures and systems. Components of a smart system. Application areas. Commercial products.
- b) What are microsystems? Feynman's vision. Micromachined transducers. Evolution of micro-manufacturing. Multi-disciplinary aspects. Applications areas. Commercial products.

05 Hours**UNIT - 2****Micro And Smart Devices And Systems: Principles And Materials:**

- a) Definitions and salient features of sensors, actuators, and systems.
- b) Sensors: silicon capacitive accelerometer, piezo-resistive pressure sensor, blood analyzer, conductometric gas sensor, fiber-optic gyroscope and surface-acoustic-wave based wireless strain sensor.
- c) Actuators: silicon micro-mirror arrays, piezo-electric based inkjet print-head, electrostatic comb-drive and micromotor, magnetic micro relay, shape-memory-alloy based actuator, electro-thermal actuator
- d) Systems: micro gas turbine, portable clinical analyzer, active noise control in a helicopter cabin

08 Hours

UNIT - 3

Micro-Manufacturing And Material Processing:

- a) Silicon wafer processing, lithography, thin-film deposition, etching (wet and dry), wafer-bonding, and metallization.
- b) Silicon micromachining: surface, bulk, moulding, bonding based process flows.
- c) Thick-film processing:
- d) Smart material processing:
- e) Processing of other materials: ceramics, polymers and metals
- f) Emerging trends

07 Hours

UNIT - 4

Modeling:

- a) Scaling issues.
- b) Elastic deformation and stress analysis of beams and plates. Residual stresses and stress gradients. Thermal loading. Heat transfer issues. Basic fluids issues.
- c) Electrostatics. Coupled electromechanics. Electromagnetic actuation. Capillary electro-phoresis. Piezoresistive modeling. Piezoelectric modeling. Magnetostrictive actuators.

06 Hours

PART – B

UNIT - 5

Computer-Aided Simulation And Design:

Background to the finite element method. Coupled-domain simulations using Matlab. Commercial software.

08 Hours

UNIT - 6

Electronics, Circuits And Control:

Carrier concentrations, semiconductor diodes, transistors, MOSFET amplifiers, operational amplifiers. Basic Op-Amp circuits. Charge-measuring circuits. Examples from microsystems. Transfer function, state-space modeling, stability, PID controllers, and model order reduction. Examples from smart systems and micromachined accelerometer or a thermal cyclers.

08 Hours

UNIT - 7

Integration And Packaging Of Microelectro Mechanical Systems:

Integration of microelectronics and micro devices at wafer and chip levels. Microelectronic packaging: wire and ball bonding, flip-chip. Low-temperature-cofired-ceramic (LTCC) multi-chip-module technology. Microsystem packaging examples.

06 Hours

UNIT - 8

Case Studies:

BEL pressure sensor, thermal cyler for DNA amplification, and active vibration control of a beam.

04 Hours

PART – C

UNIT - 9

Mini-projects and class-demonstrations (not for Examination)

09 Hours

- a) CAD lab (coupled field simulation of electrostatic-elastic actuation with fluid effect)
- b) BEL pressure sensor
- c) Thermal-cycler for PCR
- d) Active control of a cantilever beam

TEXT BOOKS AND A CD-SUPPLEMENT:

- 1. “Micro and Smart Systems” by Dr. A.K.Aatre, Prof. Ananth Suresh, Prof.K.J.Vinoy, Prof. S. Gopalakrishna,, Prof. K.N.Bhat.,John Wiley Publications
- 2. **MEMS & Microsystems: Design and Manufacture**, Tai-Ran Tsu, Tata Mc-Graw-Hill.

REFERENCE BOOKS:

- 1. Animations of working principles, process flows and processing techniques, A CD-supplement with Matlab codes, photographs and movie clips of processing machinery and working devices.
- 2. **Laboratory hardware kits for** (i) BEL pressure sensor, (ii) thermal-cycler and (iii) active control of a cantilever beam.

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

PRODUCT LIFE CYCLE MANAGEMENT

Subject Code	: 10ME769	IA Marks	: 25
Hours/Week	: 04	Exam Hours	: 03
Total Hours	: 52	Exam Marks	: 100

PART – A

UNIT – 1

Introduction to Product Life Cycle Management(PLM) : Definition, PLM Lifecycle model, Threads of PLM, Need for PLM, Opportunities and benefits of PLM, Views, Components and Phases of PLM, PLM feasibility study, PLM visioning.

4 Hours

UNIT – 2

PLM Concepts, Processes and Workflow:

Characteristics of PLM, Environment driving PLM, PLM Elements, Drivers of PLM, Conceptualization, Design, Development, Validation, Production, Support of PLM.

6 Hours

UNIT – 3

Product Data Management (PDM) Process and Workflow: PDM systems and importance, reason for implementing a PDM system, financial justification of PDM implementation. Versioning, check-in and checkout, views, Metadata, Lifecycle, and workflow. Applied problems and solution on PDM processes and workflow.

10 Hours

UNIT – 4

Collaborative Product Development: Engineering vaulting, product reuse, smart parts, engineering change management, Bill of materials and process consistency, Digital mock-up and prototype development, design for environment, virtual testing and validation, marketing collateral.

6 Hours

PART – B

UNIT – 5

Tools of Communication for collaborative work: Creation of 3DXML and CAD drawing using CAD software. Creation of an animation for assembly instructions on 3D via composer, creation of an acrobat 3D document. Applied problems and solutions on tools of communication for collaborative work.

05 Hours

UNIT – 6

Knowledge and optimization of design products: Know how, best practices, parameterization of design, Applied problems and Solution on optimization of products using power copy, publication, parameters, formula, rule, check, design table, configuration, reaction.

10 Hours

UNIT – 7

Digital Manufacturing – PLM: Digital manufacturing, benefits manufacturing, manufacturing the first-one, Ramp up, virtual learning curve, manufacturing the rest, production planning.

06 Hours

UNIT – 8

Developing a PLM strategy and conducting a PLM assessment: Strategy, Impact of strategy, implementing a PLM strategy, PLM initiatives to support corporate objectives. Infrastructure assessment, assessment of current systems and applications.

05 Hours

TEXT BOOKS:

1. Product Lifecycle Management : Grieves, Michael, McGraw-Hil, Edition 2006.ISBN 0071452303

2. PDM : Product Data Management : Burden, Rodger, Resource Pub, 2003. ISBN 0970035225.

Suggested Software Packages :

Catia V5R19, Delmia V5R19, 3D via Composer, 3DXML player, Smarteam V5R19

REFERENCE BOOKS :

1. Fabio Guidice, Guido La Rosa, Product Design for the environment- A life cycle approach , Taylor and Francis 2006.
2. Robert J. Thomas, “ NDP : Managing and forecasting for strategic processes”.
3. Hartman, “ Product life cycle management with SAP”, 2006
4. Stark, John,”Product Life cycle Management : Paradigm for 21st Century Product Realization “, Springer-Verlag, 2004. ISBN 1852338105
5. Saaksvuori, Antti and Immpnen, Anselmi. “ Product Lifecycle Management”, Springer-Verlag, 2004. ISBN 3540403736