of simple parts (sketching).

2. Part modeling and Assembly of simple parts using any of the above packages.
3. Static Analysis of Plane Truss and 2D beam for different type of loads using ANSYS / NASTRAN / ADINA etc.,
4. Static analysis of Plate with a hole to determine the SCF and Deformations and Stresses.
5. Static Analysis of connecting rod, pressure vessels.
6. Dynamic analysis: Modal Analysis of cantilever Beam and Hannonic analysis of Shaft.
7. Steady state heat transfer Analysis Cross section of chimney and Transient heat transfer analysis of solidification of casting.
8. Facing and turning, step timing, taper turning, contouring on CNC lathe.
9. Pocketing and contouring on CNC milling machine.
10. Simulation and development of NC code using any CAM software.
11. Programming for integration of various CNC machines, robots and material handling systems.

WITH EFFECT FROM THE ACADEMIC YEAR 2008-2009

ME 383

INDUSTRIAL VISIT / STUDY

Atleast days in a semester — 3 x 8 = 24 hours

Sessional — Grade*

A minimum of two industrial visits will be arranged by department and students have to attend the visits and prepare a data report of their visits to the industries and submit to the department. Students are required to present a seminar based on their report which is evaluated by Head of Department and two senior faculty to award the Grade* .

*Excellent /Good/Satisfactory/Unsatisfactory

* * *

WITH EFFECT FROM THE ACADEMIC YEAR 2009-2010

SCHEME OF INSTRUCTION AND EXAMINATION

B.E. IV/IV (REGULAR)

MECHANICAL ENGINEERING

SEMESTER - I

Sl. No.	Syllabus Ref. No.	Subject	Scheme of Instruction: Periods per Week L/T	Scheme of Instruction: Periods per Week D/P	Scheme of Examination: Duration in Hrs	Scheme of Examination: Maximum Marks Univ. Exam	Scheme of Examination: Maximum Marks Sessionals
		THEORY					
1.	ME 401	Production Drawing	6	-	3	75	25
2.	ME 402	Thermal Turbo Machines	4	-	3	75	25
3.	ME 403	Metrology & Instrumentation	4	-	3	75	25
4.	ME 404	Finite Element Analysis	4	-	3	75	25
5.	ME 405	Operations Research	4	-	3	75	25
6.		ELECTIVE - I	4	-	3	75	25
		PRACTICALS					
1.	ME 431	Thermal Engineering Lab	-	3	3	50	25
2.	ME 432	Metrology & Instrumentation Lab	-	3	3	50	25
3.	ME 433	Project Seminar	-	3	-	-	25
		Total	**24**	**9**	**--**	**550**	**225**

ELECTIVE - I

ME 406 Neural Networks
ME 407 Automobile Engineering
ME 408 Non Conventional Energy Sources
ME 409 Tool Design
ME 411 Entrepreneurship
ME 412 Computational Fluid Flows
ME 413 Design for Manufacture
ME 452 Composite Materials

Service Course : ME 472 Industrial Administration and Financial Management (Service course to ECE)

WITH EFFECT FROM THE ACADEMIC YEAR 2009-2010

SCHEME OF INSTRUCTION AND EXAMINATION

B.E. IV/IV (REGULAR)

PRODUCTION ENGINEERING

SEMESTER - I

Sl. No.	Syllabus Ref. No.	Subject	Scheme of Instruction		Scheme of Examination		
			Periods per Week		Duration in Hrs	Maximum Marks	
			L/T	D/P		Univ. Exam	Sessionals
		THEORY					
1.	ME 401	Production Drawing	6	-	3	75	25
2.	ME 403	Metrology & Instrumentation	4	-	3	75	25
3.	ME 405	Operations Research	4	-	3	75	25
4.	ME 409	Tool Design	4	-	3	75	25
5.	ME 355	Control System Theory	4	-	3	75	25
6.		ELECTIVE - I	4	-	3	75	25
		PRACTICALS					
1.	MP 431	Manufacturing Engg. Lab	-	3	3	50	25
2.	ME 432	Metrology & Instrumentation Lab	-	3	3	50	25
3.	ME 433	Project Seminar	-	3	-	-	25
		Total	**26**	**9**	**--**	**550**	**225**

ELECTIVE - I

ME 404	Finite Element Analysis	ME 412	Computational Fluid Flows
ME 406	Neural Networks	ME 413	Design for Manufacture
ME 407	Automobile Engineering	ME 452	Composite Materials
ME 411	Entrepreneurship	ME 467	Total Quality Management

WITH EFFECT FROM THE ACADEMIC YEAR 2009-2010

ME 401

PRODUCTION DRAWING

Instruction	6 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessional	25 Marks

Unit - I

Format of drawing sheet, title block, columns for materials, processes, part list, etc., conventional representation of parts(Screwed joints, Welded joints, Springs, Gears, elements of Electrical, Hydraulic and Pneumatic circuits, machine tool elements). Methods of indicating notes on drawing.

Unit - II

Limits and Fits: Basic definition of terms, alpha numeric designation of limits/fits. Types of Fits. Interchangeability and selective Assembly. Exercises involving selection/interpretation of fits and calculation of limits. Dimensional chains.

Unit - III

Production Drawing: Conventional practices of indicating tolerances on size and geometrical form, Surface finish, surface treatments, Part drawing from assembled drawings. Specification and indication of above features on the drawings. Calculation of limits suggesting suitable fits for mating parts.

Unit - IV

Assignments: Sketches of conventional representation of parts described with syllabus at (1) Process sheets, Tolerances and finishes obtainable from different processes. Study of I.S.:2709 on limits and fits.

N.B.: Tolerance charts to be provided in the examination Hall for calculation of limits.

Suggested Reading:

1. P. Narasimha Reddy, T.A. Janardhan Reddy and C. Srinivasa Rao, *"Production Drawing Practice"*, Hi-Tech Publishers, 2001
2. R.L. Murthy, *"Precision Engineering in Manufacturing"*, New Age International (P) Ltd., 1996.
3. K.L. Narayana, P. Kannaiah and K. Venkat Reddy, *"Production Drawing"*, New Age International (P) Ltd., Revised edition 1997
4. R.K. Jain, *"Engineering Metrology"*, Khanna Publishers, 8th edition, 1985

ME 402

THERMAL TURBO MACHINES

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessional	25 Marks

Unit-I

Introduction to compressible flows: Speed of propagation of pressure waves, Mach number, Acoustic velocity and Mach cone, limits of compressibility, pressure field due to a moving source of disturbance, one dimensional compressible flow

Isentropic flow with variable area, Mach number variation, Area ratio as function of Mach number, flow through nozzles and diffusers .

Flow in constant area ducts with friction-Fanno flow, variation of flow properties, variation of Mach number with duct length, isothermal flow with friction

Unit-II

Flow in constant area duct with Heat Transfer, -The Rayleigh liner, Rayleigh flow relations, variation of flow properties, Maximum heat transfer.

Flow with Shock Waves-Development of Normal Shock waves, governing equations, Prandtl –Meyer relation, Rankine-Hugoniot equations, Stagnation pressure ratio across shock.

Unit-III

Rotodynamic compressors: Introduction and general classification, Comparison of Reciprocating and Rotary compressors, Positive displacement Rotary compressors, Flow through rotary compressors. Static and total head quantities. Thermodynamic cycles and work done,calculation of various efficiencies. Velocity diagrams and prewhirl. Euler equation for energy transfer between fluid and rotor, Analysis of Centrifugal compressors and analysis of axial flow compressors, Chocking, Surging and Stalling.

Unit-IV

Steam Turbines: Classification, flow over blades, pressure velocity variations, Compounding of steam turbines- pressure compounding, velocity compounding and pressure-velocity compounding, Impulse turbine with several blade rings, Nozzle efficiency, Blade efficiency and Gross stage efficiency of Impulse turbine, Velocity diagrams for Impulse turbine-De Laval Turbine, blade efficiency of Impulse turbine, Optimum blade speed ratio, Maximum work done and blade efficiency of Impulse turbine, Degree of reaction of Reaction turbine, Parson Reaction turbine, Velocity diagram for Parson Reaction turbine, blade efficiency of Parson Reaction turbine, Maximum work done and blade efficiency of Parson Reaction turbine, Height of blades of Reaction turbine, Balancing of End thrust,

Unit-V

Gas Turbines: Applications and Classification of Gas Turbines- constant pressure and constant volume gas turbines, Joule cycle-configuration diagram and temp-entropy diagram, Thermal efficiency of Joules cycle, Maximum pressure ratio in terms of temperature ratio, optimum pressure ratio for maximum work output with and without considering machine efficiencies, Improvement of gas turbine plant performance- Inter-cooling, Reheating and Regeneration. Simple Problems on Joule cycle.

Air Craft Propulsion: Air craft engine types, air craft propulsion theory, Turbo jet engines, Ramjet engines, Pulse jet engines,

Rocket Propulsion: Types of Propellants, Types of Rocket engines, Rocket propulsion theory-Rocket applications.

Suggested Reading:

1. Yahya S M, *'Fundamentals of Compressible Flow'*, New Age International Publishers, Third Edition, 2007..
2. Mathur M L, & Mehta F S, *' Thermal Engineering'*, Jain Brothers, New Delhi, 2003
3. Dennis G Shepherd , *'Aerospace Propulsion'*, Elsevier Publishing Company, New York, 1995.
4. Cohen H Rogers G F C, Saravana Mutto H I H, *'Gas Turbine Theory'*, Longman 5th Edition, New York, 2004.
5. Ganeshan V, *'Gas Turbines'*, Tata Mc Graw Hills, New Delhi 2003
6. Yadav, R *' Steam and Gas Turbines'*, Central Publishing House Ltd, Alllahabad, 2003.

ME 403

METROLOGY AND INSTRUMENTATION

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessional	25 Marks

Unit-I

Introduction- Linear and Angular measurements - Slip gauges and End bars - Gauge material and manufacturing methods, Different types of Micrometers, Height gauges, Tomlinson gauges. Precision polygon, Sine bar, Auto collimator, Dial indicator, Sigma and Mechanical comparator, Free flow and Back pressure type Pneumatic comparator. Application of set jet gauge heads.

Unit-II

Optical projector, Chart gauges, Micro gauge bridge lines. Tool maker's Microscope, Coordinate Measuring Machine. Measurement of Straightness and Flatness. Roundness measurement with bench centers and talyround, Surface Roughness Measurements Profilometer, Taylor Hobson Talysurf.

Unit-III

Limits and Fits, ISO system: Types of interchangeability, Taylor's Principle or plain limit gauges, Use of Plug, Ring and Snap gauges. Indicating type limit gauges. Thread metrology - 2 wire and 3 wire methods, Gear measurement - Gear tooth thickness, Parkinson gear tester, Gear measurement by gratings, General geometric tests for testing machine tools.

Unit-IV

Elements of instrumentation system. Static and Dynamic characteristics. Types of errors. Displacement transducers. LVDT. Strain measurement - Wire and foil type resistance strain gauges. Rosette Gauges. Bonding procedure. Lead resistance compensation. Adjacent arm and self

compensating gauges. Proving ring. Strain gauge load cells, measurement of axial load and torsion by strain gauges. Piezo electric load cell.

Unit-V

Introduction to Seismic Transducers - displacement and acceleration measurement, Pressure measurement - Bourdon pressure gauge, bulk modulus gauge, pirani gauge, Temperature measurement by thermo couples. Laws of thermo electricity. Types of materials used in thermocouples. Protection tubes. Extension wire. Series and parallel circuits. Ambient temperature compensation.

Suggested Reading:

1. Hume, *"Engineering Metrology"*, Kalyani Publications, 1985.
2. P. Donald Echman, *"Industrial Instrumentation"*, John Wiley and Sons, 1996.
3. RK Jain, *"Engineering Metrology"*, Khanna Publications, 1996.
4. Doeblin, *"Measurement Systems Application and Design"*, Tata McGraw Hill,5th ed., 2004.

ME 404

FINITE ELEMENT ANALYSIS

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Introduction to Finite Element Method for solving field problems, Stress and Equilibrium, Boundary conditions, Strain, Displacement, Stress-Strain relations.

One dimensional problems:

Finite element modeling coordinates and shape functions, Potential Energy approach: Assembly of Global stiffness matrix and load vector, Finite element equations, Treatment of boundary conditions, Galerkin's approach, Quadratic shape functions.

Unit-II

Analysis of trusses and frames: Element stiffness matrix for a truss member, Analysis of plane truss with two at each node. Analysis of frames with two translations and a rotational degree of freedom at each node, Analysis of Beams: Element stiffness matrix for two nodes (two degrees of freedom per node).

Unit-III

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Finite element modeling of axi-symmetric solids subjected to axi- symmetric loading with triangular elements.

Unit-IV

Two dimensional four nodded iso-parametric elements and numerical integration. Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional analysis of thin plate, Analysis of circular shaft subjected to torsion.

Unit-V

Dynamic Analysis: Formulation of finite element model, element matrices, Evaluation of Eigen values and Eigen vectors for a stepped bar and a beam, Time dependent field problems: Application to one dimensional heat flow in a rod. Introduction to finite element formulation of three dimensional problems in stress analysis, Convergence requirements. Introduction to Finite Element Analysis Software.

Suggested Reading:

1. G. Ramamurthy, *Applied Finite Element Analysis*, I.K. International Publishing House Pvt. Ltd., New Delhi., 2009
2. Tirupathi R, Chandraputla and Ashok D Belagundu, *'Introduction to Finite Elements in Engineering'*, Practice Hall of India, 1997.
3. Rao S S, *'The Finite Element Method in Engineering'*, Pergamon Press, 1989.
4. Segerlind L J, *'Applied Finite Element Analysis'*, Wiley Eastern, 1984.
5. Reddy J N, *'An Introduction to Finite Element Method'*, McGraw-Hill, 1984.

ME 405

OPERATIONS RESEARCH

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessional	25 Marks

Unit-I

Introduction : Definition and Scope of Operations Research.

Linear Programming : Introduction, Formulation of linear programming problems, graphical method of solving LP problem, simplex method, maximization and minimization, Degeneracy in LPP, Unbounded and, Infeaseable solutions.

Unit-II

Duality : Definition, Relationship between primal and dual solutions, Economic Interpretation, Post optimal of sensitivity analysis, Dual Simplex Method.

Unit-III

Transportation Models : Finding an initial feasible solution - North West corner method, Least cost method, Vogel's Approximation method, Finding the optimal solution, optimal solution by stepping stone and MODI methods, Special cases in Transportation problems - Unbalanced Transportation problem.

Assignment Problems : Hungarian method of Assignment problem, Maximization in Assignment problem, unbalanced problem, problems with restrictions, travelling salesman problems.

Unit-IV

Replacement Models : Introduction, replacement of items that deteriorate igoring change in money value, replacement of items that deteriorate considering change in money value with time, replacement of items that fail suddenly - Individual replacement policy, Group replacement policy.

Game Theory : Introduction, 2 person zero sum games, Maximi - Minimax principle, Principle of Dominance, Solution for mixed strategy problems, Graphical method for 2 x n and m x 2 games.

Unit-V

Sequencing Models : Introduction, General assumptions, processing n jobs through 2 machines, processing 'n' jobs through m machines, Processing 2 jobs through m machines.

Queuing Theory : Introduction, single channel - poission arrivals - exponential service times with infinite population & finite population, Multi channel - poisson arrivals - Exponential service times with infinite population.

Suggested Reading :

1. Hamdy, A. Taha, *"Operations Research - An Introduction"*, Sixth Edition, Prentice Hall of India Pvt. Ltd., 1997.
2. S.D. Sharma, *"Operations Research"*, Kedarnath, Ramnath & Co., Meerut, 2009.
3. Hrvey M. Wagner, *"Principles of Operations Research"*, Second Edition, Prentice Hall of India Ltd., 1980.
4. V.K. Kapoor, *"Operations Research"*, S. Chand Publishers, New Delhi, 2004.
5. R. Paneer Selvam, *"Operations Research"*, Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2008.

ME 355

CONTROL SYSTEMS THEORY
(For Production only)

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessional	25 Marks

Unit-I

Control Systems Classification: Open Loop & Closed Loop Systems. Mathematical models and Transfer functions from governing equations of mechanical, electrical, hydraulic, pneumatic, thermal systems. AC, DC servomotors & Electromechanical servo systems.

Unit-II

Block diagrams, Block diagram reduction. Signal flow graphs, Mason's gain formula. Transient response. Time domain specifications of 151 and 2nd order systems. Steady state error, Error coefficients, sensitivity Performance indices. Routh criteria.

Unit-III

Routh criteria, Root Locus method. Frequency Response: Bode, Polar plots. Correlation between transient and frequency response, Bandwidth, Experimental determination of transfer functions.

Unit-IV

Nyquist criteria. Gain and phase margins, Lead. Lag and Lead-lag compensator design, PID controller, linearization of Non linear systems.

Unit-V

State - space representation of linear control systems. State transition matrix. Solution of state equations: Zero input response and Zero state response. Concept of controllability and observability.

Suggested Reading:

1. Dorf, R.C., *"Modern Control Systems"*. Addison-Wesley 1989.
2. M. Gopal, *"Control Systems"*, Tata McGraw Hill, 2004.
3. Ogata, K., *"Modern Control Engineering"*, Prentice Hall, 2004.
4. Norman S. Nise, *"Control Systems Engineering"*, John Wiley & Sons, Inc., 2001.

ME 406

NEURAL NETWORKS

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Introduction: Knowledge - based information processing. A general view of knowledge based algorithm. Neural information processing. Hybrid intelligence. Artificial neuron.

Unit-II

Basic Neural Computation Models: Basic concepts of Neural network - Network properties, node properties, sigmoid functions. System dynamics. Inference and learning algorithm. Data representation. Functional classification models - single layer perceptions. Multilayer perceptions.

Unit-III

Learning supervised and unsupervised statistical learning. AI learning. Neural network Learning - Back propagation algorithm and derivation. Stopping criteria. Complexity of Learning Generalization.

Unit-IV

Self - organizing Networks: Introduction, The Kohonen algorithm, weight initialization, weight training, associative memories, bi-directional associative memories.

Unit-V

Hopfield Networks: Introduction: The Hopfield model. Hopfield network algorithm. Boltzman's machine algorithm. Neural applications.

Suggested Reading:

1. Limin Fu, *"Neural Networks in Computer intelligence"*, Mc-Gr: w Hill, 1995. '
2. Bart Kosho, *"Neural Networks and Fuzzy systems"*, Prentice H:ll of India, 1994.
3. James A. Freeman, Simulating, *"Neural Networks"*. Addison Wesley Publications, 1995.

ME 407

AUTOMOBILE ENGINEERING

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Types of automobiles: Normal, Hybrid and Hydrogen Fuel vehicles. Engine location" and its- components, chasis layout; crank shaft proportion, firing order, piston and piston rings, cylinder liners, valves and operation mechanism, inlet and exhaust manifolds, carburetion and fuel injection system, Mechanical Fuel Injection system & Electronic Fuel Injection system.

Unit-II

Lubricating systems: Wet sump, dry sump and petroil systems.

Cooling systems: Water pumps, radiators, thermostat control anti freezing compounds.

Types of Ignition Systems, Modern Ignition systems, Types of batteries and charging systems, starting motors, lighting and electrical accessories, automobile air-conditioning.

Unit-III

Steering systems: Linkage arrangements and its components modified Ackerman linkage-Wheel alignment, caster and camber. Rack and pinion assembly - Recent Trends.

Wheel and lyres: Tyre construction, specification. Tyre wear and causes, wheel balancing, Types *of* Suspension system, independent suspension, coil and leaf springs, torsion bar, shock absorbers.

Unit-IV

Power Train: Clutches, gear and gearbox manual, semi-automatic and automatic gearboxes. Torque converter, propeller shaft, universal coupling differential, Four-wheel drive system.

Brakes Systems: Description and operation of hydraulic brake, leading and trailing shoe layout, disc brakes, master cylinder, hand brake linkage - Recent Trends.

Unit-V

Maintenance: Pollution control, trouble shooting and servicing procedure overhauling, engine tune up, tools and equipment for repair and overhaul, testing equipment, pollution control technologies used for petrol and diesel engines, types and study of catalytic converters, Euro norms 2 & 3 and Bharat Norms - Recent Trends.

Suggested Reading:

1. CROUSE & Anglin, *'Automotive Mechanics'*, Tata McGraw Hill, Publishing Co. Ltd., New Delhi, Tenth Edition - 2004.
2. Kirpal Singh., *"Automobile Engineering"*, Vol. I & II Standard Publishers, Delhi.
3. Joseph Heitner, *"Automotive Mechanics"*, Affiliated East West Pvt. Ltd.
4. C.P. Nakra, *"Basic Automobile Engineering"*, Dhanpat Rai Publishing Co.(P) Ltd., New Delhi, 2003.

ME 408

NON CONVENTIONAL ENERGY SOURCES

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessional	25 Marks

Unit-I

Statistics on conventional energy sources and supply in developing countries, Definition-Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES. Classification of NCES-Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources.

Unit-II

Solar Energy-Energy available form Sun, Solar radiation data, Solar energy conversion into heat, Flat plate and Concentrating collectors, Mathematical analysis of Flat plate collectors and collector efficiency, Principle of Natural and Forced convection, Solar engines-Stirling, Brayton engines, Photovoltaic, p-n junction, solar cells, PV systems, Stand-alone, Grid connected solar power satellite.

Unit-III

Wind energy conversion, General formula –Lift and Drag- Basis of wind energy conversion –Effect of density, frequency variances, angle of attack, and wind speed. Windmill rotors- Horizontal axis and vertical axis rotors. Determination of torque coefficient, Induction type generators- working principle.

Unit-IV

Nature of Geothermal sources, Definition and classification of resources, Utilization for electric generation and direct heating, Well Head power generating units, Basic features- Atmospheric exhaust and condensing, exhaust types of conventional steam turbines.

Pyrolysis of Biomass to produce solid, liquid and gaseous fuels, Biomass gasification, Constructional details of gasifier, usage of biogas for chulhas, various types of chulhas for rural energy needs.

Unit V

Wave, Tidal and OTEC energy- Difference between tidal and wave power generation, Principles of tidal and wave power generation, OTEC power plants, Operational of small cycle experimental facility, Design of 5 Mw OTEC pro-commercial plant, Economics of OTEC, Environmental impacts of OTEC. Status of multiple product OTEC systems.

Suggested Reading:

1. Ashok V Desai , *'Non-Conventional Energy'* , Wiley Eastern Ltd, New Delhi, 2003
2. Mittal K M, *'Non-Conventional Energy Systems'*, Wheeler Publishing Co. Ltd, New Delhi, 2003.
3. Ramesh R & Kumar K U, *'Renewable Energy Technologies'*, Narosa Publishing House, New Delhi, 2004
4. Wakil M M, *'Power Plant Technology'*, Mc Graw Hill Book Co, New Delhi, 2004.

ME 409

TOOL DESIGN

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Cutting tool materials and processes: Desired properties, Types, major constituents, relative characteristics, latest developments, ISO: Classification and coding of carbide tools, Coated tools. Principles of working and applications of USM, EDM, ECM, AJM, LBM, and EBM. Superfinishing processes: Honing, Lapping Burnishing, Ballizing, Polishing.

Unit-II

Design of single point cutting tools, Form Tools: Design of flat and circular Form Tools and tool holding methods.

Design of Multi Point Cutting tools: Milling Cutters: Major types, design and manufacturing of peripheral, end and face milling cutters. forces and power estimation. Grinding of milling cutters.

Broaches: Pull and Push types. Internal and External broaches, geometry and design and manufacturing of Pull type and push type broaches.

Unit-III

Multi point cutting tools:

Twist Drill geometry, Design and manufacturing of twist drill. Effect of variation of different angles on torque and thrust forces. Types and design of shanks. Sharpening of twist drill.

Reamers: Types, geometry, Reaming allowance, tolerance disposition, Design and manufacture of twist drills.

Taps and Dies: Types, Geometry, Design and manufacturing of Taps and Dies.

Unit-IV

Design of Press tools: Die set elements. Design of Die Set for simple components in Blanking, Piercing, bending, Drawing, Forging and Spinning. Plastic Tools: Plastic Dies for simple components.

Unit-V

Jigs & Fixtures: Design principles and construction features. Locating methods associated with flat, cylindrical, internal and external surfaces. Type of locating pins. Requirements and choice of locating systems. Redundant location, fool proofing. Setting blocks, types of clamping devices and their basic elements. Quick action clamps and nuts. Equalising and multiple clamping pneumatics. Hydraulic, magnetic, electrical and vacuum clamping. Types of drill jigs and their classification. Types of jig bushes, jig feet, Indexing jigs. Design of Fixtures for Turning, grinding, welding and Milling. Economic analysis of Jigs and Fixtures.

Suggested Reading:

1. Donaldson, Leain and Goold, *"Tool Design"*, Tata Mc Graw Hill, New Delhi, 1983.
2. Rodin – *"Design of cutting tools"*, Mir Publications, Moscow.
3. Amitabha Battacharya and Inyong Harn, *"Design Of Cutting Tools"*, Use Of Metal Cutting Theory, ASTME publication Michigan USA, 1969.
4. Surender Keshav & Umesh Chandra - *"Production Engineering"* Design (Tool Design), Satya Prakashan, New Delhi-1994.

ME 411

ENTREPRENEURSHIP

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessional	25 Marks

Unit-I

Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.

Unit-II

Identification and characteristics of entrepreneurs. Emergence of First generation entrepreneurs, environmental influence and women entrepreneurs. Conception and evaluation of ideas and their sources. Choice of Technology - Collaborative interaction for Technology development.

Unit-III

Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis. project financing in India.

Unit-IV

Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of tax burden.

Unit-V

Behavioural aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

Suggested Reading:

1. Vasant Desai, *"Dynamics of Entrepreneurial Development and Management"*, Himalaya Publishing House, 1997.
2. Prasanna Chandra, *"Project-Planning, Analysis, Selection, Implementation and Review"*, Tata Mcgraw-Hill Publishing Company Ltd. 1995
3. Stephen R. Covey and A. Roger Merrill, *"First Things First"*, Simon and Schuster Publication, 1994.
4. G.S. Sudha, *"Organizational Behaviuor"*, National publishing house, 1996.
5. Robert D. Hisrich, Michael P. Peters, *"Entrepreneurship"*, Tata Mc Graw Hill Publishing Company Ltd., 5th Ed., 2005.

ME 412

COMPUTATIONAL FLUID FLOWS

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-1

Review of the basic fluid dynamics: Continuity, Momentum and Energy equations-Navier Stokes equations, Reynolds and Favre averaged N-S equations. Heat transfer conduction equations for steady and un-steady flows, Steady convection –diffusion equation

Unit-II

Introduction to turbulence, Mixing length model, K-epsilon turbulence model. Classification of Partial differential equations – Elliptic, parabolic and hyperbolic equations. Initial and boundary value problems

Unit-III

Concepts of Finite difference methods-forward, backward and central difference. Finite difference solutions-Parabolic partial differential equations-Euler, Crank Nicholson, Implicit methods.
Errors, consistency, stability analysis –Von Neumann analysis. Convergence criteria.

Unit-IV

Elliptical partial differential equations- Jacobi, Gauss Seidel and ADI methods.

Viscous incompressible flow, Stream function –Vorticity method

Introduction to grid generation –Types of grid-O,H,C.

Unit V

Introduction to finite volume method. Finite volume formulations for diffusion equation, convection diffusion equation. Solution algorithm for pressure velocity coupling in steady flows Staggered grid, simple

Algorithm

Suggested Reading:

1. Pradip Niyogi, Chakrabartty S K, Laha M K, *' Introduction to Computational Fluid Dynamics'*, Pearson Education,2005.
2. Muralidhar K, Sundararajan T, *'Computational Fluid Flow and Heat Transfer'*, Narosa Publication House, New Delhi, 2003
3. Chung T J, *'Computational Fluid Dynamics"*, Cambridge University Press, New York, 2002.
4. John D Anderson, *'Computational Fluid Dynamics'*, Mc Graw Hill Inc., New York, 2003
5. Patankar S V, *'Numerical Heat Transfer and Fluid flow'*, Hemisphere Publishing Company, New York, 1980.
6. H.K.Versteeg, W. Malalasekara, *"An Introduction to Computational Fluid Dynamics"*, Pearson Education, 2nd Ed.2007.

ME 413

DESIGN FOR MANUFACTURE

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessional	25 Marks

UNIT-I

Introduction: General design principles for manufacturability, strength and mechanical factors, mechanisms selection, evaluation method, geometrical tolerances, tolerances control and utilization.

Economic Use of Raw Materials: Ferrous steel, hot rolled steel, cold finished steel, stainless steel, non ferrous materials aluminium, copper, brass, non metallic materials, plastics, rubber and composites.

UNIT-II

Metallic Components Design: Metal extrusion, metal stamping, fine blanking, four slide parts, spring and wire forms, spun metal parts, cold headed parts, extruded parts, tube and section bends, rolled formed parts, power metal parts, forging electro forming parts, specialized forming methods, turned parts, machined round holes, drilled parts, milled parts.

UNIT-III

Metallic Components Design: Planned shaped and slotted parts, screw threaded contoured and internal ground parts, center less ground, electrical discharged, rolled furnished parts, electro chemical and advanced machine parts, Sand cast, diecast, investment cast and other cast products.

UNIT-IV

Non Metallic Component Design: Thermosetting plastic, injection moduled and rotational moulded parts, blow moulded, welded plastic articles, ceramics.

Assembled Parts Design: Welded parts, arc, resistance, brazed and soldered parts, gear box assembly, bearing assembly.

UNIT-V

Assembled Parts Design: Retension, bolted connection, screwed connections, flanged connections, centered connections, press fitted connections, surface finishing, plated parts, heat treated parts, NC machining, group technology, low cost automation, computer aided manufacture, product design requirements.

Case Studies: Identifications of economical design and redesign for manufacture

Suggested Reading:

1. James G. Bralla, *"Hand book of product design for manufacturing"* McGraw Hill Co., 1986
2. K.G. Swift *"Knowledge based design for Manufacture"*, Kogan page Limited, 1987.

ME 452

COMPOSITE MATERIALS

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Introduction : Definition and classification of Composites (PMC, MMC, CMC), FRP Composites, Fiber Reinforcements: Fiber Types and its properties, Fiber Forms, Matrix materials and its properties: Thermoset Matrices, Thermoplastic Matrices, Applications of Composite Materials.

Unit-II

Manufacturing Processes: Hand-Lay-up, Prepreg Lay-up, Bag Molding, Autoclave processing, Compression Molding, Resin Transfer Molding, Pultrusion, Filament Winding, Gel time test for resins, Curing Cycle.

Measurement of basic composite properties: Fiber and matrix tests, Tensile test, Compressive test, in-plane shear test, interlaminar shear test, flexure test.

Unit-III

Micromechanics of Composites:

Basic Concepts: Volume and Mass fraction, Heterogeneous, Anisotropic, Orthotropic, Transversely Isotropic and Isotropic Materials.

Mechanical Properties: Prediction of Elastic constants, micromechanical approach, Stress Partitioning Parameter, Halpin-Tsai equations.

Thermal Properties: Thermal Expansion, Moisture Expansion, Transport Properties.

Unit-IV

Macromechanics of Composites:

Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation, Classification of Laminated composites, analysis of

laminated composites, stresses and strain with orientation, Interlaminar stresses and edge effects.

Unit-V

Strength of Orthotropic lamina: Tensile and compressive strength of unidirectional fiber composites, fracture modes in composites, delamination failure, Maximum stress theory, Maximum Strain theory, Tsai-Hill Criterion, Tsai-Wu Criterion.

Laminate Strength: First Ply Failure, Fiber Failure, Truncated- Maximum-Strain Criterion.

Suggested Reading:

1. Ronald F.Gibson, *"Principles of Composite Materials Mechanics"*, McGraw-Hill, Inc, 1994.
2. Krishna, K,Chewla, *"Composite Materials"*, Springer-Verlag, 1987.
3. Carl. T.Herakovich, *"Mechanics of Fibrous Composites"*, John Wiley Sons inc., 1998.
4. Ever J. Barbero, *"Introduction to Composite Materials Design"*, Taylor & Francis, 1999.
5. Jones, R.M., *"Mechanics of Composite Materials"*, McGraw-Hill Co., 1967.

ME 467

TOTAL QUALITY MANAGEMENT
(For Production only, Elective - I)

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit - I

Strategic Quality Management: Quality policies, quality goals, obstacles to achieving successful strategic quality management.. Organization for quality role of {Top. middle, work force teem (Quality Circles). Developing, a quality work culture - Maslow need theory, Herzbeg 2 factor theory, theory X, Y & Z. Methods to create and maintaina awareness of quality, provide evidence of management leadership, types of self development and empowerment programmes, methods of participations means of inspiring action, recognition and rewards. Supplier quality rating plans (lot plot plan, OC curve, parento analysis) assignment of supplier capability, Methods of evaluating supplier products, contract management (Joint economic plan, join technological forecasting).

Unit - II

Design for quality: Basic functional requirements of quality, Design for (reliability, safety cost and product performance) concurrent engineering (DFMA) value engineering. Support for quality improvement processes (Block diagram, brain storming, cause effect analysis, pareto analysis) Quality function deployment, reliability analysis, failure rate, failure pattern of complex products (bath tub curve) weibull distribution relationship between part and the system exponential reliability, availability, FMEA (Fracture mode and Effect Analysis) Design for experiments: Factorial experiments, construction fractional designs.

Unit - III

Technical tools for quality: Comparison of two methods: observation of data, distribution. statistical analysis. chi square test, F test. T test. Hypothesis testing significance testing. linear correlation and regression. Analysis of variance (ANOVA). 4 factor ANOVA experiment 2 levels. Analysis of means. Techniques for on line quality: : Data collection plan,

variable an attribute charts, interpreting the control charts, charts for drifting processes. mufti variant charts. alternatives to statically process controls. Techniques for off line quality control: Background to Taguchi method (Quality loss and loss function. controllable factor and non controllable factors in parameter performance, tolerance design. Taguchi Analysis Techniques: Net variation and contribution ratio, estimation of process performance. Accumulating analysis, performance measures-avoiding means variance dependents, choosing noise perform ince measure, minute analysis and life testing Taguchi tolerance desigi and tolerance (re) design.

Unit - IV

Quality Information System: Scope of quality information system. Different between QIS and MIS. Creating new software (steps, types, defects) reports on quality (operational and executive reports) Features of QIS software. Software for inspection.

Inspection system: Operational sorting and correction sorting. AQL, LTPD, AOQL. Non destructive test. Audit systems: (quality improvement planning and implementation, describing quality function. process control system. Control of measurement system. material identification and control. drawing and specification control. process corrective action) the concept of POKA YOKE.

Unit - V

Measure of customer needs: The need to measure customer satisfaction. Importance of proper packaging, customer processing and installation of product. dealing with customer complaints, using weibull analysis, field feed back, parameter to measure customer (Dis) satisfaction. Problems with the customer satisfaction system. Beyond TOM: Difficulties in implementing TOM system, rating your quality system. JIT system. the people side of TOM. system integration, Kansei engineering and flexibility in manufacturing.

Suggested Reading:

1. H. G. Menon. *TOM in view Production Manufacturing*, Mc Graw Hill, Publishers.
2. N. G. Logothetis, *Managing for total quality.*
3. J. M. Juran & Frank Gryna. *Quality planning and analysis.*
4. Hanson and Ghare. *Quality control and application.*

ME 431

THERMAL ENGINEERING LAB

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessional	25 Marks

1. Determination of COP of the Air Conditioning system.
2. Determination of percentage relative humidity and study of humidification and dehumidification process in Air Conditioning systems.
3. Determination of COP of Refrigeration systems using capillary tube/ thermostatic expansion valve.
4. Determination of overall efficiency of centrifugal blower.
5. Determination of overall efficiency of axial flow fan.
6. Pressure distribution on symmetrical and non-symmetrical specimen in wind tunnel
7. Measurement of lift and drag force of the models in wind tunnel test section.
8. Determination of thermal conductivity of metal bar.
9. Determination of the efficiency of pin-fin subjected to natural and forced convection.
10. Determination of effectiveness of heat parallel flow and counter flow heat exchanger.
11. Determination of emissivity of given test plate.
12. Determination of Stefan-Boltzman constant.

ME 432

METROLOGY AND INSTRUMENTATION LAB

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessional	25 Marks

1. Measurement with inside, outside and depth micrometers.
2. Measurement with height gauges, height masters, etc.
3. Measurement of Linear and Angular dimensions with Tool Maker's Microscope - Flat specimens plain, cylindrical specimens with centers and threaded components.
4. Measurement with - Dial Indicator / Electrical Comparator / Mechanical Comparator / Dial Bore Gauges, etc.
5. Measurement of angles with Sinebar, Bevel protractor and Precision level, Block level, etc.
6. Measurement of roundness errors with bench centres.
7. Geometrical tests on Lathe machine.
8. Measurement of flatness errors (surface plate) with precision level.
9. Measurement with optical projector.
10. Checking machined components with plug gauges, adjustable snap gauges, indicating gauges, etc.
11. Force measurement with strain gauge type load cell / proving ring / piezoelectric load cell etc.
12. Temperature measurement with thermocouples.

MP 431

MANUFACTURING ENGINEERING LAB
(For Semester - I, Production only)

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessional	25 Marks

One of the following items are to be manufactured using all the production processes as far as possible and assembly techniques with fits and tolerances using CAD system.

1. V Block with U Clamp
2. Dial test indicator stand
3. Simple Jig
4. Simple fixture
5. Simple die set
6. Gear pump using spur gears
7. Cam - operated valve mechanism (An eccentric mechanism)
8. Machine vice
9. Simple tail stock mechanism
10. Lathe tool post
11. Milling machine arbor
12. Pipe vice
13. 2 Axis table
14. Paper punch (double punch)
15. Hydraulic cylinder
16. Gear box (Spur, helical or worm)

ME 433

PROJECT SEMINAR

Instruction	3 Periods per week
Sessional	25 Marks

The objective of the project seminar is to actively involve the student in the initial work required to undertake the final year project. It may comprise of:

- Problem definition and specifications.
- A broad understanding of the available techniques to solve a problem of interest.
- Presentation (Oral and Written) of the project.

The Department can initiate the work related to project allotment at the end of III year II semester and complete it in the first two weeks of the fourth year I semester.

First 4 weeks of IV year 1st semester will be spent on special lectures by faculty members, research scholar speakers from industries and R&D institutions. The objective of these talks is to be expose students to real like / practical problems and methodologies to solve them.

A seminar schedule will be prepared by the coordinator for all the students. It should be from the 5th week to the last week of the semester and should be strictly adhered to.

Each student will be required to

1. Submit a one page synopsis of the seminar to be delivered for display on notice board.
2. Give a 20 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write up on the talk delivered.

At least two teachers will be associated with the evaluation of the project seminar for the award of the Sessionals marks which should be on the basis of performance on all the three items stated above.

Note: Three periods of contact load will be assigned to each project guide.

ME 472

INDUSTRIAL ADMINISTRATION & FINANCIAL MANAGEMENT

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessional	25 Marks

Unit-I

Industrial Organisation: Types of various business organizations. Organisation structures and their relative merits and demerits. Functions of management.

Plant location and layouts: Factors affecting the location of plant and layout. Types of layouts and their merits and demerits.

Unit-II

Work study, Definitions, objectives of method study and time study. Steps in conducting method study. Symbols and charts used in method study. Principles of motion economy. Calculation of standard time by time study and work sampling. Performance rating factor. Types of ratings. Jobs evaluation and performance appraisal. Wages, incentives, bonus, wage payment plans.

Unit-III

Inspection and quality control: Types and objectives of inspection S.Q.C., its principles. Quality control by chart and sampling plans. Quality circles, introduction to ISO.

Production planning and control: Types of manufacture. Types of production. Principles of PPC and its function. Production control charts.

Unit-IV

Optimisation: Introduction to linear programming and graphical solutions. Assignment problems.

Project Management: Introduction to CPM and PERT. Determination of critical path. .

Material Management: Classification of materials. Materials planning. Duties of purchase manager. Determination of economic ordering quantities. Types of materials purchase.

Unit-V

Cost accounting: Elements of cost. Various costs. Types of overheads. Break even analysis and its applications. Depreciation. Methods of calculating depreciation fund. Nature of financial management. Time value of money. Techniques of capital budgeting and methods. Cost of capital. Financial leverage.

Suggested Reading:

1. Pandey I.M. *"Elements of Financial Management"*, Vikas Publ. House, New Delhi, 1994.
2. Khanna O.P., *"Industrial Engineering and Management"*, Dhanapat Rai & Sons.
3. Everrete E. Adama & Ronald J. Ebert, *"Production & Operations Management"*, Prentice Hall of India, 5th Edition, 2005.
4. S.N. Chary, *"Production and Operations Management"*, Tata McGraw Hill, 3rd Edition, 2006.
5. Paneer Selvam, *"Production and Operations Management"*, Pearson Eduction, 2007.

WITH EFFECT FROM THE ACADEMIC YEAR 2009-2010

SCHEME OF INSTRUCTION AND EXAMINATION

B.E. IV/IV (REGULAR)

MECHANICAL ENGINEERING

SEMESTER - II

Sl. No.	Syllabus Ref. No.	Subject	Scheme of Instruction		Scheme of Examination		
			Periods per Week		Dura-tion in Hrs	Maximum Marks	
			L/T	D/P		Univ. Exam	Sessi-onals
		THEORY					
1.	ME 451	Management Information Systems	4	-	3	75	25
2.	ME 461	Production and Operations Management	4	-	3	75	25
3.		ELECTIVE - II	4	-	3	75	25
4.		ELECTIVE - III	4	-	3	75	25
		PRACTICALS					
1.	ME 481	Seminar	-	3	-	-	25
2	ME 482	Project	-	6	Viva voce	Gr*	50
		TOTAL	**16**	**9**	**-**	**300**	**175**

*Excellent/Very Good/Good/Satisfactory/Unsatisfactory

ELECTIVE – II

EC 441 Microprocessor Applications
ME 453 Artificial Intelligence and Expert Systems
ME 454 Machine Tool Design
ME 455 Manufacturing Systems and Simulations
ME 456 Mechatronics
LA 454 Intellectual Property Rights
ME 462 Nano Materials &Technology
ME 463 Power Plant Engineering

ELECTIVE – III

ME 457 Robotics.
ME 458 Product Design and Process Planning
ME 459 Modern Machining and Forming Methods
ME 460 Plastics Engineering & Technology
CS 452 Computer Graphics **
CS 408 Internet Programming
ME 464 Fuels & Combustion
ME 465 Rapid Prototyping Technologies

SERVICE COURSE

ME 472 Industrial Administration and Financial Management (Service course to EE&IE)

** same as CS 352

WITH EFFECT FROM THE ACADEMIC YEAR 2009-2010

SCHEME OF INSTRUCTION AND EXAMINATION

B.E. IV/IV (REGULAR)

PRODUCTION ENGINEERING

SEMESTER - II

Sl. No.	Syllabus Ref. No.	Subject	Scheme of Instruction		Scheme of Examination		
			Periods per Week		Duration in Hrs	Maximum Marks	
			L/T	D/P		Univ. Exam	Sessionals
		THEORY					
1.	ME 451	Management Information Systems	4	-	3	75	25
2.	ME 461	Production and Operations Management	4	-	3	75	25
3.		ELECTIVE - II	4	-	3	75	25
4.		ELECTIVE - III	4	-	3	75	25
		PRACTICALS					
1.	ME 481	Seminar	-	3	-	-	25
2.	ME 482	Project*	-	6	Viva voce	Gr*	50
		TOTAL	16	9	-	300	175

*Excellent/Very Good/Good/Satisfactory/Unsatisfactory

ELECTIVE – II

EC 441 Microprocessor Applications
ME 453 Artificial Intelligence and Expert Systems
ME 454 Machine Tool Design
ME 455 Manufacturing Systems and Simulations
ME 456 Mechatronics
LA 454 Intellectual Property Rights
ME 462 Nano Materials &Technology
ME 463 Power Plant Engineering

ELECTIVE – III

ME 457 Robotics
ME 458 Product Design and Process Planning
ME 459 Modern Machining and Forming Methods
ME 460 Plastics Engineering & Technology
CS 452 Computer Graphics **
CS 408 Internet Programming
ME 465 Rapid Prototyping Technologies
ME 466 Material Handling

ME 451

MANAGEMENT INFORMATION SYSTEMS

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Inventory control: Deterministic and stochastic inventory models; variable demand, lead time, specific service level, perishable products and service.

Inventory control in application; concepts for the practitioners; saving money in inventory systems; ABC classifications.

Inventory control procedures; Quantity - reorders versus periodic inventory systems; material requirement planning (MRP); MRP as a scheduling and ordering system; MRP system components; MRP computational procedure; Detailed capacity planning; MRP -limitation and advantages; Manufacturing Resource Planning (MRP-II).

Unit-II

Forecasting: Demand over time; dependant versus independent demand; Forecast error; Forecast models for operations; Qualitative models - Delphi, Nominal group technique, Time - series qualitative models; Single average; single moving average; Weighted moving average; Exponential smoothing; Smoothing coefficient selection; Adaptive exponential smoothing; Double exponential smoothing.

Unit-III

Marketing Management: Marketing concept - 4P components of marketing mix management, product life cycle and its forecasting strategies. Marketing Research Techniques and different sales promotion methods.

Financial Management: Element of cost - establishing selling price of a product, overheads and its distribution. Nature of financial management. Time value of money, techniques of capital budgeting.

Unit-IV

Project Management:

Network analysis; Network fundamental; PERT/CPM; Scheduling the activities; Fulkersons's rule; Earliest and latest times; Determination of ES and EF in the forward pass; LS and LF in backward pass; Determination of critical path; Beta distribution; Deterministic and probabilistic models; Time-Cost trade-offs; Resource analysis and allocation.

Unit-V

Information Systems: Managerial functions and roles, comparison of the characteristics of the information systems used at operational, tactical and strategic planning levels, concepts of systems and organizations, Model of an information system, Strategic uses of information technology. Categories of computers, input/output devices, primary and secondary storage, introduction to operating systems.

Suggested Reading:

1. Everett E. Adam, Jr and Ronald J. Ebert, *"Production and Operations Management – concepts, models and behavior"*, 51h ed. 1998, (EEE), Prentice - Hall of India (P) Ltd., New Delhi.
2. Robert Schultheis, Mary Summer, *"Management Information Systems"* Irvin McGraw Hill, 1998.
3. Laudon, KC. & Laudon, J.P. *"Management Information Systems"*, Pearson Education (India), 2002.
4. Khalid Sheikh, *"Manufacturing Resource Planning (MRP-II) with Introduction to ERP, SCM ann CRM"*, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2001.

ME 461

PRODUCTION AND OPERATIONS MANAGEMENT

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessional	25 Marks

Unit-I

Scientific Management by Taylor and Fayol. Functions of Management Types of Business firms and organizational structures.

Manufacturing Process Technology: Project, job shop, batch, assembly line and continuous process technology; flt:1xible manufacturing systems.

Unit-II

Locating production and service facilities, effects of location and costs and revenues, factor rating, simple median model.

layout planning: process layout; product layout - Assembly lines; manufacturing cellular layout. Scheduling systems and aggregate planning for production and services; operations planning and scheduling systems; loading assignment algorithm; priority sequencing and other circuits.

Unit-III

Work methods analysis, work measurement techniques; predetermined time study; work sampling Managing for quality; process variation; statistical process control charts for variables and attributes.

Unit-IV

Material Handling: Earthmoving Machinery: Types, working and applications of excavators, tractors and scrapers. Operation and selection of (a) Hoisting equipment: cranes, trucks and wagons; (b) conveying equipment: Belt, Screw and bucket conveyor systems aerial ropeway.

Principles of pneumatic and hydraulic conveying systems: automatic handling, AGV, RGV.

Unit-V

Japanese management overview, value added manufacturing, Japanese manufacturing techniques; total quality emphasis - Deming contribution to TOM, quality circles; fishbone diagram, Taguchi method of quality control, push or pull system Kanban system.

Suggested Reading:

1. Everett, E. Adam. Jr and Ronald. J. Ebert - *"Production and operations management – concepts, models and behaviour"* - Prentice – Hall (India) Pvt. Ltd., New Delhi, 5th ed. 1998.
2. Lee J. Krajewski, Larry. P. Ritzman, *"Operations Management: Strategy and Analysis"* – Addison Wesley Longman (Singapore) Pvt Ltd., India Branch, 5th ed., 2000 year.
3. Richard B. 8hase, Nicholas, J. Aquilano and F. Robert Jacobs. *"Production and operations management - manufacturing and services"* - Irvin McGraw - Hill; New Delhi, 5th ed. 1998.
4. Mahesh Verma, *"Conservation equipment and its planning and application"* - Metropolitan book Co. Pvt. Ltd, New Delhi, 3111 ed. 1997.

EC 441

MICROPROCESSOR APPLICATIONS

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Basic Concepts: Evolution of microprocessors - organization of microcomputers - microprocessor programming - digital logic - timing diagram conventions.

Data Representation: Introduction- positional number systems - the binary number system - representation of integers - Representation of real number - Binary arithmetic - other number systems - Character representation.

Unit-II

Programming microprocessor: Introduction - organization of the 8085 Instruction set of the 8085 - programming the 8085 - Assembler Programming -language for writing. Algorithms - programming examples - the Zilog80.

Unit-III

Semi conductor memories: Introduction - characteristics of memories static rams - dynamic RAMS.

Reprogrammable ROMS - Memory system reliability.

Microprocessor Timings: Introduction - timing and control unit - timings of Intel 8085 - timing of Zilog Z80 - register organization.

Unit-IV

Interfacing memory and 1/0 Devices: Introduction address space partitioning - memory interfacing -data transfer schemes - programmed data transfer - direct memory access data transfer - serial data transfer. Interfacing Devices: Introduction - types of interfacing devices - address decoding for I/O -INPUT/OUTPUT ports - programmable interrupt

controller - programmable DMA controller - communication interface - analog input devices - analog output devices - analog input subsystems - analog output subsystems.

Unit-V

Application of micro processors: Temperature monitoring system - Automotive applications- closed loop process control.

Suggested Reading:

1. Aditya P. Mathur, *" Introduction to Microprocessors"*, Tata Mc Graw Hill Publisher company Ltd.,New Delhi.2002
2. Ram B, *"Fundamentals of Microprocessors and Micro-computers"*, Dhanpat Rai & Sons -2000.
3. M. Rafiq - uz – Zamon, *"Microprocessors theory and applications"*., PHI, 2001.

ME 453

ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Introduction: Intelligence, definition, types, cognitive aspects approach, measuring intelligence, early efforts. IQ and AI, aspects of intelligence, learning, problem solving, creativity, behaviour and biology.

Unit-II

Cognitive Psychology: The mid, information and cybermatics, components for thought, modes of perception, visual, auditory and other systems, memory mechanisms, problem solving - planning search, the GPS systems, types of learning - route parameters methods and concept, game playing, reasoning.

Unit-III

Knowledge Engineering: Introduction, role of knowledge engineer, knowledge representation, psychology, production rules, logic and programming, common sense and fuzzy logic, semantic networks, learning systems.

Unit-IV

Visual Perception: Introduction, biology of vision, computation aspects, towards artificial vision, picture processing - identifying real objects; vision programmed, factory vision systems. Robotics: AI impact, robot sensors, factory robots, personal robots, future robot.

Unit-V

Expert Systems: Introduction, knowledge acquisition for expert systems; features of expert systems, system structure, inference engines, uncertainties; memory mechanism, range of applications, actual expert systems – VP expert.

Suggested Reading:

1. E. Rich, Kevin Knight, *"Artificial Intelligencies"*, 2nd Edition, TMH.
2. Charnaik E. and McDermott D., *"Introduction to Artificial Intelligence"*, Addison Wesely, 1995.
3. *"Artificial Intelligence in Business Science and Industry"*, Vol.2 applications, PH. 1985.
4. PH Winston, *"Artificial Intelligence"*, Addison Wesely.

ME 454

MACHINE TOOL DESIGN

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessional	25 Marks

Unit - I

Classification of machine tools. Mechanisms used for converting rotary to linear motion and intermittent motion. Kinematic structures of machine tools - general purpose, special purpose, automatic screw cutting machines. Basic features of transfer machines. Numerical Control of machine tools, advantages and limitations. Schematic diagrams of NC systems.

Unit - II

Drives of machine tools; selection of range of speeds and feeds. Speed layout in GP, AP and logarithmic progression. Standardization of speeds and feeds. Productivity loss.

Selection of highest and lowest speeds, range ratio. Design of ray diagram and structural diagrams for machine tool gear boxes. Determination of number of teeth and module of gears in gear box design. Rules for lay out of gear box having sliding clusters. Sliding cluster and clutched drives, Ruppert drive.

Unit - III

Feed gear boxes: Norton and Meander gear boxes. Stepped and step less regulation of speeds.

Strength and Rigidity design analysis. Design of beds, frames, Columns and Guide ways.

Materials for structures. Methods to improve the rigidity of structures. Overall compliance of machine tool. Thermal effects – functional accuracy of machine tool.

Unit - IV

Spindle units: Spindles of lathe, Drilling, Milling and Grinding machines.aterials for spindles. Spindle design. Effect of clearance on the rigidity of spindle.

Hydro-dynamic and Hydro-static bearings; Requirements of spindle bearings.

Unit - V

Hydraulic controls: various controls used in machine tools. Hydraulic and Pneumatic systems used in machine tools. Positive displacement pumps. Power pack. Relief valves, check valves, flow control valves, multi position direction control valves, Filters, Accumulators. Speed regulation of surface grinding machine. Hydro- copying systems.

Suggested Reading:

1. G C Sen & Bhattacharya, *"Principles of machine tools"*, New Central Book Agency, Calcutta
2. N K Mehta, *"Machine Tool Design and Numerical Control"*, Tata McGraw-Hill publishing co. Ltd.
3. S.K.Basu, *"Design of machine tools"*, Allied Publishers
4. S R Majumdar, *"Hydraulic Systems- Principles & Maintenance"*, Tata Mc.Graw-Hill Publishing Company *Limited; New* Delhi

ME 455

MANUFACTURING SYSTEMS AND SIMULATIONS

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Manufacturing systems: Definition of systems; basic concepts and problems concerning systems; Systems design: Decision making procedures; Structural, Transformational and procedural aspects of manufacturing; Modes of production. Process systems for manufacturing; logistic systems; material flow & technological information flow. Management and information systems for manufacturing: Managerial information flow in manufacturing systems.

Unit-II

Information systems: Fundamentals of information technology, information systems, information networking, parts oriented production information systems, and computerized production scheduling, online production control systems. Computer based production management systems. Automation systems for manufacturing: Industrial automation, kinds of automation, principles of CIM, effectiveness of CIM, factory automation, automatic machine tools for mass production, NC machine tools, computer controlled manufacturing systems, FMS, automated assembly, automatic material handling, automatic inspection and testing, computer integrated automation systems - unmanned factory.

Unit-III

System Models: Concepts, continuous and Discrete systems, systems modeling, type of models, subsystems, corporate model, system study. System simulation: Techniques, comparison of simulation and analytical methods, types of simulation, distributed log model, cobweb models.

Unit-IV

Continuous system simulation: Numerical solution of differential equation, analog computers, hybrid computers, continuous system simulation languages CSMP, system dynamic growth models, logistic curves. Discrete systems simulation: Events generation of arrival patterns, simulation programming tasks, analysis of simulation output.

Queuing theory: Arrival pattern distribution, service times, queuing disciplines, and measure of queues.

Unit-V

GPSS and SIMSCRIPT: General description of GPSS and SIMSCRIPT, programming in GPSS Simulation Programming Techniques: Data structures, implementation of activities, event and queues, event scanning, simulation algorithms in GPSS and SIMSCRIPT.

Suggested Reading:

1. David Bedworth & James Bailey, *"Integrated production control system management, analysis & design"*, 2nd ed., John Wiley & Sons Ltd.
2. Ronald zskin & Charles Standridge, *"Modeling and Analysis of Manufacturing Systems"*, John Wiley & Sons Ltd.
3. Geofery Gordan, *"Systems Simulation"*, Prentice Hall, 1980.
4. Deo. N., *"System Simulation with Digital Computers"*, Prentice Hall, 1980.

ME 456

MECHATRONICS

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Introduction to mechanization & automation. Need of interface of electrical & electronic devices with mechanical elements. The concept of Mechatronics: Flow chart of mechatronics system, elements of mechatronics system, drive mechanisms, actuators, feedback devices and control system. Application in industries and systems development.

Unit-II

Drive mechanisms: Feeding and indexing, orientation, escapement and sorting devices, conveyor systems. Introduction to electrical actuators: A.C servo motors, D.C. servomotors, stepper motors.

Unit -III

Introduction to fluid power systems: Industrial pneumatics and hydraulics. Merits of fluid power. Pneumatic and hydraulic elements symbols. Study of hydraulic control values, pumps & accessories. Hydraulic circuits and mechanical servo control circuits, Electro-hydraulic and Hydro-pneumaticcircuits

Unit IV

Introduction to industrial electronic devices: Diodes, Transistors, Silicon controlled Rectifiers (SCR), Integrated Circuits (IC), Digital Circuits. Measurement systems & Data acquisition systems: sensors, digital to analog and analog-to-digital conversion. Signal processing using operational amplifiers. Introduction to micro processor & micro controller. Temperature measurement interface and LVDT interface. Systems Response.

Unit-V

Design of Modern CNC machines and mechatronics elements: machine structures, guide ways, spindles, tool monitoring systems, adaptive control systems. Flexible manufacturing systems. Multipurpose control machines. PLC programming

Suggested Reading:

1. W.Bolton, *"Mechatronics"*, Pearson Education Ltd.
2. HMT Limited, *"Mechatronics"*, 1998 Tata Mc.Graw-Hill publishing Company *Limited; New* Delhi,
3. Michaels Histand & David G. Alciatore, *"Introduction to Mechatronics and Measurement Systems"* Tata McGraw-Hill International edition.
4. S R Majumdar, *"Oil hydraulic systems- Principles & Maintenance"*, Tata Mc.Graw-Hill publishing Company *Limited; New* Delhi,

LA 454

INTELLECTUAL PROPERTY RIGHTS

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Introduction: Meaning of Intellectual property - Nature of I.P. Rights - Kinds of Intellectual property rights -International conventions of Intellectual property rights. Patent Treaty 197O, GATT 1970, GATT 1994, TRIPS & TRIMS International organization for protection of IPR-WTO, WIPO, UNESCO.

Unit-II

Patents: Meaning of Patents -Commercial significance -Obtaining of patent Patentable subject- matter-rights and obligations of patentee - Specification Registration of patents -Compulsory licensing and licenses of rights Revocation.

Unit-III

Industrial Designs: Definition of designs -Registration of design -Rights and duties of Proprietor of design -Piracy of registered design.

Unit-IV

Trade Marks -Meaning of trade marks -Purpose of protecting trademarks, Registered Trademark -Procedure -passing off -Assignment and licensing of trade marks -Infringement of trademarks.

Unit-V

Copy Right -Nature, scope of copy right -subject matter of copyright - rights conferred by copyright -Publication- Broad-Casting, telecasting -Computer programme -Database write -Assignment -Transmission of copyright, Infringement of copy right.

Suggested Reading:

1. Cronish W.Rt *"Intellectual property; Patents, copyright, Trade marks and Allied rights"*; Sweet & Maxwell, 1993,
2. P. Narayanan, *"Intellectual property law"*; Eastern Law House 2nd Edn.,1997.
3. Robin Jacob and Daniel Alexander, *"A Guide Book to Intellectual property patents, Trade Marks, Copy rights and designs"*, Sweet & Maxwell 4th Edition. 1993.

ME 462

NANO MATERIALS AND TECHNOLOGY

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessional	25 Marks

Unit-I

Introduction: Nanoscale, Properties at Nanoscale, advantages and disadvantages, importance of Nano Technology, Bottom-up and Top-down approaches, challenges in Nano Technology, Proximal probe technologies.

Unit-II

Materials of Nano Technology: Introduction-Si-based materials, Ge-based materials, metals, Ferroelectric materials, Polymer materials, GaAs & InP (III-V) group materials, Nano tribology and Materials, characterization using Scanning Probe Microscope, AFM, FFM.

Unit-III

Nano Structures: Zero dimensional Nano structure (Nano Particles)- Synthesis procedure, characterization techniques, properties and applications of Nano Particles

One dimensional Nano structures (Nano Wires, Nano Tubes)- Various Synthesis procedure, characterization procedure and principles involved, properties and applications of Nano Wires, Types of Nano Tubes, Synthesis procedure, characterization properties and applications of Nano Tubes.

Unit-IV

Nano Fabrication: Introduction, Basic fabrication techniques (Lithography, thin film deposition, and doping) MEMS fabrication techniques, Nano fabrication techniques (E-beam Nano-imprint fabrication, Epitaxy and strain engineering, Scanned probe techniques).

Unit-V

Special Nano Materials Nano Composites: Introduction, Synthesis procedures, various systems (metal-polymer, metal-ceramics and polymer-Ceramics), Characterization procedures, applications.

Nano Biomaterials: Introduction, Biocompatibility, anti-bacterial activity, principles involved, applications.

Suggested Reading:

1. A.K.Bandyopadyay, *"Nano Materials"*, New Age Publications.
2. T. Pradeep, *"Nano Essentials"*, TMH
3. Carl C. Koch, *"Nano Materials Synthesis, Properties and Applications"*, Jaico Publishing House.
4. Willia Illsey Atkinson, *"NanoTechnology"*, Jaico Publishing House.
5. George W. Hanson, *"Fundamentals of Nanoelectronics"*, Pearson Education, 2009.

ME 463

POWER PLANT ENGINEERING

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-1

Introduction to Sources of Energy-Resources and Development of Power in India.

Steam Power Plant: Plant layout, working of different Circuits, Fuel and handling equipment, types of coal, coal handling, choice of handling equipment, coal storage, ash handling systems.

Unit-II

Combustion Process: Properties of coal- overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers, and heat rejection, corrosion and feed water treatment.

Gas Turbine Power Plant: Introduction –classification-Layout with auxiliaries-Principles of working of closed and open cycle gas turbines

Unit-III

Hydro Electric Power Plant: Water power-Hydrological cycle, flow measurement- drainage area characteristics-Hydrographs-storage and pondage- classification of dams and spill ways.

Unit-IV

Nuclear Power Station: Nuclear fuel-breeding and fertile materials – Nuclear reactor-reactor operation-Pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breeder reactor, homogeneous reactor, gas-cooled reactor.

Radiation hazards and shielding –radio active waste disposal.

Unit V

Power Plant Economics and Environmental Considerations: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, average load and load factor, delivery factor –related exercises

Effluents from power plants and impact on environment –Pollutants and Pollution Standards –Methods of pollution control

Suggested Reading:

1. Rajput, R K, *'A Text Book of Power Plant Engineering'*, 3rd Edition, Laxmi Publications, New Delhi, 2005.
2. Arora S C, Domukundwar S, *'A Course in Power Plant Engineering'*, Dhanapat Rai & Sons, New Delhi, 2005.
3. Yadav R, *'Steam & Gas Turbines and Power Plant Engineering'*, 7th Edition, Central Publishing House, Allahabad, 2007
4. Nag P K, *'Power Plant Engineering'*, 2nd Edition, Tata Mc Graw Hills Co. Ltd, New Delhi, 2002
5. Wakil M M, *'Power Plant Technology'*, Mc Graw Hill Publications, New york, 2005.

ME 457

ROBOTICS

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Robots: History and evolution of robots, Laws of robotics, Basic configuration, degree of freedom, work envelope, motion control methods. Application in industry - material handling, loading & unloading, processing, welding & painting applications, assembly and inspection, Robot specification requirements.

Unit-II

Rotation matrix: Homogenous trânsformation matrix. Denavit - Hartenberg convention. Euler angles, RPY reprensation. Direct and inverse Kinematics for industrial robots for position and orientation. Redundancy.

Unit-III

Manipulator Jacobian: Joint - End effector velocity - direct and inverse velocity analysis, Trajectory planning, interpolation, cubic polynomial, linear segments with parabolic blending. static force and moment transformation, Solvability, Stiffness, Singularities.

Unit-IV

Robot dynamics: Lagrangian formulation, link Inertia tensor and manipulator Inertia tensor, Newton - Euler formulation for RR & RP Manipulators. Control: Individual joint, computed torque.

Unit-V

End effectors, Position and velocity measurement. Sensors: Proximity and range, tactile, force and torque. Drives for robots; Electrical, hydraulic and pneumatic. Robot vision: Introduction to technique, image acquisition and processing. Introduction to robot programming languages.

Suggested Reading:

1. Spong and Vidyasagar, *"Robot Dynamics and Control"*, John Wiley and Sons, 1990
2. R.K. Mittal, I.J. Nagrath, *"Robotics and Control"*, Tata McGraw-Hill 2003.
3. Groover, *"Industrial Robotics"*, McGraw-Hill.
4. Asada and Siotine, *"Robot Analysis and Intelligence"*. Wiley Interscience, 1986.
5. Fu.K.S. Gon Zalez RC., Lee C.S.G., *"Robotics, Control Sensing Vision and Intelligence"* McGraw Hill, int. Ed., 1987.

ME 458

PRODUCT DESIGN AND PROCESS PLANNING

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Product Design and Process Design functions. Selection of right product. Systematic procedure of product innovation. Factors contributing to successful technological innovation - need for creativity and innovation. Techniques of innovation like brain storming and Delphi techniques.

Unit-II

Project Selection and Evaluation: Function of design - Design with Human Machine Interaction (HMI). Collection of ideas and purpose of project. Selection criteria - screening ideas for new products using evaluation techniques. Principles of ergonomics.

Unit-III

New Product Development: Research and new product development. Patents, definitions, patent search, patent laws, international code for patents -Intellectual Property Rights (IPR).

Unit-IV

New Product Planning : Interaction between the functions of design, manufacture, quality, testing and marketing. Steps for introducing new products after evaluation.

Unit-V

Process Planning : Process planning, process sheets. selection of manufacturing process, estimation of machining time in various cutting operations - estimation of costs for manufacture. Value engineering in product design, group technology, concepts of concurrent engineering.

Suggested Reading:

1. Niebel BW & Draper AB: *"Production Design & Process Engg."*, McGraw Hill, Kogakusha, 1974.
2. Harry Nystrom, *"Creativity and Innovation"*, John Wiley & Sons, 1979.
3. Brain Twiss, *"Managing Technological Innovation"*, Pittman Publ, 1992.
4. Harry, B. Waton, *"New Product Planning"*, Prentice Hall Inc., 1992.
5. Chitale, A. K. & Gupta RC., *"Product Design & Manufacturing"* - PHI, 1997.

ME 459

MODERN MACHINING AND FORMING METHODS

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Ultrasonic Machining (USM): Introduction, process description, abrasive slurry, Abrasive materials and their characteristics. Functions of liquid medium in slurry, Types of Transducers, effect of process parameters, applications and limitations. Abrasive Jet Machining (AJM): Principle of operation, process details, process variables and their effect on MRR and accuracy.

Equation for MRR. Advantages, disadvantages and applications. Water Jet Machining (WJM): Schematic diagram, equipment used, advantages and applications.

Unit-II

Electro Discharge Machining (EDM): Process description with schematic diagram, process parameters, functions and characteristics of dielectric medium, dielectric fluids, over cut and side taper' Flushing, Mechanism of metal removal, crater volume, types of power supply circuits, mathematical analysis of metal removal rate (MRR), characteristics of spark eroded surfaces, advantages, disadvantages and applications. Wire EDM: Process description and applications. Electro-Chemical Machining (ECM): Schematic of the process parameters, function and characteristics of electrolyte, chemistry of the process, Equation for specific MRR and electrode feed rate, advantages, limitations and applications., Rotary Machining, Hot machining, high speed machining, description of each process, process parameters, advantages and applications.

Unit-III

LASER Beam Machining (LBM): Principle of LASER Beam production, materials used, thermal analysis of the process, process parameters, equations for power density and machining rate, advantages, limitations and applications. Plasma Arc Machining (PAM): Introduction,

equipment used, process description and parameters, types of plasma arc; Transferred arc and non transferred arc and process applications. Electron Beam Machining (EBM): Schematic of the process, process parameters, principle of production of Electron beam, equipment used, Advantages, disadvantages and applications. ION Etching: Process description and applications.

Unit-IV

Rubber Pad Forming: Principle of the process, process details and its types; Guerin, wheelon, Marfoming and Hydro forming processes and applications. Electro-Hydraulic forming (EHF): Schematic of the process description and its applications. High Energy Rate Forming (HERF): HERF hammers, principle of explosive forming, Explosive materials, types of explosive forming, stand off operation and contact operation, the pressure pulse, Gas bubble and the process applications.

Unit-V

Stretch Forming: Introduction, types of stretch forming: stretch draw forming, rotary stretch forming or stretch wrapping, compression forming, radial draw forming. Stretch forming equipment and accessories, accuracy and surface finish, process variables and limitations. Tube spinning: Introduction, methods of tube spinning, Backward spinning, Forward spinning, machines and tools used. Machine variables, speeds and feeds, effect of tube spinning on work metal properties and applications. Hydrostatic Forming: Process principle, description and applications. Water Hammer Forming (WHF): Schematic diagram of the process, principle of operation, process variables, work materials, process limitations and applications.

Suggested Reading:

1. P.C. Pandey and H.S. Shah, *"Modern Machining Process"*, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1980.
2. A. Bhatacharya, *"New Technology"*, The Institution of Engineers (India), 1984.
3. Davies and Austin, *"Developments in High Speed Metal Forming"*, The Machinery Publishing Co. Ltd., 1985.
4. *"Production Technology"* - HMT.

ME 460

PLASTICS ENGINEERING AND TECHNOLOGY

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

General properties of plastics: Polymeric Materials, Plastics available to the designer, Engineering Plastics, Thermosets, composites, structural foam, Polymer alloy, selection of plastics, Mechanical properties, Impact Enhancement, Degradation, wear resistance and frictional properties, special properties processing, costs -selection for strength at minimum cost.

Unit-II

Mechanical properties of plastics -Deformation, Viscoelastic behaviour of plastics, short term testing of plastics, long term testing of plastics, Design methods of plastic using deformation data, Mathematical models of viscoelastic behaviour, Intermittent loading, Deformation behaviour of reinforced plastics.

Unit-III

Mechanical properties of plastics -Fracture.

The concept of stress concentration, Energy approach to fracture, Stress Intensity Factor approach to fracture, J-integral approach, General fracture behaviour of plastics, creep failure of plastics. Fatigue of plastics, Impact behaviour of plastics.

Unit-IV

Processing of plastics.

Extrusion -Mechanism of flow, analysis of flow in extruder, Extruder volumetric efficiency, power requirements.

Injection Moulding: Moulds, CAD of moulds, structural foam Injection moulding, Reaction injection moulding, Injection blow moulding, injection moulding of thermosets.

Thermoforming, calendering, Rotation moulding, compression moulding, transfer moulding, automatic processes, die design of plastics, Joining process -Hot air, ultrasonic, and solvent welding.

Unit-V

Analysis of polymer melt flow. General behaviour of polymers melts, Isothermal flow of polymers Melts, Residence and Relaxation times, Experimental Methods used to obtain flow data.

Suggested Reading:

1. Plastics and Rubber - *"Engineering Design and Application"*, R.J. Crawford.
2. N.A. Waterman, *"The selection and use of Engineering Materials"*.
3. Rossi, *"Welding Engineering"*, McGraw Hill.

CS 452

COMPUTER GRAPHICS

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Overview of Graphics Systems: Refresh CRT, Raster - Scan Displays, random-Scan Systems, Color CRT, Flat Panel Displays, Three Dimensional Viewing Devices, Input Devices, Graphics Software.

Output Primitives: Line drawing algorithms, Circle Generating Algorithms, Ellipse Generating Algorithm, Pixel Addressing, Fill Area Primitives, Character generation.

Unit-II

Getting Started Drawing Figures Using OpenGL: Getting started making pictures, Drawing basic Graphics Primitives, Making line drawing, Simple interaction with Mouse and Keyboard.

Two Dimensional Geometric Transformations: Basics Transformation, Homogeneous Coordinates, Composite, transformations, other transformations, Transformation between coordinates, Affine transformations, Transformation functions, Raster methods of transformations.

Unit-III

Two Dimensional viewing: Viewing Pipeline, Viewing Transformations & Functions. Clipping operations, Point Clipping, Line Clipping, Polygon Clipping, Curve Clipping, Text Clipping, Exterior Clipping.

Graphical User Interface & Interactive Input, Methods : The user dialogue, logical classification of input devices, Input functions & modes, Interactive picture construction techniques.

Unit-IV

Three Dimensional Concepts : Three Dimensional Display Methods. Three Dimensional Object Representations: Polygon surfaces, Curved line and surfaces, Spline representations, Bezier Curves & Surfaces, B-Spline curves and surfaces, Constructive solid-Geometry Methods, actress, BSP tress, Fractal geometry methods.

Unit-V

Three Dimensional Geometric and Modeling Transformations.

Three Dimensional Viewing: Projections

Visible Surface Detection Methods: Back face detection method, depth buffer method.

Basic illumination methods: Phong & Gourand Shading, Texture Mapping. Computer Animation : Design of Animation Sequences, General Computer Animation, Raster Animation, Computer - Animation Languages, Key frame systems, Motion specifications.

Suggested Reading

1. D. Hearn, P. Baker, *"Computer Graphics - C Version"*, 2nd Edition, Pearson Education, 2004.
2. F.S.Hill, *"Computer Graphics Using Open GL"*, 2nd Edition, Pearson Education, 2003.
3. S.Harrington, *"Compter Graphics"*, McGraw Hill.
4. James D. Foley, Steven K. Feiner, Adam, F.Hughes John, *"Computer Graphics: Principles & Practice"* 2nd Edition, Pearson Education.

CS 408

INTERNET PROGRAMMING

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-I

Introduction to Internet and Intranet HTTP protocol. TCP/IP - Concepts, addressing routing, web application building blocks, HTML, CGI, Integrating ODBC and CGI.

Unit-II

Java programming - Overview of Java, Data types, Variables, Arrays, Operators, Control structures, Classes, Inheritance, packages and interface.

Unit-III

Java programming - Exception handling, multithreaded programming, I/O, Applets,Networking, AWT, AWT Controls.

Unit-IV

Internet Concepts - Cross - Platform client browser setup, corporate information models, structuring company information resources, document management, workflow software, groupware, case studies.

Unit-V

Information servers - DNS, Mail Servers, News Servers, Chat, FTP Servers, proxy servers, security and firewalls, search engines.

Suggested Reading:

1. John Desborough, *Intranet Web Development*, New Riders Publ. 1996.
2. Partrik Naughton, Robert Schildt, *The complete reference Java*, TataMc Graw HilL, 1997.

ME 464

FUELS & COMBUSTION

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit-1

Types of fuels-solid, liquid and gaseous fuels, family of coal, origin of coal, analysis and properties of coal, action of heat on coal, oxidation of coal, hydrogenation of coal, efficient use of solid fuels, manufactured fuels, agro fuels, solid fuel handling, properties related to combustion, handling and storage.

Unit-II

Origin and classification of Petroleum, refining and other conversion processes, composition of petroleum with respect to combustion, property and testing of petroleum products, various petroleum products, Nature of Indian Crudes & Petroleum refining in India, storage and handling of liquid fuels, liquid fuels combustion equipment.

Types of gaseous fuels, Natural gases, methane from coal mine, Producer gas, water gas, blast furnace gas, LPG.

Unit-III

Stoichiometry Stoichiometry relations, theoretical air required for complete combustion, calculation of minimum amount of air required for known composition, calculation of dry flue gases if fuel composition is known, calculation of composition of fuel and excess air supplied from exhaust gas analysis, flue gas analysis (O_2, CO_2, NOx, SO_x)

Unit-IV

Burner Design: Ignition and concept of ignition, auto ignition, temperature flame propagation, various methods of flame stabilization, Incorporation in burner design, basic features of solid, liquid and gaseous fuel burner, design consideration of different types of coal, oil and gas burners, recuperative and regenerative burners

Unit V

Alternate Fuels for IC Engines: Edible oils and non-edible oils for use in diesel engines, Gaseous fuels like hydrogen, CNG, LPG for use in petrol engine.

Suggested Reading:

1. Sharma S P, *'Fuels and Combustion'*, Tata Mc Graw Hills, New Delhi, 2000.
2. Roger A, *'Combustion Fundamentals'*, Mc Graw Hills, New Delhi, 2000
3. Shaha A K, *'Combustion Engineering & Fuel Technology'*, Oxford and IBH Publications, New York, 2003
4. Kenneth K Kou, *'Principles of Combustion'*, Wiley & Sons Publications, New York, 2002.

ME 465

RAPID PROTOTYPING TECHNOLOGIES

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit – I

Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages of Rapid Prototyping, Commonly used Terms, Rapid Prototyping Process Chain, 3D Modeling, Data conversion and Transmission, Checking and Preparing, Building, Postprocesing, RP Data formats, Classification of RP process.

Unit – II

Liquid-based Rapid Prototyping Systems: Stereolithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photopolymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Unit – III

Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Unit – IV

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Unit – V

Applications of Rapid Prototyping Technology: Functional models, Pattern for investment and vacuum casting, Medical Models, Art Models, Engineering Analysis Models.

Suggested Reading:

1. Chua C.K., Leong K.F. and LIM C.S, *"World Rapid prototyping: Principles and Applications"*, Scientific Publications , Second edition, 2004.
2. D.T. Pham and S.S. Dimov, *"Springer Rapid Manufacturing"*, 2001
3. Terry Wohlers, *"Wholers Report 2000 , Wohlers Associates"*, 2000.

ME 466

MATERIAL HANDLING
(For Production only, Elective - III)

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

Unit - I

Mechanical Handling Systems: Construction, Operation and Maintenance of Belt Conveyors and Design, Bucket Elevators, Package conveyors, chain and Flight Conveyors, Screw Conveyors, Vibratory Conveyors, Cranes and Hoists.

Unit - II

Pneumatic and Hydraulic Conveying Systems: Modes of Conveying and High pressure conveying systems Low Velocity Conveying System. Components of Pneumatic Conveying Systems: General Requirements, Fans and Blowers, Boots-Type Blowers, Sliding-Vane Rotary Compressors, Screw Compressors, Reciprocating Compressors, Vacuum Pumps.

Unit - III

Bulk Solids Handling: Particle and Bulk Properties. Adhesion, Cohesion and Moisture Content. Gravity Flow of Bulk Solids: Static and Dynamic Pressure Distribution in Bulk Solids. Modes of Flow : Mass Flow, Funnel Flow and Expanded Flow from Hoppers, Bins and Silos.

Unit - IV

Modern Material Handling Systems: Constructional features of (i) AGV (ii) Automated storage and retrieval systems. Sensors used in AGVs and ASRS.

Bar Code Systems and RFID systems: Fundamentals and their integration with computer-based information systems.

Unit - V

Total MH Throughput: Calculation for no. of MH systems; storage space estimation based on no. of aisles. Maintenance of MH equipment, spare parts management, cost of materials handling, cost per unit load computations.

Suggested Reading :

1. Dr. Mahesh Varma, *"Construction Equipment and its Planning & Application"*, Metropolitan Book Co. (P) Ltd., New Delhi, India 1997.
2. James M. Apple, *"Material Handling Systems Design"*, The Ronald Press Company, New York USA, 1972.
3. Woodcock C.R. and Mason J.S., *"Bulk Solids Handling: An Introduction to Practice Technology"*. Leonard Hill USA, Chapman and Hall, New York.
4. M.P. Groover etal. *"Industrial Robotics"*, Mc Graw Hill. 1999.

ME 481

SEMINAR

Instruction	3 Periods per week
Sessional	25 Marks

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of state of the art topics in a broad area of *his / her* specialization.

Seminar *topics* may be chosen by the students with advice from the faculty members. Students are to be exposed to following aspects of seminar presentations.

Literature survey Organisation of material

Preparation of OHP slides / PC presentation Technical writing

Each student will be required to

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Give a 20 minutes presentation through OHP, PC, Slide projector followed by 10 minutes discussion.
3. Submit a report on the seminar topic with list of references and slides used.

Seminars are to be scheduled from the 3rd week to the last week of the semester and any change in schedule should be discouraged.

The Sessionals marks will be awarded to the students by at least 2 faculty members on the basis of an oral and a written presentation as well as their involvement in the discussions.

ME 482

PROJECT

Instruction	6 Periods per week
Duration of University Examination	Viva
University Examination	Grade*
Sessional	50 Marks

Solving a real life problem should be the focus of U.G. project. Faculty members should prepare project briefs well in advance. They should be made available to the students at the Department Library. A project may be classified as hardware / software / modeling / simulation. It should involve elements such as analysis, design and synthesis.

The Department will appoint a project coordinator who will be in-charge of the following

- Grouping of students (Maximum of three in a group).
- Allotment of projects and project guide.
- Project monitoring at regular intervals.

A project allotment is to be completed by the 4th week of 1st semester of IV year so that students get sufficient time for completion of their project.

All the projects are to be checked for progress at least twice in a semester. It should be on the basis of presentation of the students.

Sessionals marks to be based on the Grade / Marks awarded by a monitoring committee comprising of faculty members as well as by the supervisor.

Efforts to be made so that some of the projects are carried out in industries. Projects may also be invited from industries.

Norms of final documentation of the project report are to be provided by the Department.

* Excellent / Very Good / Good / Satisfactory / Unsatisfactory.

Note: Three periods of contact load will be assigned to each project guide.