

**MAHARSHI DAYANAND UNIVERSITY, ROHTAK**  
**SCHEME OF STUDIES & EXAMINATIONS**  
**B.Tech. 4<sup>th</sup> YEAR MECHANICAL ENGINEERING, SEMESTER- VII**  
**(Proposed Scheme-F)**  
**W.E.F 2012-13**

Course	Course Title	Teaching schedule				Marks For class work	Marks for Examination		Total Marks	Duration of Exam
		L	T	P	Total		Theory	Practical		
ME-401-F	Strength of Material-II	3	1	-	4	50	100	-	150	3
ME-403-F	Refrigeration & Air-Conditioning	3	1	-	4	50	100	-	150	3
ME-405-F	Operation Research	3	1	-	4	50	100	-	150	3
ME-407-F	Power Plant Engineering	3	1	-	4	50	100	-	150	3
ME-409-F	Mechanical Vibration	3	1	-	4	50	100	-	150	3
-----	Deptt. Elective	3	1	-	4	50	100	-	150	3
ME-411-F	Refrigeration & Air-Conditioning Lab	-	-	2	2	50	-	50	100	3
ME-413-F	Advanced CAD/CAM Lab	-	-	2	2	50	-	50	100	3
ME-415-F	Practical Training-II	-	-	2	2	-	-	-	-	-
	Total	18	6	6	30	400	600	100	1100	

**LIST OF DEPARTMENTAL ELECTIVES**

S.NO.	SUBJECT CODE	DEPTT. ELECTIVE
1.	ME-417-F	QUALITY ENGINEERING
2.	ME 419-F	FINITE ELEMENT METHODS
3.	ME-421-F	ENERGY MANAGEMENT PRINCIPLES
4.	ME-423-F	ENGINEERING DESIGN
5.	ME- 425-F	COMPUTER INTEGRATED MANUFACTURING
6.	ME-427-F	MANUFACTURING MANAGEMENT
7.	ME- 429-F	RELIABILITY ENGINEERING
8.	ME-431-F	SOLAR ENERGY ENGINEERING
9.	ME- 433-F	VALUE ENGINEERING

## ME- 401-F STRENGTH OF MATERIALS-II

L    T    P  
3    1    -

Sessional    : 50Marks  
Theory        : 100 Marks  
Total         : 150 Marks  
Duration of Exam: 3Hrs.

**Note: Examiner will set 9 questions in total, two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt 5 questions in total at least one question from each section.**

### SECTION A

Strain Energy & Impact Loading: Definitions, expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with impact, strain energy of beams in bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection, Castigliano's & Maxwell's theorems, Numericals.

Theories of Elastic Failure: Various theories of elastic failures with derivations and graphical representations, applications to problems of 2- dimensional stress system with (i) Combined direct loading and bending, and (ii) combined torsional and direct loading, Numericals.

### SECTION B

Unsymmetrical Bending: Properties of beam cross section, product of inertia, ellipse of inertia, slope of the neutral axis, stresses & deflections, shear center and the flexural axis Numericals.

Thin Walled Vessels : Hoop & Longitudinal stresses & strains in cylindrical & spherical vessels & their derivations under internal pressure, wire wound cylinders, Numericals.

### SECTION C

Thick Cylinders & Spheres : Derivation of Lamé's equations, radial & hoop stresses and strains in thick, and compound cylinders and spherical shells subjected to internal fluid pressure only, wire wound cylinders, hub shrunk on solid shaft, Numericals.

Rotating Rims & Discs: Stresses in uniform rotating rings & discs, rotating discs of uniform strength, stresses in ( I ) rotating rims, neglecting the effect of spokes, (ii) rotating cylinders, hollow cylinders & solids cylinders. Numericals.

### SECTION D

Bending of Curved Bars : Stresses in bars of initial large radius of curvature, bars of initial small radius of curvature, stresses in crane hooks, rings of circular & trapezoidal sections, deflection of curved bars & rings, deflection of rings by Castigliano's theorem stresses in simple chain link, deflection of simple chain links, Problems.

Springs: Stresses in open coiled helical spring subjected to axial loads and twisting couples, leaf springs, flat spiral springs, concentric springs, Numericals.

### Text Books:

1. Strength of Materials – G.H.Ryder, Third Edition in SI Units 1969 Macmillan, India.
2. Strength of Materials – Sadhu Singh, Khanna Publishers

### Reference Books :

1. Book of Solid Mechanics – Kazmi, Tata Mc Graw Hill
2. Strength of Materials – D.S. Bedi - S. Chand & Co. Ltd.
3. Strength of Materials – U.C Jindal - Pearson India Ltd.
- 4.

## ME-403-F REFRIGERATION & AIR CONDITIONING

L T P  
3 1 -

Sessional : 50 Marks  
Theory : 100Marks  
Total : 150 Marks  
Duration of Exam : 3Hrs.

**Note: Examiner will set 9 questions in total, two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt 5 questions in total at least one question from each section.**

### SECTION A

Introduction: Definition of refrigeration & air conditioning; Necessity; Methods of refrigeration; Unit of refrigeration; Coefficient of performance (COP), Fundamentals of air-conditioning system; Refrigerants- Definition, Classification, Nomenclature, Desirable properties, Comparative study, secondary refrigerants, Introduction to eco-friendly Refrigerants; Introduction to Cryogenics.

Air Refrigeration System: Carnot refrigeration cycle. Temperature. Limitations; Brayton refrigeration or the Bell Coleman air refrigeration cycle; Necessity of cooling the aero plane; Air craft refrigeration systems, Simple cooling and Simple evaporative types, Boot strap and Boot strap evaporative types, Regenerative type and Reduced Ambient type system, Comparison of different systems, problems.

### SECTION B

Vapour Compression (VC) Refrigeration Systems: (A) Simple Vapour Compression (VC) Refrigeration systems-Limitations of Reversed Carnot cycle with vapour as the refrigerant; Analysis of VC cycle considering degrees of sub cooling and superheating; VC cycle on p-v, t-s and p-h diagrams; Effects of operating conditions on COP; Comparison of VC cycle with Air Refrigeration cycle.

Multistage Ref. Systems- Necessity of compound compression, Compound VC cycle , Inter-cooling with liquid sub –cooling and / or water inter cooler: Multistage compression with flash inter-cooling and / or water inter-cooling; systems with individual or multiple expansion valves; Individual compression system with individual or multiple expansion valves; Individual compression systems with individual or multiple expansion valves but with and without intercoolers.

Other Refrigeration Systems: (A) Vapour Absorption Refrigeration Systems – Basic Systems, Actual COP of the System, Performance, Relative merits and demerits; Properties of aqua ammonia; Electrolux Refrigeration; Problems. Steam Jet Refrigerating System- Introduction, Analysis, Relative merits and demerits, Performance Applications, Problems.

### SECTION C

Psychrometry of Air & Air Conditioning Processes: Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temp., Thermodynamics wet bulb temp., Psychrometric chart; Psychrometry of air-conditioning processes, Mixing Process, Basic processes in conditioning of air; Psychrometric processes in air washer, Problems.

Air- Conditioning Load Calculations: Outside and inside design conditions; Sources of heating load; Sources of cooling load; Heat transfer through structure, Solar radiation, Electrical applications, Infiltration and ventilation, Heat generation inside conditioned space; Apparatus selection; Comfort chart, Problems.

### SECTION D

Air Conditioning Systems with Controls & Accessories: Classifications, Layout of plants; Equipment selection; Air distribution system; Duct systems Design; Filters; Refrigerant piping; Design of summer air-conditioning and Winter air conditioning systems; Temperature sensors, Pressure sensors, Humidity sensors, Actuators, Safety controls; Accessories; Problems.

Refrigeration and Air Conditioning Equipments: Type of compressors and their performance curves; Types of Condensers, Heat transfer in condensers; Types of expansion devices; types of evaporators, Cooling and Dehumidifying coils, Problems.

#### Text Books :

1. Refrigeration & Air conditioning –R.C. Jordan and G.B. Priester, Prentice Hall of India.
2. Refrigeration & Air conditioning –C.P. Arora, TMH, New Delhi.

#### Reference Books:

1. A course in Refrigeration & Air Conditioning – Arora & Domkundwar, Dhanpat Rai & Sons.
2. Refrigeration & Air conditioning –W.F. Stocker and J.W. Jones, TMH, New Delhi.
3. Refrigeration & Air conditioning- Manohar Prasad Wiley Estern limited, New Delhi.

## ME- 405-F OPERATIONS RESEARCH

L T P  
3 1 -

Sessional : 50 Marks  
Theory : 100 Marks  
Total : 150 Marks  
Duration of Exam : 3 Hrs.

**Note: Examiner will set 9 questions in total, two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt 5 questions in total at least one question from each section.**

### SECTION A

Introduction: Definition, role of operations research in decision-making, applications in industry. Concept on O.R. model building –Types & methods.

Linear Programming (LP): Programming definition, formulation, solution- graphical, simplex Gauss-Jordan reduction process in simplex methods, BIG-M methods computational, problems.

### SECTION B

Deterministic Model: Transportation model-balanced & unbalanced, north west rule, Vogel's Method, least cost or matrix minimal, Stepperg stone method, MODI methods, degeneracy, assignment, traveling salesman, problems.

Advanced Topic Of LP: Duality, PRIMAL-DUAL relations-its solution, shadow price, economic interpretation, dual-simplex, post-optimality & sensitivity analysis, problems.

### SECTION C

Waiting Line Models: Introduction, queue parameters, M/M/1 queue, performance of queuing systems, applications in industries, problems.

Project Line Models: Network diagram, event, activity, defects in network, PERT & CPM, float in network, variance and probability of completion time, project cost- direct, indirect, total, optimal project cost by crashing of network, resources leveling in project, problems.

### SECTION D

Simulation: Introduction, design of simulation, models & experiments, model validation, process generation, time flow mechanism, Monte Carlo methods- its applications in industries, problems.

Decision Theory: Decision process, SIMON model types of decision making environment- certainty, risk, uncertainty, decision making with utilities, problems.

### Text Books:

1. Operation Research – TAHA, PHI, New Delhi.
2. Principle of Operations Research – Ackoff, Churchman, Arnoff, Oxford IBH, Delhi.

### Reference Books :

1. Operation Research- Gupta & Sharma, National Publishers, New Delhi.
2. Quantitative Techniques- Vohra, TMH, New Delhi
3. Principles of operation Research (with Applications to Managerial Decisions) by H.M.Wagher, Prentice Hall of India, New Delhi.
4. Operation Research – Sharma, Gupta, Wiley Eastern, New Delhi.
5. Operation Research – Philips, Revindran, Solgeberg, Wiley ISE.

## ME- 407-F POWER PLANT ENGINEERING

L	T	P
3	1	-

Sessional Marks	: 50
Theory Marks	: 100
Total Marks	: 150

**Duration of Exam: 3 Hrs.**

**Note: Examiner will set 9 questions in total, two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt 5 questions in total at least one question from each section.**

### SECTION-A

Introduction: Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants.

Hydro Electric Power Plants : Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants.

### SECTION-B

Steam Power Plants: Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator.

Combined Cycles: Constant pressure gas turbine power plants, Arrangements of combined plants ( steam & gas turbine power plants ), re-powering systems with gas production from coal, using PFBC systems, with organic fluids, parameters affecting thermodynamic efficiency of combined cycles. Problems.

### SECTION-C

Nuclear Power Plants: Principles of nuclear energy, basic nuclear reactions, nuclear reactors-PWR, BWR, CANDU, Sodium graphite, fast breeder, homogeneous; gas cooled. Advantages and limitations, nuclear power station, waste disposal.

Power Plant Economics: load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance & operating characteristics of power plants- incremental rate theory, input-output curves, efficiency, heat rate, economic load sharing, Problems.

### SECTION-D

Non-Conventional Power Generation: Solar radiation estimation, solar energy collectors, low, medium & high temperature power plants, OTEC, wind power plants, tidal power plants, geothermal power plants.

Direct Energy Conversion Systems: Fuel cell, MHD power generation-principle, open & closed cycles systems, thermoelectric power generation, thermionic power generation.

### Text Books :

1. Power station Engineering and Economy by Bernhardt G.A. skrotzki and William A. Vopat – Tata Mc Graw Hill Publishing Company Ltd., New Delhi
2. Power Plant Engineering : P.K. Nag Tata McGraw Hill second Edition 2001.

### Reference Books :

1. Power Plant Engg. : M.M. El-Wakil McGraw Hill 1985.

## ME -409- F MECHANICAL VIBRATIONS

L T P  
3 1 -

Sessional : 50 Marks  
Theory : 100 Marks  
Total : 150 Marks  
Duration of Exam: 3 Hrs.

**Note: Examiner will set 9 questions in total, two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt 5 questions in total at least one question from each section.**

### SECTION A

Fundamentals : Importance of Study of Vibrations, Classifications of Vibrations, Free and Forced, Undamped and Damped, Linear and Non-linear, Deterministic and Random, Harmonic Motion, Vector and Complex Number Representations, Definitions and Terminology, Periodic Functions, Harmonic Analysis, Fourier Series Expansion.

Free and Damped Vibrations : Single Degree of Freedom system, D'Alemberts Principal, Energy Methods, Rayleighs Method, Application of these Methods, Damped Free Vibrations, Logarithmic Decrement, Under Damping, Critical and Over Damping, Coulomb Damping.

### SECTION B

Harmonically Excited Vibrations : Forced Damped Harmonic Vibration of Single Degree of Freedom Systems, Rotating Unbalance, Rotor Unbalance, Critical Speeds and Whirling of Rotating Shafts, Support Motion, Vibration Isolation, Energy Dissipated by Damping, Equivalent, Viscous Damping, Structural Damping Sharpness of Resonance, Vibration Measuring Instruments.

Transient Vibrations : Impulse Excitation, Arbitrary Excitation, Response to Step Excitations, Base Excitation Solution by Laplace Transforms, Response Spectrum, Runge-Kutta Method.

### SECTION C

Two Degrees of Freedom Systems : Introduction to Multi-Degree of Freedom Systems, Normal Mode Vibrations, Coordinate Coupling, Principal Coordinates, Free Vibrations in Terms of Initial Conditions, Forced Harmonic Vibrations, Vibration Absorber, Centrifugal Vibration Absorber, Vibration Damper.

Multi degrees of Freedom Systems and Numerical Methods Introduction, Influence Coefficients, Stiffness Matrix, Flexibility Matrix, Natural Frequencies and Normal Modes, Orthogonality of Normal Modes, Dunkerley's Equation, Method of Matrix Iteration, The Holzer Type Problem, Geared and Branched Systems, Beams.

### SECTION D

Normal Mode Vibration of Continuous System: Vibrating String, Longitudinal Vibrations of Rod, Torsional Vibrations of Rod, Lateral Vibrations of Beam.

Text Books :

1. Theory of Vibrations with Applications W.T. Thomson, Prentice Hall of India.
2. Mechanical Vibration : G.K. Grover and S.P. Nigam, Nem Chand and Sons

Reference Books :

1. Theory and Practice of Mechanical Vibrations J.S. Rao and K. Gupta, Wiley Eastern Ltd.
2. Mechanical Vibrations S.S. Rao, Addison – Wesley Publishing Company

**ME- 411- F REFRIGERATION & AIR CONDITIONING LAB.**

L T P  
- - 2

Sessional : 50 Marks  
Practical : 50 Marks  
Total : 100 Marks  
Duration of Exam : 3Hrs.

**List of Experiments :**

1. To study the vapour compression Refrigeration System and determine its C.O.P. and draw P-H and T-S diagrams.
2. To Study the Mechanical heat pump and find its C.O.P.
3. To study the Air and Water heat pump and find its C.O.P.
4. To study the cut- sectional models of Reciprocating and Rotary Refrigerant compressor.
5. To study the various controls used in Refrigerating & Air Conditioning systems.
6. To study the Ice- plant, its working cycle and determine its C.O.P and capacity.
7. To study the humidification, heating, cooling and dehumidification processes and plot them on Psychrometric charts.
8. To determine the By-pass factor of Heating & Cooling coils and plot them on Psychrometric charts on different inlet conditions.
9. To determine sensible heat factor of Air on re-circulated air-conditioning set up.
10. To study the chilling plant and its working cycle.

**Note : 1. At least ten experiments are to be performed in the semester.**

**2. At least seven experiments should be performed from the above list. Remaining three experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.**

## ME- 413- F Advanced CAD/CAM Lab

L     T     P  
-     -     2

Sessional     : 50 Marks  
Practical     : 50 Marks  
Total         : 100 Marks

**The students will be required to carry out the following exercises using software packages (e.g. 3D modeling package / Pro Engineer/ I-Deas/ Solid Edge etc.)**

### 1. CAD Modeling Assignments

- (i) Use and learn import/export techniques and customization of software.
- (ii) Construction of simple machine parts and components like Coupling, Crankshaft, Pulley, Piston , Connecting rod, nuts, bolts, gears and helical springs
- (iii) Assembly drawing with sectioning and bill of materials from given detailed drawings of assemblies: Lathe Tail stock, Machine vice, Pedestal bearing, Drill jigs and Milling fixture.
- (iv) Make the part family/family table of a bolt.

### 2. CAM Assignments

Tool path generation, Part programming, G & M codes development for machining operations, Physical interpretation of machining features and tool geometries



**ME – 415- F PRACTICAL TRAINING – II**

L T P  
- - 2

At the end of Sixth semester each student would undergo six weeks Practical Training in an industry/ Professional organization / Research Laboratory with the prior approval of the Director- Principal/ Principal of the concerned college and submit a written typed report along with a certificate from the organization. The report will be a evaluated during VII Semester by a Board of Examiners to be appointed by the Director- Principal/ Principal of the concerned college who will award one of the following grades:

**Excellent: A**

**Good: B**

**Satisfactory: C**

**Not satisfactory: F**

A student who has been awarded 'F' grade will be required to repeat the practical training.

## ME-417-F QUALITY ENGINEERING

L	T	P	Theory	: 100 Marks
3	1	-	Total	: 150 Marks
			Duration of Exam	: 3 Hrs.

**Note: Examiner will set 9 questions in total, two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt 5 questions in total at least one question from each section.**

### SECTION-A

**Basic Concept Quality Costs:** Fitness for Use, Quality Characteristics, Parameters of Fitness for use, Definition of quality and its meaning and importance in industry, Control and Quality control, Quality Tasks, Quality functions, The system Concept, Quality systems, quality assurance and ISO 9000 quality system standards, Quality costs concept, Quality cost categories, Examples of Quality cost studies, Securing the Cost figures, Pareto Analysis, Cost reduction Programs and economics of quality.

### SECTION-B

**Control charts:** Statistical Tools in Quality control, The concept of variation, Tabular Summarization of Data, Frequency distribution, Graphical Summarization of Data: The Histogram, Quantitative methods of summarizing data: Numerical Indices, Probability distributions : General, The normal Probability distribution, The normal curve and Histogram Analysis, The causes of variation, statistical aspect of control charting, concept of rational sub-grouping and detecting patterns on the control charts, for variables and attributes: X and R, X and S, p, np, c and u charts; specification and tolerances, natural tolerance limits, specification limits, process capability ratio analysis and narrow limit gauging

### SECTION-C

**Basic statistical concepts:** Descriptions of Binomial, Poisson and Normal distribution with practical examples basics of sampling distribution. Acceptance Sampling: Principle of acceptance sampling, Acceptance sampling by attributes: single multiple and sequential sampling plans, lot quality protection and average outgoing quality protection, Acceptance sampling by variables sampling plans of process parameters,

### SECTION-D

**Total quality Management:** Basic concepts of TQM, historical review, leadership, concepts, role of senior management, quality statements, plans for process parameters, Modern Quality Management Techniques: TQM tools: Benchmarking, QFD, Taguchi quality loss function TPM, FMEA. Lean Manufacturing continuous improvement techniques, JIT systems, pareto diagrams, cause and effect diagrams, scatter diagram, run charts, affinity diagrams, inter-relationship diagram, process decision program charts

### TEXT BOOKS:

1. Quality planning and Analysis, Juran and Gryna, TMH, New Delhi
2. Quality Management, Kanishka Bed, Oxford University Press, New Delhi
3. Introduction to SQC, Montgomery DC, 3e, Wiley, New Delhi
4. Fundamentals of quality control and improvement, A Mitra, Mcmillan pub. Company, NY

### REFERENCE BOOKS:

1. Fundamentals of Applied Statistics, Gupta and Kapoor, Sultan Chand and Sons, New Delhi.

## ME 419-F FINITE ELEMENT METHODS

L	T	P	Theory	: 100 Marks
3	1	-	Total	: 150 Marks
			Duration of Exam	: 3 Hrs.

**Note: Examiner will set 9 questions in total, two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt 5 questions in total at least one question from each section.**

### SECTION-A

Fundamental Concepts: Introduction; Historical Background, Stresses and Equilibrium, Boundary Conditions, Strain-displacement, Relations, Stress- strain Relations, Temperature Effects, Potential Energy and Equilibrium; The Rayleigh-Ritz Method, Galerkin's method. Saint Venant's Principle, Matrix Algebra, Gaussian Elimination. One-Dimensional Problems: Introduction; Finite Element Modeling, Coordinates and a Shape Functions, The Potential Energy Approach; The Galerkin Approach, Assembly of the Global Stiffness Matrix and Load Vector. Properties of Stiffness Matrix, The Finite Element Equations; Treatment of Boundary Conditions, Quadratic Shape Functions; Temperature effects.

### SECTION-B

Two-Dimensional Problems using Constant Strain Triangles: Introduction, Finite Element Modeling, Constant Strain Triangle, Problem Modeling and Boundary conditions; Axis Symmetric Solids subjected to Axis Symmetric Loading:- Introduction, Axis Symmetric Formulation, Finite Element Modeling; Triangular Element, Problem Modeling and Boundary conditions.

Two Dimensional Isoparametric Elements and Numerical Integration: Introduction, The Four- Node quadrilateral, Numerical Integration Stress Calculations, High – Order Element; Nine-Node quadrilateral, Eight-Node Quadrilateral, Six-Node triangle, Comment on Midside Node; Problems.

### SECTION-C

Beams & Frames: Introduction, Finite Element formulation, Load Vector, Boundary considerations, Shear Force and Bending Moment, Beams on Elastic supports, Plane Frames, Simple Numerical.

Three-Dimensional Problems in Stress Analysis: Introduction, Finite Element Formulation, Stress Calculations, Mesh Preparation, Hexahedral Elements and Higherorder Elements, Problem Modeling.

### SECTION-D

Transfer,: Introduction One-Dimensional Heat Conduction, Heat transfer in thin Fins, Two-dimensional steady-state Heat conduction, Potential Flow, Seepage, Fluid flow in Ducts. Dynamic Considerations: Introduction, Formulation, Element Mass Matrices: Evaluation of Eigen values and Eigenvectors, Interfacing with previous Finite Element Programs and a program for determining critical speeds of Shafts.

### Text Books :

1. Introduction to Finite Elements in Engineering Analysis by Tirupathi R. Chandrupatla and Ashok R. Belagundu. Prentice Hall
2. The Finite Element Method in Engineering by S.S.Rao, Peragamon Press, Oxford.

### Reference Books:

1. Finite Element Procedures , by Klaus Jurgen Bathi, Prentice Hall.
2. Concepts and Applications of Finite Element Analysis, by Cook, Malkus and Plesha, John Wiley.
3. The Finite Element Method by Zienkiewicz published by Mc Graw Hill.
4. An Introduction to Finite Element Method by J.N. Reddy published by Mc Graw Hill.

## ME-421-F ENERGY MANAGEMENT PRINCIPLES

L	T	P	Theory	: 100 Marks
3	1	-	Total	: 150 Marks
			Duration of Exam	: 3 Hrs.

**Note: Examiner will set 9 questions in total, two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt 5 questions in total at least one question from each section.**

### SECTION-A

Planning for Energy Management : Initiation phase, Audit and analysis phase; Implementation phase; General methodology for building and site energy audit; Site survey, Methodology; Site survey-Electrical system, Steam & water systems; Building survey methodology; Basic energy audit instrumentation; Measurements for building surveys.

Management of Heating and Cooling General Principles : The requirements for human comfort; Description of typical systems-dual duct HVAC system, Multi zone HVAC systems, Variable an volume system, Terminal reheat system, Evaporative HVAC systems; Modeling of heating and cooling loads in buildings; Problems.

### SECTION-B

Electrical load and Lighting Management : General principles; Illumination and human comfort; Basic principles of lighting system; Typical illumination system and equipment; Fundamentals of single phase and 3-phase A.C. circuits; Energy management opportunities for lighting systems, Motors and electrical heat; Electrical load analysis and their parameters; Peak, demand control.

Management of Process Energy : General Principles; Process heat; Combustion; Energy saving in condensate return, Steam generation & distribution, auto-motive fuel control, hot water and water pumping, direct & indirect fired furnaces over; Process electricity; Other process energy forms – compressed air & manufacturing processes; Problems.

### SECTION-C

Economics of Efficient Energy Use : General Consideration Life Cycle Costing, Break Even Analysis, Cost of Money, Benefit / Cost Analysis, Pay Back Period Analysis, Present Worth Analysis, Equivalent Annual Cost Analysis, Capital Cost Analysis, Perspective Rate of Return.

Integrated Building System : General Principles; Environmental conformation; Passive design consideration; Building envelope design consideration; Integration of building system; Energy storage ; Problems.

### SECTION-D

Use of Computer for Energy Management : Energy management; Energy management principle involving computers, Basics of computer use; Analysis – Engineering & Economic calculations, Simulation, Forecast, CAD/CAM; Controls – Microprocessor & minicomputers, Building cycling & control, Peak demand limiting & control; Industrial Power management; Problems.

#### **Text Books :**

1. Energy management Principles by Craig B. Smith, Published by Pergamon Press.
2. Energy systems and developments – Jyoti Parikh, Oxford University Press.

#### **Reference Books :**

1. Energy – resources, demand and conservation with reference to India – Chaman Kashkari, TMH.
2. Integrated renewable energy for rural development– Proc. of natural solar energy convention, Calcutta.

## ME-423-F ENGINEERING DESIGN

L	T	P	Theory	: 100 Marks
3	1	-	Total	: 150 Marks
			Duration of Exam	: 3 Hrs.

**Note: Examiner will set 9 questions in total, two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt 5 questions in total at least one question from each section.**

### SECTION-A

Design Philosophy : Definition of Design, Difference between Science, Engineering and Technology, Morphology of Design, Definition of Product Design, Design by Evolution, Design by Innovation, Invention and Brainstorming. Considerations Dictating Mechanical Design : Basic Considerations- Convenience of Use, Maintenance Cost and Appearance; Operational Considerations: Operational Requirements -Strength ( Volume & Surface ), Rigidity ( proper and contact ), Vibration, Thermal Resistance etc.; Design for Strength, Design for Rigidity. Design for Stability ( buckling ) with Illustrations; Functional Requirements – Conforming ( among various components ), Concept of Synthesis and Assembly, Role of Fits, Tolerance and Process Capability.

### SECTION B

Human Engineering : Human factors in Engineering Design, Man-machine Systems, Human Physical Activities and Human Control of Systems, Visual Displays of Static and Dynamic Information, Work Environment – Illumination, Atmospheric Conditions, Noise etc.

Ingenuity in Design : Tips to increase Strength and Rigidity of m/c components, Concept of Standardization. Simplification ( Preferred numbers or Renard series ). Concept of Slim Design – Use of Reinforcement, Ribs, Corrugations, Laminations etc. – their Design Analysis; Designation of different types of Fits, Design of Interference Fit Joints, Cumulative Fatigue Failure & Minor's Equation.

### SECTION C

Modeling, Analogy & Simulation : Types of Models and their uses with emphasis on Mathematical Modeling, Importance of Analogy in Design, Electrical – Mechanical Analogy, Membrane Analogy. Similitude and Scale Models.

Material Selection: Spectrum of material properties: Performance Characteristics of materials, Evaluation Methods for material selection – Cost vs Performance Relations, Weighted- property Index, Value Analysis – Illustrations.

### SECTION-D

Interactions of Materials, Processing and Design : Role of processing in design, Economics of Manufacturing, Design for Casting, Design for Machining, Design for Welding, Design for Powder Metallurgy, Design for Assembly.

Cost Analysis: Objectives, Costs Classification, Cost Estimate Methods, Labour Costs, Product Pricing.

#### **Text Books :**

1. Product Design and Manufacturing – A.Kale & R.C. Gupta, P H I, New Delhi.
2. Engineering Design–A material & Processing Approach – George Dietor, McGraw Hill

#### **Reference Books :**

1. Machine Elements - C.B. Rovoloky et.al., MIR Punleshan, Moscow.
3. Mechanical Engg. Design – Joseph Shigley Published by MGH.
4. Engineering Design Process : Yousef Haik, Books/Cole 2003.

## ME- 425-F COMPUTER INTEGRATED MANUFACTURING

L	T	P	Theory	: 100 Marks
3	1	-	Total	: 150 Marks
			Duration of Exam	: 3 Hrs.

**Note: Examiner will set 9 questions in total, two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt 5 questions in total at least one question from each section.**

### SECTION-A

Introduction : CAD/CAM Definition, Computer Technology-central processing unit (CPU), types of memory, input/output, the binary number system, computer programming languages. Automation- Types of Automation, CIM, reasons for automating, automation strategies. Conventional Numerical Control: Basic components of NC system, the NC procedure, NC coordinate systems, NC motion control system, applications of numerical control, advantages and disadvantages of NC, computer controls in NC, problems with conventional NC, NC controller technology, computer numerical control, functions of CNC, advantages of CNC, Direct numerical control, components of a DNC system, functions of DNC, advantages of DNC.

### SECTION-B

NC Part Programming: Introduction, the punched tape in NC, tape coding and format, NC words, manual part programming, computer assisted part programming, the part programmer's job, the computer's job, NC part programming languages. The APT language: Geometry, statements, motion statements, post processor statements, auxiliary statements.

### SECTION C

Robotics Technology : Joints and links, common robot configurations, work volume, drive systems, types of robot control, accuracy and repeatability, end effectors, sensors in robotics, applications of robots.

Automated Material Handling & FMS: The material handling function, types of material handling equipment, conveyor systems, types of conveyors, automated guided vehicle systems, applications. FMS-Components, types of systems, applying FMS technology, FMS workstation, planning.

### SECTION D

Computer Aided Quality Control: Introduction, terminology in Quality Control, the computer in QC, contact and non-contact inspection methods-optical and non-optical, and computer aided testing.

Computer Integrated Manufacturing Systems: Introduction, types, machine tools and related equipments, material handling systems, computer control systems, function of the computer in a CIMS, CIMS benefits.

#### **Text Books:**

1. Automation, Production Systems and Computer Integrated Manufacturing. Groover M.P, Prentice Hall of India.
2. CAD/CAM – Groover M.P, Zimmers E.W, Prentice Hall of India.

#### **Reference Books:**

1. Approach to Computer Integrated Design and Manufacturing Nanua Singh, John Wiley

## ME-427-F MANUFACTURING MANAGEMENT

L	T	P	Theory	: 100 Marks
3	1	-	Total	: 150 Marks
			Duration of Exam	: 3 Hrs.

**Note: Examiner will set 9 questions in total, two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt 5 questions in total at least one question from each section.**

### SECTION-A

Manufacturing Systems Designs: Definition, Systems, Subsystems, Systems Approach Fundamentals, Systems Approach for designing, Manufacturing Systems, Systematic Layout Planning (SLP), Computerized Plant Layout- CRAFT, ALDEP, CORELAP, Assembly Line balancing, Problems and solutions of assembly lines, Group Technology & Cellular Systems, Classification & Grouping, overview of FMS. Strategic consideration for comparison of various systems.

Manufacturing Systems Economics: Concept of time value of money, Preparation of time profile of project, Single payment, Equal Series payment, various machine and project selection & evaluation techniques: Payback period, Present worth, Equivalent annual cost, Cost- benefit ratio, Evaluation for both equal & unequal life. Depreciation concept various methods- straight line, declining balance, Sum of the digits, Sinking fund.

### SECTION-B

New Product Development (NPD): Product Development, Customer Need, Strategies for New Product Development, Product life cycle, Product status. Corporate Design Strategies, Japanese Approach to NPD. PUGH total Design approach, PAHL & BEITZ Approach, Project Approach, Cross functional Integration – Design, manufacturing, Marketing, Concurrent Engineering, Modular Design, Standardization Value Engineering & Analysis.

Manufacturing Planning & Control Systems: Overview of Aggregate Planning Models, Linear Decision Rules, Management Coefficient, Direct Search Methods, Master Production Schedule, Modular Bill and Materials, Capacity planning & control, language, medium range, short range capacity planning, Just in Time (JIT), Manufacturing – Philosophy, Elements, KANBAK, effects on layout, workers & vendors, optimized production technology (OPT).

### SECTION-C

Forecasting Methods: Forecasting Framework, Forecasting cost and accuracy, Forecasting Uses and Methods – Delphi, Exponential Smoothing, Forecasting Errors – MAD, Regression Methods \_ Linear Model for single & multiple variables, Brief idea of computerized forecasting systems.

Material Requirements Planning (MRP): Definition of MRP systems. MRP versus Order point, MRP Elements, Types of MRP – MRP I & II. Structured Bill of Materials. Regenerative & Net change MRP, Operating an MRP, Integration of Production & Inventory Control.

### SECTION-D

Maintenance & Reliability: Concept of preventive & breakdown maintenance, maintenance cost, optimal preventive maintenance simple replacement models individual and group replacement, MAPI - methods, reliability definitions, failure analysis and curve, systems reliability- series parallel, redundancy, methods of improving reliability, MTBF, MTTR, Maintainability, availability, brief concept of zero-technology.

#### Text Books:

1. Operations Management – SCHOROEDER, MGH, New York.
2. Production Operations Management – CHARY, TMH, New Delhi.

#### Reference Books:

1. Production Operations Management – ADAM & EBERT, PHL, New Delhi
2. Operational Management – MONKS, McGraw Hill, Int.
3. Production & Operations Management – I. Hill, Prentice Hall, Int.
4. Production Planning & Inventory Control – NARASIMHAM et al, PHL, New Delhi
5. Production & Operation Management- Panneerselvam, PHI, New Delhi
6. Managing for total Quality-LOGOTHETIS, PHI, New Delhi
7. Concept of Reliability Engineering – L.S. Srinath, Affiliated East West.
8. Revolutionizing Product Development – WHEELWRIGHT & CLARK, Free Press.
9. Management in Engineering – FREEMAN-BALL & BALKWILL, PHI, New Delhi.
10. Production & Operations Management – MARTINICH, John Wiely SE, New Delhi.

## ME- 429-F RELIABILITY ENGINEERING

L	T	P	Theory	: 100 Marks
3	1	-	Total	: 150 Marks
			Duration of Exam	: 3 Hrs.

**Note: Examiner will set 9 questions in total, two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt 5 questions in total at least one question from each section.**

### SECTION-A

Reliability: Definition; Probability Concept; Addition of Probabilities; Complimentary Events; Kolmogorov Axioms.

Failure Data Analysis: Introduction, Mean Failure Rate, Mean Time to Failure ( MTTF ), Mean Time between Failures ( MTBF), Graphical Plots, MTTF in terms of Failure Density, MTTF in Integral Form.

### SECTION-B

Hazard Models: Introduction, Constant Hazard; Linearly Increasing Hazard, The Weibull Model, Density Function and Distribution Function, Reliability Analysis, Important.

Distributions and their Choice, Standard Deviation and Variance. Conditional Probability: Introduction, Multiplication Rule, Independent Events, Venn Diagram, Hazard Rate as conditional probability, Bayes Theorem.

### SECTION-C

System Reliability: Series. Parallel and Mixed Configurations, Complex Systems, Logic Diagrams, Markov Models.

Reliability Improvement & Repairable Systems: Redundancy, Element, Unit and standby Redundancy, Optimization; Reliability – cost trade- off, Introduction to Repairable Systems, Instantaneous Repair Rate, MTTR, Reliability and Availability Functions, Important Applications.

### SECTION-D

Fault-Tree Analysis and Other Techniques: Fault-tree Construction, Calculation of Reliability, Tie- set and Minimal Tie-set.

Maintainability and Availability : Introduction, Maintenance Planning, Reliability and Maintainability trade – off.

### Text Books:

2. Reliability Engineering, L.S. Srinath, Affiliated East-West Press, New Delhi.
3. Reliability Engineering, A.K.Govil, Tata Mc-Graw Hill, New Delhi.

### Reference Books:

1. Reliability Engineering, L.Balagurusamy, Tata Mc-Graw Hill, New Delhi, 1984.
2. Reliability Based Design, S. Rao, Mc-Graw Hill, 1992.
3. Reliability in Engineering Design, K.C. Kapur and L.R. Lamberson, Wiley Publications.
4. Reliability Engineering, D.J. Smith, 1972, E.W. Publications.



## ME-431-F SOLAR ENERGY ENGINEERING

L     T     P  
3     1     -

Theory                    : 100 Marks  
Total                     : 150 Marks  
Duration of Exam       : 3 Hrs.

**Note: Examiner will set 9 questions in total, two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt 5 questions in total at least one question from each section.**

### SECTION-A

Solar Radiation: Introduction, solar system – sun, earth and earth-sun angles, time, derived solar angles, estimation of solar radiation (direct and diffuse), measurement systems – pyrreheliometers and other devices. Effect of Solar radiation upon structures: Steady state heat transmission, solar radiation properties of surfaces, shading of surfaces, periodic heat transfer through walls and roofs.

### SECTION-B

Solar Collectors: Flat plate and concentrating – comparative study, design and materials, efficiency, selective coatings, heliostats.

Heating Applications of Solar Energy: Air and Water heating systems, thermal storages, solar bonds, solar pumps, solar lighting systems, solar cookers, solar drying of grains.

### SECTION-C

Cooling Applications of Solar Systems: Continuous and Intermittent vapour absorption systems for cooling applications, absorbent – refrigerant combination, passive cooling systems.

### SECTION-D

Solar Electric Conversion Systems: Photovoltaics, solar cells, satellite solar power systems. Effects on Environment, economic scenario, ozone layer depletion, green house effect, global warming, Remedial measures by international bodies.

#### **Text Books:**

1. Solar Energy – S P Sukhatme, Tata McGraw Hill
2. Solar Energy Process – Duffie and Bechman, John Wiley

#### **Reference Books:**

1. Applied Solar Energy – Maniel and Maniel, Addison Wiley
2. Solar Energy: Fundamentals and Applications – R P Garg and Jai Prakash, TMH.

## ME- 433-F VALUE ENGINEERING

L     T     P  
3     1     -

Theory                     : 100 Marks  
Total                        : 150 Marks  
Duration of Exam        : 3 Hrs.

**Note: Examiner will set 9 questions in total, two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal marks (20 marks). Students have to attempt 5 questions in total at least one question from each section.**

### SECTION-A

Introduction: Value Engineering concepts, Advantages, Applications, Problem recognition, and role in productivity criteria for comparison, element of choice.

### SECTION-B

Organisation: Level of VE in the organization, Size and skill of VE staff, small plant VE activity. Unique and quantitative evaluation of ideas.

### SECTION-C

Analysis Of Function: Anatomy of the function, Use esteem and exchange values, Basic vs secondary vs. unnecessary functions.

### SECTION-D

Value Engineering Techniques: Selecting products and operation for VE action, VE programmes, determining and evaluating function(s) assigning rupee equivalents, developing alternate means to required functions, decision making for optimum alternative, Use of decision matrix, Queuing theory and Monte Carlo method, make or buy, Measuring profits, Reporting results, Follow up, Use of advanced technique like FAST (Function Analysis System) Tech.

### Reference and Text Books:

1. Techniques of Value analysis and engineering – Miles, Pub.- McGraw Hill.
2. Value Management – Heller Pub.- Addison Wesley.
3. Value Analysis and Value – Oughson, Pub.- Pitman.

**MAHARSHI DAYANAND UNIVERSITY, ROHTAK**  
**SCHEME OF STUDIES & EXAMINATIONS**  
**B.Tech. 4<sup>th</sup> YEAR MECHANICAL ENGINEERING, SEMESTER- VIII**  
**(Proposed Scheme-F)**  
**W.E.F 2012-13**

<b>Sl. No.</b>	<b>Course No.</b>	<b>Subject</b>	<b>Internal Marks</b>	<b>External Marks</b>	<b>Total Marks</b>
1.	ME- 402-F	Industrial Training/Institutional Project Work	150	150	300

**Note:**

The students are required to undergo Industrial Training or Institutional Project Work of duration not less than 4 months in a reputed organization or concerned institute. The students who wish to undergo industrial training, the industry chosen for undergoing the training should be at least a private limited company. The students shall submit and present the mid-term progress report at the Institute. The presentation will be attended by a committee. Alternately, the teacher may visit the Industry to get the feedback of the students.

The final viva-voce of the Industrial Training or Institutional Project Work will be conducted by an external examiner and one internal examiner appointed by the Institute. External examiner will be from the panel of examiners submitted by the concerned institute approved by the Board of Studies in Engg. & Technology. Assessment of Industrial Training or Institutional Project Work will be based on seminar, viva-voce, report and certificate of Industrial Training or Institutional Project Work obtained by the student from the industry or Institute.

**The internal marks distributions for the students who have undergone Industrial Training consist of 50 marks from the industry concern and 100 marks by the committee members consisting of faculty members of concerned department of the parent institute.**

The teachers engaged for Institutional Project work shall have a workload of 2 hours per group (at least 4 students) per week.

