Syllabus for
B.E. (Mechanical Engineering)
IV Year

ME- 401 E AUTOMOBILE ENGINEERING

L	T	P
3	1	-

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

Unit I Introduction to Automobiles : Classification, Components, Requirements of Automobile Body; Vehicle Frame, Separate Body & Frame, Unitised Body, Car Body Styles, Bus Body & Commercial Vehicle Body Types; Front Engine Rear Drive & Front Engine Front Drive Vehicles, Four Wheel Drive Vehicles, Safety considerations; Safety features of latest vehicle; Future trends in automobiles.

Unit II Clutches : Requirement of Clutches – Principle of Friction Clutch – Wet Type & Dry Types; Cone Clutch, Single Plate Clutch, Diaphragm Spring Clutch, Multi plate Clutch, Centrifugal Clutches, Electromagnetic Clutch, Over Running Clutch; Clutch Linkages.

Unit III Power Transmission : Requirements of transmission system; General Arrangement of Power Transmission system; Object of the Gear Box; Different types of Gear Boxes; Sliding Mesh, Constant Mesh, Synchro- mesh Gear Boxes; Epi-cyclic Gear Box, Freewheel Unit. Overdrive unit-Principle of Overdrive, Advantage of Overdrive, Transaxle, Transfer cases.

Unit IV Drive Lines, Universal Joint, Differential and Drive Axles: Effect of driving thrust and torque reactions; Hotchkiss Drive, Torque Tube Drive and radius Rods; Propeller Shaft, Universal Joints, Slip Joint; Constant Velocity Universal Joints; Front Wheel Drive; Principle, Function, Construction & Operation of Differential; Rear Axles, Types of load coming on Rear Axles, Full Floating, Three quarter Floating and Semi Floating Rear Axles.

Unit V Suspension Systems : Need of Suspension System, Types of Suspension; factors influencing ride comfort, Suspension Spring; Constructional details and characteristics of leaf springs.

Unit VI Steering System : Front Wheel geometry & Wheel alignment viz. Caster, Camber, King pin Inclination, Toe-in/Toe-out; Conditions for true rolling motions of Wheels during steering; Different types of Steering Gear Boxes; Steering linkages and layout; Power steering – Rack & Pinion Power Steering Gear, Electronics steering.

Unit VII Automotive Brakes, Tyres & Wheels : Classification of Brakes; Principle and constructional details of Drum Brakes, Disc Brakes; Brake actuating systems; Mechanical, Hydraulic, Pneumatic Brakes; Factors affecting Brake performance, Power & Power Assisted Brakes; Tyres of Wheels; Types of Tyre & their constructional details, Wheel Balancing, Tyre Rotation; Types of Tyre wear & their causes.

Unit VIII Emission Control System & Automotive Electrical : Sources of Atmospheric Pollution from the automobile, Emission Control Systems – Construction and Operation of Positive Crank Case Ventilation (PVC) Systems, Evaporative Emission Control, Heated Air Intake System, Exhaust Gas Recirculation (ECR) Systems, Air Injection System and Catalytic Converters; Purpose construction & operation of lead acid Battery, Capacity Rating & Maintenance of Batteries; Purpose and Operation of Charging Systems, Purpose and Operations of the Starting System; Vehicle Lighting System.

Text Books:

1. Automobile Engineering by Anil Chhikara, Satya Prakashan, New Delhi.
2. Automobile Engineering by Dr. Kirpal Singh, standard Publishers Distributors.

Reference Books:

1. Automotive Mechanics – Crouse / Anglin, TMH.
2. Automotive Technology – H.M. Sethi, TMH, New Delhi.
3. Automotive Mechanics – S.Srinivasan, TMH, New Delhi.
4. Automotive Mechanics – Joseph Heitner, EWP.
5. Motor Automotive Technology by Anthony E. Schwaller – Delmer Publishers, Inc.
6. The Motor Vehicle – Newton steeds Garrett, Butter Worths.

Note : In the semester examination, the examiner will set eight questions in all, at least one question from each unit & students will be required to attempt only 5 questions.

ME-403 E REFRIGERATION & AIR CONDITIONING

L	T	P		
3	1	-	Sessional	: 50 Marks
			Theory	:100Marks
			Total	:150 Marks
			Duration of Exam : 3Hrs.	

Unit I 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.

Unit II 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.

Unit III 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.

(B) 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.

Unit IV 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.

(B) Steam Jet Refrigerating System- Introduction, Analysis, Relative merits and demerits, Performance Applications, Problems.

(C) Cascade Refrigerating Systems-Necessity Selection of Pairs of refrigerants for the system, Concept of cascade temperature, Analysis, Multistaging, Comparison with V.C. systems, Applications, Problems.

Unit V 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.

Unit VI 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.

Unit VII 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.

Unit VIII 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.

Note : In the semester examination the examiner will set eight questions in all one question from each unit. The students will be required to attempt only 5 questions.

ME- 405 E OPERATIONS RESEARCH

L	T	P
3	1	-

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

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

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

Unit III 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.

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

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

Unit VI 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.

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

Unit VIII 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, Churchaman, 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.

Note: Paper setter will set eight questions, at least one from each unit. Students are required to answer five questions.

ME- 407 E AUTOMOBILE ENGINEERING LAB

L	T	P
-	-	2

Sessional : 25 Marks
Practical : 25 Marks
Total : 50 Marks
Duration of Exam : 3Hrs.

List of Experiments :

1. To study and prepare report on the constructional details, working principles and operation of the following Automotive Engine Systems & Sub Systems.
   (a) Multi-cylinder : Diesel and Petrol Engines.
   (b) Engine cooling & lubricating Systems.
   (c) Engine starting Systems.
   (d) Contact Point & Electronic Ignition Systems.

2. To study and prepare report on the constructional details, working principles and operation of the following Fuels supply systems:
   (a) Carburetors
   (b) Diesel Fuel Injection Systems
   (c) Gasoline Fuel Injection Systems.

3.. To study and prepare report on the constructional details, working principles and operation of the following Automotive Clutches.
   (a) Coil-Spring Clutch
   (b) Diaphragm – Spring Clutch.
   (c) Double Disk Clutch.

4. To study and prepare report on the constructional details, working principles and operation of the following Automotive Transmission systems.
   (a) Synchromesh – Four speed Range.
   (b) Transaxle with Dual Speed Range.
   (c) Four Wheel Drive and Transfer Case.
   (d) Steering Column and Floor – Shift levers.

5. To study and prepare report on the constructional details, working principles and operation of the following Automotive Drive Lines & Differentials.
   (a) Rear Wheel Drive Line.
   (b) Front Wheel Drive Line.
   (c) Differentials, Drive Axles and Four Wheel Drive Line.

6. To study and prepare report on the constructional details, working principles and operation of the following Automotive Suspension Systems.
   (a) Front Suspension System.
   (b) Rear Suspension System.
7. To study and prepare report on the constructional details, working principles and operation of the following Automotive Steering Systems.
   (a) Manual Steering Systems, e.g. Pitman –arm steering, Rack & Pinion steering.
   (b) Power steering Systems, e.g. Rack and Pinion Power Steering System.

(c) Steering Wheels and Columns e.g. Tilt & Telescopic steering Wheels, Collapsible Steering Columns.

8. To study and prepare report on the constructional details, working principles and operation of the following Automotive Tyres & wheels.
   (a) Various Types of Bias & Radial Tyres.
   (b) Various Types of wheels.

9. To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems.
   (a) Hydraulic & Pneumatic Brake systems.
   (b) Drum Brake System.
   (c) Disk Brake System.
   (d) Antilock Brake System.
   (e) System Packing & Other Brakes.
10. To study and prepare report on the constructional details, working principles and operation of Automotive Emission / Pollution control systems.

11. Modeling of any two automotive systems on 3D CAD using educational softwares (eg. 3D modeling package/Pro Engineering/I-Deas/ Solid edge etc.)

12. Crash worthiness of the designed frame using Hypermesh and LS-Dyna solver or other software.

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 institution as per the scope of the syllabus.

ME- 409 E REFRIGERATION & AIR CONDITIONING LAB.

L	T	P
-	-	2

Sessional : 25 Marks
Practical : 25 Marks
Total : 50 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 form 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- 411 E PROJECT

L	T	P
-	-	6

Sessional : 100 Marks
Practical : 100 Marks
Total : 200 Marks
Duration of Exam : 3Hrs.

Project involving design/ fabrication/ testing computer simulation/ case studies etc. which is commenced in VIIth Semester, will be completed in VIIIth Semester and will be evaluated through a panel of examiners consisting of HOD of the concerned department, project coordinator and one external examiner to be appointed by the University.

The student will be required to submit three copies of his/her project report to the office of the concerned department for record (one copy each for the deptt. Office, participating teacher and college library).

Project coordinator will be assigned the project load of 2 hrs., per week while the participating teachers will be assigned 1 hr. load for the same.

ME – 413 E PRACTICAL TRAINING – II

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- 451 E FINITE ELEMENT METHODS

L	T	P
3	1	-

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

Unit I 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.

Unit II 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.

Unit III 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.

Unit IV 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.

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

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

Unit VII Scalar Field Problems : Introduction, Steady-state Heat Transfer,: Introduction One-Dimensional Heat Conduction, Heat transfer in thin Fins, Two-dimensional steady-state Heat conduction, Potential Flow, Seepage, Fluid flow in Ducts.

Unit VIII 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. Chandruipatala 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.

Note : In the Semester examination, the examiner will set eight questions. At least one question from each unit. The students will be required to attempt only 5 questions.

ME– 453 E ENERGY MANAGEMENT PRINCIPLES

L	T	P
3	1	-

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

UNIT I 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.

UNIT II 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.

UNIT III 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; Problems.

UNIT IV 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.

UNIT V 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. Problems.

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

UNIT VII 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.

NOTE : In the semester examination, the examiner will set Eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 455 E ENGINEERING DESIGN

L	T	P		
3	1	-	Sessional	: 50 Marks
			Theory	: 100 Marks
			Total	: 150 Marks
			Duration of Exam	: 3 Hrs.

Unit I 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.

Unit II 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 – Conformiting (among various components), Concept of Synthesis and Assembly, Role of Fits, Tolerance and Process Capability.

Unit III 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.

Unit IV 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.

Unit V 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.

Unit VI 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.

Unit VII 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.

Unit VIII 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.

Note: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 457 E COMPUTER INTEGRATED MANUFACTURING

L	T	P
3	1	-

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

Unit I 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.

Unit II 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.

Unit III 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.

Unit IV 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.

Unit V 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.

Unit VI 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.

Unit VII 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

Note : The paper setter will set 8 questions taking at least one question from each unit . Students will be required to answer only five.

ME 459 E MANUFACTURING MANAGEMENT

L	T	P
3	1	-

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

Unit I 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.

Unit II 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.

Unit III 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.

Unit IV 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).

Unit V 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.

Unit VI 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.

Unit VII 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 tero-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 etal, 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.

Note :In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt five questions.

ME- 461 E RELIABILITY ENGINEERING

L	T	P		
3	1	-	Sessional	: 50 Marks
			Theory	: 100 Marks
			Total	: 150 Marks
			Duration of Exam	: 3 Hrs.

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

Unit II 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.

Unit III 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.

Unit IV Conditional Probability: Introduction, Multiplication Rule, Independent Events, Vernn Diagram, Hazard Rate as conditional probability, Bayes Theorem.

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

Unit VI 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.

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

Unit VIII 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.

Note: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 463 E SOLAR ENERGY ENGINEERING

L	T	P
3	1	-

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

Unit I Solar Radiation: Introduction, solar system – sun, earth and earth-sun angles, time, derived solar angles, estimation of solar radiation (direct and diffuse), measurement systems – phyrheliometers and other devices.

Unit II 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.

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

Unit IV 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.

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

Unit VI Solar Electric Conversion Systems: Photovoltaics, solar cells, satellite solar power systems.

Unit VII 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.

Note: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 465 E DESIGN OF HEAT EXCHANGERS

L	T	P
3	1	-

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

UNIT I Classification of Heat exchangers: Introduction ; Recuperation and regeneration, Transfer processors, Geometry of construction–tubular heat exchangers, plate heat exchangers, extended surface heat exchanges, Heat transfer mechanisms, Flow arrangements, Selection of heat exchangers.

UNIT II Basic Design Methods of Heat Exchanges: Introduction, Arrangement of flow path in heat exchangers , Basic equations in design, Overall heat transfer coefficient , Log mean temperature difference method for heat exchanger analysis , The $\in$-NTU method for heat exchanger analysis, Heat exchanger design calculation, Variable overall heat transfer coefficient , Heat exchanger design methodology.

UNIT III Design Correlations for Condensers and Evaporators :Introduction, Condensation, Film condensation on a single horizontal tube-laminar film condensation, forced convection, Film condensation in tube bundles-effect of condensate inundation, effect of vapor shear, Combined effects of inundation and vapor shear, Condensation inside tubes-condensation in vertical tubes, Flow boiling-sub-cooled boiling, flow pattern, flow boiling correlations.

UNIT IV Shell and Tube Heat Exchangers: Introduction, Basic components-shell types, tube bundle types, tubes and tube passes, tube layout, baffle type and geometry, allocation of streams, Basic design procedure of a heat exchanger-preliminary estimation of unit size, rating of preliminary design, Shell-slide heat transfer and pressure drop-shell-side heat transfer coefficient, shell-side pressure drop, tube-side pressure drop, Bell-Delaware method.

UNIV V Compact Heat Exchangers: Introduction, Plate-fin heat exchangers, tube-fin heat exchangers, Heat transfer and pressure drop-heat transfer, pressure drop for finned-tube exchangers, pressure drop for plate-fin exchangers.

UNIT VI Gasketed Plate Heat Exchangers: Introduction, Mechanical features-plate pack and frame, plate types, Operational characteristics-main advantages, performance limits, Passes and flow arrangements, Application-corrosion, maintenance, Heat transfer and pressure drop calculations-heat transfer area, mean flow channel gap, channel equivalent diameter, heat transfer coefficient, channel pressure drop, port pressure drop, overall heat transfer coefficient, heat transfer surface area, performance analysis, Thermal performance.

UNIT VII Condensers and Evaporators: Introduction, Shell-and-tube condensers-horizontal shell-side condensers, vertical shell-side condensers, vertical tube-side condensers, horizontal in-tube condensers, Steam turbine exhaust condensers, Plate condensers, Air-cooled condensers, Direct contact condensers, Thermal design of shell-and-tube condensers, Design and operational considerations, Condensers for refrigeration and air-conditioning-water cooled condensers, air-cooled condensers, evaporative condensers, Evaporative for

refrigeration and air-conditioning-water-cooling evaporators (chillers), air-cooling evaporators (air coolers), Thermal analysis-shah correlation, Kandlikar correlation, Gungor and Winterton correlation, Standards for evaporators and condensers.

UNIT VIII Regenerators: Classifications-fixed bed regenerators, rotary regenerators, basic design method, Influence of fluid bypass carry-over, Pressure drop evaluation, The rating problem, surface geometrical properties, Pressure drop, Sizing problem.

Text Books:

1. Heat Exchangers, Sadik Kakac, Hongtan Hiu , CRC Press.
2. Principles of Heat Transfer, F.Krieth & M.S. Bohn, Asian Books Pvt. Ltd., Delhi.

Reference Books:

1. Heat exchangers, Design and Theory Source Book, N.H. Afgan and Schliinder MGH.
2. Compact Heat Exchanger, W.M. Kays & A.L. London, MGH.

Note: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 467 E VALUE ENGINEERIN

L	T	P
3	1	-

Sessional marks : 50
Theory marks : 100
Total marks : 150
Duration of exam : 3Hrs

PART- A

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

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

PART- B

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

UNIT – IV 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.

Note: In the semester examination, the examiner will set eight questions in all, taking two questions from each unit. The students will be required to attempt 5 questions in all, taking at least two questions from each Part.

ME- 402 E COMPUTER AIDED DESIGN & MANUFACTURING

			Sessional	: 50 Marks
L	T	P	Theory	: 100 Marks
3	1	-	Total	: 150 Marks
			Duration of Exam	: 3 Hrs.

UNIT – I **Introduction**: Introduction to CAD/CAM, Historical developments, Industrial look at CAD/CAM, Introduction to CIM; Basics of geometric and solid modeling, explicit, implicit, intrinsic and parametric equations, coordinate systems.

UNIT – II **Transformations:** Introduction, transformation of points and line, 2-D rotation, reflection, scaling and combined transformation, homogeneous coordinates, 3-D scaling, shearing, rotation, reflection and translation, combined transformations, orthographic and perspective projections, reconstruction of 3-D objects.

UNIT – III **Curves**: Algebraic and geometric forms, tangents and normal, blending functions reparametrization, straight lines, conics, cubic splines, Bezier curves and B-spline curves.

UNIT – IV **Surfaces**: Algebraic and geometric forms, tangents and normal, blending functions, reparametrization, sixteen point form, four curve form, plane surface, ruled surface, surface of revolution, tabulated cylinder, bi-cubic surface, bezier surface, B-spline surface.

UNIT – V **Solids:** Solid models and representation scheme, boundary representation, constructive solid geometry, sweep representation, cell decomposition, spatial occupancy enumeration.

UNIT – VI **Automation and Numerical Control:** Introduction, fixed, programmable and flexible automation, types of NC systems, MCU and other components, NC manual part programming, coordinate systems, G & M codes, Part program for simple parts, computer assisted part programming.

UNIT – VII **Group Technology:** Part families, part classification and coding, production flow analysis, Machine cell design, Advantages of GT

UNIT – VIII **Flexible Manufacturing Systems & Computer aided process planning**: Introduction, FMS components, types of FMS, FMS layouts, planning for FMS, advantages and applications Coventional process planning, types of CAPP, Steps in variant process planning, planning for CAPP.

Text Books:

1. CAD/ CAM by Groover and Zimmer, Prantice Hall.
2. CAD/ CAM Theory and Practice by Zeid, McGraw Hill
3. Numerical Control and Computer Aided Manufacturing by Kundra, Rao & Tiwari, TMH.

Reference Books :

1 CAD/CAM (Principles, Practice & Manufacturing Management) by Chirs Mc Mohan & Jimmie Browne, Published by Addison- Wesley.

Note : In the semester examination, the examiner will set eight questions in all, at least one question from each unit. The students will be required to attempt only 5 questions

ME- 404 E POWER PLANT ENGINEERING

L	T	P		
3	1	-	Sessional Marks	: 50
			Theory Marks	: 100
			Total Marks	: 150

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

Unit II **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.**

Unit III 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.

Unit IV **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.**

Unit V **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.**

Unit VI **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-out put curves, efficiency, heat rate, economic load sharing, Problems.**

Unit VII **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.**

Unit VIII **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 Campany 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.

Note : In the semester examination, the examiner will set eight questions in all, at least one question from each unit. The students will be required to attempt only 5 questions

ME 406 E MECHANICAL VIBRATIONS

L	T	P
3	1	-

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

Unit I 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.

Unit II 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.

Unit III 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 Camping, Structural Damping Sharpness of Resonance, Vibration Measuring Instruments.

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

Unit V 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.

Unit VI 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.

Unit VII 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 – Wesely Publishing Company

Note : In the semester examination, the examiner will set eight questions in all, at least one question from each unit & students will be required to attempt only 5 questions.

ME- 408 E COMPUTER AIDED DESIGN & MANUFACTURING LAB

L	T	P
-	-	2

Sessional : 25 Marks
Theory : 25 Marks
Total : 50 Marks
Duration of Exam: 3 Hrs

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. Implement simple programmes for the graphics representation of
    a. Transformation and projections.
    b. Conic Sections, cubic splines, and B-splines.
    c. Surfaces- Bilinear, Bicubic surface patch and Bezier surface.

2. CAD Modelling Assignments.
    a. Construction of simple machine parts and components.
    b. Modelling of machine components.
        i. Surface of a Diffuser section, Propeller.
        ii. Gear blank and other mechanical parts.
        iii. Mechanical assembly of parts.

ME-410 E INDEPENDENT STUDY SEMINAR

L	T	P		
-	-	4	Sessional	: 50 Marks
			Total	: 50 Marks

The student will select a topic in emerging areas of Mech. Engg. and study independently. He will give a seminar talk on the same before the committee constituted by the head of the dept. The committee should comprise of at least three faculty members from Thermal, Production & Design specializations.

ME-412 E| GENERAL FITNESS FOR THE PROFESSION

L	T	P
-	-	-

Class Work : 50 Marks
Practical : 100 Marks
Total Marks : 150 Marks

At the end of each year students will be evaluated on the basis of their performance in various fields. The evaluation will be made by the panel of experts/examiners/teachers to be appointed by the Principal/Director of the College. A specimen perform indicating the weight age to each component/ activity is given below :-

Name : _____ College Roll No. _____
Univ.Roll No._____ _____
Branch _____ Year of Admission _____._____

I. Academic Performance (15 Marks) :

(a) Performance in University Examination :-

Sem.	**Result**	**%age of Marks obtained**	**Number of Attempt in which the Sem. exam. has been cleared**
I			
II			
III			
IV			
V			
VI			
VII			

II. Extra Curricular Activities (10 Marks) :

Item	**Level of Participation**	**Remarks (Position Obtained)**
Indoor Games (Specify the Games	_____ _____ _____	_____ _____
Outdoor Games (Specify the Games)	_____ _____ _____	
Essay Competition	_____ _____ _____	

Scientific _____
Technical _____
Exhibitions _____

Debate _____
_____
_____

Drama _____
_____
_____

Dance _____
_____
_____

Music _____
_____
_____

Fine Arts _____
_____
_____

Painting _____
_____
_____

Hobby Club _____
_____
_____

N.S.S. _____
_____
_____

Hostel Management _____
Activities _____
_____

Any other _____
activity (Please _____
Specify) _____

III. Educational tours/visits/Membership of Professional Societies (5 Marks)

1. _____
2. _____
3. _____
4. _____

5. _____
6. _____

IV. Contribution in NSS Social Welfare Floor Relief/draught relief/Adult Literacy mission/Literacy Mission/Blood Donation/Any other Social Service (5 Marks)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

V. Briefly evaluate your academic & other performance & achievements in the Institution (5 Marks)

_____
_____
_____
_____

VI. Performance in Viva voce before the committee (10 Marks)

_____
_____
_____
_____
_____

*Marks obtained 1.( )+II( )+III( )+IV( )+V( )+VI( ) =

**Total Marks :

Member Member Member Member Member

ME- 452 E OPTIMIZATION METHODS FOR ENGINEERING SYSTEMS

L	T	P	Sessional :	50 Marks
3	1	-	Theory :	100 Marks
			Total :	150 Marks
			Duration of Exam: 3 Hrs.	

Unit I **Introduction: Engineering Applications; Statement of the Optimal Problem: Classification; Optimization Techniques.**

Unit II Classical Methods: Single Variable Optimization; Multivariable Optimization without any Constraints with Equality and Inequality Constraints.

Unit III One-Dimensional Minimization Methods: Uni-model Function; Elimination Methods – Dichotomous Search, Fibonacce and Golden Section Methods; Interpolation Methods – Quadratic and Cubic Interpolation Methods.

Unit IV Unconstrained Minimization Methods: Univariate, Conjugate Directions, Gradient and Variable Metric Methods.

Unit V Constrained Minimization Methods: Characteristics of a constrained problem; Direct Methods of feasible directions; Indirect Methods of interior and exterior penalty functions.

Unit VI Geometric Programming : Formulation and Solutions of Unconstrained and Constrained geometric programming problems.

Unit VII Dynamic Programming: Concept of Sub-optimization and the principle of optimality; Calculus, Tabular and Computational Methods in Dynamic Programming; An Introduction to Continuous Dynamic Programming.

Unit VIII Integer Programming : Gomory's Cutting Plane Method for Integer Linear Programming; Formulation & Solution of Integer Polynomial and Non-linear problems.

Text Books :

1. Optimization (Theory & Applications) – S.S. Rao, Wiley Eastern Ltd., New Delhi.
2. Optimization Concepts and Applications in Engineering - Ashok D.Belegundu and Tirupathi R Chandrupatla -- Pearson Education.

Reference Books :

1. Optimization: Theory and Practice, C.S.G. Beveridge and R.S. Schechter, MGH, New York.

Note : In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions

ME- 454 E MACHINE TOOL DESIGN

L	T	P
3	1	-

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

Unit I **Introduction:** Kinematics of Different Types of Machine Tools, Selection of Cutting Conditions and Tools, Calculation of Cutting Force on Single Point and Multipoint Tools, Hole Machining, Calculation of Power, Accuracy Requirements and Standards.

Unit II **Design of Rotary Drives**: Design of Spindle Drives, AC Motors with Stepped Drive, DC and AC Variable Speed Drive Motors Characteristics and Selection, Principle of Speed Controllers, Timings Belts and other Types of Transmission Belting, Pulleys, Closed Loop Operation of Main Drives, Rotary Indexing Drives.

Unit III **Design of Feed Drives:** Feed Drive using Feed Boxes, Axes Feed Drive of CNC Drives, DC and AC Servomotors, Types characteristics Controllers and Their Selection, Ball Screws and Friction Screws- Guide Ways, Linear Motion Systems, Design Calculations of Drives, Closed Loop Operations of Feed Drives, Linear Indexing Drives.

Unit IV **Control Elements** : Single and Multi Axis CNC Controllers, Hydraulic Control, Pneumatic Control, Limit Switches, Proximity Switches, Sequencing Control using Hard Wired and PLC Systems.

Unit-V **Design of Machine Tool Structures**: Static and Dynamic Stiffness, Dynamic Analysis of cutting process, Stability, Forced Vibration, Ergonomics and Aesthetics in Machine Tool Design.

Unit VI **Design of Spindle and Spindle Supports** : Function of Spindles, Design Requirements, Standard Spindle Noses, Design Calculations of Spindles, Bearing Selection and Mounting.

Unit VII **Finite Elements Analysis of M/C Tool Structures:** Examples of Static, Dynamic and Thermal Analysis and Optimization of Typical Machine Tool Structures Like Column, Table, Over-arm, Knee using a Finite Element Analysis Package.

Unit VIII **Design of Special Purpose Machines** : Modular Design Concepts, Standard Modules, Example of Design of a Typical SPM with CNC, Transfer Machines.

Text Books:

1. " Machine Tool Design" Mehta, N.K. Tata McGraw Hill,
2. Design Principal of Cutting Machine Tools : Koenigs berger f. Pergman Press Oxford.

Reference Books :

1. "Machine Tool Design", Vol I and Vol III, Mir Publishers, Moscow, Macherkan.

Note : In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions

ME- 456 E TOTAL QUALITY CONTROL

L	T	P		
3	1	-	Sessional	: 50 Marks
			Theory	: 100 Marks
			Total	: 150 Marks
			Duration of Exam: 3 Hrs.	

Unit I **Quality Control:** Introduction, objectives, quality of design, quality of production, quality of conformance to design, quality of inspection, process monitoring, quality and productivity, quality cost. Advantages of Statistical Quality Control in Industry.

Unit II **Fundamentals of Statistics and Probability in Quality Control:** Events and probability, laws of probability. Statistical Distributions: Normal, Binomial and Poisson distribution, their importance in SQC. Poisson Probability as approximation to Normal Probability, use of Normal and Poisson distribution tables.

Unit III **Control Charts for Variables:** Fundamentals of process control, tools of process control,quality characteristic, Design and use of Control Charts for Variables: Trial control limits, control limits for future use, revision of control limits. Cause and effect diagram, inferences on the state of the process from control charts, Type I and Type II errors and methods to reduce them. Use of X (X bar) charts and R- charts, X (X bar) and σ- charts. Efficiency of a control chart. OC curve of a control chart. Computing average run length for X- chart.

Unit IV **Trend Control Charts**, Control Charts with Reject Limits and Modified Control Charts. Relationship between Specification Limits and Control Chart Limits, Process capability analysis and its importance in quality of conformance.

Unit V **Control Charts for Attributes** : Defects and Defectives, control charts for fraction defectives and percent fraction defectives and number of defectives. Control charts for number of defects. Comparison of control charts for variables with the charts for attributes. Computing Average run length for a p- chart.

Unit VI **Product Control and its Tools**. Fundamentals of lot-by-lot acceptance sampling by attributes: Notations, OC curve and its importance in acceptance sampling, AQL and LTPD for a sampling plan, Producer and consumer risks, Single and Double sampling plans and constructing OC curves, interpretation of the operating characteristics curve, Effect of change of sample size and acceptance number on OC curve, ATI, ASN, AOQ and AOQL concepts, economics of inspection. Item- by- item sequential sampling plans, OC curve and ASN curve for sequential sampling plan.

Unit VII **Standard Sampling Plans**: Types of Standard Sampling Plans, Difference between Acceptance-Rectification and Acceptance- Rejection Plans, single and double sampling plans based on AOQL and LTPD. Sampling plans based on Mil-Standards 105 E.

Unit VIII **Motivation** for quality assurance, zero defect program, quality circles, total quality management. Indian Standards on Process and Product Control. ISO-9000 Standards.

Text Books :

1. Quality control Application – By Hansen BL, Ghare PH; Prentice Hall of India.
2. Statistical Quality Control - By E.L. Grant & R.S. Levenworth; T MH.

Reference Books :

1. Quality Control – Paranthaman, D.; Tata McGraw Hill, India
2. Quality Planning and Analysis – Juran J.M. and F.M. Gryna, TMH, India
3. Total Quality Control – By Feigenbaum, A.V.; McGraw Hill International.
4. Statistical Quality Control – By Montgomery, D.C.; John Wiley & Sons (Asia)

Note : 1. Statistical Q.C. Tables will be supplied in examination.

2.The paper setter will set Eight questions, taking at least one from each unit. Students will be required to answer only five.

ME- 458 E PUMPS, FANS, BLOWERS AND COMPRESSORS

L	T	P
3	1	-

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

Unit I Pumps: Theory of centrifugal pump impeller, vortex theory, design of impeller, volute and diffusers, specific speed and design constants.

Unit II Design of Mixed Flow Impellers: Geometric relationship, axial flow pumps, design, use of aerofoil data for impeller design, guided vane, pump casting.

Unit III Fans: Fan laws, performance coefficients, effect of change in fan speed, density. Series and parallel operation, fan design losses, blade shape, casings.

Unit IV Propeller Fans: Cross flow fans, principle of operation, applications, regulation of volume flow. Sources of vibration in fans, noise, attenuation testing.

Unit V Blowers: Types, centrifugal and axial, design procedure, selection, performance, special application, control of volume flow.

Unit VI Performance Estimation: Instrumentation test rig layout, measurement of pressure, temperature, use of hot wire anemometer, boundary layer probes, measurement of sound.

Unit VII Compressors: Centrifugal compressor, multistage arrangement, blade design, types of diffusers, performance, series and parallel operation.

Unit VIII Axial Flow Compressors: Cascade theory, efficiency, two dimensional cascade, velocity triangles and stage loading, stage reactions, losses compressor testing procedure.

Text Books :

1. Val, S. Lobanoff, and Robert, R. Ross, "Centrifugal Pumps Design and Application", Jaico Publishing House
2. Allam Wallis, R., "Axial Flow and Ducts", John Wiley and Sons

Reference Books :

1. Ronald, P. Lapina, "Estimating Centrifugal Compressor Performance", Gulf Pub. Company

Note : In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions

ME- 460 E DESIGN OF AIR CONDITIONING SYSTEMS

L	T	P		
3	1	-	Sessional	: 50 Marks
			Theory	: 100 Marks
			Total	: 150 Marks
			Duration of Exam:	3 Hrs.

UNIT - I Air Conditioning Systems, Hydronic Piping Systems And Terminal Units:
Scope of air conditioning, All-water (Hydronic) air- conditioning systems, All-air air-conditioning systems, Human comfort, Comfort standards, Hydronic piping systems - Piping arrangements, Series loop, One-pipe main, Two-pipe direct and revere returns, Three-pipe and four pipe systems, Terminal units- Radiators, Convectors, Baseboard, Fin-tube, Radiant panels, Unit heaters, Fan-coil and induction units, Selection of terminal units, System design procedure.

UNIT – II Heat Transfer In Building Structures And Load Calculation:
Fabric heat gain, Overall heat transfer coefficient, Periodic heat transfer through walls and roofs, Empirical methods to evaluate heat transfer through wall and roofs, Infiltration, Passive heating and cooling of buildings, Internal heat gains, System heat gains, Break-up of ventilation load and effective sensible heat factor, cooling-load estimate, Heating-load estimate, Psychometric calculations for cooling.

UNIT – III Psychometric Analysis Of The Air Conditioning System:
Determining moist air properties, The psychrometric chart, Air conditioning processes, Determining supply air conditions, Sensible heat ratio, The RSHR or condition line, Coil process line, The contact factor and bypass factor, The effective surface temperature, Reheat, Part load operation and control, Fan heat gains, Comfort chart.

UNIT – IV Fluid Flow In Piping And Ducts:
The continuity equation, The flow energy equation, Pressure loss in closed and open systems, Total, static and velocity pressures in piping, Pressure loss in pipe fitting, System pipe sizing, Friction loss from air flow in ducts, duct fittings at fan inlet and outlet, Duct system pressure loss, Duct design methods.

UNIT – V Fans, Air Distribution Devices And Centrifugal Pumps:
Fan - Types, Performance characteristics, Selection, Ratings, Selection of optimum conditions, Laws, Arrangement and installation, Air distribution devices – Air patterns, Location, Types, Selection, Accessories, Return air devices, Sound and its control, Pumps – Types, Characteristics, Similarity laws, Net positive suction head, The expansion and compression tanks, Air control and venting.

UNIT – VI Planning And Designing The Hvac System:
Classification of A/C systems- Single zone, Reheat, Multi zone, Dual duct, Variable air volume, All-water systems, Air water systems, Unitary air conditioners, Rooftop units, Air handling units, Procedures for designing a hydronic system, Calculating the heating load, Type, location and selection of terminal units, Piping system arrangements, Flow rates and temperature, Pipe sizing, Duct layout, Pump selection, Boilers selection, Compressor tanks, Procedure for designing and all-air system, Calculating the cooling

load, Type of system, Equipment and duct locations, Duct sizes, Air distribution devices,

Reference Books:

1. Air Conditioning Principles and Systems by Edward G. Pita, Published by PHI, New Delhi
2. Refrigeration and Air Conditioning by C.P. Arora, Published by TMH, New Delhi.
3. Refrigeration and Air Conditioning by W.F. Stocker and J.W. Jones, Published by TMH, New Delhi.
4. Refrigeration and Air Conditioning by Manohar Prasad, , Published by Wiley Eastern Limited, New Delhi.

Note: 1. In the semester examination the examiner will set 8 questions in all covering the entire syllabus and students will be required to attempt only 5 questions.

2. Use of scientific calculator will be allowed in the examination. However programmable calculator and cellular phone will not be allowed.

ME- 462 E COMPUTER AIDED VEHICLE DESIGN

L	T	P		
3	1	-	Sessional	: 50 Marks
			Theory	: 100 Marks
			Total	: 150 Marks
			Duration of Exam:	3 Hrs.

PART-A

Unit I Vehicle Frame and Suspension: Study of Loads-Moments and Stresses on Frame Members. Computer Aided Design of Frame for Passenger and Commercial Vehicles. Computer Aided Design of Leaf Springs-Coil Springs and Torsion Bar Springs.

Unit II Front Axle and Steering Systems: Analysis of Loads-Moments and Stresses at different sections of Front Axle. Determination of Bearing Loads at Kingpin Bearings. Wheel Spindle Bearings. Choice of Bearings. Determination of Optimum Dimension and Proportions for Steering Linkages ensuring minimum error in Steering.

Unit III Drive Line and Read Axle : Computer Aided Design of Propeller Shaft. Design of Final Drive Gearing. Design details of Full-floating., Semi-floating and Three Quarter Floating, Rear Axle Shafts and Rear Axle Housings.

PART-B

Unit IV Clutch: Torque capacity of Clutch. Computer Aided Design of Clutch Components. Design details of Roller and Sprag Type of Clutches.

Unit V Gear Box : Computer Aided Design of Three Speed and Four Speed Gear Boxes.

Note : Use of Software Packages for Analysis and Design of Mechanical Systems may be used for Design Problem.

Text Books :

1. Dean Averns,Automobile Chassis Design, llliffe Books
2. Heldt, P.M., Automotive Chassis, Chilton Co., New York

Reference Books:

1. Steeds.W., Mechanics of Road Vehicles, llliffee Books Ltd., London
2. Giles, J.G. Steering, Suspension and Tyres, llliffee Books Ltd., London,.
3. Newton, Steeds & Garret, Motor Vehicle, llliffee Books Ltd., London,.
4. Heldt, P.M. Torque Converter, Chilton Book Co., New York,

Note : In the semester examination, the examiner will set eight questions in all, taking two questions each from Units I, II, III & one question each from Units IV & V. The students will be required to attempt 3 questions from PART-A & two questions compulsorily from Part-B .

ME- 464 E MECHATRONICS

L	T	P		
3	1	-	Sessional	: 50 Marks
			Theory	: 100 Marks
			Total	: 150 Marks
			Duration of Exam:	3 Hrs.

Unit I **Introduction and Basics: What is Mechatronics?; A Measurement System with its constituent elements; Open and Closed Loop Systems; Sequential Controllers; Micro-processor Based Controllers; The Mechatronic Approach.**

Unit II Hardware of Measurement Systems; A review of Displacement, Position Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors / alongwith Performance Terminology; Selection of Sensors; Input Data by Switches; Signal Conditioning; Brief Review of Operational Amplifier; Protection; Fitering; Wheat Stone Bridge; Digital Signals; Multiplexers; Data Acqusition; Digital Signal Processing; Pulse Modulation; Data Presentation Systems – Displays; Data Presentation Elements; Magnetic Recording; Data Acquisition Systems; Testing & Calibration; Problems.

Unit III Pneumatic, Hydraulic, Mechanical and Electrical Actuation Systems: Pneumatic and Hydraulic Systems; Directional Control Valves; Valve Symbols; Pressure Control Valves; Cylinder Sequencing; Process Control Valves; Rotary Actuators; Mechanical Systems – Types of Motion, Kinematic Chains, Cams, Gear Trains, Ratchet & Pawl, Belt & Chain Drives, Bearings, Mechanical Aspect of Motor Selection; Electrical Systems; Mechanical & Solid State Switches; Solenoids; D.C. & A.C. Motors; Stepper Motors; Problems.

Unit IV System Modeling and Performance: Engg. Systems; Rotational – Translational Systems; Electro-mechanical Systems; Hydraulic – Mechanical Systems; A review of modeling of First and Second Order Systems and Performance Measures; Transfer Functions for first order System, Second Order System, Systems in series & Systems with Feedback Loops; Frequency Response of First Order and Second Order Systems; Bode Plots: Performance Specifications: Stability; Problems.

Unit V Closed Loop Controllers: Continuous and Discrete Processes – Lag, Steady State Error; Control Modes; Two- step Mode; Proportional Mode – Electronic Proportional Controllers; Derivative Control – Proportional plus Derivative Control; Integral Control - Proportional plus Integral Control; PID Controller – Operational Amplifier PID Circuits; Digital Controllers – Implementing Control Modes; Control System Performance; Controller Tuning – Process Reaction Method & Ultimate Cycle Method; Velocity Control; Adaptative Control; Problems.

Unit VI Digital Logic and Programmable Logic Controllers : A Review of Number Systems & Logic Gates; Boolean Algebra; Kanaugh Maps; Sequential Logic; Basic Structure of Programmable Logic Controllers; Input/ Output Processing; Programming; Timers, Internal Relays and Counters; Master & Jump Controls; Data Handling; Analogue Input/ Output; Selection of a PLC; Problems.

Unit VII Microprocessors and Input/Output Systems: Control; Microcomputer Structure; Micro-controllers; Applications; Programming Languages; Instruction Sets; Assembly Language Programs; Subroutines; Why C Language ? A review of Program Structure, Branches, Loops, Arrays, Pointer; Examples of Programs; Interfacing; Input/ Output; Interface Requirements; Peripheral Interface Adaptors; Serial Communication Interface; Examples of Interfacing; Problems.

Unit VIII Design and Mechatronics: Design Process; Traditional and Mechantronics Design; Possible Mechatronics design solutions for Timed Switch, Wind Screen Wiper Motion, Bath Room Scale, A Pick & Place Robot, Automatic Camera, Engine Management System & Bar Code Recorder.

Text Books :

1. Mechatronics by W. Bolton, Published by Addition Wesley.
2. Mechatronics System Design – Devdas Shetty and Richard A. Kolx Brooks/ Cole 1997.

Reference Books :

1. Introduction to Mechatronics and Measuring System : david G. Alciation and Michael B. Hist and Tata McGraw Hill
2. Mechtronics – Sensing to Implementation - C.R.Venkataraman, Sapna

Note : In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 466 E FLEXIBLE MANUFACTURING SYSTEMS

L	T	P		
3	1	-	Sessional	: 50 Marks
			Theory	: 100 Marks
			Total	: 150 Marks
			Duration of Exam: 3 Hrs.	

Unit I Automation: Types of automation, reasons for automating, automation strategies, Detroit-type automation: Automated flow lines, methods of work part transport, Transfer mechanisms, buffer storage, automation for machining operations.

Unit II Automated assembly systems: Design for automated assembly, types of automated assembly systems, part feeding devices, quantitative analysis of the delivery system operation, analysis of a single-station assembly machine, numericals.

Unit III Group Technology: Part families, parts classification and coding, types of classification and coding systems. Machine cell design: The composite part concept, types of cell designs, determining the best machine arrangement, benefits of group technology.

Unit IV Flexible Manufacturing Systems: Components of an FMS, types of systems, where to apply FMS technology, FMS work stations. Material handling and storage system: Functions of the handling system, FMS layout configurations. Material handling equipment. Computer control system: Computer function, FMS data file, system reports. Planning the FMS, analysis methods for FMS, applications and benefits.

Unit V Robotic technology: Joints and links, common robot configurations, work volume, types of robot control, accuracy and repeatability, other specifications, end effectors, sensors in robotics.

Unit VI Robot programming: Types of programming, lead through programming, motion Programming, interlocks, advantages and disadvantages. Robot languages: Motion programming, simulation and off-line programming, work cell control.

Unit VII Robot applications: Characteristics of robot applications, robot cell design, types of robot applications: Material handling, processing operations, assembly and inspection.

Text Books:

3. Automation, Production Systems and Computer Integrated Manufacturing. Groover M.P, Prentice Hall of India.
4. 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 and Sons, 1998.
2. Production Management Systems: A CIM Perspective Browne J, Harhen J, Shivnan J, Addison Wesley, 2nd Ed. 1996.

Note : In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt five questions.

ME- 468 E NON-CONVENTIONAL ENERGY

L	T	P		
3	1	-	Sessional	: 50 Marks
			Theory	: 100 Marks
			Total	: 150 Marks
			Duration of Exam: 3 Hrs.	

Unit I Introduction: Trends of energy consumption, sources of energy – conventional and renewable, fossil fuel – availability and limitations, need to develop new energy sources.

Unit II Solar Energy: Solar radiation characteristics and estimation, Solar Collectors, Flat Plate and concentrating types. Their comparative study, design and material selection, efficiency. Selective paints and surfaces. Heating of air and water for building and other uses. Thermal storages, Solar Ponds, Solar pumps, solar Power, Solar Cookers etc. Direct Conversion of Solar energy to electricity and its various uses, materials, limitations and costs.

Unit III Bio-conversion: Generation of bio-gas, digesters and their design, selection of material, feed to digester, paralytic gasification, production of hydrogen, Algae production and the their uses.

Unit IV Wind Energy: Types of rotors, horizontal axis and vertical axis systems, system design and site selection.

Unit V Geo-thermal Energy: Sites, potentiality and limitation, study of different conversion systems.

Unit VI Tidal Energy: Sites, potentiality and possibility of harnessing from site, limitations.

Unit VII Ocean Thermal Energy: Principle of utilization and its limitations, description of various systems.

Unit VIII Other non-conventional energy sources: Fluidized bed combustions, heat from waste and other sources.

Text Books :

1. Solar Energy Utilization – G.D. Rai
2. Solar Heating and Cooling – Duffie and Bakeman

Reference Books :

1. Power Plant Technology – M.M EL – Wakil, McGraw Hill Book Co.
2. Power Plant Engineering – P C Sharma, S K Kataria and Sons

Note : In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 482 E MAINTENANCE ENGINEERING

L	T	P
3	1	-

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

UNIT I Introduction: Evolution of maintenance, objective of maintenance, maintenance policies and philosophies, maintenance concept maintenance management & terotechnology, relationship with other functional areas, importance of maintenance, elements of good maintenance, economics of maintenance, training and safety aspects in maintenance.

UNIT II Maintenance Strategies: Classification of maintenance programs, corrective, preventive and predictive maintenance, comparison of maintenance programs, preventive maintenance- concept functions, benefits, limitations.

UNIT III Condition Based Maintenance (CBM); Objectives, what to monitor, when to monitor, principles of CBM, condition based maintenance techniques, manual inspections, performance monitoring, vibration monitoring, current monitoring, oil debris/spectroscopy, thermography and corrosion monitoring, steps in implementation of CBM, benefits of CBM.

UNIT IV Reliability Centred Maintenance (RCM): RCM logic, maintenance and RCM, benefits of RCM, total productive maintenance (TPM), introduction, key supporting elements of TPM, methodology, evaluation and benefits.

UNIT V Non-Destructive Testing (NDT): Purpose and challenges; Techniques, visual aids-boroscopes, endoscopes, fibre obtics scanners, magnetic particles inspection, liquid penetrants, eddy current, ultrasonic radiography, selection of NDT techniques, merits/demerits and applications of various techniques.

UNIT VI Maintenance Planning and Control: Basic ingredients, basic steps in maintenance management, maintenance planning and control system, documentation, maintenance productivity areas for improvement.

UNIT VII Reliability, Maintenance & Availability: Techniques for improvement of operational reliability, safety and availability of machines and production systems, maintainability criteria, checklist to assess the maintainability of a system, maintainability programs, objectives, key issues in availability improvement program, fault diagnosis, pareto principle Ishikawa diagram.

UNIT VIII Application of Computers to maintenance management: Data processing systems for integrated maintenance, maintenance information and reporting systems.

Text Books :

1. Maintenance planning and control - Higgin L.R. Mc Graw Hill Book Company
2. Maintenance planning and control - Kelley Anthony, East-West Press Pvt. Ltd.,

Reference Books :

1. Maintainability principle and practices – Blanchard B.S., Lowey E.E., Mc Graw Hill.
2. Practical NDT – Raj B., Jayakumar T., Thavasimutyi K., Narora Publishing House.
3. Engineering maintenance management – Niebel Benjamin W., Marcel Dekher.

Note : Eight questions will be set by the examiner, taking at least one question from each unit. Students will be required to attempt five questions.

ME- 484 E ROBOTICS ENGINEERING

L	T	P		
3	1	-	Sessional	: 50 Marks
			Theory	: 100 Marks
			Total	: 150 Marks
			Duration of Exam:	3 Hrs.

Unit I **Robotic Manipulation: Automation and Robots; Robot Classification – Drive Technologies, Work-Envelope Geometries, Motion Control Methods, Applications; Robot Specifications – No. of Axes, Capacity and Speed, Reach and Stroke, Tool Orientation, Repeatability, Precision, Accuracy, Operating Environment, An Example; Rhino X-3.**

Unit II Direct Kinematics: The Arm Equation Homogenous Co-ordinates – Frames, Translations and Rotations, Composite Homogenous Transformations; Screw Transformations; Link Co-ordinates; The Arm Equation; A Five-Axis Articulated Robot; A Four-Axis Scara Robot; A Six-Axis Articulated Robot; Problems.

Unit III Inverse Kinematics: Solving the Arm Equation: The Inverse Kinematics Problem; General Properties of Solutions; Tool Configuration; Inverse Kinematics of a Five-Axis Articulated Robot, Four-Axis Scara Robot, Six-Axis Articulated Robot and Three-Axis Planer Articulated Robot; A Robotic Work Cell; Problems.

Unit IV Work Space Analysis and Trajectory Planning : Work Space Analysis; Work Envelope of a Five-Axis Articulated Robot; Work Envelope of a Four Axis Scrara Robot; Work Space Fixtures; The Pick and Place Operation; Continuous Path Motion; Interpolated Motion; Straight Line Motion; Problems.

Unit V Differential Motion and Statics : The Tool Configuration Jacobian Matrix; Joint – Space Singularties; Generalised Inverses; Resolved – Motion Rate Control; $n > 6$; Rate Control of Reduntant Rebots : $n > 6$; Rate Control using (1) – Inverses; The Manipulator Jacobian; Induced Joint Torques and Forces; Problems.

Unit VI Manipulator Dynamics : Lagrange's Equation; Kinetic & Potential Energy; Generalised Force; Lagrange – Euler Dynamic Model; Dynamic Models of a Two-Axis Planer Articulated Robot and A Three-Axis SCARA Robot; Direct & Inverse Dynamics; Recuresive Newton - Euler Formulation; Dynamic Model of a One-Axis Robot; Problems.

Unit VII Robot Control : The Control Problems; State Equations; Constant Solutions; Linear Feedback Systems; Single-Axis PID Control; PD-Gravity Control; Computed –Torque Control; Variable-structure Control; Impedance Control; Problems.

Text Books:

1. Fundamental of Robotics (Analysis & Control) by Robert J.Schilling, Published by PHI, Pvt. Ltd., New Delhi.
2. Introduction to Robotics (Mechanics & Control) by John J. Craig, Published by Addition Wesley (Intl. Student Edition).

Reference Books:

1. Analysical Robotics & Mechatronics by Wolfram Stadler, Published by Mc-Graw Hill, Inc., New Delhi.

2. Industrial Robotics - Technology, Programming & Applications by Mikell P. Grover, Weiss, Nagel and Ordef , Published by Mc-Graw Hill International Edition.

3. A Robot Engg. Test Book - Mohsen Shahinpoor, Harper & Low, Publishing New York.

4. Robotic Engineering – An Integrated Approach : Richard D.Klafter, Thomas A. Chmielewski and Michael Negin PHI 1989.

5. Foundations of Robotics Analysis and Control - Tsuneo Yashikawa MIT Press 1990, Indian Reprint 1998.

6. Robots and Control - R.K.Mittal and I.J.Nagrath - Tata McGraw Hill 2003.

Note: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 486 E ERGONOMICS AND WORK PLACE DESIGN

L	T	P
3	1	-

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

Unit I Basic Principles of Ergonomics, Anthropometry, Posture and Health; Anthropometry Practical; Displays, Controls and HMI; Tools and Equipment Design; Workplace Design and Assessment; Task Analysis; Questionnaire and Interview Design; Product Design and Evaluation; Designing for manufacture and maintenance; Health and Safety Legislation and Ergonomics.

Unit II Application of Ergonomics Principles, Cognitive Ergonomics, Human Information Processing; Memory; Reading; Perception; Navigation; Problem Solving; Decision Making, Human-Computer Interaction, Input/Output Technology, Usability; Evaluation; Health problems.

Unit III Future Systems, Job Design, Scientific Management, Enrichment, Enlargement, Rotation, Cells, Shift work, Management Style and Job Design, Change Management. New Technology, Unemployment, Deskilling, Introducing new technology. Questionaire design and assessment. Task analysis techniques. Measurement of human error and risk. Use of simulation and prototypes. Product Evaluation. Experimental Design.

Unit IV Case Studies: A set of case studies will be used to demonstrate how ergnomics has lead to changes in work activity, safety and product design. Case studies will include advanced computer applicatons, workplace assessment and re-design, accident analysis and industrial inspection, and in manufacturing. Students will be required to apply the principles to a real life ergonomic design as applied to a product, service or computer application.

Text Books:

1. Work Design: Industrial Ergonomics – Knoz, Stephan A., Johnson, Steven, Holcomb Hathaway, Scottsdale, AZ.
2. Human factors in engineering and design – Sanders, M.S. & McCormick, E.J., 6th ed., McGraw-Hill, New York.

Reference Books:

1. Ergonomics: Man in his working environment- Murrell, K.F.H, Champan & Hall, London.
2. Man – Machine Engineering – Chapanis A: Wordsworth Publishing Co.
3. The Practice and Management of Industrial Ergonomics – Alexander, D.C., Prentice-Hall, Englewood Cliffs, NJ.
4. Textbook of Work Physiology – Astrand, P.O. & Rhodahl, K.– McGraw-Hill, New York.
5. Human Factors in Lighting – Boyce, P.R. Macmillan, New York.
6. The Ergonomics of Workspaces and Machines : A design manual – Clark, T.S. & Corlett, E.N. Taylor & Francis, London.
7. Ergonomics at work. Oborne, D Wiley, London.
8. Bodyspace–Anthropometry, Ergonomics and Design. – Pheasant, S. Taylor & Francis,.

Note: In the semester examination, the examiner will set eight questionsin all , taking at least two question from each unit. The students have to attempt 5 questions.

ME- 488 E MODERN MANUFACTURING PROCESSES

L	T	P		
3	1	-	Sessional	: 50 Marks
			Theory	: 100 Marks
			Total	: 150 Marks
			Duration of Exam:	3 Hrs.

Unit I Mechanical Processes: Ultrasonic Machining- Elements of process, cutting tool system design, effect of parameters, economic considerations, applications, limitations of the process, advantages and disadvantages. Abrasive Jet Machining- Variables in AJM, metal removal rate in AJM. Water Jet Machining- Jet cutting equipments, process details, advantages and applications.

Unit II Electrochemical and Chemical Metal Removal Processes: Electrochemical Machining- Elements of ECM process, tool work gap, chemistry of the process, metal removal rate, accuracy, surface finish and other work material characteristics, economics, advantages, applications, limitations. Electrochemical Grinding - Material removal, surface finish, accuracy, advantages, applications.

Unit III Thermal Metal Removal Processes: Electric Discharge Machining (EDM) or spark erosion machining processes, mechanism of metal removal, spark erosion generators, electrode feed control, dielectric fluids, flushing, electrodes for spark erosion, selection of electrode material, tool electrode design, surface finish, machining accuracy, machine tool selection, applications. Wire cut EDM. Laser beam machining (LBM)- Apparatus, material removal, cutting speed and accuracy of cut, metallurgical effects, advantages and limitations.

Unit IV Plasma Arc Machining (PAM): Plasma, non thermal generation of plasma, mechanism of metal removal, PAM parameters, equipments for D.C. plasma torch unit, safety precautions, economics, other applications of plasma jets. Electron Beam Machining (EBM) - Generation and control of electron beam, theory of electron beam machining, process capabilities and limitations.

Text Books :

1. Modern Machining Processes – P.C.Pandey, H.S.Shan, Tata McGraw Hill
2. Machining Science- Ghosh and Malik, Affiliated East-West Press

Reference Books :

1. Non Traditional Manufacturing Processes- Benedict G.F, Marcel Dekker
2. Advanced Methods of Machining- Mc Geongh J.A, Chapman and Hall

Note: In the semester examination, the examiner will set eight questions in all , taking at least 2 questions from each unit. The students will be required to attempt only five questions.

ME- 490 E CRYOGENIC ENGINEERING

L	T	P			
3	1	-	Sessional	:	50 Marks
			Theory	:	100 Marks
			Total	:	150 Marks
			Duration of Exam	:	3 Hrs

Unit I Introduction: Limitations of vapour compression system for production of low temperature, multistage system, cascade system, production of solid carbon dioxide, magnetic cooling.

Unit II Cryogenic Gases: Properties of cryogenic fluids – oxygen, nitrogen, air, hydrogen and helium, Joule- Thomson effect and liquefactions of gases, liquefaction of air, hydrogen and helium, critical components of liquefiers, rectifier columns, separation of air, separation of helium from natural gas, distillation of liquid hydrogen, purification.

Unit III Low Temperature Thermometry: Temperature scales, gas-vapour pressure thermometry, adiabatic demagnetization.

Unit IV Insulation: Vacuum insulation, gas filled powders and fibrous materials, solid forms, comparison of various insulating materials.

Unit V Storage: Types of insulated storage containers, various design considerations, safety aspects – flammability hazards and high-pressure gas hazards.

Unit VI Transportation: Two phases flow, transfer through insulated and un-insulated lines, liquid line indicators, pumps and valves for cryogenic liquids.

Unit VII Applications: Industrial applications, research and development; Mechanical, thermal and thermoelectric properties of structural materials at cryogenic temperatures.

Text Books :

1. Cryogenics and refrigeration – Coldin
2. Experimental techniques in low temperature physics – G.K. White, Clayrendon Press, Oxford

Reference Books:

1. Cryogenic research and applications – Marshall Sitting and Stephen Kid, D. Van Nostrand Company, Inc USA
2. Cryogenics – Bailey C A.
3. Refrigeration and air conditioning – Spark and Dillo

Note: In the semester examination, the examiner will set eight questions from each unit. The students will be required to attempt only five questions.

ME- 492 E ENTREPRENEURSHIP

L	T	P
4	-	-

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

Unit I Engineering Economics: Definition and concept, Importance of Economics for engineers, present value , Wealth, Goods, Wants, Value and price , capital, money, utility of consumer and producer goods.

Unit II Costing: Introduction, Elements of cost, Prime cost, Overhead, Factory cost, Total cost, Selling Price, Nature of cost, Types of Cost.

Unit III Depreciation: Definition and concept, Causes of Depreciation, Methods of calculating depreciation.

Unit IV Economic analysis of investment and selection of alternatives: Introduction, Nature of selection problem, Nature of replacement problem, Replacement of items which deteriorate, Replacement of machines whose operating cost increase with time and the value of money also changes with time, methods used in selection of investment alternatives.

Unit V Entrepreneurship: Entrepreneurship, Role of entrepreneur in Indian economy, Characteristics of all entrepreneur, Types of entrepreneurs, some myths and realities about entrepreneurship.

Unit VI Small scale Industries: Introduction, Role and scope of small scale industries, concept of small scale and ancillary industrial undertaking, How to start a small scale industry, Steps in launching own venture, procedure for registration of small scale industries, various development agencies-their functions and role in industrial and entrepreneurship development, Infrastructure facilities available for entrepreneurship development in India.

Unit VII Product planning and Development: Introduction, Requirement of a good product design, product development approaches, Product development process, Elements of concurrent engineering, quality function development, Rapid prototyping, Various controlling agencies involved their role and formalities for getting clearance before starting individual venture.

Unit VIII Preparation of feasibility Project Report: Tools for evaluation of techno economic feasibility project report, SWOT analysis.

Text Books :

1. The practice of Entrepreneurship - G.G. Meredikh, R.E. Nelson and P.A. Neck
2. Handbook of Entrepreneurship - Rao and Pareek

Reference Books :

1. Automobile Engineering - K.M. Gupta Umesh Publication
2. Engineering Economics - Tarachand
3. Industrial Engineering and Management - Ravi Shankar

Note : The paper setter will set 8 questions taking at least one question from each unit . Students will be required to answer only five.

ME- 494 E FACILITIES PLANNING

L	T	P
3	1	-

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

Unit I General: Concepts and factors governing plant location, location economics, rural vs. urban plant sites, case studies:- (i) Selection of a site for software company. (ii) Selection of a site for XYZ Company: Analysis of alternatives. Introduction of plant layout, principles and objectives of effective layout, advantages of good layout, symptoms of bad layout. Types of plant layout, their features, application and comparison. Introduction to group technology; its relevance, application and advantages.

Unit II Planning the layout: Factors influencing plant layout; material factors, machinery factors, man factors, movement factors, waiting factors, service factors change factors building factors, workstation design, methods of plant and factory layout, plant layout procedure, factory building, types of factory building, building equipments, common problems in plant layout, tool and techniques of layout, operation process chart, flow process chart, flow diagram, string diagram, evaluating alternate layout-various methods.

Unit III Line balancing: Objectives in line balancing problems, constraints in line balancing problems, terminology in assembly line, preventive measures to achieve a balanced production line. Types of line balancing. (a) Assembly line balancing. (b) Fabrication line balancing, Heuristic and other method of line balancing, simple numerical problems in line balancing.

Unit IV Materials handling : Objectives of materials handling, functions and principles of materials handling, method of material handling system, types of material handling system, material handling engineering survey, basic features of handling, various materials handling considerations including combined handling, space for movements, analysis of handling methods, economical and technical considerations of handling equipment, cost analysis of material handling systems.

Unit V Material handling equipments : Introduction, types of material handling equipment, selection and maintenance of material handling equipments, characteristics of material handling equipments such as conveyers, cranes, hoist, mobile equipment's etc. Amount of equipment required and predicting in process inventory by graphical technique.

Unit VI Travel Chart: Procedure for travel charting, numerical problem on optimum arrangement of various departments or shops under given constraints and to check their effectiveness.

Text Books:

1. Plant layout and design -By Moore
2. Plant layout and material handling - By Apple

Reference Books

1. Plant layout - By Shubhin

Note : In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt five questions.

ME- 496 E GAS TURBINES AND JET PROPULSION

L	T	P
3	1	-

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

Unit I Compressible Flow: Wave propagation and sound velocity; Mach number and compressible flow regimes; basic equations for one-dimensional compressible flow, isentropic flow relations; area-velocity relation; normal shock waves, relation between upstream and downstream flow parameters

Unit II Gas Turbine Systems and Cycles: System of operation of gas turbines-constant volume and constant pressure gas turbines; thermodynamics of Brayton cycle; regeneration-inter-cooling, reheating and their combinations; closed cycle and semi-closed cycle gas turbines; gas v/s I.C engines and steam turbines.

Unit III Compressors: Classification-positive displacement and dynamic compressors, Operation of single stage reciprocating compressors; best value of index of compression; isothermal efficiency; effect of clearance and volumetric efficiency; multi-stage compression; air motors.
Centrifugal compressors; static and total head values; velocity vector diagrams; slip factor; pressure coefficient and pre-whirl. Axial flow compressors; degree reaction and polytropic efficiency Performance characteristics; surging, choking and stalling.

Unit IV Combustion Systems: Types, combustion process, combustion intensity efficiency and pressure loss.

Unit V Air-breathing Propulsion Systems: Principle of jet propulsion; analysis and performance characteristics of turbojet, turboprop, ramjet and pulsejet; thrust power and propulsion efficiency.

Unit VI Rocket Propulsion: Operating principle; solid and liquid propellants, performance analysis-calculations for specific impulse and propulsive efficiency.

Text Books :

1. Gas Turbine Theory – Cohen and Rogers
2. Principle of Jet Propulsion and Gas Turbine – Zucrow M J

References Books :

1. Heat Engineering – Vasandani V P and Kumar D S, Metropolitan Book Co Pvt Ltd

Note : In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt five questions.

ME- 498 E EMERGING AUTOMOTIVE TECHNOLOGIES

L	T	P		
3	1	-	Sessional	: 50 Marks
			Theory	: 100 Marks
			Total	: 150 Marks
			Duration of Exam	: 3 Hrs.

UNIT I The Future Of The Automotive Industry : Challenges and Concepts for the 21st century. Crucial issues facing the industry and approaches to meet these challenges.

UNIT II Fuel Cell Technology For Vehicles : What is fuel cell, Type of fuel cell, Advantages of fuel cell. Current state of the technology. Potential and challenges. Advantages and disadvantages of hydrogen fuel.

UNIT III Latest Engine Technology Features : Advances in diesel engine technology. Direct fuel injection Gasoline engine. Diesel particulate emission control. Throttling by wire. Variable Valve Timing, Method used to effect variable Valve Timing. Electromagnetic Valves, Camless engine actuation.

UNIT IV 42 Volt System : Need, benefits, potentials and challenges. Technology Implications for the Automotive Industry. Technological evolution that will occur as a result of the adoption of 42 volt systems.

UNIT V Electrical And Hybrid Vehicles : Types of hybrid systems, Objective and Advantages of hybrid systems. Current status, Future developments and Prospects of Hybrid Vehicles

UNIT VI Integrated Starter Alternator: Starts stop operation, Power Assist, Regenerative Braking. Advanced lead acid batteries, Alkaline batteries, Lithium batteries, Development of new energy storage systems, Deep discharge and rapid charging ultra capacitors.

UNIT VII X-By Wire Technology : What is X-By Wire, Advantage over hydraulic systems. Use of Automotive micro controllers. Types of censors. Use of actuators in an automobile environment.

UNIT VIII Vehicles Systems : Constantly Variable Transmission, Benefits, Brake by wire, Advantages over power Braking System. Electrical assist steering, Steering by wire, Advantages of Steering by wire. Semi-active and fully-active suspension system. Advantages of fully active suspension system.

Text & Reference Books :

1. Advanced Vehicle Technologies by Heinz Heisler-SAE International Publication.
2. Electric and Hybrid Electric vehicles by Ronald K. Jurgen.- SAE International Publication
3 .Electronic Braking, Traction and Stability control-SAE Hardbound papers.
4. Electronics steering and suspension systems- SAE Hardbound papers.
5. 42 Volt system by Daniel J. Holt- SAE International Publication
6. Diesel Particulate Emission by J.H. Johnson- SAE Hardbound papers.
7. Fuel Cell Technologies for vehicles by Richard Stobart- SAE Hardbound papers.

Note : In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt five questions.

ME- 500 E DESIGN FOR MANUFACTURING

L	T	P			
3	1	-	Sessional marks	:	50
			Theory marks	:	100
			Total marks	:	150
			Duration of exam	:	3 hrs

UNIT I **Introduction to Product Design**

Definition, Design by Evolution &Innovation, Essential Factors of Product Design and Cycle. The morphology of Design and Flowcharting, Role of Allowances, Process Capability and Tolerance in Detailed Design and Assembly, Summary of Detailed Design Phase.

UNIT II **Product Design Practice and Industry**

Introduction, Product strategies, Analysis of the product & Three S's, The Designer : Myth & Reality, Basic Design Considerations, Types of models designed by Industrial Designers, Role of aesthetic in Product Design & Function Design practice.

UNIT III. **Strength, stiffness & Rigidity Consideration in Product Design**

Force flow lines, Balanced Design, Criterion & Objectives of Design, Mapping of Principal Stresses, Plastic Design, Practical Ideas for material saving in Design, Ribs, Corrugations, Laminates & Membranes.

UNIT IV. **Production Processes & Design for Production-Metal parts**

Introduction, Primary Processes, Producibility Requirements in the Design of Machine Components, Design for Machining ease etc.

UNIT V. **Material Processing & Designing with Plastics, Rubber & Ceramics**

Properties & Classifications, Transfer moulding, Forming & drawing of Plastic sheets, Design of Plastic parts etc, Approach to design with plastics etc , Design recommendations for rubber Parts etc,

UNIT VI. **Optimization & Economic Factors in design**

Classifications of Design approaches, Optimizations by differential calculus, Lagrange Multipliers, Simplex Method, Geometric programming, Product Value, Design for Safety, Reliability & Environmental Considerations, Economic analysis, Samual Eilon Model.

UNIT VII. **Human Engg considerations & Modern Approaches to product Design**

Human being as Applicator of forces, Anthropometry, Design of Controls & displays; Value Engineering, Historical prospective, Nature & measurement of value, The value analysis of Job plan. Concurrent Design. Q.F.D.

UNIT VIII **Role of computer in product Design, Manufacturing & Management**

Product cycle & CAD/CAM, Role of computers n Manufacturing & Design process, Creation of Manufacturing data base, Communication network, Group technology, Production flow analysis, CIM, CAPP.

TEXT BOOKS:

1.Product Design & Manufacturing –A.K. Chitale, R.C. Gupta, Pub.-PHI

2. The Engineering Design Process- Alita Ertas & J.C. Jones, Pub- John Wiley & Sons

REFERENCE BOOKS:

1. Fundamentals of Engineering Design,-Asimow.M., Pub-P H, Englewood Cliffs, New Jersey.
2. Design for Manufacturing- Trucks.F., Society of Manufacturing Engineers , Dearborn(Michigan).
3. Innovation in Design- French M., Pub- McGraw Hill, New York.
4. Cost reduction in product design- Chow W.W, Van Nonstrand Reinhold, New York.
5. Fundamentals of process Engineering-Kovan, V. Pub- MIR , Moscow.
6. Hand Book of Product Design for manufacturing- Bralla, McGraw Hill, New York.
7. Human factors Engineering- McCormic, E.J., Pub.MGH. NEW YORK.
8. Value Engineering- A Systematic Approach, Mudge,A.E., Pub.MGH. New York

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