Proposed Syllabus

B. E. (Mechanical)

w.e.f. 2011-12

Swami Ramanand Teerth Marathwada University,

Nanded

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED.

Teaching & Examination scheme for
Final Year Mechanical Engineering
w.e.f. 2011-12

Part -I

Sr. No.	Subject	Teaching Scheme			Examination Scheme				
		L	P	Total	Th	Test	TW	Pr	Total
1	Internal Combustion Engine	04	02	06	80	20	25	25	150
2	Finite Element Methods	04	02	06	80	20	25	25	150
3	Statistical Quality Control	04	02	06	80	20	25	25	150
4	Operations Research Techniques	04	02	06	80	20	25	25	150
5	Elective- I	04	--	04	80	20	--	--	100
6	In-plant Training	--	02	02	--	--	25	25	50
7	Project-I	--	02	02	--	--	25	25	50
	Total	**20**	**12**	**32**	**400**	**100**	**150**	**150**	**800**

Elective- I:

A. Tribology
B. Mechatronics
C. Industrial Product Design
D. Non Conventional Machining Processes
E. Analysis and Synthesis of Mechanisms
F. Non conventional Energy Sources

Part -II

Sr. No.	Subject	Teaching Scheme			Examination Scheme				
		L	P	Total	Th	Test	TW	Pr	Total
8	Refrigeration & Air-Conditioning	04	02	06	80	20	25	25	150
9	Automobile Engineering	04	02	06	80	20	25	25	150
10	Production Management	04	02	06	80	20	25	25	150
11	Elective- II	04	--	04	80	20	--	--	100
12	Project- II	--	06	06	--	--	50	100	150
13									
	Total	**16**	**12**	**28**	**320**	**80**	**125**	**175**	**700**

Elective – II:

A. Reliability Engineering
B. Costing and Cost Estimation
C. Automation and Robotics
D. Micro and Nano Machining
E. Computational Fluid Dynamics
F. Power plant Engineering

Note: L- Lectures, P-Practical, Th-Theory, TW-Term-work, Pr-Practical exam.

Minimum three Unit tests shall be conducted, covering the complete syllabus, during the semester and average of best two tests shall be considered for Final Test Marks.

B.E.(Mechanical) Part – I

Internal Combustion Engineering

[Paper : 80 marks, - Test : 20 Marks, Term work: 25Marks, Parctical: 25 marks]

Unit I

Introduction: Classification of I.C. engines, arrangement of cylinders, slow and high speed engines. (02 Hours)

Cycle analysis of I.C. Engines and Fules: Air standard cycles, Otto, Diesel & Dual Cycle. Variation of specific heat with temperature, effect of variation of specific heat on thermal efficiency of I.C. engine, I.C. engine fuels. Important qualities and rating of fuels for S.I. and C.I. engines. (04 Hours)

Unit II

Carburetion: Theory of carburetion, simple carburetor, calculation of Air-Fuel ratio for simple carburetor with and without compressibility of air, petrol injection system, LUCAS petro injection system, aircraft carburetor. (06 Hours)

Combustion in SI Engines: Combustion limits, stages of combustion engine variables affecting combustion stages, normal and abnormal combustion, per-ignition, detonation, effect of detonation, control of detonation, combustion chamber design principles, requirements, various types of combustion chambers and their comparison. (04 Hours)

Unit III

Fuel injection system: Requirements, heat release pattern, types of injection systems namely common rail, individual pump distributor and unit injection systems, types of nozzles. (04 Hours)

Combustion in CI Engines: Stages of combustion, variables affecting stages of combustion, delay period, knocking, its effects and control. Combustion chambers used in C.I. engines, requirements ,types viz. open swirl M-combustion chamber. (04 Hours)

Unit IV

Testing performance of Engines: Performance parameters, methods for measurement of B.P., I.P. and F.P., performance of S.I. and C.I. engines engine tests and heat balance sheet.(Numerical treatment) (06 Hours)

Selection criteria of Engines: Type of service, type of fuel to be used general service requirements, diesel v/s S.I. engine two stroke v/s four stroke engine air cooled v/s water cooled, supercharged v/s un-supercharged engine, number of cylinders and cylinder arrangements. (02 Hours)

Unit V

Supercharging: Introduction, necessity of supercharging, thermodynamic cycles with supercharging, supercharging of S.I. and C.I. engines, advantages and limitations of supercharging, Methods of supercharging. (04 Hours)

Unit VI

Special design engine : Startified- charge engine wankal engine (Rotating combustion engine), Free piston engine , Duel fuel engine, Lean Burn engine, Ram jet engine, Pulse jet engine, Rocket engine. (02 Hours)

I.C.Engine Emissions: Emissions from S.I. and C.I.engines, pollutants and their effects, methods for controlling emissions, current techniques of emission control. (02 Hours)

Term work: Term work shall consist of record of any eight experiments from the following.

1. Trial on diesel engine with variation of load.
2. Trial on diesel engine with variation in speed for torque speed characteristics.
3. Trial on petrol engine with variation of load.
4. Trial on petrol engine with variation in speed for torque speed characteristics.
5. Morse test.
6. Study of ignition system and variation of timing of spark and adjustment of contact breaker gap and spark plug gap.
7. & 8. Dismantling and assembling of fuel pumps and injectors for single and multi cylinder engines any one.
9. Dismantling and assembling of any one automotive carburetor.
10. Actual valve timing diagram for high and low speed engines.
11. Analysis of exhaust emission from S.I. engine.

Practical Examination:

It shall consist of practical and oral based on above syllabus and term work.

References:

1. I.C. Engines – Gill, Smith
2. I.C. Engines – Mathur, Sharma
3. I.C. Engines – V. Ganeshan
4. I.C. Engines – Maleeve
5. I.C. Engines – S.P.Sen
6. I.C. Engines and Air Pollution – E. F. Obert-Harper and row pub. New York
7. I.C. Engines – Litchy

B.E.(Mechanical) Part-I

FINITE ELEMENT METHODS

[Paper : 80 marks, - Test : 20 Marks, Term work: 25Marks, Practical: 25 marks]

Unit-I

FUNDAMENTAL CONCEPT OF FEM:

Introduction, History background, stresses and equilibrium boundary conditions, strain displacement relations, stress – strain relations, temperature, effects, variational approach solution techniques. (6 hrs)

Unit-II

DESCRIPTION OF THE METHOD:

Step wise procedure of Finite element method, variational techniques for derivation of finite element equations, assembly procedure, solution methods. (8 hrs)

Unit-III

FEA OF ONE DIMENSIONAL PROBLEMS:

Introduction, finite element modeling, shape functions, variational approach, weighted residual approach, Assembly of finite element equations, Higher- order element, Boundary conditions, Temperature effects. (6 hrs)

Unit-IV

FEA OF TWO DIMENSIONAL PROBLEMS:

Introduction, FE modeling, formulation of constant strain triangular element, problem modeling and boundary conditions. (6 hrs)

Unit-V

ISOPARAMETRIC ELEMENTS:

Introduction, 2-D Isoparametric elements, the 4-nodes quadrilateral, computation of stiffness, matrix & load vectors, numerical integration, Higher Order Elements convergence criteria. (8 hrs)

Unit-VI

PREPROCESSOR AND POST PROCESSORS:

Introduction, Mesh Generation, post processing, requirements of a pre processor and post processor, preprocessor and post processors in analysis software. (6 hrs)

TERM WORK

Introduction to FEA Software like ANSYS, NASTRAN, COSMOS-WORKS TERM WORK

The term work shall consist of the following assignments, using ANSYS, Nastran, Hypermesh and other analysis softwares.

- ♦ Assignment on mesh generation for different geometries
- ♦ Assignment on static structural analysis.
- ♦ Assignment on steady state thermal analysis
- ♦ Assignment on thermo-structural analysis

REFERENCE BOOKS:

1. Introduction to Finite Element Method in Engineering by S.S.Rao, Butterworth Heinmann Publication.
2. Finite Elements in engineering, Chandrupatla T. R., 2nd Edition, PHI,2000
3. Finite Element Procedures by Bathe K.J., Prentice Hall of India, New Delhi.
4. Finite Element Method with applications in Engineering – Desai- Pearson Education
5. ANSYS & other software manuals.

B.E. (Mechanical) Part-I

STATISTICAL QUALITY CONTROL

[Paper: 80 marks, - Test : 20 Marks, Term work: 25Marks, Practical: 25 marks]

UNIT- I

Introduction : Quality –The changing business condition, Significance and meaning of quality, quality function, various definitions of quality viz. Juran, P.Crosby ASQC, ISO 9000 , Taguchi, etc., their comparison, brief discussion on quality of design, quality of manufacturing and quality assurance. (2 Hours)

Probability Concepts: The histogram, Box and whisker plot, numerical indices for summarizing data (mean, median, Standard deviation, etc. probability distribution (Normal, Exponential, poison, Binomial Concept, nature and applicability. (3 Hours)

UNIT-II

Statistical Tools for Analyzing Data: Scope of data analysis, statistical inference, sampling variation and sampling distribution, statistical estimation : confidence limits, importance of confidence limits in planning test programmers, sample size determination for given accuracy, Hypothesis testing and drawing conclusion, determination of sample size required for testing of hypothesis. Simple numerical based on above. (4 Hours)

UNIT-III

Control Charts: Control chart point of View, System of Chance Causes , Patterns of Variations SPANPLAN Method, Interpretation of Lack of Statistical Control, Interpretation of Patterns of Variation on X & R Charts, Shewart's Normal Bowl, Estimation of Control Limits For X,R Charts .Control Charts For Variables, Control Chart Points of View, X& R , 6 Charts Control Charts For Attributes : p,c,np,u-charts. (8 Hours)

UNIT -IV

Process Capability Analysis: Objectives of Analysis, Estimation of Process Capability, Process Capability Indices, Viz : Cp,Cpk, Cpm, and Their Interpretation. (4 Hours)

UNIT- V

Scientific Sampling: Concept and importance of sampling, economics of inspection, symbols and terms used in relation to sampling plans.Lot-by-lot acceptance using single sampling plan, OC curves, sampling risk, AQL,LTPD, alpha and beta risk, construction of OC curve for given sampling plan, estimating alpha and beta risks for a given plan, Effect of lot size, sample size, acceptance number, producer's and customer's risk, Indexing of acceptance sampling plans by using a single point on OC curve. Average outgoing and the AOQL Double sampling plans analysis of double sampling plans minimizing average total inspection

Use of ANSI/ASQCZ1.4 standards for attribute sampling plans switching procedure for normal and tightened inspections. Calculation of an average sample numbers in double sampling plans. Use of DodgeRomig sampling plans, Construction of OC curves. Estimation of average inspection, Sampling risks, etc. for single and double sampling plans selected for the standard plan. (10 Hours)

Unit-VI:

Experimental design and Taguchi method. Introduction , experimental design fundamentals features of experimentation, Anova, factorial experiment, experimental design in the Taguchi method, parameter design in Taguchi method. (8 hrs)

Termwork:

1. Collect and arrange data of any industrial component in order to study its behavior and determine x & sigma of the same.
2. Determine the process capability &process capability index of a machine.
3. Plot any two of the charts given below by taking real time case & interpret the behavior of the chart.
   a. x & R chart
   b. x & sigma chart
   c. p chart
   d. np chart
   e. c chart
   f. u chart
4. study of O.C. curve.
5. Study of Design of experiment.

References:

1. Quality planning and Analysis : J.M. Juran Frank M.Gryna –Tata McGraw Hill
2. Statistical Quality Control – E.L.Grant, R.S. Leavenworth –Tata McGraw Hill
3. Quality Control & Total Quality Management –Jain, Tata McGraw Hill.
4. Quality Control Besterfield-Prentice Hall, New Jercy
5. Mechanical Reliability –L.S.Srinath
6. Quality Control & Reliability Analysis, Dr. Brijendra Singh
7. Fundamentals of Quality Control and Improvement: Amitava Mitra, Prentice Hall

B.E. (Mechanical) Part – I

Operations Research Techniques Part -I

[Pper : 80 marks,TTW- Test : 20 Marks,T/W : 25, Parctical]

Unit-I

Linear Programming: Formulation, objective function, constraints, decision variables, canonical and standard forms, parameters and variables, classical problems such as crew scheduling, knapsack, napkin / cater, product mix, etc.

Graphical method for two variables problem simplex algorithm and tabular representation, types of solution such as feasible / infeasible, degenerate / non degenerate, optimal / sub optimal, unique / alternate / infinite optimal, bounded / unbounded value and solution and their interpretation from simplex table cycling phenomenon manual solution of problems involving up to three iterations two phase method big M method Duality concept dual problem formation dual simplex method. (08 Hrs.)

Unit -II

Dynamic Programming

Introduction, Bellman's principle of optimality, recursive equation approach, characteristics of dynamic programming problems. (02 Hrs.)

Introduction to Integer programming (02 Hrs.)

Introduction to Non-linear programming (04 Hrs.)

Unit-III

Transportation Models: Different techniques used for solving transportation problems, MODI method for solving balanced and unbalanced transportation problems and problems of degeneracy problems on maximization objective and maximization time. (06 Hrs.)

Unit-IV

Assignment Models: Hungarian method for solving maximization and maximization problems with and without non-permissible sales, travelling salesman problems as the special case of assignment problem. Branch and bound method for solving travelling salesman problem. (06 Hrs.)

Unit-V

Simulation: Introduction, elements of simulation model event type simulation generation of random phenomenon, Monte-Carlo inventory cost. (02 Hrs.)

Sequencing : Processing in jobs through machines with the same processing order with all types, n jobs m machines problems be treated by a heuristic based on Johnson's rule. (04 Hrs.)

Unit-VI

Network Models: Introduction to PERT and CPM, fundamental concept of network models and construction of network diagrams, Fulkursons rule PERT activity time estimates, critical path, probability of project completion date. CPM- start and finish times of activities, float.

Project cost analysis: Optimisation of project time and cost in network, crashing application. Resource allocations and load smoothening, updating a project. (08 Hrs.)

Term Work:

At least seven assignments based on theoretical concepts and problems / case studies.

Practical Examination:

It shall consist of an oral based on above syllabus and term work.

References :

1. Operations Research – Taha
2. Operations Research –Hira and Gupta
3. Operations Research – S.D. Sharma
4. Operations Research – Kantiswaroop
5. Introduction to Operations Research –Hiller, Tata McGraw Hill.

B.E. (MECHANICAL) Part-I

Elective- I(A)

TRIBOLOGY

[Paper: 80 marks, - Test : 20 Marks]

Unit -I [7 hrs]

Introduction, Properties and Testing Of Lubricants, Viscosity, Effect of Temperature and Pressure on Viscosity, Basic Equations, Generalized Reynold's Equation, Energy Equation, Equation of State.

Unit -II [8 hrs]

Idealized Hydrodynamic Bearings, Plane Slider Bearings, Slider Bearing with Pivoted Shoes, Step Bearings, Idealized Journal Bearings, Finite Bearings, Electrical Analogy Method, Analytical Solution, Numerical Solutions, Oil flow and Thermal Equilibrium, Circumferential and Axial flow, Heat Balance.

Unit-III [7 hrs]

Bearing Design, Practical Considerations, Design of Journal Bearings, Squeeze Film Bearings, Parallel Surface Bearing, Step Bearings, Hydrodynamic Instability, Stiffness and Damping coefficients, Stability.

Unit- IV [8 hrs]

Externally Pressurized Oil Bearings, Circular Step Bearings, Rectangular Thrust Bearings, Opposed Pad Bearings, Multi-Races Bearings, Gas Lubricated Bearings, Governing Equations, Infinitely Long Plane Slider Bearings, Infinitely Long Journal Bearings, Finite Journal Bearings, Externally Pressurized Gas Bearings, Porous Gas Bearings, Elasto-hydrodynamic Lubrication, Dimensionless Parameters, Film Thickness Equations.

Unit-V [7 hrs]

Ball Bearings, Deep Groove Radial Bearings, Angular Contact Bearings, Thrust Ball Bearings, Surface Roughness On Hydrodynamic Bearings and Elasto-hydrodynamic Line Contacts, Derivation Of Average Reynold's Equation for Partially Lubricated Surface, Effect of Surface Roughness on Journal Bearings.

Unit-VI [8 hrs]

Friction of Metals, Friction Theories, Surface Contaminants, Frictional Heating, Wear of Metals, Classification of Wear, Mechanisms of Wear, Quantitative Laws of Wear, Wear Resistance Materials.

Text Book:

• Bassani R. and Piccigallo B., "Hydrostatic Lubrication", Elsevier Publication, London, 1992.
• Stolarski T.A., "Tribology of Machine Design", Butterworth Heinemann, Oxford, 2000.
• Barwell F.T., "Bearing System, Priciples and Practice", Oxford University Press, 1979.

Reference Books:

• Bowden F.P. and Tobor D., "Friction and Lubrication of Solids", Clarendon Press, oxford, 1986.
• Denis Summers Smith J., "An Introductory Guide to Industrial Tribology", Mechanical Engineering Publication, London, 1992.
• Bharat Bhushan and Gupta B.K., "Handbook of Tribology", Mc Graw Hill, New Delhi, 1991

B.E. (MECHANICAL) Part-I

Elective- I (B)

MECHATRONICS

[Paper: 80 marks, - Test : 20 Marks]

Unit-I

Introduction to Sensors and Transducers

Introduction to Mechatronics, Measurement systems, static characteristics, Classification of Transducers and Sensors, Basic Divider Circuits, Bridge Circuits, Filters, Level measurements,

strain measurements: Strain Gauge principles, types, strain gauge circuits, Load cells, temperature Compensation.

Temperature measurement: Thermister, RTD, Thermocouples

6Hrs

Unit-II

Mechanical Sensors

Displacement & Position sensors: Potentiometric Sensor, Capacitive and Inductive Sensors, Variable Reluctance Sensors, Linear Variable Differential Transformers.

Motion Sensors: Translational and Rotary Optical Encoders, Tachometers with output signal as electrical quantity. 6Hrs

Unit-III

Converters and Controller Fundamentals

Data Acquisition system: concept of sampling, sample & hold operation, analog to digital converters, digital to analog converters. Introduction to SCADA & its application.

System Models: Mathematical models, introduction to mechanical, electrical, fluid and thermal system. Rotational and transnational systems, Basic concepts of transfer function.

6Hrs

Unit-IV

Controller Principles

Control systems: Types of control system, Open loop, closed loop systems, transfer functions, feed back and feed forward control systems and their applications.

Process Characteristics: Process equation, process load, Error, Variable range, Control Parameter Range, Dead time. 8Hrs

Unit-V

Controller Modes

Continuous Controller Modes: Proportional Controller, Integral Controller, Derivative Controller, with mathematical equations, advantages, disadvantages and applications.

Composite controller Modes: Proportional, Proportional+Integral(PI), Proportional+ Derivative(PD), Proportional + Integral + Derivative(PID) controllers, with simple numerical treatment. 6Hrs

Unit-VI

Discrete State Process Control

Relay Controllers and Ladder Diagrams: Ladder Diagram Elements, and Ladder Diagram Examples.

Programmable Logic Controllers: Relay sequencers, PLC Programming Concepts, logic, basic structure, input/output processing, timers, internal relays and counters, shift resisters, ladder diagram and programming, selection of PLCs,

Case studies of Mechatronics with different applications like washing machine, dish washer, bottle filling plant, elevator, building automation. 6Hrs

Text Book

1. Johnson C.D., Process Control Instrumentation Technology, Prentice Hall of India Pvt Ltd., New Delhi.

Reference Books

1 Doebelin E.O., Measurement System-Application and Design, Tata McGraw Hill Publications Ltd., New Delhi.
2 Bolton W., Mechatronics : A Multidisciplinary Approach Pearson-Education
3 Rangan C.S. Sarma G.R., Mani V.S, Instrumentation- Devices and Systems, Tata McGraw Hill Publishing Company Ltd.,New Delhi.
4 Histand B.H. Alciatore D.G. ,Introduction to Mechatronics and Measurement Systems.
5 HMT, Mechatronics, HMT.
6 Mahalik N.P. Mechatronics – Principles, concepts and applications, Tata McGraw Hill Publishing Company Ltd.,New Delhi.
7 Kolk R.A., Shetty D., Mechatronics Systems Design, Vikas Publishing Manual Delhi.
8 Fawcett J.R.- Pneumatic Circuits and Low Cost Automation
9 Ian C Turner -Engineering Applications of Pneumatics & Hydraulics
10 Mikell P Groovar- Automation, Production Systems and CIM.
11 Z.J Lansky, Lawrence F Schrader, JR. -Industrial Pneumatic Controls
12 Necsulescu – 'Mechatronics' 1/e - Pearson-Education

B.E. (MECHANICAL) Part-I

Elective- I(C)

INDUSTRIAL PRODUCT DESIGN

[Paper: 80 marks, - Test : 20 Marks]

An approach to Industrial Design: Technical requirements, Ergonomic requirements, Aesthetic requirements. Ergonomics and Industrial, Anthropometric data, Agronomical design aspects of machine tools; Testing machines; instruments automobiles; process equipments; etc. (4 hours)

Visual Effects of Line and Formal: Mechanics of seeing psychology of seeing , general inference of line and form, color and light, color terms color combinations, color of engineering equipments/color and machine, their forms (4 hours)

Aesthetic Concepts: Concept of unity6; concept of order with variety; concept of purpose; style and environment; Aesthetic expression; symmetry balance; contract continuity proportion; rhythm radiance (3 hours)

Style : Component of style; Basic factor; environment factor ; social factor; Basic style; observing style in capital goods. (3 Hours)

Industrial Design in Practice: General design situation, specifyi8ng design requirement, rating the importance of industrial design; industrial design in the design process analysis;

Market question influencing industrial design, "Production" questions, synthesis presentation working with the specialist (6 hours)

New Product Development: Initiation, Idea collection, creative design; brain storming; creative thinking; creative development, inventiveness ; concept ional design. Function and use: What will it do? Legal standard requirement; international standards; do by dimensions, vision, interpretation of information. Design of Production; Costs; standardization; design evolution techniques, estimation of production cost; Reduction of cost, impact of DFP on other factors, prototype design pre production, inspection. Design for maintenance: Life test; classification of components for facilitating maintenance. Coordination of design: Design organization, stages in design, development process design tem design process. (10 hours)

Decision Making: Optimization, Probability, Reliability (2 Hours)

Computer Aided Product Design: Manufacturing consideration: For casting, welding, machining, forgoing, forming etc. (8 hours)

References:

1. Product Design and development – Kari T. Ulrich Steven D. Eppinge.
2. Industrial Design for Engineers – W.H. YALI iifff Books Ltd., London.
3. Cost Reduction in product Design – Willian Chow – Ven Nostand Reinhold Co.,
4. Engineering Design Connectional stage – N.J. French. Heinmenn Educational Books.
5. Product Design – Otto- Pearson Education
6. Principles of Machine Design – R.C. Pujara.
7. Design Engineering John Diwan McGraw Hill Ltd.,

B.E.(Mechanical) Part-I

Elective- I(D)

NON CONVENTIONAL MACHINING PROCESSES

[Paper: 80 marks, - Test : 20 Marks]

INTRODUCTION: Non Traditional machining, Definitions of various processes. Classification of NCMP, Historical background of New- Technological processes. (4HRS)

MECHANICAL PROCESSES: Processes principles, equipment process parameters and applications. Examples of Abrasive jet machining, Ultrasonic machining, Abrasive flow machining, water jet machining, magnetic abrasive machining. Evaluation of material removal rate (MRR) in AJM. (8HRS)

ELECTRO CHEMICAL MACHINING (ECM): Background of ECM process, Classification of ECM processes introduction to ECD fundamental principles of ECM. Electrochemistry of ECM, Equipment required in ECM. Process capabilities processes parameters and application examples. Trouble shootings. Evaluation of MRR of pure metal in ECM. (6HRS)

ELECTRO CHEMICAL GRINDING: Process principles, process parameters, Applications.

(2HRS)

ELECTRICAL DISCHARGE MACHINING (EDM): Fundamental principle of EDM, Equipments required for EDM process parameters, process capabilities. Application example trouble shooting, Introduction to wire EDM, Process principle and parameters, process capacities and its applications. (6HRS)

CHEMICAL MACHINING: Introduction, Fundamental principles, process parameters, classification and selection of etchant resistant materials, Photo chemical machining (4HRS)

LASER BEAM MACHINING (LBM): Introduction, Background of laser action, production of photon cascade in solid optical laser. Machining applications of laser wire drilling, cutting, marking, welding, heat treating, cladding. Introduction and process principle of thermal energy method, EBM. (8HRS)

PLASMA ARC CUTTING (PAC): Process principles, equipment, applications, and examples. (2HRS)

References:

1. Modern machining process – P.C.P ANDEY and H.S. SHAH
2. Manufacturing science – AMITABHA GHOSH and ASHOK KUMAR MALLIK (EWP)
3. Nontraditional machining process – E. J. WELLER
4. Nontraditional manufacturing processes – G. F. BENEDICT (MARCEL DEKKER JNC)
5. Nonconventional Machining by – P. K. MISHRA (NAROSA PUBLICATIONS)

B.E. (Mechanical) Part – I

Elective – I (E)

ANALYSIS AND SYNTHESIS OF MECHANISMS

[Paper: 80 marks, Test : 20 Marks]

Unit-I [7 hrs]

Introduction: Introduction to Mechanisms and kinematics of mechanisms and Basic Concepts of Design Process, Axiomatic Design, Transmission Angle...etc. Computer aided kinematic analysis, Kinematic Inversions.

Unit-II [7 hrs]

Kinematics Fundamentals: D.O.F., Types of Motion, kinematic Chains, Determination of mobility, Mechanisms and Structures, Isomers, Paradoxes, Linkage Transformation, Intermittent Motion, Classification of the four bar Linkages.

Unit-III [8 hrs]

Kinematic Analysis of Plane Mechanisms : Position and displacement analysis of a point, Graphical and complex algebra method for displacement. Rotational and Translation displacement. Velocity Analysis – relative motion, linear and angular velocity, Freudenstein's theorem, velocity analysis and acceleration analysis using auxiliary point method, Goodman's indirect method.

Unit-IV [7 hrs]

Curvature Theory: Fixed and moving centroids, envelopes – velocity and acceleration, inflection points and inflection circle. Euler – Savary equation, Bobillier's theorem, Hartman's construction, return circle, cusp points, cubic of stationery curvature, Ball's point. Applications in dwell mechanism.

Unit-V [8 hrs]

Kinematic Synthesis of plane Mechanism: Type, Number and dimensional synthesis, branch and order defects. Function generation and path generation, rigid body guidance. Chebychev spacing – three, four and five-point synthesis, Burmester point theory, synthesis by analytical and graphical methods.

Unit-VI [8 hrs]

Spatial Mechanisms: Position, Velocity and acceleration analysis of RGGR mechanisms, Eulerian angles theorem on angular velocities and acceleration, DH parameters, DH Matrix method, application of special mechanism to robotics, Kinematic analysis of an industrial robot.

Text Books

• A. Ghosh and A. K. Malik, " Theory of Mechanisms and Machines " East-West Press Pvt. Ltd.
• R. L. Norton , " Design of Machinery ", 3rd edition , TATA McGraw Hill .

Reference Books

• J.E. Shigley and J. J. Vicker, " Theory of Machines and Mechanisms " , International student edition , McGraw Hill Publications.
• R.S. Hartenberg , J. Donavit , " Kinematic Synthesis of Linkages " , McGraw Hill
• G. N. Sandor and A G Erdman , " Mechanism Design – Analysis and Synthesis. Vol. I and Vol. II ", Prentice Hall of India Pvt. Ltd. , Eastern Economy Edition.

B.E. (Mechanical) Part – I

Elective – I (F)

NON CONVENTIONAL ENERGY SOURCES

[Paper : 80 marks, Test : 20 Marks]

Energy requirement of India and world: Present energy sources world's Production and reserves. Global energy crises. Short comings and limitations to the existing sources for alternative energy sources. (4Hrs)

Solar Energy: Solar radiation – Terrestrial and extra terrestrial solar instruments, Energy potential of sun simple flat plate collector design of liquid flat plate collator selective coatings applications of LFPC. Concentrating collectors, solar Ponds, solar distillators solar satellite power system solar cooker, solar air heaters, solar driers photovoltaic direct energy conversion solar cells solar thermal power system solar energy storage. (10 Hrs)

Hydro power: Principle of hydro power – Mini and micro power systems, hydro power conversion devices- turbines and ram pumps. (4 Hrs)

Wind Energy: History, Principle of wind power Betz model Bet criterion wind mills wind turbines, wind mill site characteristic, Magnus effect application of wind energy , recent developments. (6Hrs)

Geothermal Energy: History and future origin and types of geothermal energy regions dry roc and hot aquifer analysis, vapor dominated and liquid dominated geothermal systems, operational and environmental problems. (4Hrs)

Ocean Energy: Types of ocean energy, sources, temperature difference OTEC (closed and open) comparison with normal vapor power cycles. Ocean waves- Wave motion energy power form waves wave energy conversion devices. Tidal power –formation and cause of tides power form tides tidal power devices. (4Hrs)

Biomass Energy: Various forms of biomass as a potential energy source, energy plantain, various species of plants suitable for India, bio-fuel production processes, biogas plants, gassifiers principle, construction and design of gassifiers, individual and community biogas and gobar gas plants. (4Hrs)

Integrated Approach: Integrated system for community energy need, alternative energy to meet the needs, over all need for non conventional energy sources system, impact of such system. (4Hrs)

Reference Books

1. Solar energy – Principle of thermal collection aqnd storage – S.P. Sukhatme (Tata Mc Graw Hill Pub.)
2. Principle of Solar Engineering – Krieten, Krieder - Mc Graw Hill Pub. Co.
3. Renewable Energy Resources – John W. Tidwell and Anthony d. Weir (ELBS pub.)
4. Non conventional energy sources – G.d. Rai.
5. Solar Energy of Thermal Processes – J.A. duffy, W.A. Beckerman – John Willey.

B.E. (Mechanical)
Part – I
INPLANT TRAINING

[Term work: 25marks; Practical: 25marks]

Every student will be undergoing in- plant training for maximum 6 weeks in one Engineering Industry immediately after T.E. examination and before admitted to final year.

A student is expected to study the following aspects of the industry where he /she is undergoing inplant training.

1. Organization structures.
2. General Plant layout.
3. Type of Production. Viz. continuous / Batch / Tailor-made, Custom Oriented.
4. Special Techniques / Methods observed such as Industrial Engineering Methods, Q.C. Techniques, Management techniques, Material Handling, Industrial Safety measures, Environmental Standards M/C Tools Production processes, etc.

He should submit a report on training along with the diary of activities to the Principal at the time of his admission to BE. The report should be neatly typed on A-4 size white papers with

spacing, hard or comb bound. The report should bear certificate from the appropriate authority of the industry regarding the satisfactory completion of the training special work assigned, etc. The cover of comb bound copies should have transparent front cover and non-transparent plastic back cover.

The in plant training report shall be evaluated based on a seminar by the student or internal viva conducted at department.

INPLANT TRAINING REPORT

The Inplant training report shall consist of the study carried by the student and the following information.

1. Name of the student
2. Roll No.
3. Academic year
4. Name and address of the industry
5. Organization: Company /Pvt. Ltd. /Partnership/ Propriety/ Co-operative.
6. Name of the top executives: Name Phone No.

a. General Manager
b. Plant Manager
c. Personnel Manager
d. Production Manager
e. Foreman

B.E. (Mechanical)Part – I

PROJECT – I

[Term work: 50]

The students in a group of not more than FIVE will work under the guidance of the faculty member on the project work undertaken by them. The completion of work, the submission of the report and assessment should be done at the end of Part I (1st Semester).

The project work may consist of,

1. A comprehensive and up-to-date survey of literature related to study of a phenomenon or product.
2. Design of any equipment and / or its fabrication and testing.
3. Critical Analysis of any design or process for optimizing the same.
4. Experimental verification of principles used in applications related to Production Engineering.
5. Software development for particular applications.
6. A combination of the above.

The **Project – I** is intended to strengthen the final project to be undertaken by the student/ students in II semester under **Project –II.** Hence it should be treated as a preparatory work (in consultation with guide) to fulfill the requirements for project II in semester II. A synopsis of the selected project work (two to three pages typed on A4 size sheets) certified by the project guide, should be submitted in the beginning of the first semester. The synopsis shall be a part of the final project report.

The term work shall consist of the following:

i) A record containing the literature survey in relevant area. The candidate will have to deliver a seminar in the presence of faculty and students based on his findings.

ii) A preliminary report related to the project work to be completed under project – II (for part – II). This report should contain details of literature survey collected data, details of design and drawing lists of components fabrication details.

The term work will be assessed by two internal examiners appointed by the Principal of the institution, one of whom will be his guide and a faculty of the concerned discipline. The student shall be evaluated based on a seminar delivery, of about 30 minutes duration on his project –I report.

B.E. (Mechanical) Part – II

Refrigeration and Air Conditioning

[Paper : 80 marks, Test : 20 Marks T/W : 25 Marks, Practical 25 Marks]

Unit-I

Introduction & Refrigeration

Review of thermodynamics, Refrigeration, unit of refrigeration, COP and exegetic efficiency, applications of refrigeration such as domestic, industrial, medical, cryogenics and transportation.

Defination, classification nomenclature desirable properties satiation of refrigerants for particular application from group of refrigerants, ozone depletion need for eco-friendly refrigerants, charging of refrigerants, detection of leakages. Green house effect from CFCs & CO_2, Alternative refrigerants for CFCS & HCFCS, Antifreeze solutions. (04 Hours)

Unit-II

Vapor Compression Cycle

Different types of compressors, condensers, evaporators and expansion devices controls such as pressure cutouts, thermostat, humidistat, solenoid valve, oil pressure cutout, relays, Thermostatic Expansion valve.

Carnot cycle reversed Carnot cycle for refrigerants, limitations of reversed Carnot cycle, theoretical vapor compression cycle, Effects of working parameter on VCC, deviation of actual cycle from theoretical cycle, Frosting methods of defrosting. (10 Hours)

Unit-III

Multi Pressure system

Removal flash gas inter cooling one evaporator and one compressor system, Multi-evaporator and one compressor system one evaporator and Multi compressor system cascade refrigeration system and production of solid CO_2. (04 Hours)

Unit- IV

Air Cycle Refrigeration

Bell-Coleman cycle, joule and Bray ton cycle of air refrigeration different methods used for aircraft cooling, advantage of using air refrigeration over VCC, Mortinovsky-Dubinsky cycle.(Numerical treatment) (08 Hours)

Unit-V

Vapor Absorption System

Principle components working modifications use of enthalpy concentration charts for studying performance of refrigeration system different types of absorption system like aqua ammonia lithium bromide Electrolux etc. (04 Hours)

Unit-VI

Psychrometry & Air conditioning

Necessity of air conditioning human requirements of comfort study of psychometric and psychometric process such as mixing of air streams sensible heating sensible cooling humidification dehumidification cooling and dehumidification heating and dehumidification, cooling and humidification heating and humidification. bypass factor sensible hear factor.

Factors affecting control Air-conditioning, Classification of Air-conditioning. Winter, summer & year round Air-conditioning system.

Factors considered to calculate air conditioning cooling load calculation, Solar refrigeration solar air conditioning, Air-conditioning of special type buildings, Marine air conditioning, Mobile air conditioning. (8 Hours)

Term Work

Term work shall consist of any eight experiments from the following.

1. Trial on vapor compression refrigeration system
2. Trial on air conditioner. (Test Rig)
3. Trial on ice refrigeration system
4. Demonstration of different compressors used in refrigeration.
5. Demonstration of household refrigeration and its wiring diagram.
6. Study of different controls used in refrigeration system such as thermostat, solenoid valve, compressor capacity control.
7. Study of different controls such as H.P. & L.P. control OLP, relays.
8. Study of psychrometer used in determination of D.B.T. W.B.T study of humidistat.
9. Charging refrigerant in refrigeration system or finding refrigeration capacity of refrigerating unit.
10. Visit to cold storage plant or any such application of refrigeration.
11. Visit to air-conditioned / air-cooled premises (visit report should be included in the journal).
12. Visit to ice factory.

Practical Examination

It shall consist of an oral based on the above syllabus and term work.

References

1. Refrigeration & Air-conditioning- C.P. Aroa -Tata McGraw Hill
2. Refrigeration & Air-conditioning – W.F.Stoecker, J.W.Jones McGraw Hill
3. Refrigeration & Air-conditioning – Roy J. Dossat.- Pearson Education
4. A course in Refrigeration & Air-conditioning – S.Domkundwar, S.C. Arora.
5. A course in Refrigeration & Air-conditioning – R.S. Khurmi & J.K.Gupta
6. A course in Refrigeration & Air-conditioning – Manohan Prasad

B.E. (Mechanical) Part – II

AUTOMOBILE ENGINEERING

[Paper: 80 marks, Test : 20 Marks T/W: 25 Marks, Practical: 25 Marks]

Unit- I (5 Hrs)

Introduction: Classification of automobiles, major components and their functions, different automobile layouts.

Automobile power plants: Requirements of automotive power plants, comparison and suitability considerations, Types and special features of automotive engines, Fuel cells, Electric vehicles, Hybrid vehicles, advantages and limitations.

Unit-II (10 Hrs)

Engine: Engine parts and their functions: cylinder block, cylinder head, cylinder liners, piston, piston rings, gudgeon pin, connecting rod, crankshaft, valve and valve mechanism, engine mountings, vibration damper.

Balancing : Mechanical and power balancing, Firing orders in multi-cylinder engines.

Fuel supply systems: Fuel feed system of petrol and diesel engines, petrol injection

Lubrication: Necessity of lubrication, types of lubrication systems, filters and filtering arrangements, oil pumps, crankcase ventilation, troubles with lubrication systems.

Cooling system: Necessity of cooling, air cooling, pressurized cooling systems, troubles and remedies.

Unit-III (5 Hrs)

Electrical System

Storage batteries: Capacity, rating, charging and testing.

Charging systems: DC dynamo, AC dynamo, combined regulators.

Starting systems: Starting motor drives.

Electrical instruments: Lighting and signaling circuits, wiper motor, electric horn.

Unit –IV (9 Hrs)

Clutches: Types of clutches, their construction and working

Transmission: Necessity of gear box, Types of gear boxes, operating mechanisms for gear systems, torque converter

Drive line and rear axle: Propeller shaft, universal joint, slip joint, final drives, Hotchkiss and torque tube drives, rear axle types and construction, principle of differential, types of differential.

Unit-V (7 Hrs)

Front axle and steering: types of front axle, steering requirements, wheel alignment, steering geometry, steering mechanism, under-steer and over-steer, power steering

Brake system: Shoe and disc brakes, brake actuators and adjustors, servo and power brakes, air brakes, parking brakes, brake troubles, ABS.

Unit- VI (4 Hrs)

Chassis, suspension and wheels: Chassis frame layout, unit construction, types of springs, spring dampers, air suspension, conventional and independent suspension, shock absorber, stabilizers, wheels and tyres, parameters affecting tyre life.

TERM WORK:

Minimum eight experiments from the list given below should be conducted.

1. Study of different automobile layouts.
2. Study and demonstration of working of single plate automobile clutch.
3. Study and demonstration of synchromesh gear box.
4. Study and demonstration of final drive and differential.
5. Study and demonstration of working of hydraulic brake system.

6. Study and demonstration of front wheel steering geometry and steering mechanism.
7. Study of suspension system of a four wheeler.
8. Study and demonstration of starter motor drive.
9. Study and demonstration of wheel alignment and wheel balancing.
10. Study and demonstration of cooling system for automobile engine.
11. Study and demonstration of lubrication system for automobile engine.

REFERENCE BOOKS:

1. **Automotive mechanics**, Joseph Heitner, CBS Publishers and distributors.
2. **Fundamentals of Automobile Engineering,** K.K.Ramalingam, Scitech Publications (India) Pvt. Ltd.
3. **Automobile engineering, Vol I and II,** Kirpal Singh , Standard publishing house
4. **Automotive Mechanics,** S. Srinivasan, Tata McGraw Hill
5. **Automotive Mechanics,** Crouse & Anglin, Tata McGraw Hill
6. **Motor Vehicle,**Newton & Steeds

B.E. Mechanical Part – II

Production Management

[Paper: 80 marks, Test : 20 Marks T/W: 25 Marks, Practical: 25 Marks]

Unit-I

Introduction: Definition and function of PPC, production cycle, factors affecting the place of PPC in an organization viz; type of production, size of plant, type of industry, organization of PPC department. (3Hrs)

Product development and Design: Company policy, product analysis considering marketing aspect, product characteristics, economic and production aspect, break even analysis should include step and slop changes in cost lines, dumpingnon-linearity, multiple products etc. (3Hrs)

Unit-II

Demand forecasting: Introduction, factors restricting consumption, sources of forecasting, time series analysis, time series calculating methods viz; least square method with linear quadratic and exponential curve fitting, simple and moving average method, Exponential smoothing correlation, selection of forecasting method. (4Hrs)

Capacity planning and analysis: Life cycle analysis and capacity planning, labor machine output, multi machine provision of operator machine interference, line balancing, analysis of production capacities in multi product system and profit maximization, assembly line balancing, largest candidate and ranked position weight method. (6Hrs)

Unit-III

Plant location and layout: Introduction to Plant location, factors affecting location and their evaluation. Introduction to layout flow system, types of layout, product process statics and group technology. Layout symptoms of bad layout, layout analysis, introduction to computerized layout, draft corelap. (4Hrs)

Elements of cost: Direct cost, indirect costs, over heads, methods of allocation of overheads, finding the total cost of the product including the cost deprecation, method of deprecation. (3Hrs)

Unit – IV

Quantities in Batch Production: Stock control methods of determining optimal batch size based on the following criteria: (4Hrs)

- Maximum cost per piece
- Maximum profit for the batch
- Maximum profit to the cost ratio
- Maximum rate of return.

Inventory control: - Purchasing, inventory concepts, inventory models considering certainty risk, discounts and shortage, inventory manufacturing. (3Hrs)

Unit-V:

Replacement Problems: Introduction, replacement of items that deteriorate with time, replacement of items whose maintenance cost increase with time and value of the money remain same during the period. Replacement of items whose maintenance cost increases with time and value of the money also changes with time. Recruitment and promotion problems. (4Hrs)

Production Scheduling: Forms of schedule, basic scheduling problems, the assignment problems, effects of overtime or sub contracting. (3Hrs)

Unit-VI:

Work study Techniques

Method Study: Definition, procedure, factors affecting selection process, chart flow diagram, string diagram, travel chart, multiple activity chart, micro motion study, two handed process chart, principles of motion economy. Therbligs Simo chart. (3Hrs)

Work Measurement: - Techniques, time study equipments, selection of jobs for time study, breakdown jobs into elements, types of elements PMTS. (3Hrs)

Term Work:

It shall consist of any eight assignments out of the following.

1. Assignment on the one type of production for a particular product.(This assignment should include the study of function of PPC with respect to the corresponding product.)
2. Assignment of analysis of product from product development and design point of view considering at least marketing product and production aspects.
3. Assignment on break even analysis.
4. Assignment on lay out analysis.
5. Assignment on machine capacity and line balanancing.
6. Assignment on assembly line balancing.
7. Assignment on order scheduling with random arrivals.
8. Assignment on Inventory control.

Practical examination

Oral based on above term work and syllabus.

References

1. Production process and control by Samuel Eilon.
2. Production process and control by Jain and Agarwal.
3. Production planning and inventory control by Narasimhan, Mc Leavey and Billington.
4. Industrial engineering and product management by Martand Telang.
5. Production and operation Management by Chaze Aaullano and Jacob S.
6. Production and operation Management by Robert Russel, Bennard w. Taylor III.
7. Industrial Engineering and Management: O.P. Khanna
8. Management Today : Principals and Practice by Gene Burton, Manab Thakur-McGraw `Hill(1996).
9. Work Study : National Productivity council (NPC Journal)
10. Industrial Organization and management : Banga, Sharma.

B.E. (Mechanical) Part-II

Elective-II (A)

Reliability Engineering

[Paper: 80 marks; Test: 20 marks]

Unit-I: (8 Hrs)

Reliablity Definition – Introduction & definition of Reliability. Bathtub curve, causes of failure, concepts. Failure Data analysis – Introduction , Failure Date, Mean Failure Rate, Mean Time To Failure(MTTF), Mean Time Between Failure(MTBF), Graphical Plots, MTTF in terms of Failure Density, Generalization , Reliability in terms of Hazard Rate & Failure Density (in integral form), Mean Time To Failure in Integral Form, Reliability in other Situations.

Unit-II: (4 Hrs)

Hazard Models – Introduction, Constant Hazard, Linearly increasing Hazard, The Weibull Model, On Density Function & Distribution Function & Reliability Analysis., Some important Distribution.

Unit-III: (6 Hrs)

Evaluation of System Reliability for various configuration using – Reliability of series and parallel systems, Star Delta, Conditional probability Method, Optimal tie set or cut set method, Event tree analysis.

Unit-IV: (8 Hrs)

Fault – tree analysis and other techniques. – Introduction, Fault Tree construction, Calculation of Reliability from Fault Tree, Introduction to tie set & cut set and their methods, FMEA, FMECA, RPN & AHP.

Use of Boolean Algebra – Introduction, Basic Operations, Truth tables, De Morgan's Theorem, application to reliability analysis, Probability Calculations.

Unit-V: (6 Hrs)

Reliability Improvement – Introduction, Improvement of Components, Redundancy, Element Redundancy, Unit Redundancy, Stand by Redundancy, Optimization, Reliability-Cost Trade-Off

Unit-VI: (8 Hrs)

Reliability Allocation – AGREE, ARINC, MATRIX, MEAN, MEDIAN METHODS, Parametric Reliability using variable and attribute methods.

Engineering Design Reliability – Introduction, Design Synthesis, Strength – Load Interaction, Reliability of the System, Design based on reliability, iterative design.

References:

1. Reliability Engineering by Kapoor and Lumbersom
2. Reliability Engineering by L.S.Srinath
3. Reliability engineering- by Singh & Dhillon.

B.E. (Mechanical) Part-II

Elective-II (B)

COSTING AND ESTIMATION

[Paper: 80 marks; Test: 20 marks]

Cost Concept and Terminology: (04 hrs)

Nature of cost: Opportunity and outlay cost, Cost and Expenses; Period cost versus Product costs, Costs of Inventory, Stages of production, Costs of Goods manufactured and solid statement; Prime and conversion costs; Direct versus Indirect costs; Joint costs; Differential costs; Fixed versus Variable Costs, Significance of differential costs, Sunk costs. Numerical problems on element of costs.

Cost Allocation concepts (06 hrs)

Introduction, methods of costs allocation, allocation of manufacturing overheads, Job costing; Accumulating costs for jobs, Job costing in service organization, Cost flow with multiple production department, Use predetermined overhead rates, Process costing, Equivalent unit concept and assigning costs to units, methods of allocating process costs, Spoilage, Job costing versus Process costing.

Cost Estimation (08 hrs)

Methods: Account analysis, engineering analysis estimates, scatter graph and high low estimates, regression and Activity Based Costing; Learning Curves and applications.

Activity Based Costing: Cost accuracy – its importance and strategic role, traditional costing and ABC, Concepts of ABC, Activities, Costs objects and Costs Drivers, Identifying activities and cost derivers, two stage allocation process: Implementing ABC, Consequences of ABC: product decisions, engineering design decisions, cross functional orientation.

Process Cost Estimation: (08 hrs)

For casting, forging, Machining, Welding and sheet metal working

Cost Comparisons (08 hrs)

Time value of money, cc with equal and unequal durations, concept of uncast and capitalized cost: Depreciation methods, Taxes and Inflation in cc.

Cost Volume Profit Analysis (06 hrs)

Profit equation, CVP relations, the economists profit maximization model, modifications of the basic model: CVP with cash flow analysis, income taxes, semi-fixed costs, nonlinear costs, dumping and over-utilization of capacity, Limitations and assumptions.

Reference Books:

1. Cost Accounting, Edward B. Deakin and M. W. Maher, Richard D. Irwin Inc.
2. Cost and Optimization Engineering, F. C. Jelen and J. H. Black, McGraw Hill Int.
3. Competitive Manufacturing Management, John. M. Nicholas, McGraw Hill Int.
4. Mechanical Estimation and Costing, Banga Sharma,
5. Mechanical Estimation and costing, D. Kannapan et.al., TTTI, Madras
6. Mechanical Estimation and costing, B. P. Sinha.

B.E. (Mechanical) Part-II

Elective-II (C)

AUTOMATION AND ROBOTICS

[Paper: 80 marks; Test: 20 marks]

Unit-I 06 Hrs

Introduction of Automation: Automated manufacturing systems, fixed /programmable /flexible automation, Need of automation, Basic elements of automated systems- power, program and control. Advanced automation functions, Levels of automation; Industrial control systems in process and discrete manufacturing industries, Continuous and discrete control; Low cost automation, Economic and social aspects of automation.

Unit-II 04 Hrs

Assembly Automation: Types and configurations, Parts delivery at workstations- Various vibratory and non-vibratory devices for feeding and orientation, Product design for automated assembly.

Unit-III 06 Hrs

Introduction of Robotics: Definition & History of robots, Automation and Robotics, Robot-Anatomy, Robot classification – Drive technologies, Work –Envelope Geometries, Motion control methods, Robot specifications – Payload, Reach, Precision, Accuracy and Repeatability.

Unit –IV 08 Hrs

Robot Kinematics: Matrix representations of coordinate transformation, Transformation about reference frame and moving frame, Forward & Inverse Kinematics. Examples of 2R, 3R & 3P manipulators, RPY and Euler's angle. Homogeneous coordinate transformation and examples, D-H representation of kinematics linkages. Forward and Inverse kinematics of various manipulators using D-H representations.

Unit-V 06 Hrs

Robot End Effectors and Vision System:

End Effectors: – Types of end effectors, mechanical, vacuum, magnetic, adhesive grippers, tools as end effectors, Gripper force analysis and design.

Sensors: - Need of sensors in a robotic system, Robotic sensors – Types of sensors based on working principle, desirable features of sensors, various sensing devices used in robot work cells, sensor characteristics, selection of sensors, photo-sensors, limit switches. Range sensors, proximity sensors, touch / sensors, Remote Center Compliance (RCC) device.

Vision Systems: - Need of vision in a robotic system, Image acquisition, Illumination Techniques, Image conversion, Cameras, sensors, Camera and system interface, Frame buffers and Grabbers.

Unit-VI 08 Hrs

Robot Programming Languages: Lead through method, Robot program as a path in space, Methods of defining positions in space, Motion interpolation, branching; Textual robot programming languages-VAL II.

Industrial Applications: General considerations in Robot applications, Material transfer, Machine loading, Welding, Spray painting, Assembly, Inspection.

References:

1. S.R.Deb- 'Robotics Technology and Flexible Automation- Tata McGraw Hill M.P.Groover, M. Weiss R.N. - 'Industrial Robotics' - McGraw Hill
2. K.S.Fu, R.C.Gonzalez and C.S.G.Lee- 'Robotics: Control , sensors , vision and intelligence- McGraw-Hill.
3. J.J.Craig- 'Introduction to Robotics '- Pierson Publications
4. Klafter , Richard D., et al- 'Robotics Engineering' - Prentice Hall of India Pvt. Ltd.
5. Robert J. Schilling - 'Fundamentals of Robotics Analysis and control- Prentice Hall of India
6. R K Mittal and I J Nagrath- 'Robotics and Control' - Tata McGraw Hill
7. Saeed B Niku- 'Fundamentals of Robotics Analysis and control' - Prentice Hall of India Pvt. Ltd
8. Groover, M.P., "Automation, Production Systems & Computer Integrated Manufacturing" (Pearson Edu.)
9. Groover, M.P.; Weiss, M.; Nagel, R.N. & Odrey, N.G. "Industrial Robotics, Technology,
10. Programming & Applications", McGraw Hill Intl.
11. Keramas, James G. " Robot Technology Fundamentals", Thomson Learning
12. Noff, Shimon Y. "Handbook of Robotics", John Wiley & Sons
13. Niku, Saeed B. "Introduction to Robotics, Analysis, Systems & Applications",Prentice Hall of India
14. Koren, Yoram "Robotics for Engineers", McGraw Hill
15. Edwin Wise - 'Applied Robotics Volume I & II ,- Cengage Learning.

B.E. (Mechanical) Part-II

Elective-II (D)

MICRO AND NANO MACHINING

[Paper: 80 marks; Test: 20 marks]

Unit-I

Introduction: Need, evolution, fundamentals and trends in micro and nano technologies; Consequences of the technology and society; Moore's law , challenges to manufacturing technology; evolution of precision in manufacturing, tooling and current scenario; micro-nano fabrication tool, requirements and scales. (6 Hrs)

Unit-II

Mecahnical Micro Machining: Introduction, principle, tools and application of: Micro Drilling, Turning, Milling, Diamond turning, Grinding, honing, lapping, and super finishing. (6 Hrs)

Unit-III

Non-conventional micro-nano manufacturing and finishing approaches: Manufacturing and finishing approaches like, WAJM,USM, AFM, MAF micro: ECM, EDM, WEDM, LBM, EB, Focused ion beams, Hybrid processes, ELID- process principle, application and technological information, chemical machining and mechano chemical finishing. (10 hrs)

Unit-IV

Modelling and Analysis approach and size effect for micro machining. Introduction to Nano machining. (4 Hrs)

Unit-V

Generative and other processing routes: Lithography techniques, PVD, CVD, LIGA, Electro and Electroless deposition; nano structured films and coatings, sputtering deposition. (6 Hrs)

Unit-VI

Characterization and metrology tools: Introduction and example of SEM, XRD,AFM, TEM, indentation, scanning tunneling microscope, etc, on machine measuring devices, micro CMM, accuracy and precision introductory treatment and awareness. (4 Hrs)

Micro assembly: MEMS, NEMS, Market prospects assembly problems, micro assembly systems and example, micro robots and applications, flip-chip technology and joining of micro parts. (4 Hrs)

References:

Fundamentals of Machining Processes, Hassan El-Hofy, Taylor and Francis, 2007.
Non traditional Manufacturing Processes – G.F.BENEDICT (MARCEL DEKKER JNC.)
Non-conventional machining by – P.K. MISHRA (NAROSA PUBLICATIONS)
Advanced Machining Processes, by V. K. Jain, Allied Publishers Pvt. Ltd, (2005)

B.E. (Mechanical) Part-II

Elective-II (F)

COMPUTATIONAL FLUID DYNAMICS

[Paper: 80 marks; Test: 20 marks]

Unit -I

Introduction: Insight into power and philosophy of CFD. CFD ideas to understand. CFD application. Need for parallel computers for CFD algorithms. Models of flows. Substantial derivative, Divergence of velocity. 04 Hrs

Unit-II

Governing Equations: Continuity, Momentum and Energy equations; derivation in various forms. Integral versus Differential form of equations. Comments on governing equations. Physical boundary conditions. Forms of the governing equations particularly suited for CFD work: Shock fitting and Shock capturing methods. Generic form of equations. 05 Hrs

Unit III

Mathematical Behavior of Partial Differential Equations: Classification of partial differential equations. Cramer rule and Eigen value method. Hyperbolic, parabolic and elliptic forms of equations. Impact on physical and computational fluid dynamics; case studies: steady inviscid supersonic flow; unsteady invisid flow; steady boundary layer flow; and unsteady thermal conduction. 04 Hrs

Unit- IV

Discretization: Essence of discretization. Taylor series approach for the construction of finite difference quotients. Higher order difference quotients. Up-wind differencing. Midpoint leap frog method. Reflection boundary condition. Difference equations. Explicit and Implicit approach: definition and contrasts. Errors and analysis of stability. Error propagation. Stability properties of Explicit and Implicit methods. 07 Hrs

Unit-V

Grid Generation: Body–fitted coordinate system. Need for grid generation. Essential properties of grids. Types of grids (O-type, C-type and H- type). Various grid generation techniques - Algebraic, and Numerical grid generation. Elliptic grid generation. Structured, Un-structured grids, Adaptive grids, Grid collapse. Multi-Grid methods. Grid accuracies. 05 Hrs

Unit -VI

Appropriate Transformation: General transformation of equations. Metrics and Jacobians. Generic form of the governing flow equations with strong conservative form in the transformed space. Transformation of continuity equation from physical plane into computational plane; application of Grids stretching . 05 Hrs

Unit- VII

Finite Volume Techniques: Finite Volume Discretization - Cell Centered Formulation. High resolution finite volume upwind Scheme. Runge - Kutta Time Stepping . Multi - Time –Step Integration scheme. Cell Vertex Formulation. Numerical dispersion. 04 Hrs

Unit- VIII

CFD Application to Some Problems : Time and space marching. LAX-WENDROFF Technique . Relaxation technique. Point iterative mehod. Successive over-relaxation/under relaxation. Aspects of numerical dissipation and dispersion; artificial viscosity. The Alternating Direction-(ADI) Implicit Technique. Approximate factorization scheme. Upwind schemes; Flux vector splitting. 06 Hrs

Text Books:

1. John D Anderson Jr. Computational Fluid Dynamics,'The Basics with Applications', McGraw Hill International Edn; 1995 .
2. Tapan K. Sengupta, 'Fundamentals of Computational Fluid Dynamics', Universities Press (India) Private Limited; 2005.

References:

1. F. Wendt (Editor), "Computational Fluid Dynamics - An Introduction", Springer – Verlag, Berlin; 1992.
2. Charles Hirsch, "Numerical Computation of Internal and External Flows", Vols. I and II. John Wiley & Sons, New York; 1988.
3. Jiyuan Tu, Guan Heng Yeoh, and Chaoqun Liu,' Computational Fluid Dynamics- A Practical Approach', Elsevier Inc; 2008.
4. Suhas V. Patankar, 'Numerical heat transfer and fluid flow' Butter-worth Publishers
5. Niyogi, 'Computational Fluid Flow and Heat Transfer'- Pearson Publications

B.E. (Mechanical) Part-II

Elective-II (F)

POWER PLANT ENGINEERING

[Paper: 80 marks; Test: 20 marks]

Unit I : 6 Hrs.

Power Plants: Factors affecting Selection of site, Schematic Diagrams and relative merits of Steam ,Gas Diesel ,Hydro Power Plants, Present status of Power generation in India.

Nuclear Power Plants: Classification, Site Selection, Types of Various Reactors with working of various Components. Nuclear Power plants In India. Waste Disposal.

Unit- II: 7 Hrs.

Fuels for thermal power plants: Coal – basic ingredients & effect on furnace design coal beneficiation, blending, selection for thermal power plants, Liquid fuels, Gaseous fuels, slurry or emulsion type fuels, Handling , storage preparation & feeding, burning of fuels, Ash handling & dust collection, Draught system, Principle of Fluidized bed combustion.

Unit- III: 8 Hrs.

High Pressure Boilers

High pressure boilers, types of fluidized bed boilers (CFBCB, PFBCB) Steam piping and layout

Improved Rankine Cycle

Rankine Cycle With Reheating and Regeneration. Steam Power Plants with Process Heating.

Unit -IV: 6 Hrs.

Steam Nozzles : Flow of fluids through nozzle, subsonic, supersonic nozzles, and diffusers, continuity equation, variation of velocity, area and specific volume, mass of discharge through nozzle, maximum discharge and critical pressure ratio, chocking of nozzle, effect of friction, nozzle efficiency, velocity coefficient, , supersaturated flow.

Unit- V: 7 Hrs.

Condensers : Necessity of condensers, types of condensers, Dalton's law of partial pressures, condenser vacuum and vacuum efficiency, condenser efficiency, air pumps, capacity of air extraction pumps, types of cooling towers, cooling water requirements.

Unit- VI: 8 Hrs.

Economics Power Generation

Load curves, load duration curves, Connected load , maximum load , peak load, base load, and peak load power plants. load factor, plant capacity factor, plant use factor, demand factor, diversity factor. Performance at variable load of power plants, heat rate and incremental heat rate curves, load sharing among generators and prime movers, load shading between power stations, cost analysis, unit energy cost.

Text Books:

1) A Course in Power Plant Engg- Arora, & Domkundwar,Dhanpat Rai & Co.
2) Power Plant Engg. -P K Nag, Tata Mcgraw Hill & Co. New Delhi

REFERENCES:

1. Collier J.G., and Hewitt G.F, "Introduction to Nuclear power" Hemisphere Publishing, NewYork.
2. Wakil M.M.El., "Power Plant Technology" – McGraw-Hill International, 1984.
3. Lipschutz R.D "Radioactive Waste-Politics, Technology and Risk", Ballingor, Cambridge
4. Thomas J.Cannoly, "Fundamentals of nuclear Engineering" John Wiley

B.E. (Mechanical)Part – II

PROJECT – II

[Term work: 50 marks; Practical: 100 marks]

The students in a group of not more than FIVE will work under the guidance of the faculty member on the project work undertaken by them. The completion of work, the submission of the report and assessment should be done at the end of Part II (2nd Semester).

The project work may consist of,

1. A comprehensive and up-to-date survey of literature related to study of a phenomenon or product.
2. Design of any equipment and / or its fabrication and testing.
3. Critical Analysis of any design or process for optimizing the same.
4. Experimental verification of principles used in applications related to Production Engineering.
5. Software development for particular applications.
6. A combination of the above.

The objective is to prepare the students to examine any design or process or phenomenon from all angles, to encourage the process of independent thinking and working and to expose them to industry. The students may preferably select the project works from their opted elective subjects.

A synopsis of the selected project work (two to three pages typed on A4 size sheets) certified by the project guide, should be submitted in the first semester under Project-I. The synopsis shall be a part of the final project report.

The students should submit the report in a prescribed format, at the end of semester. The report shall be comprehensive and presented in duplicate, typed on A4 size sheets and hard bound.

The report should follow the guidelines as below

a) The format of standard Journal, e.g. ASME Trans, I.J.P.R.,J of Mtl. Pro., Productivity, etc. prescribed for technical Paper should be followed for writing and presenting the report.

b) The report shall consists of front cover and the title sheet, the introduction of the project work, the literature survey, report of any analytical or experimental work discussions and conclusions.

c) The equations /figures should be numbered appropriately.

d) Tables should be typed in text. A separate sheet could be used if necessary.

e) The nomenclature symbols and key words used should be mentioned separately.

f) No blank sheet be left anywhere in the report.

g) The reference shall form the last section and would be followed by 'Appendix' if any reference would contain list of works (papers books etc.) reference to in the order in which they are cited in the text. The citing shall be done in numericals enclosed in square bracket e.g.[1].

[paper]

1.P.W.Bridgman,'The stress Distribution at the Neck of a Tension Specimen', vol .32 p.553(1944).

[Book]

2. Sarkar S. : fuels and combustion-Orient Longmans Ltd. First Edition (1974).

Front cover

The front cover shall have the following details in Block-Capitals.

a) Title at the top.

b) Name of the candidate in the center.

c) Name of the institute and the year of submission on separate lines at the bottom.

Title Sheet:

The title sheet would be the first sheet and would contain the details in the given order with proper spacing as shown.

TITLE OF THE PROJECT UNDER TAKEN

(IN UPPER CASE-NOT MORE THAN FIFTEEN WORDS)

(Spacing*)

Project Report

Submitted in partial fulfillment of the requirements of S.R.T.M.U for the degree of

B.E.(Mechanical)

(In Title Case)

(Spacing*)

By

Name of the Students

(In title Case)

(Spacing*)

Mechanical Engineering Department

(In title case)

Name of The College/Institute With Short Address

(In Title case)

(Academic Year)

(In Numerals)

***Not to be typed.**

1. Term work will be assessed by the project guide along with one colleague appointed by the Head of Department.
2. The students will be examined orally by the external examiner and the project guide, as the internal examiner. Marks will be awarded on the basis of the work done and performance in the oral examination.