UNIVERSITY OF KERALA
MECHANICAL ENGINEERING
SCHEME OF STUDIES AND EXAMINATION AND SYLLABUS FOR B. TECH DEGREE
III to VIII SEMESTERS 2003 SCHEME

Semester III

Course No	Name of subject	Weekly load, hours			Max sessional marks	Exam Dur Hrs	Exam max marks	Credits
		L	T	D/P				
03.301	Engineering. Mathematics – II	3	1	-	50	3	100	4
03.302	Humanities (MNPU)	3	0	-	50	3	100	3
03.303	Fluid Mechanics	3	1	-	50	3	100	4
03.304	Mechanics of Solids (MNPU)	3	1	-	50	3	100	4
03.305	Computer Programming & Applications (MN)	3	2	-	50	3	100	5
03.306	Machine Drawing – I	0	0	4	50	3	100	4
03.307	Civil Engg. Drawing & Estimation (MN)	0	0	3	50	3	100	3
03.308	Civil Engineering Lab (MN)	0	0	2	50	3	100	2
	Total	15	5	9	400		800	29

Semester IV

Course No	Name of subject	Weekly load, hours			Max sessional marks	Exam Dur. Hrs	Exam max marks	Credits
		L	T	D/P				
03.401	Engineering Mathematics - III	3	1	-	50	3	100	4
03.402	Thermodynamics (MU)	3	1	-	50	3	100	4
03.403	Hydraulic Machines	3	1	-	50	3	100	4
03.404	Theory of Machines (MU)	3	1	-	50	3	100	4
03.405	Electrical Technology(MU)	3	1	0	50	3	100	4
03.406	Machine Drawing II	0	0	3	50	3	100	3
03.407	Fluid Mechanics & Machines Lab(MN)	0	0	3	50	3	100	3
03.408	IC Engines Lab	0	0	3	50	3	100	3
	Total	15	5	9	400		800	29

Semester V

Course No	Name of subject	Weekly load, hours			Max sessional marks	Exam Dur Hrs	Exam max marks	Credits
		L	T	D/P				
03.501	Engineering Mathematics - IV	3	1	-	50	3	100	4
03.502	Thermal Engineering.	3	1	-	50	3	100	4
03.503	Dynamics of Machinery (MU)	3	1	-	50	3	100	4
03.504	Metallurgy & Material science(MNPU)	3	1	-	50	3	100	4
03.505	Manufacturing Process (MN)	3	1	-	50	3	100	4
03.506	Industrial Electronics	2	1	-	50	3	100	3
03.507	Machine shop I(MNU)	0	0	3	50	3	100	3
03.508	Electrical Lab*	0	0	3	50	3	100	3
	Total	17	6	6	400		800	29

Semester VI

Course No	Name of subject	Weekly load, hours			Max sessional marks	Exam Dur Hrs	Exam max marks	Credits
		L	T	D/P				
03.601	Heat & Mass Transfer	3	1	-	50	3	100	4

03.602	Design of Machine Elements - I	3	1	-	50	3	100	4
03.603	Computer Aided Design (MN)	2	1	-	50	3	100	3
03.604	Machine Tools (MN)	3	1	-	50	3	100	4
03.605	Principles of Management (MPU)	3	1	-	50	3	100	4
03.606	Elective – I	3	1	-	50	3	100	4
03.607	CAD Lab (MNU)	0	0	3	50	3	100	3
03.608	Machine shop II (MNU)	0	0	3	50	3	100	3
	Total	17	6	6	400		800	29

Semester VII

Course No	Name of subject	Weekly load, hours			Max sessional marks	Exam Dur Hrs	Exam max marks	Credits
		L	T	D/P				
03.701	Refrigeration & Air conditioning	3	1	-	50	3	100	4
03.702	Gas Dynamics	3	1	-	50	3	100	4
03.703	Design of machine Elements - II	3	1	-	50	3	100	4
03.704	Metrology & Instrumentation (MN)	3	1	-	50	3	100	4
03.705	Industrial Engineering(MPU)	2	1	-	50	3	100	3
03.706	Elective II	3	1	-	50	3	100	4
03.707	Thermal Engineering Lab	0	0	2	50	3	100	2
03.708	Mechanical Engineering Lab	0	0	2	50	3	100	2
03.709	Project & Seminar	0	0	2	100			2
	Total	17	6	6	500		800	29

Semester VIII

Course No	Name of subject	Weekly load, hours			Max sessional marks	Exam Dur Hrs	Exam max marks	Credits
		L	T	D/P				
03.801	Energy Conversion & Management	3	1	-	50	3	100	4
03.802	Computer Integrated Manufacturing (MN)	3	2	-	50	3	100	5
03.803	Automobile Engineering	3	1	-	50	3	100	4
03.804	Seminar *	0	0	3	50	3	100	3
03.805	Elective III	3	1	-	50	3	100	4
03.806	Elective IV	3	1	-	100			4
03.807	Project & Viva voce	0	0	5	150		100	5
	Total	15	6	8	500		600	29

List of Electives offered by the Mechanical Engineering Department

03.606 Elective I	**03.706 Elective II**
1. Advanced mechanics of solids	1. Glimpses of world thought
2. New Energy systems	2. Computer Graphics
3. Object Oriented Programming	3. Advanced Thermodynamics
4. Nuclear Engineering	4. Industrial Heat Transfer
5. Foundry Technology	5. Plant Engg & Maintenance
6. Mechanical working Methods	6. Fracture Mechanics
7. Internet Technologies	7. Marketing Management.
8. Artificial Intelligence Systems	8. Entrepreneurship
9.System Modeling & Simulation	9. Industrial Hydraulics
10. Instrumentation and control	10. Finite Element Methods
11. Numerical. Methods	11. Metal Forming
12. Non-conventional Machining Techniques	12. Machine tool Technology

13. Tool Engineering 14. Composite Material Technology 15. Materials Handling 16. Agro Machinery	13. Turbo Machines 14. Mechatronics 15. Experimental Methods in Engineering 16. Costing and cost Control 17. Non Destructive Testing 18. Precision Engineering. 19. Methods Engineering.
03. 805 Elective III	**03. 806 Elective IV**
1. Experimental Stress Analysis Techniques 2. Aerospace Engineering 3. Facilities Planning 4. Advanced Decision Modelling 5. Non linear Dynamics and Chaos 6. Design of jigs and fixtures 7. Environmental Pollution Control 8. Multiphase flow 9. Welding Technology 10. Advanced Fluid Mechanics 11. Controls in Machine tool 12. Design of Pressure Vessels & Piping 13. Tribology 14. Value Engineering. 15. Software Engineering 16. Cryogenic Engineering 17. Bio Medical Engineering. 18. Vehicle mechanics & Dynamics 19. Investment Analysis & Fin. Control 20. Failure analysis & Design	1. Propulsion Engineering 2. Industrial Refrigeration 3. Industrial Quality Control 4. Design of Heat transfer equipment 5. Creativity& Product Development 6. Computerised Materials Management 7. Random vibrations 8. Mech. Vibration & Noise Control 9. Advanced Kinematics of Machines 10. Financial Management 11. Flexible Manufacturing Methods 12. Computational Fluid Dynamics 13. Technology Forecasting 14. Management Information Systems 15. Production & Operations Management 16. Project Management 17. Design of IC Engines 18. Automation & Robotics 19. Surface Engineering. 20. Rapid Prototyping

03.301 Engineering Mathematics- II 3-1-0 4 Credits
(Common to all branches)

MODULE 1: Ordinary Differential Equations

Differential equations of the first order and higher degree: Equations solvable for p-Equations solvable for x-Equations solvable for y-Clairut's Equation.

Linear Differential Equations: Higher order with constant coefficients-Method of variation of parameters-Homogeneous linear equations (Cauchy's and Legender's)-
Simultaneous linear equations with constant coefficients.

Orthogonal Trajectories: Cartesian form only.

MODULE 2: Fourier Series And Multiple Integrals

Fourier Series: Dirichlet's conditions-Euler's Formula-Functions with periods 2π and $2l$-Even and odd functions-Half range sine and cosine series.

Multiple Integrals: Evaluation-Change of order of integration-Transformation to polar coordinates-Area as double integral-Volume as triple integral (cartesian coordinates only).

MODULE 3: Vector Calculus

Vector differentiation: Derivative of a vector function-Velocity and acceleration-Scalar and vector fields-Gradient-It's geometrical interpretation-Directional derivative-Divergence and Curl-Their physical meaning-Relations involving ∇ -Solenoidal and irrotational fields-Scalar potentials(simple problems).

Vector Integration: Line integral, surface integral and volume integral-work done by a force-Statement and verification of Green's theorem, Stoke's theorem and Gauss' Divergence theorem-their use in evaluating the integrals.

References:

1.Engineering Mathematics, Vol 2: S.S Sastry, Prentice Hall of India (P) Ltd
2.Higher Engineering Mathematics: B.S.Grewal, Khanna Publishers
3.Engineering Mathematics: Sarveswara Rao Koneru, Universities Press
4.Advanced Engineering Mathematics: Michael D.Greenberg, Pearson Education

Note:

The question paper consists of two parts. Part A (40 marks). Ten compulsory questions of 4 marks each. Part B (60 marks). Students must answer one out of two questions from each module.. Each question carries 20 marks

03.302 Humanities (MNPU) 3-0-0 3 Credits
Part I – Economics (2 Periods per week)
Module I

1. Definition and scope of Economics- Definition of basic terms-Goods-wants and their classifications-wealth- Income –Money- -Near money- Credit money- Utility, features and kinds of utility – National Income and related concepts as GNP, NNP, -Disposable Income Resource Allocation, Technological choice & production possibility curve. Indifference curve analysis- the concept of supply- Supply curves-Cost curves – loss of returns.
2. Basic laws in Economics – Law of Diminishing marginal utility – Demand, Law of Demand and demand curve- The concept of supply- Supply schedule and supply curve**.**

Module II

3. Market structure – Classifications – Pricing under different markets as perfect competition, monopoly and oligopoly. Pricing under monopolistic competition.
4. Inflation – Measures to control inflation – Monetary measures and fiscal measures – Effects of inflation.
5. Tax – Classification of Taxes – Direct & Indirect taxes specific and AdValorem taxes – personal income tax – characteristics of a good tax system – Tax evasion.

Module III

6. International Monetary Fund – Issues & Challenges – International liquidity – Special Drawing Rights - India & IMF.
7. Welfare Economics – Old Welfare Economics -Pigou's Analysis – New Welfare Economics Pareto's welfare criterion**.**

Books for Study : Part-I

Dewtt.K.K Modern Economic theory

Books for References:-

1. Prof. G.Narendrababu " Elements of Ecomic Analysis"
2. Sundaran K.P.M " Money, Banking . Trade & Finance "

Part II – Communicative English (1 period per week)

Reading- Skimming-scanning-detailed reading-predicting content-interpreting charts and tables-identifying stylistic features in texts - evaluating texts-understanding discourse coherence-guessing meaning from the context- note making / transferring information.

Word formation with prefixes and suffixes-discourse markers and their functions-degrees of comparison-expressions relating to recommendations and comparisons-active and passive voice-antonyms-tense forms- gerunds-conditional sentences-modal verbs of probability and improbability-acronyms and abbreviations - compound nouns and adjectives-spelling-punctuation.

Sentence definition-static description-comparison and contrast-classification of information-recommendations-highlighting problems and providing solutions-formal and informal letter writing-using flow-charts/diagrams paragraph writing-editing.

Defining, describing objects-describing uses/functions-comparing-offering suggestions-analysing problems and providing solutions-expressing opinions (agreement/ disagreement) –expressing possibility/certainty – framing questions-providing answers.

Text Books: Part II

1. " English for Engineers and Technologists ", Volume I. Authors : Humanities and Social Science Department, Anna University, Published by Orient Longman Ltd., 1990.
2. Sarah Freeman, Written communication in English, Orient Longman, 1977.

References:

1. Narayanaswami, V.R, .Strengthen Your Writing, Orient Longman Ltd., Chennai 1996 (Revised Edition)
2. Pickett and Laster, Technical English, Writing, Reading and Speaking, New York Harper and Row Publications.
3. Swan, Michael, Basic English Usage, Oxford University Press, 1984.
4. Bhatnagar and Bell, Communication in English, Orient Longman, 1979.
5. Pravin.S.R.Bhatia, A.M.Sheikh, Professional Communication skills, S.Chand and Company Ltd., 2003.

University Question

Note: Part I and Part II to be answered in separate answer books.

Part – I Humanities

Part A – 30 Marks (short answers) Covering entire syllabus (3x10=30)

Part B – 40 Marks (50% choice – One out of two or two out of four from each module.)

Part - II Communicative English

30 marks (50 % choice)

03.303 Fluid Mechanics 3-1-0 4 Credits

Module – I

Fluid; Properties of fluid, Density, Specific weight, Pressure, Shear stress and viscosity, Newton's law of viscosity, Newtonian and non- Newtonian fluids, surface tension, compressibility, incompressible and compressible fluids, Atmospheric pressure, Gauge pressure and Absolute pressure. Pascal's Law Measurement of pressure, Piezo meter, manometers, pressure gauges.

Fluid Statics : Pressure in incompressible fluids and compressible fluids, Forces in plane and curved surfaces, center of pressure, equilibrium of floating bodies, buoyancy, stability, center of buoyancy, metacenter, metacentric height, period of oscillations, Fluid subjected to translation with uniform acceleration, rotation.

Module – II

Kinematics of Fluids: Velocity and acceleration, components of velocity, Cartesian and cylindrical coordinates, local and convective components of acceleration, rotation, circulation and vorticity, steady and unsteady, uniform and non-uniform flow, inviscid and viscous flow, rotational and irrotational flow, potential flow, stream function, stream line, flow potential and iso-potential lines, problems.

Fluid Dynamics: Energies in flowing fluid, head, pressure, dynamics and static head, total head, discharge, continuity equation, continuity equation for one and two dimensions

(Cartesian and polar), Euler' equation for one and two dimension (Cartesian and polar), Bernaulli's equation, Practical applications: Flow rate measurements (Venturi and orifce meters, Notches and Weirs). Velocity measurements- Pitot tube and Pitot –static tube.

Module – III

Flow through pipes: Reynolds experiment, Reynolds number, Laminar and Turbulent flow, Hagen- Poiseuille equation, concept of boundary layer, velocity distribution in boundary layer, boundary layer, displacement and momentum thickness , Laminar boundary layer over a flat plate, Blasius equation (without proof), local shear coefficient, drag coefficient, favourable and adverse pressure gradients, boundary layer separation Turbulent flow through pipes, head loss due to friction, friction factor, Darcy's and Chezy's coefficients, Losses at entry, exit, sudden expansion and sudden contractions, Compound pipes, branching of pipes, siphon effect, water hammer.

Reference:

1. J. F. Douglas, *Fluid Mechanics (IV th Edn.)*, Pearson education.
2. Robert W. Fox, *Introduction to fluid dynamics*, John Wiley and sons
3. K. Subrahmanya, *Theory and applications of fluid mechanics*, (TMH)
4. Shames. I. H, *Mechanics of fluids*
5. R.K.Bansal ,*Fluid Mechanics and Machines*
6. Jagadishlal, *Hydraulics & Fluid Machines*
7. Modi & Seth , *Fluid Mechanics & Machines, Standard Publications.*

Note: University question paper consists of two parts. Part A – 40 Marks (10 compulsory questions of 4 marks each to cover the entire syllabus). Part B – 60 marks (50% Choice, One out of Two or Two out of Four from each module)

03.304 Mechanics of Solids (MNPU) 3-1-0 4 Credits

Module I

Stress and strain, stress-strain relationships – Hook's law – deformation of axially loaded bars- Poisson's ratio – elastic constants-relationship between elastic constants-thermal strain and deformation – Saint-Venant's Principle and stress concentration- definition of plane stress, plane strain and axi-symmetric problems and their examples – principle stress and principal strains- Mohr's circle representation of principal stress and strains.

Shear force and bending moment – cantilever, simply supported and over hanging beams-concentrated and UD loads-analytical and geometric methods. Theory of simple bending-bending stress and shear stress distribution-rectangular, circular and I sections.

Module II

Slope and deflection of simply supported beams and cantilevers-simple proof of deflection of beams-double integration and area moment method only-torsion of circular shafts-solid and hollow shafts-power transmitted by shafts.

Thin cylinders and shells subjected to internal and external pressures – thick cylinders and spherical shells- Lame's equation – compound cylinders – rotary discs and cylinders, critical speeds – disc of uniform strength.

Module III

Direct and bending stress – short columns – instability of slender columns – Euler's theory – different end conditions – empirical formulae.

Strain energy – axial loads- gradually and suddenly applied impact loads- strain energy and complementary strain energy theorems- castigliano's theorems. Statically indeterminate systems – Elastic theory of bucking loads-virtual work principles – virtual force and deflections, virtual force equation- trusses and beams.

Text book

S.B.Junarkar, Mechanics of structures Vol I & II,

References

1. Egor P Popov, Engineering Mechanics of solids,PHI
2. Timoshenko, Strength of Materials

Note: University question paper consists of two parts

Part A – 40 Marks (10 compulsory questions of 4 marks each to cover the entire syllabus)

Part B – 60 marks (50% Choice, One out of Two or Two out of Four from each module)

03.305 Computer Programming & Applications (MN) 3-2-0 5 Credits

Module – I

Introduction to computer- Hardware- CPU, Memory, Input/Output and storage devices – Software – system software-operating systems-Application packages.

Data representation- Algorithms & Flowchart – Programming paradigms – Monolithic programming – Procedural programming – Structured programming – Object oriented programming – Concept of OOP – Benefits of OOPS – Application of OOPS- Object Oriented Languages.

Module – II

Introduction to C++ - Structure of C++ program – key words- identifiers – C++ declarations – Data type – Operators - declaration of variables-- dynamic initialization of variables- Operators in C++, Scope resolution operator - Predefined classes in C++ - Input and output statements – Streams in C++ - Formatted console input/Output Operations- manipulators - Control structures – Decision making statements – Loop statements- Functions in C++ - Inline functions – Function over loading .

Module –III

Introduction to Classes and Objects . User defined data types – specifying a class – Defining class member - Controlling access to class members- member functions – Static member functions – array of objects- Pointers and Arrays, Constructor and Destructors – Operator overloading and type conversion- Inheritance – Polymorphism and virtual functions –Templates, exception handling. File handling, File pointers and their manipulations, Command line arguments.

(**Note** : 2 periods per week for practical training in computer lab, Exercises in word processing, spread sheet, database and presentation software in addition to exercises in C++ have to be done in the lab. 50% credit of sessional marks (25 marks) to be given to lab work.)

Text Book

Ashok M. Kamthane , Object oriented Programming with ANSI & Turbo C++, Pearson Education

References

1. Nagler, Learning C++, A Hands on Approach, Jaico publications
2. Balaguruswamy, Object Oriented Programming with C++,TataMcgraw Hill
3. Nabajyothi barkakati ,Object Oriented Programming in C++ , Prentice Hall
4. Introduction to Computers , S.Jose

The question paper shall contain two parts. PART- A & PART – B

Part – A shall contain 10 compulsory short answer type questions of 4 marks each, covering the entire syllabus (10 x 4 = 40)

Part – B shall contain 2questions from each module. Each question carries 20 marks. Student has to answer three full questions selecting one each from module I , II and III. (3x 20 = 60).

03.306 Machine Drawing – I 0-0-4 4 Credits

A. Sheet Practice 2 periods (Sessional Marks – 25)

Conversion of pictorial views into Orthographic views – Dimensioning techniques – Different forms of screw thread and conventional representation of screw threads. Orthographic views of Hexagonal bolt with Hexagonal nut (Dimensioned drawing), Square headed bolt and Nut (Dimensioned drawing), sketching of different types of lock nuts. Sketching of Foundation bolts.

Riveted Joints – Lap and butt joints with single andmultiple rows and riveting in Chain and zig-zag arrangements (both Dimensioned drawing and sketching). Forms of rivet heads (sketching).

Fully dimensioned and sectional drawings of the following

Joints : Socket and spigot joint, Cotter Joint, Knuckle Joint

Shaft couplings : Flanged coupling, Protected type Flanged coupling, Bushed Pin flexible coupling

Pipe joints : Armstrong joint (Hydraulic joint)

Sketching only

Cotter Joint with sleeve, Jib and cotter joint. Pipe Joint such as Flanged Joint, Union Joint

B. CAD Lab Practice - Introduction to Computer Aided Drafting -2 periods (Sessional Marks – 25)

Creation of simple geometric bodies using basic primitives (line, arc, circle) and editing the drawing.

Dimensioning and text writing - concept of layers (creation and setting) line types and forms.

Creation of blocks, attributes for standard parts and inserting them in the drawing.

Preparation of 2-D drawings for machine components (bolts, nuts, Joints, Shaft coupling, connecting rod, cam profile)

Important : **University examination for sheet practice only**

Note : 1. First Angle Projection to be followed

2. The student should be made conversant with relevant BIS specifications

Reference

1. N.D. Bhatt, *Machine Drawing* , Charotar
2. P.I.Varghese, *Machine Drawing* ,VIP, Thrissur

03.307 Civil Engg. Drawing & Estimation (MN) 0-0-3 3 Credits

Module I

Drawing : Principles of building drawing, preparation of drawing of buildings such as office building, residential building (RCC and tiled roof, single storied and two storied), factory building with steel trusses for small scale industries. (33 hrs.)

Module II

Estimating: Principles of estimation, quantity estimation and cost estimation of building such as residential building and factory buildings. (15 hrs)

Exam. Duration: 3 hrs.

Scheme of examination:

Module I Drawing for 60 marks

Module II Estimation for 40 marks

Question paper pattern : Students shall answer one question out of two from each Module.

Reference:

1. Balagopal.R.S.Prabhu ,Vincent Paul - "Building drawing and detailing"
2. Dutta B.N. - "Estimating and Costing in Civil Engineering"
3. Chakrabarti M. – "Estimating and Costing in Civil Engineering"

03.308 Civil Engineering Lab (MN) 0-0-2 2 Credits

Experiments

1. Test on Mild Steel, High carbon steel and Cast Iron specimens
2. Shear test on MS Rod
3. Torsion test on MS Rod
4. Torsion test using Torsion Pendulum on MS, Aluminium and Brass wire
5. Izod and Charpy Impact tests
6. Hardness test (Brinell Hardness & Rockwell Hardness)
7. Spring test (Open and closed coiled)

8. Bending test on Wood
9. Determination of Moment of Inertia of Rotating Bodies
10. Chain Surveying and Levelling (4hrs only.)

Scheme of Examination:-

Exam. Duration: 3 hrs.

No examination for chain surveying and levelling, but viva shall be asked.

03. 401 Engineering Mathematics – III 3-1-0 4 credits

(Common to all branches)

MODULE 1: Partial Differential Equations

Formation of P.D.E-Solution by direct integration-solution of Lagrange's linear equations-Nonlinear equations of first order-Types f(p,q)=0,f(z,p,q)=0,f(x,p)=g(y,q)-

Homogeneous P.D.E with constant coefficients-solution by the method of separation of variables.

MODULE 2: Application of partial differential Equations

Derivation of one dimensional wave equation-solution of the wave equation by the method of separation of variables –Boundary value problems involving wave equation-Derivation of one dimensional heat equation-solution by the method of separation of variables-Problems with zero and nonzero boundary conditions-Solution of Laplace equation in two dimensions (cartesian only)-Problems on finite and infinite strips.

MODULE 3: Fourier Transforms and Optimization Techniques

Fourier Transforms: Fourier integral Theorem(no proof)-Fourier sine and cosine integrals-Fourier Transforms-complex form-Sine and cosine Transforms-Inversion Formula-simple problems.

Optimization techniques: Linear Programming Problems-Formulation-Graphical solution-General L.P.P-Slack and Surplus variables-Basic feasible solution-Solution of L.P.P. using Simplex method-Big-M-method-Duality-Dual Simplex method.

References:

1. EngineeringMathematics,Vol.3:V.Sunderam, .Balasubramanian, K. A. Lakshminara-yanan, Vikas Publishing House (P) Ltd.
2. Higher Engineering Mathematics: B.S.Grewal, Khanna Publishers.
3. Advanced Engineering Mathematics: Michael D Greenberg, Pearson Education.
4. Engineering Mathematics,Vol2: S.S.Sastry, Prentice Hall Of India(P)Ltd.
5. Engineering Mathematics: Sarveswara Rao Koneru,Universiries Press. Quantative Techniques: P. C. Tulsian and Vishal Pandey, Pearson Education.

Note:

The question paper consists of two parts. Part A (40 marks). Ten compulsory questions of 4 marks each. Part B (60 marks). Students must answer one out of two questions from each module. Each question carries 20 marks

03. 402 Thermodynamics (MU) 3-1-0 4 credits

Module I

Review of the basic concepts and Laws of Thermodynamics, Classical and Statistical approaches. Scope and Limitations of Thermodynamics.

Properties of Pure Substance: Pure Substance, phases of a Pure Substance, Phase Change processes of Pure Substances, Property diagrams for phase change processes, The P.V.T. Surface, The ideal Gas Equation and Other Equations of State, Compressibility Factor, law of Corresponding states.

First Law Applied to flow Processes:- Control Mass and control volume Analyses, Analysis of steady and Transient flow processes with some Examples.

Module II

Second Law of Thermodynamics :- Physical description of the second Law, Review of Kelvin – planck and Clausius statements. Equivalence of the above Statements – Reversible Processes and Cycles. The Carnot cycle – corollaries of the Second Law

Absolute thermodynamic temperature Scale , ideal gas thermometer, International Temperature Scale (ITS). Entropy – The Entropy and Directional Law of Nature. The Inequality of Clausius, The Causes of Entropy Change, Entropy changes in various thermodynamic processes, The principles of increase of entropy, The Third Law of Thermodynamics, Nernst, Planck's and Simon's versions.

Chemical Reactions in combustion Systems – Combustion processes. Application of 2^{nd} laws to combustion processes – Adiabatic and general combustion problems.

Available and Unavailable energy, Availability function, Second law analysis in closed systems, Availability and irreversibility in steady and unsteady flow systems. Practical consideration with Availability.

Module III

General Thermodynamic Relations – Combined First and Second law equations – Helmholtz and Gibb's functions - Maxwell's Relations – The Clapeyron Equation , Equations for specific heat, Internal energy, Enthalpy and entropy, The h, u and s of Real Gases Joule Thomson Coefficient – Simple Applications to Thermodynamic Properties.

Properties of Gas Mixtures : The composition of a gas mixture – Mass and Mole Fraction. The Gibbs – Daltons Law, Properties of gas mixtures – Internal energy, enthalpy, Specific Heats and Entropy of Gas Mixtures. Mixtures of an ideal Gas and a Vapor. Introduction to Real Gas Mixtures.

References:

1. J.P.Holman, Thermodynamics, McGraw – Hill Book Company.
2. P.K.Nag, Engineering Thermodynamics,
3. E.Rathakrishnan, Fundamentals of Engineering Thermodynamics
4. Gordon J.Van Wylen, Richard E Sonnttag, Fundamentals of Classical Thermodynamics
5. H.W.Zemansky, Heat and Thermodynamics,
6. M.Achuthan, Engineering Thermodynamics
7. Michael A Spaldling, Thermodynamics
8. Y.V.C.Rao, An Introduction to Thermodynamics
9. Gordon Rogers & Y.O.N Maghew, Engineering Thermodynamics: Work & Heat Transfer , Pearson Eduction.

Note:

Question paper consists of two parts. Part A – 10 Compulsory short answer type of questions of 4 Marks each covering the entire syllabus (10 x 4 = 40). Part B – 60 Marks (50 % choice, one out of two or two out of four questions from each module)

03. 403 Hydraulic Machines 3-1-0 4 credits

Module I

Impact of jets : Stationary and moving vanes – Flat and curved vanes – Series of vanes - work done and efficiency.

Theory of Roto-dynamic machines : One dimensional theory – Vanes congruent flow – Euler's equation – Departure from Euler's theory and losses – performance of roto-dynamic machines.

Dimensional analysis : Rayleigh method, Buckingham PI theorem – Dimension less numbers – Similarity Laws – Shape numbers – Impeller shapes based on shape numbers – Scale Laws – Unit speed – Unit discharge and unit power Theory of vertex flow.

Module II

Hydraulic Turbines : Impulse and Reaction Turbines – Degree of reaction – Pelton Wheel – Constructional features - Velocity triangles – Euler's equation – Speed ratio Vs Wheel efficiency – Losses and efficiency – Characteristics – Francis Turbine – Constructional features – Velocity triangles – Inward and outward flow types – losses and efficiency characteristic curves – Axial flow turbine (Kaplan) _ Constructional features – Velocity triangles – Euler's equation – Characteristic curves – Theory of draft tubes – Cavitation in reaction turbines – Governing of turbines – Specific speed of turbine , Type Number

Module III

Centrifugal Pumps: Constructional details – Impeller Types – Velocity triangle – Head equation – Effect of change of meridional velocity and speed of impeller – H-Q characteristics – Hydraulic design of Centrifugal pumps - Cavitation in Centrifugal pumps – installation – (NPSH) required and (NPSH) available – Specific speed of pumps, Type number – Pumping System Characteristics – Operating point – Pump in series and parallel operations – Characteristic curves, Priming of Centrifugal pumps Positive displacement pumps : Reciprocating pumps : Single action and double acting multi- cylinder – indicator diagram – acceleration head – effect of friction – Speed calculation – Air vessels – Saving in work done to air vessels – Miscellaneous devices, Accumulator, Intensifier, Hydraulic ram, Jet pumps, rotory vane pump, gear pump, air lift pump.

References

1. J F Douglus, Fluid Mechanics Pearson Education – 2003 Edition
2. Jagadish Lal, Hydraulic Mechanics
3. Bansal, Hydraulic Machines
4. Purohit, Fluid Mechanics
5. R.K.Rajput, Hydraulic Machines

6. D S Kunour, Hydraulics & Hydraulic Machines
7. Modi & Seth, Fluid Mechanics & Machines , Standard Publishers.

03. 404 Theory of Machines (MU)3-1-0 4 credits

Module I

Introduction

Terminology, definitions and assumptions. Mobility, Grashof's law, kinematic inversion, concepts of mechanical advantage, transmission angle, coupler curve etc.

Straight line mechanisms, Watts Mechanism, Harts Mechanism, Chebiser mechanism, Peaucellier mechanism. steering mechanism, Hooke's joint, Quick return mechanisms, intermittent motion mechanisms-Geneva mechanism, pawl and ratchet.

Synthesis

Introduction to Kinematic synthesis. Type, Dimensional and number synthesis. Function generation, Chebyshev spacing. Graphical synthesis for path generation-three prescribed positions without prescribed timing, Freudenstein's equation (Analytical method).

Module II

Analysis

Introduction to analysis. Velocity analysis-Instantaneous centre of velocity. Aronhold-Kennedy's theorem. Locating instantaneous centers (up to a 6 link mechanism). Velocity analysis using instant centre method, Centrodes. Velocity Analysis by relative velocity method. Graphical acceleration analysis including Coriolis component of acceleration Klien's Construction, Analytical Method. Introduction to Velocity and acceleration analysis of floating links using method of auxiliary points.

Governors

Introduction, different types of governors like Porter, Proell and Hartnell, sensitivity, stability, hunting, isochronism etc.

Brakes and Dynamometers

Types of brakes: Analysis of block, band and internal expanding shoe brakes, self energizing and self locking brakes, Disk brakes.

Dynamometers- Description of Absorption and Transmission type dynamometers.

Module III

Gears

Gears. Types- Spur, Helical, Herringbone, Bevel, Spiral, Hypoid and Worm gears. Terminology, theory-law of gearing, different types of gear tooth profiles. Involute gears, standard types, interference and under cutting, calculation of minimum number of teeth, number of teeth in contact, ratio of contact, length of path of contact, arc of contact, effect of friction in gears.

Gear trains-compound, reverted and epicyclic. The differential torque in epicyclic gear trains.

Cams

Introduction, classification of cams and followers, displacement diagrams, graphical layout of cam profiles, derivations of follower motion, standard cam motions, matching derivatives of displacement diagrams, plate cam with reciprocating or pivoted flat-face follower or roller follower. Description of Tangent cam and circular arc cams.

References

1. Shigley and Uicker, Theory of Machines and Mechanisms,McGraw Hill
2. Rao and Dukkipatti, Mechanism and Machine theory,Wiley Eastern
3. V. Ramamoorthi, Mechanics of Machinery, Narosa
4. Kinematics of Machines, Myzka, Pearson Education
5. Charles E Wilson and J Peter Sadler , Kinematics and Dynamics of Machinery 3rd ed, Pearson Education
6. S S Rattan, Theory of Machines, TMH

Note: Question Paper consists of two parts.

Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40)

Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)

03. 405 Electrical Technology (MU) 3-1-0 4 credits

Module I

DC Machines – principles of operation-EMF equations-types of excitations-separately excited, shunt and series excited DC generators- general idea of armature reaction – OCC and load characteristics - simple numerical problems. Principles of DC motors – torque and speed equations – torque – speed characteristic – variations of speed, torque and power with motor current – applications of shunt motor for traction and hoists. Principles of starting losses and efficiency – testing –load test – simple numerical problems.

Module II

Transformers – principles of operation – EMF equation – vector diagrams – reduction losses and efficiency – OC and Sc tests – equivalent circuit – auto transformers – current voltage transformers – constant voltage transformers – simple numerical problems – Synchronous machines – types – EMF equations – principles of operation of synchronous motor – V curve – methods of starting.

Electric traction – systems of power supply – functional schematic of a.c. electric locomotives – types of motors used in traction systems and methods of speed control – methods of braking.

Module III

Phase induction motors – slip ring and squirrel cage – rotating magnetic field – torque slip characteristics, simple circle diagrams, no load and blocked rotor tests, methods of starting, principles of operation and applications of single phase stepper motor, universal motor.

Electric heating – resistance furnaces and ovens- methods of temperature control. Electric arc furnaces and induction furnace. High frequency heating – induction and dielectric heating – applications.

Text books:

1. B.L.Theraja and A.K. Theraja, A Text book of Electrical Technology,
2. Pratab, Art and Utilisation of Electric Energy

References

1. Mehta V.K.,Principles of Electrical Engineering and Electronics
2. Gupta, J.B.,A course in Electric Power

03. 406 Machine Drawing II 0-0-3 3 credits

Introduction – information to be furnished in drawings – fits and tolerances. Size tolerances, form tolerances and position tolerance – Indication of fits and tolerance in drawings, Geometrical tolerance.

Assembly and working drawing (Part drawing) of the following

1. Shaft bearing and supports – journal bearings, Plummer block, foot step bearing
2. Steam Engine parts such as piston, stuffing box, cross head, eccentric
3. I.C. Engine parts – Piston, Connecting Rod
4. Valves – Stop valve, Safety valves for boilers- Ramsbottom safety valve-dead weight safety valve, feed check valve.
5. Machine parts – Lathe tail stock, screw jack, Four jaw chuck

Note : First angle projection to be followed

Reference:

1, Machine Drawing, N.D.Bhatt
2, Machine Drawing, Venugopal
3. Machine Drawing, P.I. Varghese
4. Machine Drawing, Parkinson

03. 407 Fluid Mechanics & Machines Lab(MN) 0-0-3 3 credits

Study of pipe fittings (GI and PVC), plumbing tools and materials, pressure gauge, vacuum gauge, manometers, flow measuring equipments-water meters-venturi meter-orifice meter-current meter.

Study of pumps-centrifugal-reciprocating-rotary-jet. Study of Turbines-impact and reaction types. Study of Hydraulic ram, accumulator etc.

Experiments

1. Determination of Coefficient of discharge of Notches, Orifice, Nozzle, Venturi meter.
2. Calibration of Notches, Orifice, Nozzle, Venturi meter.
3. Experiment on pipe friction apparatus
4. Determination of Hydraulic coefficients of circular orifice

5. Determination of Metacentric Height and radius of gyration of floating bodies.
6. Experiment on Bernoulli's apparatus
7. Experiment on Reynolds apparatus
8. Performance evaluation test on pumps
9. Performance evaluation test on turbines
10. Speed ratio test on impulse turbine
11. Determination of best guide vane opening for Francis turbine
12. Determination of best blade angle for Kaplan turbine
13. Performance test on variable speed pump and plotting iso-efficiency curves
14. Test on Hydraulic Ram

03. 408 IC Engines Lab 0-0-3 3 credits

1. Study of I.C engines :-
    a) Diesel engines - all systems and parts
    b) Petrol engines - all systems and parts
2. Study of pollution testing equipment and flue gas analyser
3. Repairing of I C engines – tools and accessories used for it
4. Determination of flash and fire points of petroleum products
5. Determination of viscosity of lubricating oil using Redwood Viscometer
6. Determination of calorific value of solid, liquid and gaseous fuels using Bonb calorimeter and Gas Calorimeter
7. Experiment on I C Engines
    a) Load test to obtain performance curves based on B.P and B.M.E.P
    b) Heat Balance test
    i) Heat exchanger method
    ii) Flue gas analysis method
    iii) Volumetric efficiency method
    c) Valve timing diagram
    d) Economic speed test
    e) Best cooling water Temperature test
    f) Retardation test
    g) Volumetric efficiency and Air-fuel ratio test

8. Morse test on petrol engine.

03.501 Engineering Mathematics – IV 3-1-0 4 Credits

(Common to all branches)

MODULE 1: Complex Analysis-Differentiation

Differentiation of functions of complex variable-Analytic functions-Cauchy-Riemann Equations(cartesian only)-Harmonic function-Orthogonal system-velocity potential

Conformal mapping-Mapping by $w=1/z, w=z^2, w=e^z, w=z+1/z, w=\sin z, w=\cos z$.

Bilenear Transformation-fixed points-Problems to find the transformation when three points and their images are given.

MODULE 2: Complex Analysis-Integration

Line integrals-simple problems-Statements of Cauchy's integral theorem,Cauchy's integral formula-Formula for higher derivatives-Evaluation of integrals using the above results.

Taylor series and Laurent's series(no proof)-simple problems.

Singularities-Residues-Cauchy's Residue theorem(no proof)-problems.

Evaluation of real definite integrals of the following types:

$\int_0^{2\pi} f(\sin\theta,\cos\theta)d\theta$, $\int_0^{\infty} [f(x)/F(x)]dx$, $\int_0^{\infty} [\sin mx/f(x)]dx$, $\int_0^{\infty} [\cos mx/f(x)]dx$

MODULE 3: Probability and statistics

Random variable-continuous and discrete distribution-mean and variance-

Binomial distribution-mean and variance-fitting a Binomial distribution-Problems.

Poisson distribution-Poisson distribution as a limiting case of the Binomial distribution-mean and variance-Problems.
Normal distribution-Properties-Problems
Curve fitting-Fitting of a straight line and a second degree parabola,by the method of least squares.
Testing of Hypothesis-Types of errors-Null hypothesis-level of significance-Confidence limits-Large sample tests-testing of proportion of attributes-confidence limits for unknown mean-test of significance for means of two large samples-Use of Student's t distribution for small sample tests-Significance test of a sample mean-Significance test of difference between sample means.

References:

1.Higher Engineering Mathematics:B.S.Grewal,Khanna Publishers
2.Engineering Mathematics,Vol.2:S.S.Sastry,Prentice Hall of India(P)Ltd.
3.Complex Variables Theory And Applications:H.S.Kasana,Prentice Hall of India(P)Ltd
4.Advanced Engineering Mathematics:Michael D Greenberg,Pearson Education
5.Probability and Statistics for engineers ;Miller & Freund ,Pearson Education

Note:

The question paper consists of two parts. Part A (40 marks). Ten compulsory questions of 4 marks each. Part B (60 marks).Students must answer one out of two questions from each module.Each question carries 20 marks.

03.502 Thermal Engineering 3-1-0 4 Credits

Module I

Steam Engineering – Entropy of steam – Temperature entropy diagram – Mollier chart – Rankine cycle. Modified Rankine cycle – Binary Vapour cycle. High pressure boilers – La-Mount boiler , Denson Boiler , De-Lavel boiler , Schmidt Harman boiler, Steam condensors .
Steam nozzles – Flow through steam nozzles –Effect of friction – super Saturated flow
Steam turbines – Impulse and reaction turbines- Velocity diagram – condition for maximum efficiency – Multi – Stage turbines- Condition lines. Cycles with reheating and regenerating heating – reheat factor- Degree of reaction –Governing of turbines – End trust balancing – leakage prevention.

Module II

Fuels and combustion – stochiometry, calculation of A/F ratio and equivalence ratios – volumetric and Gravimetric analysis Fuel properties
IC Engines : Normal combustion and flame front propagation in SI Engines – auto ignition – Pre- ignition and detonation – factors affecting detonation - combustion chambers for SI engines. Knocking in CI engines-combustion chamber for CI engines. Engine tests – Heat balance , measurement of BP, IP, FC, FP, A/F ratio and calculation of efficiency.

Module III

Compressors Reciprocating compressors- work done and efficiency – Volumetric efficiency – effect of clearance –Rotary compressors- roots blowers- vane type compressor –centrifugal and axial flow compressor- work done , efficiency and performance characteristics
Gas turbines- open, closed and semi closed - ideal gas turbine cycle. Simple cycle- simple cycle with regeneration, inter cooling reheating - cycle efficiency and work output. Performance of practical gas turbine cycle .Compressor and turbine efficiency , mechanical losses- variation of specific heats-combustion efficiency- type of turbine combustion chambers.

References

1. Ballaney.P.L, Thermal Engineering
2. Keralin, Steam turbines
3. J.B.Heywood, I.C.Engines Fundamentals
4. Cohen, Rogers and Saravanamittoo, Gas Turbine Theory
5. Ob, I.C. Engines
6. Gill and Smith, I.C. Engines
7. Rajput, Thermal Engineering
8. T.D.Eastop and A McConkay, Applied Thermo Dynamics for Engineering Technology Pearson Education.

03.503 Dynamics of Machinery (MU) 3-1-0 4 Credits

Module I

Force analysis:

Static force analysis-introduction, Free body diagrams-Conditions for equilibrium. two and three force members, four force members, Analysis of mechanisms without considering friction, Analysis with sliding and pin joint friction. Method of virtual work.

Dynamic force analysis, introduction, inertia and D'Alemberts principle, analysis of mechanisms, principle of superposition, kinetically equivalent systems, shaking forces and moments.

Module II

Gyroscopes

Principle, analysis of gyroscopic action on vehicles-two wheelers, four wheelers, air planes and ships, Principle of gyroscopic stabilization of ships, and inertial guidance

Flywheel Analysis

Fly wheel- Turning moment diagrams, fly wheel in different applications like IC engine, Punching press etc.

Balancing

Static and Dynamic unbalance. Balancing of masses distributed on the shaft, balancing a single cylinder engine, balancing multi-cylinder engines including V-Engines. Balancing machines.

Module III

Vibration Analysis

Undamped free vibrations, different methods of analysis, free vibrations with viscous damping, logarithmic decrement, forced vibrations, isolation and transmissibility,vibrometers and accelerometers and their characteristics. Critical speed of a shaft, Transverse vibration, Dunkerley's method.

Torsional vibrations, Two rotor, three rotor and geared systems, Studola and Holzer's methods.

References

1. Holowenko, Dynamics of Machinery,John Wiley
2. Shigley and Uicker, Theory of Machines and Mechanisms, Mcgrawhill
3. Charles E Wilson and J Peter Sadler , Kinematics and Dynamics of Machinery 3rd ed, Pearson Education
4. Ballaney, Theory of Machines
5. V. Ramamoorthi, Mechanics of Machinery, Narosa
6. S S Rattan, Theory of Machines,TMH

Note: Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)

03.504 METALLURGY AND MATERIAL SCIENCE (MNPU) 3-1-0 4 Credits

Module I

Classification of engineering materials – selection of materials with reference to properties, service and economic considerations. Thermal properties, Physical and Mechanical properties Electrical and magnetic properties, dielectric properties of materials, super conductivity. Super plasticity . Bonds in solids, Importance of metallic bonds Crystal structure, Space lattice, unit cell-types, coordination number Atomic packing factor polymorphism and allotropy, Miller indices, Imperfections in crystals, Structure & material property relationships, Deformation of metals, Elastic and Plastic deformation, Slip, Critical shear stress, Dislocation. Frank-Read source, Strain hardening.

Module II

Diffusion, Mechanism of diffusion in crystals, Fick's Laws. Theory of alloys, Phases, Gibb's phase rule, Solid solutions, Hume Rothery's rule. Equilibrium diagrams – Construction and uses; Equilibrium diagram of binary alloys: Eutectic, Eutectoid, peritectic and peritectoid reactions. Iron-Carbon Equilibrium diagram, Isothermal TTT diagrams, Critical cooling rate. Heat treatment processes, Hardenability , Jomini end quench test, Case Hardening, Surface heat treatment , Precipitation hardening, Recovery, Re-crystallisation and Grain Growth. Strengthening mechanisms in metals.

Module III

Testing of materials- Tensile test Compression test, Impact test Fracture of metals, Brittle fracture, Griffith's crack theory Ductile fracture, Factors leading to crack formation, Ductile Brittle transition in steels fatigue-Mechanism-Creep, mechanism of creep-creep residence .Properties. composition and uses of important non-ferrous metals and its alloys, Effect of various alloying elements. Brass, Bronze, Aluminium and its alloys- Ni-Cr high temperature alloys bearing materials, Fusible alloys, properties, composition and use of various types of cast Iron and Steels – Effect of various alloying elements. Composites, Metal matrix composites Smart Materials.

References:

1. Elements of Materials Science –L.W.Van Wlack – Addison Wesley Publication.
2. Material Science Vol-I, II, III, Iv Wulff – Series.
3. Introduction of Engineering materials – By B.K.Agrawal – Tata McGraw Hill
4. Engineering Material Science – C.W.Richards.
5. Material Science and Engineering – R.K Rajput, S.K.Kataria & Sons
6. Engg. Physical Metallurgy – Prof Y.Lakhtin
7. Mechanical Metallurgy - Dieter
8. Manufacturing Engg and Technology Serope Kalpakjain, Pearson Education
9. Advanced Material Science – R.K.Dogra & A K Sharma
10. Introduction to Material Science – William.D.Callister , John Wiley

Note: Question paper consists of two parts. Part A- 40 Marks (10 compulsory short answer type questions of 40 marks each covering the entire syllabus)

Part B- 60 Mark(50% choice, one out of two from each module)

03.505 Manufacturing Process (MN) 3-1-0 4 Credits

Module I

Foundry – basic requirements of casting processes. Patterns – types, Materials, Allowances. Moulding Sand – Properties, testing, Sand Muller, Sand Slinger, Types of mould – Green Sand Mould, Dry Sand Mould, Sodium Silicate – Carbon Dioxide Moulding, Shell Moulding, Ceramic Mould Casting , Plaster mould casing. Moulding Machines – Plain Squeezing Machine, Jolt Squeezing machines – Cores – Core Sand, Core Types, Core Prints , Core Baking, Principles of gating and Risering – Riser location and Direction Solidification, Blind riser, Chills and Chaplets. Internal external chills, Pressurised and Unpressurised Gating systems – Sodification of Castings – Cleaning and Inspection of castings, casting Defects.

Module II

Welding- classification, Weldability, Metallurgy of welding, structure of weld, HAZ, solid phase welding-forge, butt, flash butt, friction welding, oxyacetylene pressure welding. Arc welding-Arc welding with coated electrodes, TIG, Consumable Metal inert gas welding, submerged arc welding. Resistance welding-electroslag welding, spot welding, projection, seam welding. Thermit welding, ultrasonic welding, electron beam welding-explosive welding. Weld defects and inspection.

Principles of liquid phase and solid phase welding-calculation of arc length and power-simple problems.

Module III

Forming-plastic deformation and yield criteria-relation between tensile and shear yield stress-Rolling-cold hot rolling-Types of rolling mills-Rolling of channels, I and rail sections. Rolling of tubes, wheels and axles. Defects in rolled products. Forging-analysis of forging of strip-problems open and closed die forging, press forging, roll forging, surging, forging hammers, presses. Defects in forging. Extrusion-hot and cold extrusion-wire drawing-Rotary piercing-rotary swaging, cold forming-thread rolling, metal spinning.

References

1. Amitabh Ghosh and Amitkumar Mallik, Manufacturing Science, Affiliated East West press(p) Ltd, NewDelhi, 2002
2. H.F.Taylor, M.C.Flemmings, John Wulff: Foundry Engineering, Wiley Eastern Pvt. Ltd.
3. Campbell: Principles of Manufacturing materials and processes – TMH
4. Paul dE Grarmo , J.T.Black, RA.K Kosher: Materials and process in Manufacturing , PHI

Note: Question paper shall consist of 2 parts

Part A – Compulsory short answer questions of 4 marks each covering the entire syllabus (10x4=40 marks)

Part B – 60 Marks (50 % choice, one out of two or from each module)

03.506 Industrial Electronics 2-1-0 3 Credits

Module I

Thyrister converters-single phase – half wave, full wave single phase bridge converters, Resistance welding – digital welding control, Electronic control, Ignitron contact, Non sysnchronous timer, synchronous timer sequence timer. Photo electric devices – photo electric theory, photo emissive cell, photo multiplier, photo diode APD. Photo EFT, Light activated SCR, Photo voltaic cell, photo resistive devices.

Flip flops, Register, shift register, semiconductor memory, Buffer, encoders and decoders, digital multiplexors and demultiplexors, counters.

Module II (Qualitative Analysis)

Microprocessor Architecture – Intel 8085, Instruction cycle, instruction set for Intel 8085 processor (over view only).

Peripheral devices and their Interfacing- Memory and I/O interfacing, data transfer scheme , interrupts of 8085, I/O devices-8255, 8257, 8259, 8251, 8253, A/D and D/A converters- interfacing ADC 0800, DAC 0800, DAC 0808(no programs).

Data acquisition- measurement of temperature and control, strain measurement, deflection measurement and display.

Module III (Qualitative analysis)

16 bit Microprocessors – Intel 8086 – overview of operating modes, Addressing modes and configuration of 8086 system.

Micro controllers – Intel 8051-Architecture, Basic Assembly language programming concepts, Instruction set for 8051(over view only), Applications. Introduction to 16 bit Micro controllers.

Text Books

Module I : 1. Harish C Raj, Industrial and Power Electronics, Umesh Publications, Delhi (IV Edition).
2. B.Ram- Fundamentals of Microprocessor and micro Computers (IV Ed), Dhanpat Rai & Sons (Chapter 2).

Module II : 3. B.Ram-Fundamentals of Microprocessor and micro Computers (IV Ed), Dhanpat Rai & Sons (Chapter 3,4,7,8,and 9)

Module III 4. B.Ram-Fundamentals of Microprocessor and micro Computers (IV Ed), Dhanpat Rai & Sons (Chapter 11)
5. Kenneth J Ayala – The 8051 Microcontroller – Architecture, Programming & Applications – 2nd Edn., Penram International

References

1. Power Electronics, 2nd Edn., Muhammad H Rashid, PHI
2. Microprocessor, Architecture, Programming & Applications with the 8085, 3rd Edn., Ramesh S.Gaonkar, Penram International.
3. 8051 Microcontroller, Predko, TMH

Question Paper

The question paper shall consist of two parts. Part 1 is to the entire syllabus, and carries 40 marks. This shall contains 10 compulsory questions of 4 marks each. Part II is to cover 3 modules, and carries 60 marks. There shall be 3 questions from each module (10 marks each) out of which 2 are to be answered.

03.507 Machine shop I(MNU) 0-0-3 3 Credits

General study of Lathe and Accessories, Tools used for different operations. Exercises involving plane turning, Groove cutting, form turning, taper turing, facing and thread cutting.

Study of shaping and slotting machines, and planning machines, exercises involving production of flat surfaces, grooves and key ways.

03.508 Electrical Lab* 0-0-3 3 Credits

Study of DC Motor, DC Generator, Transformer (single phase), Polyphase induction motor, Synchronous machines.

Experiments

1. OCC of DC self Excited shunt Generator
2. Load Characteristic of shunt generator
3. Load test on Series motor
4. Load Characteristics of compound Generator
5. Load characteristics of single phase transformer
6. Load characteristics of slip ring induction motor
7. Starting and Load test of squirrel cage 3 -phase induction motor
8. Synchronising of alternator by Dark Lamp Method
9. Load test on Alternator by Direct Loading

10. Starting and Load test of single phase induction motor – determination of characteristics.

Electrical Workshop

03.601 Heat and Mass Transfer 3-1-0 4 Credits

Module – I

Conduction:- Fourier law- thermal conductivity of solids, liquids and gases- Factors affecting thermal conductivity – most general equation for conduction in Cartesian, cylindrical and spherical co-ordinates – One Dimensional steady state conduction with and without heat generation- conduction through homogeneous and composite surfaces- Plane walls, cylinders and spheres- Variable thermal conductivity – conduction shape factors- heat flow through corners and edges.

Relaxation method for 2-D heat conduction- Newtonian heating and cooling.

Module – II

Convection:- Principles of dimensional analysis- Buckinghan's pi theorem- Application to free and forced convection – elementary ideas of hydrodynamics and thermal boundary layers- empirical relations- problems using empirical relations.

Combined effect of conduction and convection heat transfer between two fluids separated by plane and cylindrical walls- overall heat transfer coefficient – critical radius of insulation.

Fins- heat transfer from a rod heated at one end- application to straight rectangular fin – fin effectiveness.

Heat Exchangers – types- LMTD- effectiveness- NYU method.

Heat pipe- principle- Construction details- application.- Low density heat transfer- Condensation and Boiling heat transfer (elementary ideas only)

Module – III

Radiation:- Nature of thermal radiation- definitions and concepts- monochromatic and total emissive power- absorptivity, reflectivity and transmissivity- black, gray and real surfaces- concept of a black body- Plank's law- Kirchoff's law- Weins displacement law- Stefan- Boltzman's law- Configuration factor(derivations for simple geometric only) –change between black surfaces in finite parallel black plates, equal parallel and opposite black surfaces, discs- black rectangles perpendicular to each other having a common edge- heat exchange between infinite parallel planes of different emissivity- radiation shield (no derivation) – simple problems with the use of charts and equations.

Mass transfer:- diffusion mass transfer- Fick's law- Steady state diffusion of gases and liquids through solids- equimolar diffusion – Isothermal evaporation of water in to air- mass transfer coefficient- simple problems- convective mass transfer- mass transfer through boundary layer- analogy between heat and mass transfer – dimensional analysis of convective mass transfer – simple problems.

Data Book

Heat and Mass Transfer Data Book ---- Kothandaraman.

References:

1.Fundamentals of engineering Heat and Mass Transfer- R. C. Sachdeva.
2. Heat Transfer - Holman
3. Essentials of heat Transfer Long.
4. Engineering Heat and Mass Transfer - Sarit K. Das
5. A course in Heat and Mass Transfer - Domkundavar.
6. Heat and Mass Transfer --- D. S. Kumar
7. Heat and Mass Transfer --- Y. V. C. Rao.
8. Heat Transfer- --- Dutta.
9.Fundamentals of Heat & Mass Transfer Incropera & Dewitt

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).
4. Use of Heat and Mass Transfer data book is permitted in University Examination

03.602 Design of Machine Elements – I 3-1-0 4 Credits

Module I

Introduction to design - steps in design process - design factors - tolerances and fits - principles of standardisation – Materials and their properties- Elastic and plastic behaviour of metals- ductile and brittle behaiour-true stress and true strain- stress strain curves- Selection of materials – stresses in machine parts-tension,compression, shear, bending, and torsional stresses, combined stress- stress concentration – stress intensity factor- Fracture toughness-factor of safety-margin of safety-variable stress-endurance limit-fatigue factor-theories of failure –combined steady and variable stress-Gerber, Goodman, Soderberg method- impact load - fatigue loading - consideration of creep and thermal stresses in design

Module II

Detachable joints-Pins, keys, splines, cotters, set screws, Threaded fasteners - thread standards - stresses in screw threads, Power screw- analysis of power screws.

Bolted joints - preloading of bolts- shaft couplings, - stresses in couplings - design of couplings.

Riveted joints – types of rivets- stresses in riveted joints - strength analysis - boiler joints - structural joints-eccentric loading.

Welded joints - types of welded joints - stresses in butt and fillet welds - torsion and bending in welded joints - welds subjected to fluctuating loads - design of welded machine parts and structural joints

Module III

Friction and power loss in pivots and collars, clutches-dog clutch-selection of single plate ,multiple plate and cone clutches, centrifugal clutch.

Springs: classification and use of springs- spring materials- stresses in helical springs - deflection of helical springs - extension, compression and torsion springs - design of helical springs for static and fatigue loading - critical frequency of helical springs - design of leaf springs.

Power shafting - stresses in shafts - design for static loads - reversed bending and steady torsion - design for strength and deflection - design for fatigue loading

Design Data hand books

Prof. Narayana Iyengar B. R. & Dr Lingaiah K., *Machine Design Data Handbook*, Vol. I &II

P.S.G., Tech., *Machine Design Data Handbook*

Design data Book -K. Mahadevan – C.B.S Pub.

Text book

Shigley J.E., *Mechanical Engineering Design*, McGraw Hill Book Company

Reference books

1. Siegel, Maleev & Hartman, *Mechanical Design of Machines*, International Book Company
2. Phelan R.M., *Fundamentals of Mechanical Design*, Tata McGraw Hill Publishing Co. Ltd.
3. Doughtie V.L., & Vallance A.V., *Design of Machine Elements*, McGraw Hill Book Company
4. Juvinall R.C. & Marshek K.M., *Fundamentals of Machine Component Design*, John Wiley
5. Machine Design Robert L Norton , Prentice Hall India
6. Design of machine elements M.F.Spotts, Prentice Hall India
7. Machine Design – Wentzell, Thomson Learning

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).
4. Use of Design Data hand books allowed for reference during examinations

03.603 Computer Aided Design (MN) 2-1-0 3 Credits

Module –I

Computer Aided Design – Definition , necessity for CAD Design process – Application of computers in Design-Geometric modeling, Engineering analysis, design review and evaluation, Automated drafting. Benefits of CAD. Hardware in CAD- components, Design workstation, computer graphics terminal, types of display devices, CRT tubes, directed beam refresh, DVST and raster scan displays, LCD and plasma discharge displays. User interaction devices.

Module II

Computer graphics. Computer graphics software, functions of CG packages. Methods of defining points, lines- arcs - Bresenhams algorithm. 2D Transformations– translation, scaling, rotation, mirroring, concatenation of transformations. 3D transformations. Windowing and Clipping- Cohen Sutherland line clipping algorithm. 3D modeling, types of models- wire frame - surface and solid models

Module III

Introduction to finite element analysis-steps involved in FEM- Preprocessing phase-discretisation-types of elements-selection of interpolation functions- Formulation of stiffness matrix - formulation of load vector- Transformation of coordinates- assembly of global equations-solution procedure, post processing phase. Simple problems with Axial element - beam element, CST element. Isoparametric formulation. Solution of 1D and 2D structural and solid mechanics problems - linear static analysis. Dynamic analysis.

Reference:

1. Daryl Logan, A First course in Finite Element Method, Thomson Learning
2. Mikell P Groover, CAD/CAM, Prentice Hall
3. Roger and Adams, Mathematical Elements of CAD, Prentice Hall.
4. Hearn and Baker, Computer Graphics, Prentice Hall
5. Sait, CAD/ CAM,
6. Thirupathi R Chandrupatla and Ashok D. Belagundu, Introduction to Finite Elements in Engineering, Pearson Education.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.604 MACHINE TOOLS (MN) 3-1-0 4 Credits

Module-I

Introduction to Metal cutting, Orthogonal and Oblique cutting, Chip formation, Types of chips, Tool Signature – Tool Geometry – Machinability – Tool Wear and wear measurement – Factors affecting tool life – Analysis of cutting forces in orthogonal cutting - Merchants theory (simple problems), Work done. Economic of Machining – Tools for different materials and cutting speeds. Characteristics of Tool materials, Measurement of cutting forces. Tool dynamo meters, Cutting Fluids. Introduction to Powder Metallurgy process – Compacter and Sintering

Module II

General Purpose Machine Tools – Principle of operation of Late – Types of lathers and size specification, Work holding parts of lathes and their functions – Main operations – attachments – Feeding Mechanisms. Shaper mechanism – Calculation of cutting speed – Shaper operation and tools used, Milling Machine – Types – Principal parts – Types of milling cutters – Elements of plain milling cutters – Up milling, Down milling and face milling operations – Indexing – Simple Indexing – Differential indexing angular Indexing. Grinding Machines – Classification – Operations – Surface, Cylinderical and Centreless grinding, Standard marking systems of grinding wheels. Glazing and Loading in wheels. Dressing and Truing of Grinding wheels. Introduction to Jigs and Fixtures.

Module III

Semi – automatic Machine Tools – Turret and Capstan Lathes. Automatic Machine Tools – Single Spindle and Multi-spindle machines , Swiss Type, transfer machines, unconventional machining process – EDM, ECM, LBM, AJM, EBM and Chemical Machining, High energy rate forming process –Explosive forming , Hydro forming, Electromagnetic forming.

Reference:

1. Manufacturing Engineering & Technology : Kalpakjian – Addison Wesley
2. Materials and Processes in Manufacturing : Poul De Garmo, J.T.Black, R.A.Kosher – Printice Hall of India.Pvt. Ltd. 1997.
3. Tool Engineering & Design : G.R.Nagpal –Khanna Pub.
4. Mechanical Estimating and Costing : T.R.Banga & S.C.Sharma – Khanna Pub.
5. design & Manufacturing : Dr.M.Ramaswamy – S.K.Kataria & Sons.
6. Product Design and Manufacturing : A.K.Chitale & R.C.Gupta – Printice Hall of India Pvt. Ltd.
7. Chernov – Machine Tools, Mir Publishers
8. R.K.Jain – Production Technology, Khanna Publishers

9. R.K.Gupta - Production Technology, Sathya Prakashan
10. Ghosh A and Malic A.K – Manufacturing Science, Affiliated East West Press
11. Mechatronics, HMT, TMH
12. Production Technology , HMT, TMH

03.605 Principles of Management (MPU) 3-1-0 4 Credits

Module- I

Evolution of Scientific management :- planning ,organizing, staffing, directing, motivating, communication and co-ordinating

Organisational structure:- line-staff-project and matrix organisation system concept of management, authority, responsibility and span of control

Formation of companies:- Proprietary Partnership and joint stock companies –private limited and public limited companies- joint stock and cooperative

Module- II

Selection of site:- factors to be considered and different methods used, Plant layout-different types, process, product, group layout

Personal management:- objectives and function-recruitment, selection and training f workers –safety and health-labour welfare –industrial psychology scope and objective

Sales management:- objectives and function forecasting demand-various methods Marketing-Market segmentation-marketing mix-product life cycle

Module 111

Quantitative techniques in management:- linear programming and transportation problems- inventory control-statistical decision theory-Game theory and its applications-simple problems

Book keeping and accountancy-Elements of double entry book keeping, rules for journalizing –Ledger accounts-Cash books –banking transactions – the journal proper-profit and loss account, balance sheet preparation

Reference

1. Principles & Practice of Management-T N Chabra, Dhanpat Rai (pub)
2. Industrial Engineering & Production Management, M. Mahajan - Dhanpat Rai
3. Industrial engineering and management: O P Khanna
4. Double entry book keeping : Batliboi
5. Fundamentals of operation research: Hillier and Lieberman
6. Business Organisation & Management - C.R. Basu - Tata Mc Graw Hill
7. Principles of Management - Tripathi & Reddy - Tata McGraw Hill
8. Engineering Management - Fraidoon Mazda – Pearson Edn. Asia

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.606.1 Advanced Mechanics of Solids 3-1-0 4 Credits

Module I

Analysis of stress; State of stress at a point; Rectangular stress components; stress components on an arbitrary plane; Principal stress and Principal planes; Planes of maximum shear; State of pure shear; Differential equations of equilibrium in rectangular co-ordinates; Analysis of stress in two dimensions; Plane stress and plane strain. Transformation of stresses. Analysis of strain, strain-displacement relations–Principal strains and principal axes. Compatibility conditions. Stress-Strain relations.

Module II

Energy methods; Reciprocal relations; Maxwell-Betti-Rayleigh reciprocal theorem; Castigliano's I theorem; Fictitious load method; Theorem of virtual work; Castigliano's II theorem; Engessers theorem.

Bending of beams; Straight beams and asymmetrical bending; shear centre; shear stresses in thin walled open sections; Bending of curved bars (Winkler–Bach formula)

Module III

Torsion -Torsion of General prismatic bars; Torsion of circular, elliptic and equilateral triangular bars; Membrane analogy. Torsion of thin- walled tubes. Torsion of bars with narrow rectangular cross-section. Torsion of thin-walled multiple cell closed sections, Torsion of rolled sections, Center of twist and flexural centre.

References:

1. Advanced Mechanics of Solids-L.S Srinath (T.M.H)
2. Theory of Elasticity –Timoshenko and Goodier (Mc Graw Hill)
3. Solid Mechanics – S.M.A Kazimi (T.M.H)

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.606.2 New Energy systems 3-1-0 4 Credits

Module I

Direct Energy Conversion Systems: Basic principles of thermoelectric and thermionic generations- Thermoelectric effects- Design and selection of materials.

Principle of MHD Generators – Choice of generator parameters – Applications.

Fuel cells- Thermodynamics of fuel cells- Selection of fuel and operating conditions- Practical fuel cells – The Redox cell- Merits and demerits. Photoelectric conversion – Conceptual Description of photovoltaic effect – Solar cell – Materials and prospects .

Module II

Nuclear fusion- Fusion fuels and reactions- Sustained fusion reaction- Production and containment of plasma – Fusion – breeder concept.

Solar energy – Terms and definitions- Applications- Solar collectors and Concentrations- performance analysis of flat plate collectors- Solar thermal devices – Solar power generation- Thermal storage. Ocean Power- Resources- Principle of OTEC systems- Ocean wave energy conversion systems- Tidal power.

Module III

Wind Energy- Fundamentals and Applications- Wind turbine- generator systems- Wind forms- Solar – wind hybrid.

Geothermal Energy- Energy resources – Geothermal electrical power plants – Non-electric applications- Biogas energy- Principle of biogas production- Biogas plants- Design and construction- socio- economic relevance.

Hydrogen- Introduction and Applications- Production, Storage and Transportation – production and application of methanol.

References :

1. R. A. Coobme – “An Introduction to Direct Energy Conversion”, Isaac Pitman & Son Ltd.
2. Sheldon S. L. Chang – “Energy Conversion”, Prentice Hall Inc.
3. Rao & Parulekar – “ Energy Technology”, Khanna Publishers.
4. G. D. Rai, “Non- Conventional Energy Sources”
5. Duff ice & Beckman, ‘Solar Energy Thermal Processes”, John wiley & Sons, Newyork.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.606.3 Object Oriented Programming 3-1-0 4 Credits

Module I

OOPS and Java basics - Java virtual machine - Java platform API - extended security model - applet classes - exceptions and abstract classes - Java applet writing basics - GUI building with canvas - applet security - creating window applications - writing console applications - utility and math packages

Module II

Swing programming - working with swing components - using the clipboard - input/output streams - printing - working with 2D and 3D Graphics - using audio and video - creating animations

Java beans development kit - developing beans - notable beans - network programming - client and server Programs - naming and directory services - working with Java management APIS

Module III

Distributed application architecture - CORBA - RMI and distributed applications - working with remote objects - object serialization and Java spaces - Java IDL and ORBs, connecting to database - using JDBC - integrating database - support into web applications - Java servlets - JSDK - JAR files - Java native interface

Text books

1. Campione, Walrath & Huml Tutorial team, "*The Java Tutorial Continued: The Rest of the JDK*", Addison Wesley
2. Jamie Jaworski, "*Java 2 Platform Unleashed: The Comprehensive Solution*", SAMS Teachmedia

References books

1. Holzner S., *Java 2, Swings, Servlets, JDBC & Java Beans Programming*, IDG Books
2. Campione M. & Walrath K. " *The Java Tutorial: Object-Oriented Programming for the Internet*", Addison Wesley
3. Naughton Patrick & Herbert Schildt, "*Java 2: The Complete Reference"*, Tata McGraw Hill

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.606.4 Nuclear Engineering 3-1-0 4 Credits

Module I

Review of Elementary nuclear physics: Atomic structure – nuclear energy and nuclear forces – Nuclear fission. Nuclear reactions and radiations – Principles of radio active decay interactions of an ray with matter – Neutron cross sections and reactions – The fission process – Chain reactions – Basic principles of controlled fusion .

Nuclear reactor principles – Reactor classification – Critical size – Basic diffusion theory - Slowing down of neutrons – Neutrons – Neutron flux and power – Four factor formula – Criticality condition – Basic features of reactor control .

Module II

Boiling water reactor . Description of reactor system – Main components – Control and safety features .

Materials of reactor construction – Fuel , moderator , coolant – Structural materials – Cladding –Radiation damage.

Nuclear fuels : Metallurgy of Uranium – General principles of solvent extraction – Reprocessing of irradiated fuel – Separation process fuel enrichment .

Module III

Reactor heat removal / equations of heat transfer as applied to reactor cooling – Reactor heat transfer systems – Heat removed in fast reactors .

Radiation safety : Reactor shielding – Radiation dozes – Standards of radiation protection – Nuclear waste disposal.

References

1. Classtone & Sesonske, Nuclear reactor Engineering –D Van Nostrand Co.
2. S Glasstono, Source book on atomic energy –. D.Van Nostrand Co.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03. 606.5 Foundry Technology 3-1-0 4 Credits

Module I

Casting as process of manufacture – Its advantages and limitations

Pattern making – Pattern materials – Factor effecting the choice of pattern materials – Pattern allowances – Types of pattern – Line diagram description and use of different types of patterns- colour codes of pattern .

Moulding process – Hand moulding tools and their uses – Different types of moulding boxes – Green sand moulds , dry hand moulds , Loan moulds , plaster moulds , cement bonded moulds – bench moulding , floor moulding and pit moulding .

Module II

Moulding sands : Natural sand , synthetic sand , sand mixing – General properties of moulding sand – testing of moulding sand – Ingredients for moulding sand - Special additives – Reliability of moulding sands - Maintenance of sand properties for regular use – Sand conditioning .

Cores and core making – Purpose of cores – core prints – Types of cores – Core sand and ingredients – Requirements of core sands – Core sand mixtures – Binding materials – Core boxes – Types of core boxes – Process of core making – Core baking , core creating , core reinforcing – core venting etc.

Gating and Risering – Solidification of pure metals and alloys in moulds – Factors affecting the nature and type of solidification – Gate and gating system – Types of gates – Deign of gating systems – Risering – Needs for risering – Requirements of a riser . Theoretical considerations – Riser shape and directional solidification – General considerations for risering – Bling riser – Use of chille , insulators and exothermic compounds .

Module III

Melting and pouring : Types of furnaces used for cast irons , steels and non ferrous metals – Composition , size and charge calculations – Details and calculations in Cupola charging – New developments in cupola design.

Mechanisation in foundry – Elementary ideas of machines used for sand conditioning, sand supply , moulding , core making . knockout and fottling .

Special moulding and Casting processes – Shell moulding , plaster mould casting – Investment casting ,CO2 process –Graphite and ceramic moulds – Centrifugal casting – Continuous castings .

References

1. Hine and Resenthal, Principles of Metal Casting –
2. Howard, Modern foundry practice -
3. Camphell, Principles of Manufacturing materials and processes –
4. T.R.Bhanga, Foundry Engineering –
5. Russicof , Foundry practice –

03. 606.6 Mechanical working Methods 3-1-0 4 Credits

MODULE I

Introduction : Elements of mechanical processing systems – Definition of mechanical working – Hot and cold working – Comparison with other processing systems .

Elastic and plastic behaviour – Yielding and yield stress – Conventional stress – Strain curve and true stress-strain curve – Ductile and brittle behaviour – The flow curve. Energy and power requirements in plastic deformation – Factors affecting plastic deformation.– Deformation temperature – Rate of deformation – Friction and Lubrication.

Need for preheating- Need for heat treatments after mechanical working – Heat treatment methods – Furnaces for pre heating and heat treatment

MODULE II

Materials for mechanical working - A brief survey of the characteristics and composition of the common ferrous and non ferrous alloys and non metallic materials used for mechanical working .Rolling Metals – Fundamental principles of metal rolling classification of rolled products, types and sizes – Basic principles of draughting schedule design and roll pass design (simple examples) Roll load and power required in rolling – Problems encountered and defects in rolling practice.

MODULE III

Forging , Extrusion and Wire drawing – Principles of product design and die design in forging – Calculation of forging loads and selection of hammers and process for forging – Design of extrusion and wire – drawing dies – Computation of power requirements problems encountered and defects in the above processes .

Press working of metals – Description and classification of the processes – Product and die design for shearing , blanking drawing and bending – Compound and progressive dies – Computation of capacities and tonnage requirements for blanking ,piercing and drawing operations – Process selection and selection of process problems and defects in press working .

REFERENCES

1. Principles of Manufacturing Materials and processing – Cambell
2. Manufacturing properties of Materials - Alexander Brower
3. Tool Design –CB Cole.
4. Fundamentals of tool design – ASTME.
5. Metal Working Technology – Richard Little
6. The Design Handbook – ASTME

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.606.7 INTERNET TECHNOLOGIES 3-1-0 4 Credits

MODULE I

Information Technology – Introduction – applications – The Internet and World wide web – the GPS.

The Computer Systems – Types, CPU – Memory – Input and Output devices – Inputing text and Graphics – Printing Devices – The foundation of Modern outputs – Printers – Secondary storage devices and media.

MODULE II

Software – User Interface and Operating systems – Types , File management , Utilities – Document – centric computing , Word Processing & Desktop publishing – Entering and Editing documents – Other word processing features – Formatting documents – desktop Publishing for print and for the screen .

Spread sheet applications – Data base applications – Queries – Internet connectivity.

Programs – Programming languages – Programming methods – Programming Techniques – System analysis and design .

MODULE III

The Electronic web – Network applications – Fax ,voice and Information services – Person to Person and group communication – Exchanging files – Foundations of modern networks – Local area networks – Wide area networks – Links between networks – Device and Media Protocols –Dial up Access – High bandwidth personal connections- Multimedia – Introduction – Tools – multimedia authoring Tools – Presentation device – Multimedia on the web.

IT in Business – Information processing – Transaction Processing – Computers for Management control , Marketing , Advertising , and sales – Design , Production and Manufacturing – Business on the Internet – Health Issues Associated with the use of computers – Computer viruses – Intellectual property rights – Computer crime – Cryptography – Issues caused by computers – Recent developments in IT.

REFERENCES

1. Information Technology : The Breaking wave – Dennis P. Curtin et al , Tata Mc. Graw Hill Pub.Co.
2. Using Information Technology – William Sawyor & Hutchingson , IRWIN Mc.Graw Hill Pub. Ltd.

Note :- This course is intended to provide an overview of fundamentals and concepts of IT useful to an undergraduate student in Mechanical Engineering only.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.606.8 Artificial Intelligence Systems 3-1-0 4 Credits

Module I

Definition - history and applications - propositional calculus - predicate calculus - inference rules - structures and strategies for state space search - heuristic search algorithms - heuristics in games - complexity issues - control and implementation of state space search - production systems - planning - the blackboard architecture

Module II

Knowledge intensive problem solving - expert system technology - rule-based expert systems - model based reasoning - case based reasoning - knowledge representation problem - reasoning with uncertain or incomplete information - statistical approach - non-monotonic systems - fuzzy sets - knowledge representation - languages - issues - network representation - conceptual graphs - structured representation

Module III

Languages and programming techniques for AI - overview of LISP - search - higher order functions and procedural abstractions - search strategies - pattern matching - recursion - interpreters - logic programming in LISP - streams and delayed evaluation - expert system shell in LISP - network representations and inheritance - CLOS

Introduction to understanding natural language - introduction to automated reasoning - introduction to machine learning

Text book

Luger G.F. & Stubblefield W.A., *Artificial Intelligence*, Addison Wesley

Reference books

1. Nilsson N.J., *Artificial Intelligence - A New Synthesis*, Harcourt Asia Pte. Ltd.
2. Elain Rich & Kevin Knight, *Artificial Intelligence*, Tata McGraw Hill
3. Tanimotto S.L., *The Elements of Artificial Intelligence*, Computer Science Press
4. Winston P.H., *LISP*, Addison Wesley

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.606.9 System Simulation & Modelling 3-1-0 4 Credits

Module I

System concepts - components of a system - discrete and continuous systems - types of system study - system analysis - system design and system postulation - system modelling - types of models - system simulation - steps in a simulation study - comparison of simulation and analytical models - Monte Carlo simulation - examples of simulation of single server, single queue systems and simple inventory systems - concepts in discrete event system simulation - event scheduling/time advance algorithm - modelling world views

Module II

Random number generation - techniques for generating random numbers - tests for random numbers - frequency tests - the Kolmogorov-Smirnov test and the Chi-square test - random variate generation - inverse transformation method - exponential, uniform and empirical discrete and empirical continuous distributions - Input modelling for simulation - data collection - identifying the distribution using histograms - parameter estimation - Chi-square goodness of fit test Verification and validation of simulation models - verification of simulation models - calibration and validation of models - face validity - validation of model assumptions and validating input-output transformations - output analysis for a single model - types of simulations with respect to output analysis.

Module III

Measures of performance and their estimation - output analysis for terminating simulations - confidence interval estimation for a fixed number of replication - confidence intervals with specified precision - output analysis for steady-state simulations - initialization bias - replication method - sample size determination for a specified precision - batch means method.

Simulation modelling and analysis of manufacturing systems - objectives - performance measures - issues in simulation of manufacturing systems - simulation of simple job shop manufacturing systems - Introduction to simulation software for manufacturing applications - salient features of simulation languages such as general purpose simulation system (GPSS) and simulation language for alternative modelling (SLAM) - salient features of simulators such as WITNESS and ARENA

Text book

Banks J., Carson J.S. & Nelson B.L., *Discrete-Event System Simulation*, Prentice Hall of India Private Limited

Reference books

1. Askin R.G. & Standridge C.R., *Modelling and Analysis of Manufacturing Systems*, John Wiley
2. Deo N., *System Simulation with Digital Computer*, Prentice-Hall of India Private Limited
3. Gordon G., *System Simulation*, Prentice Hall of India Private Limited
4. Law A.W. & Kelton W.D., *Simulation Modelling and Analysis*, Third Edition, McGraw Hill International Editions
5. Kelton W.D., Sadowski R.P. & Sadowski D.A., *Simulation with ARENA*, WCB/McGraw Hill International Editions

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).

3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03. 606. 10 Instrumentation and Control (MNPU) 3-1-0 4 Credits

MODULE- I

Measurement: Aims- Fundamental methods- Measurement systems- Functions of Instrument- Static and dynamic Measurements, Terminology, Time element, Errors in measuring Instruments, Sources of error, Error distribution- Sensing element: Types- Sensors for motion- Angular motion, Speed, Force, ** Electrical transformation, Simple transducer elements- Types of transducers- Voltage and current generating Analog type, Variable parameter Analog type, Frequency and pulse generating transducers- Specification for transducers.

Measurement of Temperature- Temperature scales, Basic fixed point- Measuring devices and their ranges- Electrical type and mechanical type- Measuring system for resistance thermometers and Thermocouples- Bridge circuits- Calibration- Filled system thermometers- Ambient temperature compensation.

MODULE – II

Measurement of pressure- Force balance principles- Deformation of elastic members- Ring balance – Impulse line layout- Calibration Low pressure measuring devices.

Measurement of flow- Head flow meters- Primary elements – Secondary elements- Fleat monometers- squire root extraction- Flow transducers- Area flow meters- Rotameter- Measurements of liquid level- Direct methods- Inferential methods- Boiler drum- Level indicator.

MODULE – III

Control system- Classification of control system- Block diagram- Rule of Block diagram algebra- Transfer functions, Set point- Identification of plat Characteristics- First order proportional and second order proportional elements- Dynamic response – Analogues circuits stability of control systems- Routh – Hurvitz criterion- Nyquist criterion.

REFERENCES:

1. Mechanical and Industrial Measurements - R. K. Jain
2. Process Instrument and Control Hand Book - D. M. Considine
3. Measurements System, Application and Design – E. O Doeblin
4. Industrial Instrumentation - A. E. Pribanco.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.606.11 Numerical Methods (MNPU) 3-1-0 4 Credits

Module I

Introduction to problem solving – mathematical modeling – use of computers – flow charting – algorithms. Errors and approximations – floating point arithmetic – sources of errors – control of errors – propagation of errors – condition and stability – Rate of convergence.

Solution of algebraic and transcendental equations- various iterative methods and their comparison, convergence – generalized Newton- Raphson method for multiple roots- Higher order Newton-Raphson methods.

Solution of simultaneous equations-Direct and indirect methods – Gauss elimination and Gauss-Jordan methods – ill conditioning – pivoting – Jacobi, Gauss-Seidel and Relaxation methods – convergence – Eigen value problems- Vector iteration method.

Module II

Interpolation – Newton's Divided difference, Lagrange, Aitken, Hermite and Spline techniques- Inverse interpolation .

Numerical differentiation – Numerical integration – Trapezoidal rule and Simpson's rule – Gauss quadrature – Error estimates – Double integration.

Curve fitting – method of least squares – non-linear relationships – Correlation and Regression – Linear correlation – measures of correlation – Standard error of estimate – coefficient of correlation.

Module III

Solution of ordinary differential equations – Single step and multi step methods – stability of solution – simultaneous first order differential equations – higher order differential equations.

Partial differential equations – classification – Laplace equation, 1D wave equation, 1 D heat equation – Finite difference methods – relaxation methods. Stability and convergence of solution.

Note : Computer program assignments are essential as part of sessional requirements.

Text Book : E.Balaguruswamy : Numerical Methods, TMH Publishing Co. Ltd.

REFERENCES

1. Numerical Methods for Scientific and Engineering Computations – M.K.Jain , Iyengar S R K and R.K.Jain, Wiley Eastern Ltd.
2. Elementary Numerical Analysis – Conte and Carl de Boor, McGraw Hill Book Co.
3. Introduction to numerical analysis – Forberg C.E, Addison – Wesley Publishing Co.
4. An Introduction to numerical analysis – Kendall E Atkinson , John Wiley & Sons.
5. Statistics – Murrey R Spiegel, , McGraw Hill Book Co.
6. Numerical Mathematical Analysis – James B Scarborough, Oxford & IBH Publishing Co. Pvt Ltd.
7. Applied Numerical Analysis – C.F. Gerald and P.O.Wheatley,Pearson Education Asia.
8. Numerical Algorithms – E.V. Krishnamurthy and S.K.Sen, Affiliated East-West Press Pvt. Ltd.
9. Numerical Methods for Engineering. – S. C.Chapra & R.P.Canale , , McGraw Hill Book Co.
10. Computer Oriented Numerical Methods – V.Rajaraman, Prentice Hall of India Pvt Ltd.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.606.12 Non-conventional Machining Techniques 3-1-0 4 Credits

Module I

The need of the process-classification - Energies employed in the processes- EDM, EC, USM, LBM, PAM, AJM, WJM etc.

Electrical Discharge Machining Process, operating principles-Breakdown mechanism-Dielectric fluid-Electrode material-Tool wear – Power generator circuits- Process parameters - Metal removal rate - wire out EDM - Recent Developments in EDM. Applications

Module II

Electro Chemical Machining Process-principles-Equipment-Analysis of metal removal-tool material-Insulation-Process parameters-ECH,ECG etc. Applications

Electron Beam Machining Process, Principle-gun construction - Types of gun - Vacuum and non-vacuum technique Applications

Laser Beam Maching Process, principles, pumping processes, emission types-beam control. Applications

Module III

Ultrasonic Machining Process-working principles-types of transducers-concentrators-nodal point clamping-feed mechanism-metal removal rate-Process parameters. Applications

Abrasive Jet Machining Processes-Principle-Equipment-Metal removal rate process parameters. Applications

Water Jet Machining Process-Principle-Equipment. Applications

Text Book:

1. " Non Conventional Machining ", P.K.Mishra, The Institution of Engineers (India)

Text Books: Series, 1997.

Reference:

1. A Text Books: of Production Engineering, P.C.Sharma, 1995.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.606.13 TOOL ENGINEERING 3-1-0 4 credits

MODULE I

Jigs and fixtures – Necessity for jigs and fixtures – Elements of fixtures , Design considerations , locators , Types of locators clamping .

Work holding devices , different types – Design of drill jigs , bush specifications. Fixture for lathe operations , milling fixtures , fixtures for CNC machines , flexible fixtures , modular fixtures .

MODULE II

Press work tools , Blanking and piercing tools , Load variation during blanking – Reduction of cutting load stock step , striper , knecleant plates . Types of elies , simple die , compound die , progressive die , strap layout .

Fine blanking , press cycle , advantages – sheet metal bending –Bending dies , forming , forming dies – Embessing , coining , metal flow during drawing operations .

MODULE III

CAD for tooling :-

Turrent press FMS – Computer applications (CAD /CAM) in short metal press work – Quick die change method – Single minute exchange of dies – group tooling – Design of single point tools – Plastic as a tooling materials – Fluidised bed fixturing.

REFERENCES :

1. Tool Design – Cysil Donaldson TMH
2. Jig and Fixture Design Hand Book – William and Boyes
3. Fundamentals of tool design – Edward G.Hoffman
4. Fundamentals of Fixture Design – V.Koraskove Mir.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.606.14 Composite Material Technology 3-1-0 4 credits

Module I

Composite Materials:- Definition, characteristics, Classifications based on structure and matrices, Structural, functional sensory and smart composites, Advantages and limitations, History, Industrial scene, Applications.

Introduction to micro-mechanics-unidirectional lamina – laminar stresses– inter laminar stresses - static mechanical properties - fatigue properties - impact properties - environmental effects - fracture mechanics and toughening mechanisms, damage prediction, failure modes. Failure predictions - design considerations - codes - design examples.

Module II

Fiber reinforced plastics: Reinforcement fibres:- High strength man made (glass, carbon, aramid) and natural fibres, Structure, characteristics, Properties and applications.

Whiskers:- Characteristics, properties and applications

Polymer matrix composites (PMC):- Thermo set, thermoplastic and e1astomeric polymers, their properties, characteristics and utilisation as matrices. Manufacturing methods for thermo set thermoplastic and elastomeric PMC. Their characteristic features. Properties of composites made and their applications.

Metal Matrix Composites (MMC): Metals. Inter-metallics and alloys used for MMC and their properties, Manufacture of MMC, their properties-characteristics and applications.

Module III

Ceramic Matrix Composites *(CMC):-* Classification of ceramics and their potential role as matrices. Ultra structure processing of ceramics, Manufacture, properties and applications of CMC using fine ceramics, carbon, glass, cement and gypsum as matrices.

Post processing operations:- Machining. cutting. polishing. welding of thermoplastic PMC. bonding. riveting and painting. Advanced post processing methods like ultrasonic welding, plasma coating, waterjet cutting and laser machining.

Quality, inspection and non-destructive testing.

References

1. P.K.Mallicak, " Fiber-reinforced composites ", Monal Deklar Inc., New York, 1988.

2. B.D. Agarwal and L.J.Broutman, " Analysis and Performance of Fiber Composites ", John Wiley and Sons, New York, 1980.
3. F.L.Matthews & R.D.Rawlings, " Composite Materials, Engineering and Sciences ", Chapman & hall, London, 1994.
4."Hand Book of Composites", George Lubin. Van _Nostrand, Reinhold Co. 1982.
5. "Encyclopaedia of Composites (6 volumes)", Ed. by Stuart, M. Lee. International, VCH, New York-1
6. Tasi. S.W., *Introduction to Composite Materials,* Technomic Publishing Company.
7. Chawla KK., *Ceramic Matrix Composites* Chapman & Hall
8. Schwartz M.M., *Composite Material handbook,* McGraw HiIl, Inc.

Text Books:

1. Ronald Gibson, " Principles of Composite Material Mechanics ", Tata McGraw Hill, 1994.
2. Micael hyer, " Stress Analysis of Fiber - Reinforced Composite Materials ", Tata McGraw Hill, 1998.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.606.15 MATERIAL HANDLING 3-1-0 4 credits

MODULE I

Importance of Materials Handling- Principles of Materials Handling – Principal groups of Materials handling equipments – General characteristics and applications of materials handling equipments – Modern trends in Materials handling .

Lifting equipments – hoist –Components of hoist – Load handling attachments – hooks , grabs and clamps – Grabbing attachments for bulk materials – Wire ropes – and chains –

MODULE II

Lifting tackle pulleys for gain of force and speed – Tension in drop parts – Drums , shears and sprockets - Arresting gear and brakes – block brakes , band brakes , thrust brakes – Safety and hand cranks .Principle operation of EOT , Gantry and jib cranes – Hoisting Mechanisms , travelling mechanisms , luffing mechanisms – slewing mechanisms – Elevators and lifts .

MODULE III

Conveying Machines - Belt conveyers – Types , principal components of a conveyor and their purpose – Conveyor belts – tractive elements – take up devices – Special types of belt conveyors - Metal belt conveyors – Apron conveyors – Elevators , Passenger conveyors – Flight conveyors , Principal types and applications – Bucket flight conveyors – Cradle conveyors – Conveyor elevators .Overhead Conveyors – Principal types and applications – Overhead pusher conveyor – Overhead load towing truck conveyors – Load carrying car conveyors – Load towing and walking beam conveyors – Bucket elevators – Cradle conveyors – Screw conveyors - Oscillating conveyors – Roller conveyors – Hydraulic and pneumatic conveyors – Chutes – bins.

REFERENCES

1. Material Handling Equipments – Rudanko
2. Material Handling Equipment – Alexandr V
3. Conveying Machines - A. Spivakvsky and V. Dyachkov

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.606.16 AGRO MACHINERY 3-1-0 4 credits

MODULE I

Tractors – Design and Operating principles of Engine transmission and control systems – Working details of different types of attachment in the tractor –Tillage – Soil structure – Moisture – Temperature and aeration – Destruction of weeds and posts – Types of tractor plough – Life Mechanisms. Pumps and Spraying machinery – Types of pumps and their selection – Installation and working details – Regulating arrangements spraying

machinery - Spray pumps – Nozzles – Vibrated broom distribution – Spray materials – Types of field crop sprayers – Aircraft spraying – Dusting machines .

MODULE II

Earth moving equipments – Drainage Excavators – Ditching equipments – trench cutting machines – Bull dozers – Angle dozers – Earth scooper – graders – tractor winches – Road sweepers – Slurry scrappers .Working details of machinery like : Cultivators – harro weeding equipments – land levellers – seed drills – grass seed drills – Ridgers – Gapping or thinning machines – Manure distributors – Speeders – Lawn movers – Rotary grass cutters – Hay leaders - Silage and silage machinery – Winnowers - Combined clearing and grading machinery.

MODULE III

Machinery for milk production – Essentials of milking machines – Types of milking plane – Bucket , direct to churn milking parlours – Bulk handing milking bails – Milk cooling and serialisation – Cream separators .Testing of Machinery – H.P. Developed – other performance tests and testing equipments – wear testing , life testing – Tractor draw bar performance curves – Characterises curves for pumps – Maintenance Engineering – Servicing – check up – sparo parts – stand by sparo parts requirements – Service workshop – Organisation and management – Labour and Machinery required .

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.607 CAD Lab (MNU) 0-0-3 3 Credits

Introduction to CAD packages. 3D modeling, assembly and surfacing.

Introduction to FEM packages. Linear static analysis of simple systems (one dimensional and two dimensional). Dynamic analysis of simple systems. Simple problems in heat transfer and fluid mechanics.

03.608 Machine shop II (MNU) 0-0-3 3 Credits

Study of Milling Machines and Milling Cutters

Study of Grinding machines, Surface Grinding and Cylindrical grinding machines – study of Drilling machines

Exercise on Milling machines-face milling, end milling – spur and helical gear cutting – milling of keyways

Exercise on Grinding and Drilling Machines.

03.701 Refrigeration & Air conditioning 3-1-0 4 Credits

Module I

Introduction – Brief history and applications of refrigeration. Methods of refrigeration – Conventional methods. Thermodynamics of refrigeration- reversed Carnot cycle- heat pump and refrigeration machines. COP comparison- Unit of refrigeration- Air refrigeration systems- Limitations of reversed Carnot cycle- Reversed Loule cycle- Air craft refrigeration systems, simple bootstrap- Regenerative and reduced ambent system- Vortex tube refrigeration- Very low temperature refrigeration systems (concept only). Adiabatic demagnetisation of paramagnetic salts. Vapour compression systems-simple cycle representation on TS and PH Diagrams. COP- Effect of operating parameters on COP – methods of improving COP of simple, cycle, super- heating , under cooling, Liquid suction heat exchanger- actual cycle. Multi pressure systems, multi compression and multi evaporator systems. Inter cooling flash inter cooling and flash gas removal- Different combinations of evaporator and compressor for different applications, Cascade system.

Module II

Vapour absorption systems. Ammonia – water system- simple system- drawbacks- Lithium Bromide water system- Electrolux- comparison with vapour compression system- steam jet refrigeration. Refrigerants and their properties- Eco-friendly Refrigerants, selection of refrigerants for different applications. Application of refrigeration- domestic refrigerators- water coolers- ice plants. Cold storages- food preservation methods- plate freezing , quick-freezing. Refrigeration system components- Compressors, condensers, expansion devices, evaporators. Cooling towers-

Different types and their application fields- Refrigerant leakage and detection – charging of refrigerant – system controls.

Module III

Air conditioning – meaning and utility, comfort and industrial air conditioning. Psychometric properties- saturated and unsaturated air, dry, wet and dew point temperature – humidity, specific humidity, absolute humidity, relative humidity and degree of saturation- thermodynamic equations- enthalpy of moisture- adiabatic saturation process. Thermodynamic wet bulb temperature- psychometric chart- problems – Psychometric processes- adiabatic mixing-sensible heating and cooling- humidifying and dehumidifying – bypass factor- sensible heat factor-RSHF and GSHF line- Design condition- Apparent dew point temperature – Choice of supply condition, state and mass rate of dehumidified air quantity – Fresh air supplied –air refrigeration. Comfort air conditioning- factors affecting human body comfort. Effective temperature – comfort chart. Summer air conditioning- factors affecting-cooling load estimation . Air conditioning systems- room air conditioner- split system-packaged system-all air system-chilled water system. Winter air conditioning – factors affecting heating system, humidifiers . Year round air conditioning AC system controls-thermostat and humidistat. Air distribution systems- duct system and design- Air conditioning of restaurants, hospitals, retail outlets, computer center, cinema theatre, and other place of amusement . Industrial applications of air conditioning . Refrigerant Blends and their Characteristics

References :

1. Refrigeration and air-conditioning W.F. Stoecker
2. Refrigeration and air-conditioning C. P. Arora
3. Refrigeration and air-conditioning S. C. Arora and Domkundwar
4. Refrigeration and air-conditioning Manohar Prasad
5. Principles of Refrigeration Dossat. R. J
6. Refrigeration and air-conditioning P. L. Ballaney
7. ASHRAE Handbook

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.702 Gas Dynamics 3-1-0 4 Credits

Module I

Introduction to Gas Dynamics-system and control volume approaches- conservation of mass-momentum equation – conservation of energy – entropy changes in fluid flow – stagnation state- compressibility – pressure coefficient. Acoustic wave and sound velocity – classification of fluid flow based on mach number-physical differences between different types of flow- mach cone- reference velocities impulse function.

Effect of area variations on ID compressible flow – of an ideal gas- basic equations- mass flow rate - choking isentropic flow in nozzles- coefficient of velocity, nozzle efficiency and discharge coefficient.

Module II

Effects of friction on 1D flow- adiabatic flow in constant area duct with friction- Fanno flow tables – choking resulting from friction – Isothermal flow. Effects of heat exchange in 1D flow-frictionless flow in a constant area duct with heat transfer – the Rayleigh line – Rayleigh equations for a perfect gas- Rayleigh flow tables – choking resulting from heat transfer.

Module III

Irrevesible discontinuity in supersonic flow (stationary normal shock only) – Fundamental equations for normal shock – normal equation for a normal shock – normal equation for a perfect gas- Prandtl relation for normal shock-normal shock on T-S diagram-impossibility of shock from subsonic to supersonic flow- shock strength – operation of nozzles under pressure ratio-shock on converging nozzles-shock tube. Oblique shock waves, Mach waves and expansion waves-basic ideas only.

Methods of flow visualization – pressure, velocity measurements - supersonic pitot tube – Rayliegh supersonic pitot formula – temperature recovery factor – stagnation temperature probe-hot wire anemometer.

Working principle of shadowgraph, Schlieren apparatus and interferomet

References

1. Dynamics and Thermodynamics of Compressible flow – Vol 1 Shapiro
2. Fundamentals of compressible flow S M Yahya

3. Gas Dynamics E. Rathakrishnan
4. Gas Tables S M Yahya

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).
4. Use of approved Gas Tables is permitted in the University Examination

03.703 Design of Machine Elements – II 3-1-0 4 Credits

Module I

Design of gears- nomenclature – spur, helical, bevel and worm gears - gear materials -tooth loads - design stresses - basic tooth stresses - stress concentration - service factor - velocity factor - bending strength of gear teeth - Lewis equation and Lewis form factor. Working stress in gear teeth- Dynamic load and wear load on gear teeth- Buckingham's equation for dynamic load - surface strength and durability - heat dissipation - design for strength and wear, Design of spur gear, Helical gear, bevel gear and worm gear-AGMA standards-Design of gearboxes.

Module II

Bearing and Lubrication-Journal bearing-Introduction to lubrication – types of lubrication and lubricants - viscosity - Hydrodynamic bearings-Sommerfield Number, L/D ratio, Clearance ratio- Minimum film thickness-bearing materials-Hydrostatic bearings. Rolling contact bearings - bearing types - Ball & roller bearings- Static and Dynamic load capacity- Equivalent dynamic load-Bearing life- Stribeck's equations, selection of bearings.

Module III

Pressure vessels, thin cylinders, dilation of pressure vessels, Membrane stresses in vessels under internal pressure, Thick cylinder equation Hydraulic accumulators. Design of I.C engine parts-cylinder, piston connecting rod, Crankshaft, Flywheel.

Design Data hand books

1. Prof. Narayana Iyengar B.R. & Dr Lingaiah K., Machine Design Data Handbook
2. P.S.G., Tech., *Machine Design Data Handbook*
3. Design data Book -K. Mahadevan – C.B.S Pub.

References:

1.Design of Machine Elements - M.F Spotts, Prentice Hall of India,
2.Machine Design - J.E. Shigley, Mc Graw Hill Book Co.
3. Machine Design - Dr.Sadhu Singh, Khanna Pub.
4. Machine Design - P.C Sharma and DK Aggarwal (S.K/Kataria & sons)
5.A Textbook of machine design - R.S. Kurmi & J.K. Gupta, Eurasia Pub.
6.A Textbook of machine design - DR.Rajendra Karwa- Lakshmi Pub.
7. Design of pressure vessels - John F. Harry.
8. Fundamentals of Mechanical Design- Phelan R.M., Tata McGraw Hill Pub. Co. Ltd
9. Fundamentals of Machine Component Design, Juvinall R.C. & Marshek K.M
10. Machine Deign – Wentzell, Thomson Learning

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).
4. Use of Design Data hand books allowed for reference during examinations

03.704 Metrology & Instrumentation (MN) 3-1-0 4 Credits

Module-I

General Principles of Measurement: Introduction Concept of Precision, accuracy, sensitivity, calibration. Basic standards of length- Line standard and End standards – slip gauges, Angular measurements using bevel protractors, spirit levels, clino-meters, sine bar, Angle gauges, optical dividing head.

Limits and Fits:- Systems of limits and fits. Interchangeability & selective assembly. Tolerance- Allowance-Deviation as per BIS (simple problems).

Taylor's principles- Limit gauges design. Considerations- gauges materials- Gauges tolerance and wear allowance. Classification of Limit gauge- plug, ring, taper, Bore, Gap, Snap gauges, position gauges etc – merits and demerits.

Module II

Comparator:- Mechanical, Optical, Pneumatic, Electrical and Electronic comparators.

Optical Measuring Instruments:- Principle of Interferometry – Optical flat – Interferometers – angle detector Autocollimators, Tool makers- Microscope. Co-ordinate measuring machine.

Concepts of machine Vision system – CCD, CID cameras.

Surface Finish- Surface Texture – Evaluation of surface roughness- Simple problems.

Surface roughness measuring instruments – Different types.

Measurement of major elements of Screw threads and Gears.

Module III

Transducers:- Classification- Pressure, Temperature, Torque, Force, Vibration, humidity, Sound measuring Transducers (Working, Principle and Application of above transducers) and Dynamometers.

Stress- Strain Measurement: Types of strain gauges- Strain measurements by using resistance strain gauges and Mechanical strain gauges-types, application.

Basic concept in static and dynamic measurements: Analysis of Experimental errors Gaussian and normal error Distribution- methods of Least Squares- Simple problems.

Reference :

1. Measurement system (Application and Design) – Ernest O Doebelin.
2. Mechanical and Industrial measurements- R. K. Jain
3. Engineering metrology – R. K. Jain
4. Engineering precision metrology – R. C. Gupta
5. A text book of engineering of metrology- I. C. Gupta.
6. Hand book of Industrial Metrology – ASME

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.705 Industrial Engineering(MPU) 2-1-0 3 Credits

Module I

Introduction to Industrial Engineering – Evolution of modern Concepts in Industrial Engineering – Functions of Industrial Engineering – Field of application of Industrial Engineering Product Development and research- Design function – Objectives of design- Manufacturing Vs purchase- Development of designs- Experimentation- prototype production and testing simplification and standardization – Selection of materials and processes- Human factors in design- value Engineering job plan.

Plant layout and material handling- Types of layouts- Product, process, fixed, Group technology, Flexible manufacturing system- elementary concepts and structure, flow charts, use of time study data, physical facilities- Constructional details- environmental control like lighting, temperature, humidity, Ventilation, noise and dust, Industrial waste disposal- principles of material handling- Types of material handling equipments- Selection and application maintenance and replacements- Preventive and brake- down maintenance and replacement- Preventive and brake- down maintenance- economic aspect, Replacement of equipment- Method of providing for depreciation- Determination of economic life, Criteria for selection of equipment- Simple problem.

Module II

Methods engineering analysis of work methods using different types of process chart and flow diagrams- Critical examination- Micro motion study and therbligs- SIMO chart- Principles of motion economy – determination of standard time and allowances- job evaluation and merit rating – Objectives and principles of job evaluation- merit incentive plan – Merit rating plans.

Wages and Incentives- Primary wage systems- Time rate and piece rate system of wage payment- Incentive plans- essentials of a good wage incentive plan- profit sharing Co-partnership- Non momentary incentives.

Industrial relations- Psychological attitudes to work and working conditions fatigue- Methods of eliminating fatigue- Effect – Communication in Industry causes effects of industrial disputes- Collective bargaining- Trade union –

Workers participation in management- Lobour welfare and social security- Industrial safety- Important statutory provisions in labour legislation.

Module III

Production planning and control- Importance of planning – job, batch and mass production- Determination of economic lot size in batch production- Functions of production control – Routing , Scheduling, dispatching and flow up- Gantt charts- Production control in mass production industries. Inventory control determination of economic order quantity and re-order level-standardisation – Variety reduction- Codification, stores design- Stores Layout- Stores Procedures mechanism & Automation of warchouses.

Quality control and Inspection- Destructive and non-destructive testing methods- testing methods- process capability- Statistical quality control and control charts for X and R. Acceptance control and operation characteristic curves- lift testing reliability – System reliability- Simple problems (without using SQC table)

Introduction to concepts of TQM and ISO 9000- SQC- Product and System Reliability.

References:

1. Industrial Engineering and Management - O. P. Khanna
2. Time and Motion Study - Ralph and Barien
3. Statistical Quality Control - Grant and Ieven Worth
4. Modern Production management - E. S. Buffa.
5. Industrial Engineering & Production Management, M Mahajan - Dhanpat Rai (pub).
6. Industrial Engineering & Production Management, Martand Telsang – S. Chand.
7. Industrial Engineering - Dr. B. Kumar – Khanna pub.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.706.1 GLIMPSES OF WORLD THOUGHT 3-1-0 4 Credits

Module I

Introduction - Ancient Period - The History of 'ideas' - the earliest thinkers - *East and West* - Ancient Indian texts - *Vedas, Sutras, Sastras and Upanishds* - some early Greek thinkers - Anaxagoras, Ionians - other centres of learning in the ancient world - China, Egypt, South America - Mayars, Incars - Greek and Roman schools of thought

Medieval ages &Renaissance - The Dark Ages - Renaissance Thinkers - Leornardo, Copernicus and Kepler - art and literary movements (school of paintings and other forms of reputation) - The Philosophy of science and the development of the Scientific Method - Arts Vs. Science - the flowering of academic disciplines - the science of 'knowledge' - the great intellectual debates - technology and revolutions - industrial and scientific revolution

Module II

The major schools of thought - positivism, nihilism, dialectical materialism - Marxism and its social, cultural and economic dimensions - revolutions in human perception - theories of human evolution - theories of human betterment theories of social analysis (French Revolution, October Revolution) - the great inventors and discoveries and their relation to human thought (Darwin's theory and growth of imperialism) - determinism, modernism and colonial theories.

Module III:

The modern era - structuralism - definition and implications in the various sciences - post-structuralism, post-modernism, Neo-Marxism and post-colonial theories - new disciplines - cognitive science - language, culture and cognition - current trends and issues - semiotics - the science of signs. Human values in Engineering.

Text books

1. Will Durrant, *The Story of Philosophy*, Simon & Schuster
2. Will Durrant, *The Pleasures Philosophy*, Silmon
3. Bertnard Russell, *History of Western Philosophy*, George Allen & Unwin
4. *Story of Civilisation - Volumes - Life of Grees*, (Excerpts) Oriental Heritage

Recommended and suggesting reading - GWT

1. Will & Ariel Durrent, *The Story of Civilisation*, Volume I to XII
2. Edward Gibbon, *The Rise and Fall of the Roman Empire*
3. Oswald Spingler, *Decline of the West*
4. Dr Radhakrishnan S., *The Creative Life*

5. Dr Radhakrishnan S., *The Present Crisis of Faith*
6. Dr Radhakrishnan S., *Our Heritage*
7. Dr Radhakrishnan S., *Religion and Culture*
8. Dr Radhakrishnan S., *Living With A Purpose*
9. Dr Radhakrishnan S., *True Knowledge*
10. Dr Radhakrishnan S., *Towards A New World*
11. Dr Radhakrishnan S., *Recovery of Faith*
12. *Dialogues of Plato*
13. Koide & Sawant, *Science & Scientific Method*, Prentice Hall
14. Alston, *Philosophy of Language*, Prentice Hall
15. Shaffer, *Philosophy of Mind*, Prentice Hall
16. Chisholm, *Theory of Knowledge*, Prentice Hall

University Examination

4. The question paper shall contain two parts. Part A and Part B.
5. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
6. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.706.2 Computer Graphics 3-1-0 4 Credits

Module – I

Introduction to computer Graphics- Display devices and Display techniques –Description of graphic devices - Graphic standards.

Graphic primitives- Line & circle generation algorithms – text generation. Polygons, Polygon filling

Module – II

Transformation – Two and three dimensional transformations- scaling – Rotation, shearing – reflection. Inverse Transformations, Applications.

Viewing transformations, Windowing, Clipping, Cohen-Sutherland outcode algorithm, Sutherland-Hodgman Algorithm, Clipping of polygons.

Projections - Perspective geometry – Orthographic and Oblique projections – perspective transformations.

Module – III

Plane curves – Non parametric curves – space curves – Representation of space curves – cubic spline – Bezier curves , B- Spline curves , Fractals, NURBS.

Surface description and generation- Surface of revolution – Sweep surfaces, quadric surfaces .

Hidden line and hidden surfaces , Z-Buffer algorithm , Scan Line algorithm for curved surfaces.

Text Books :

1. David F. Rogers & J.H Adams : Mathematical Elements of Computer Graphics ; 2nd Edition; McGraw Hill International Editions.
2. Donald Hearn & M. Pauline Baker : Computer Graphics, Second Edition; Prentice Hall of India Private Ltd
3. Steven Harrington, Computer Graphics, Second Edition, McGraw Hill International Editions

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.706.03 ADVANCED THERMODYNAMICS 3-1-0 4 credits

MODULE I

Review of the fundamentals of classical thermodynamics – Multi phase and multi component systems – Free energy functions – Applications of free energy functions to phase changes – Clausius – Elapoyron equations – Binary systems containing liquid and solid phases.

Thermodynamics of reactive mixtures – Bond energy , heat of formation , heat of reaction –Adiabatic flame temperature entropy changes for reacting mixtures – Chemical equilibrium – Equilibrium criteria – Evaluation of equilibrium constants and equilibrium composition – Simple numerical solutions .

MODULE II

Statistical thermodynamics – Fundamentals of statistical inference – Probability and frequency stirling's approximation , Expected value , variance , elements of quantum statistics and quantum mechanics – The Schrodingar waves equation – Heisenburg uncertainty principle – Phase space – Quantum energy states . Mean free path of molecules – Distribution of mean free path – Maxwell . Boltzmann law and velocity distribution – Maxwell's distribution functions , Evaluation of distribution – Constants – Principle of equipartition of energy – Degree of freedom – Viscosity , Specific heat and thermal conductivity .

MODULE III

Bose – Einstein Fermi – Direct and Maxwell – Boltzmann statistics – Partition function and its relation to microscopic properties of an ideal gas – Translational , rotational and vibrational partition functions – Thermodynamic probability and entropy thermodynamic properties of perfect diatomic gases.

REFERENCES

1. Thermodynamics - J.P.Holman
2. Thermodynamics - Van Wylon
3. Thermodynamics - Lay
4. Thermostatics and Thermodynamics – Myron Tribus
5. Thermodynamics - Kennath Wark
6. Thermophysics- Warren Giodt

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.706.4 INDUSTRIAL HEAT TRANSFER 3-1-0 4 credits

MODULE I

One-dimensional steady state heat conduction with uniform internal heat generation. Plane wall with heat sources, cylinder with heat sources. Transient and periodic conduction (One-dimensional). Lumped heat capacity system. Simple analytical methods. Use of Heisler charts.

Principles of Convection – Viscous flow , different hydrodynamic boundary layer flow regimes and flat plates – Laminar boundary layer on a flat plate – Momentum equation of the laminar boundary layer with constant properties – Internal Momentum analysis of laminar boundary layer . Energy Equations – Significance of Prandtl Number . Flat plate sheet transfer – Conduction by integral methods (Simultaneous development of hydrodynamic and thermal boundary layer only)

MODULE II

Emission and absorption of radiation by an absorbing medium. Determination of mean beam length – Particles in combustion products – Large particles, small particles, gases in combustion products – Effect of an absorbing medium on the radiative heat transfer within an enclosures – Exchange areas for absorbing media.

Furnaces – Furnace geometry – Variation of temperature with time – Variation of temperature within the furnace – Representation of real gases – Heat transfer between real surfaces

MODULE III

Boiling heat transfer, forced convection boiling curve saturated forced convective boiling in a round tube. The two phase forced convection and nucleate boiling regions. Critical heat flow in forced convective flow –Elementary concepts.

The basic processes of condensation – Liquid formation, nucleation of drops at solid surfaces, droplet growth – Film condensation on a vertical flat plate - Nusselt equation for a laminar film – Improvements to the original Nusselt theory – The influence of turbulence – Condensation of horizontal tubes – Condensation within a vertical tube - Drop wise condensation.

Elementary concepts of : Heat transfer in magneto fluid dynamic (Transpiration cooling , low density heat transfer and ablation .) (Description only).

REFERENCES

1. Heat transfer- J.P.Holman , Mc Graw Hill Book Co.
2. Convective Boiling and Condensation- John G Gollier , Mc.Graw Hill
3. Engineering Calculations in relative hunt transfer - W.Grey A.Miller .International series on material science and technology , General editor : D.N.Hepking Vol .13

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.706.5 PLANT ENGINEERING AND MAINTENANCE 3-1-0 4credits

Module I

Wear –fundamentals and analysis – Classification – Theories of wear – Analytical treatment of wear - Effect of moisture , gas and liquids on wear – Effect of temperature – Fatigue. Wear prevention methods.

Lubricants – Solid , fluid and semi fluid – Synthetic – General properties and applications – Tests and classifications – Additives-Testing of lubricants- selection of lubricants-lubricating mechanisms.

Module II

Reliability – Analysis and Concepts – Chance failure and wearout failure – Application of stochastic model for reliability studies – Reliability of series , parallel and stand –by systems – Estimation of parameters for failure distributions – Maintainability -availability.

Replacement – Analysis of different models - Causes of deterioration and obsolescence – Sudden and gradual obsolescence. Deterioration – MAPI method –simple problems .

Module III

Maintenance – types (corrective, scheduled, preventive, predictive and proactive maintenance). – Deterioration and failure analysis – planning , scheduling and controlling of maintenance work – organisation for maintenance, Safety engineering, accident prevention programme , safety design concepts, fire protection-industrial noise-Legislations on safety in industry .

Recent Developments in maintenance methods-RCM- CBM –DMS – TPM etc.

REFERENCES

1. Modern maintenance Management – Miller and Blood (D B Tarapur)
2. Plant Engineer's Hand Book - Mc Graw Hill Pub. Co.
3. Industrial Engineering Hand Book - Maynard (Mill Pub. Co.)
4. Reliability Hand Book - W.G.Irason (Mc Graw Hill)

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.706.6 FRACTURE MECHANICS 3-1-0 4 credits

Module I

Introduction: Significance of fracture mechanics - Griffith energy balance approach - Irwin's modification to the Griffith theory - stress intensity approach - crack tip plasticity - fracture toughness - sub critical crack growth - influence of material behaviour - modes I, II & III - mixed mode problems

Linear elastic fracture mechanics (LEFM): Elastic stress field approach - mode I elastic stress field equations - expressions for stresses and strains in the crack tip region - finite specimen width - superposition of stress intensity factors (SIF) - SIF solutions for well known problems such as centre cracked plate, single edge notched plate, and embedded elliptical cracks

Crack tip plasticity: Irwin plastic zone size - Dugdale approach - shape of plastic zone - state of stress in the crack tip region - influence of stress state on fracture behaviour

Module II

Energy balance approach: Griffith energy balance approach - relations for practical use - determination of SIF from compliance - slow stable crack growth and R-curve concept - description of crack resistance

LEFM testing: Plane strain and plane stress fracture toughness testing - determination of R-curves - effects of yield strength and specimen thickness on fracture toughness - practical use of fracture toughness and R-curve data

Elastic plastic fracture mechanics (EPFM): Development of EPFM - J-integral - crack opening displacement (COD) approach - COD design curve - relation between J and COD - tearing modulus concept - standard J_{Ic} test and COD test

Module III

Fatigue crack growth: Description of fatigue crack growth using stress intensity factor - effects of stress ratio and crack tip plasticity - crack closure - prediction of fatigue crack growth under constant amplitude and variable amplitude loading - fatigue crack growth from notches - the short crack problem

Sustained load fracture: Time-to-failure (TTF) tests - crack growth rate testing - experimental problems - method of predicting failure of a structural component - practical significance of sustained load fracture testing

Practical problems: Through cracks emanating from holes - corner cracks at holes - cracks approaching holes - fracture toughness of weldments - service failure analysis - applications in pressure vessels - pipelines and stiffened sheet structures

Text book

Ewalds H.L. & Wanhill R.J.H., *Fracture Mechanics*, Edward Arnold Edition

Reference books

1. Broek D., *Elementary Engineering Fracture Mechanics*, Sijthoff & Noordhoff International Publishers
2. Kåre Hellan, *Introduction to Fracture Mechanics*, McGraw Hill Book Company
3. Prashant Kumar, *Elements of Fracture Mechanics*, Wheeler Publishing

03.706.7 MARKETING MANAGEMENT 3-1-0 4 credits

Module I

Introduction to marketing - concept of market and marketing - marketing environment - controllable factors - factors directed by top management - factors directed by marketing - uncontrollable factors - demography, economic conditions, competition, social and Marketing planning - marketing planning process - Boston consultancy group model - marketing mix - marketing mix variables. cultural forces, political and legal forces, and technology

Module II

Market segmentation and market targeting - introduction to segmentation - targeting and product positioning. Marketing research - need and scope - marketing research process - research objectives, developing research plan, collecting information, analysis, and findings - consumer behaviour - factors influencing consumer behaviour - perceived risks - product life cycle - marketing strategies for different stages of product life cycle

Module III

Marketing communication - marketing mix variables - steps in developing effective communication - identification of target audience - determination of communication objectives - designing the message - selecting the communication channels - promotion mix evaluation - advertising and sales promotion - factors in advertising - sales promotion tools

Text books

1. Kotler P., *Marketing Management: Analysis, Planning, Implementation and Control*, Prentice Hall of India Private Limited
2. Ramaswamy V.S. & Namkumari S., *Marketing Management: Planning, Implementation and Control*, Macmillan India Limited

Reference books

1. Stanton W.J., Etzel M.J. & Walker B.J., *Fundamentals of Marketing*, McGraw Hill International Edition
2. Majumdar R., *Marketing Research, Text, Applications and Case Studies*, New Age International (P) Limited Publishers
3. Robert, *Marketing Research*, Prentice Hall of India

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.706.8 ENTREPRENEURSHIP 3-1-0 4 credits

Module I

Entrepreneurial perspectives - understanding of entrepreneurship process - entrepreneurial decision process - entrepreneurship and economic development - characteristics of entrepreneur - entrepreneurial competencies - managerial functions for enterprise

Module II

Process of business opportunity identification and evaluation - industrial policy - environment - market survey and market assessment - project report preparation - study of feasibility and viability of a project - assessment of risk in the industry.

Process and strategies for starting a venture - stages of small business growth

Module III

Entrepreneurship in international environment - achievement motivation - time management - creativity and innovation structure of the enterprise - planning, implementation and growth.

Technology acquisition for small units - formalities to be completed for setting up a small scale unit - forms of organizations for small scale units - financing of project and working capital - venture capital and other equity assistance available - break even analysis and economic ratios technology transfer and business incubation

Reference books

1. Harold Koontz & Heinz Weihrich, *Essentials of Management*, McGraw Hill International
2. Hirich R.D. & Peters Irwin M.P., *Entrepreneurship*, McGraw Hill
3. Rao T.V., Deshpande M.V., Prayag Metha & Nadakarni M.S., *Developing Entrepreneurship A Hand Book*, Learning Systems
4. Donald Kurado & Richard M Hodgelts, *Entrepreneurship A Contemporary Approach*, The Dryden Press
5. Dr Patel V.G., *Seven Business Crisis*, Tata McGraw Hill
6. Timmons J.A., *New Venture Creation-Entrepreneurship for 21st Century*, McGraw Hill International
7. Patel J.B., Noid S.S., *A Manual on Business Opportunity Identification, Selections*, EDII
8. Rao C.R., *Finance for Small Scale Industries*
9. Pandey G.W., *A Complete Guide to Successful Entrepreneurship*, Vikas Publishing

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.706.9 INDUSTRIAL HYDRAULICS 3-1-0 4 credits

MODULE I

Introduction to fluid power – Hydraulics and Pneumatics systems – Fluid power systems – Fundamentals of fluid mechanics – Measurement of physical parameters – Hydraulic symbols .

Fluid power pumps and motors – Types of pumps – Characteristics – Hydraulic cylinders and rams – Fluid power pumping systems and components.

MODULE II

Pressure accumulators – Functions – Fluid reservoirs – Filter in hydraulic circuits. Loading and replacement of filter elements – Materials for filters.

Fluid temperature control – Fluid pressure control –control valves – Sequence valve – Counterbalance valve-unloading valve – Friction control valve – Servo systems.

MODULE III

Industrial hydraulic circuits - Circuit design for – shaper, grinder, material-handling equipments processes - Miscellaneous circuits.

REFERENCES

1. Industrial Hydraulics – John pippon , Tylor Hicks

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.706.10 FINITE ELEMENT METHODS 3-1-0 4 credits

Module I

Introduction, historical background, applications, advantages, disadvantages. Finte element packages.

Theory of elasticity, Stress and Equilibrium, strain-displacement relationship, stress-strain relationship, plane stress, plane strain and axi-symmetric approximation. Temperature effects. Potential energy and equilibrium, Principle of minimum potential energy. The Rayleigh-Ritz method, Discrete and Continuous systems, Galerkin method.
Solution of Algebraic equations, Banded and skyline solutions.
Global, Local and Natural coordinates in 1,2 and 3 dimensions - Area coordinates .
Finite element modeling-Types of elements, Discretization, Mesh generation and numbering, Shape functions-Types, Largrangean and Serendipity elements

Module-II

One dimensional elasticity problems -discretisation of domain into elements - Generalised coordinates approach - derivation of elements equations - assembly of element equations - transformation matrices -Global equations, load Vector, properties of stiffness matrices, imposition of Boundary conditions, penalty and elimination approach.
Multi-point constraints. Axial beam and Bending beam elements. Beams on elastic supports.
Iso parametric formulation. Numerical Integration using Gauss quadrature.

Module-III

Formulation of element equations for 2D elements with CST. Two-dimensional isoparametric elements. Axi-symmetric solid subjected to axi-symmetric loading.
Dynamic problems- Element mass matrices. Evaluation of Eigen values and Eigen vectors. Determination of critical speed of shafts.3D problems in stress analysis, Scalar field problems. One Dimensional Heat flow.

Text Book:-

Introduction to Finite Elements in Engineering, Tirupathy. R. Chandrapatla & Ashok D. Belagundu, Pearson Education

References:-

1. Finite element Methods O.C Zienkieviz & R.L.Taylor.
2. Finite element Method R. D. Cook.
3. Finite element Methods S.S.Rao.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.706.11 METAL FORMING 3-1-0 4 credits

Module I

Basic laws and theories of plasticity - stress space - yield criterion of metals - Von-Mises yield criterion - Tresca criterion - representation of the criteria in stress space - yield surface - subsequent yield surfaces - experimental investigations of the yield criteria - basic considerations of plasticity theory - simple models of material behavior - Levy-Mises stress strain relations - Prandtl-Reuss stress strain relations - experimental verification - plastic potential theory - plastic work - maximum work hypothesis - stability postulates - isotropic and kinematic hardening - plastic flow - temperature and strain rate effects in plastic flow

Module II

Processes - drawing and extrusion - process classification - lubrication - temperature effects - analysis of the processes of drawing and extrusion of wire and strip through friction less dies and dies with friction - production of seamless pipe and tubes - analysis - residual stresses in rods - wires - tubes, deep drawing
Classification of rolling processes - hot rolling - cold rolling - rolling of bars and shapes - analysis of rolling process in conditions of plane strain.
Classification of forging process - open die forging - closed die forging - analysis of forging process in conditions of plane stain - forging allowances and tolerances - sheet metal forming, shearing, blanking, bending and stretch forming

Module III

Slip line field theory - incompressible two-dimensional flow - slip lines - equilibrium equations referred to slip lines - Henkeys theorem - hodographs - simple slip line field analysis in extrusion - compression of block between parallel plates - strip load on semi-infinite body - lower and upper bound theorems with proofs and applications

Text books

1. Oscar Hoffman & George Sachs, *Introduction to Theory of Plasticity for Engineers*, McGraw Hill
2. Dieter G.E., *Mechanical Metallurgy*, McGraw Hill

Reference books

1. Johnson W. & Mellor P.B., *Plasticity for Mechanical Engineers*, D Van Nostrand Co Ltd.
2. Chen W.F. & Han D.J., *Plasticity for Structural Engineers*, Springer Verlag

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.706.12 MACHINE TOOL TECHNOLOGY 3-1-0 4 credits

MODULE I

Principal requirements and specifications – Requirements regarding quality of performance (Accuracy and surface finish) – Productivity(Rate of motel renewal) –Economy and efficiency of machine tools .

Design aspects – Kinematic principles in machine tools with respect to the basic elements and their design – tool , column , frame , slides , guide ways, shafts , spindles , bearings, clutches, rigidity of machine tools structures – Sources, effects and elimination of vibration – Machine tools drives and their kinematics – Electrical, Mechanical, Hydraulic and combination systems - Design of a stepped gear box.

MODUEL II

Hydraulic power , Transmission systems used in machine tools and their various elements – A few common hydraulic circuits used the effect movement of tools slide and work tables.

Miscellaneous – Copying devices – Automates of various kinds feasibility determination for automation – Automatics and assembly line layout – unit heads and transfer machines - Vibration isolated tool holders – Friction and lubrication in machine tools .

MODULE III

Erection and testing of machine tools – Location and layout – Foundations vibration – Isolation – Erection process – Principles of acceptance tests – Measuring equipments and methods – Direction of tolerances – Maintenance of machine tools – Test charts for different machines .

Trends in the design of modern machine tools – Aims and future development - Design for improved static and dynamic performance – Fundamental aspects of numerical control – Adaptive control and hydraulic control of machine tools .

REFERENCES

1. Design of Machine tools - S.K.Basu (Allied pub.)
2. Design principles of metal cutting machine tools – Koenisberger
3. Principles of Machine tools – G.G.Sen and Bhattacharya
4. The Design and Construction of Machine tools – M.C.Town
5. Machine tools design course – Central Machine tool Institute
6. Machine tools design Volume 1,2,3,4 – N. Acherkan
7. Tool Engineer Hand Book – Mc.Graw.Hill

University Examination

5. The question paper shall contain two parts. Part A and Part B.
6. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
7. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.706.13 Turbo Machines 3-1-0 4 credits

Module I

Energy transfer between fluid and rotor, classification of fluid machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency for compressors and turbines.

Module II

Centrifugal fans and blowers : Types, stage and design parameters, flow analysis in impeller blades, volute and diffusers, losses, characteristics curves and selection, fan drives and fan noise.

Centrifugal Compressors: Construction details, types, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

Module III

Axial flow compressors : Stage velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, work done factor, simple stage design problems and performance characteristics.

Axial and radial flow turbines : Stage velocity diagrams, reaction stages, losses and coefficients blade design principles, testing and performance characteristics.

Text Book:

1. Yahya, S.H., " Turbines, Compressor and Fans ", Tata Mc Graw Hill Publishing Company, 1996.

References:

1. Bruneck, Fans, Pergamom Press, 1973.
2. Earl Logan, Jr., " Hand book of Turbomachinery ", Marcel Dekker Inc., 1992.
3. Dixon, S.I., " Fluid Mechanics and Thermodynamics of Turbomachinery ", Pergamom Press, 1990.
4. Shepherd, D.G., " Principles of Turbomachinery ", Macmillan, 1969.
5. Stepanff, A.J., " Blowers and Pumps ", John Wiley and Sons Inc., 1965.
6. Ganesan .V., " Gas Turbines ", Tata Mcgraw Hill Pub. Co., New Delhi, 1999.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.706.14 MECHATRONICS 3-1-0 4 credits

Module I

Introduction to Mechatronics – scope-Mechatronics and Engineering Design. Sensors and transducers – classification-thermal, electrical, optical, acoustic, pneumatic, magnetic, and piezo electric sensors- Open loop and closed loop control systems- continuous and discrete processes- servo mechanism – principles-components-error detectors: Potentiometers- types. Pneumatic and hydraulic systems - mechanical and electrical systems.

Condition monitoring – principles-sensors for force, vibration, temperature, and noise-acoustic emission – principles and applications.

Module II

Design of modern CNC machines and Mechatronic elements-Machine structure-guide ways-drives-bearings-anti friction bearings, hydrostatic bearing, hydrodynamic bearing. Measuring system for NC machines-direct and indirect measuring system- Smart sensors.

Closed loop controllers - proportional, derivative and integral controls - PID controller - digital controllers - controller tuning - Adaptive control of machine tools.

Mechtronics in Robotics-robot position and proximity sensing-tactile sensing. Man-machine interface.

Module III

Micro controllers and microprocessors - digital logic circuits - micro controller architecture and programming - programmable logic controllers. Automatic control and real time systems-Neural network systems-Fundamentals of ANN – perceptions – back propagation.

System modelling - mathematical models - mechanical, electrical, fluid and thermal system building blocks - system models - dynamic response of systems - first and second order systems - modelling dynamic systems - system transfer functions - frequency response - stability

Stages in Designing mechatronic systems - Traditional and Mechatronic design -Possible design solutions-Case studies of mechatronic systems - Pick and place robot - automatic car park system -engine management system.

Text book

Bolton W., Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Addison Wesley Longman Limited

Reference books

1. Dorf R.C. & Bishop R.H., Modern Control Systems, Addison Wesley
2. Krishna Kant, Computer Based Industrial Control, Prentice Hall of Indian Private Limited
3. HMT Limited, Mechatronics, Tata McGraw Hill Publishing Company Limited
4. Herbert Taub & Donald Schilling, Digital Integrated Electronics, McGraw Hill International Editions
5. Dan Necsulescu, "Mechatronics",Pearson Education Asia,2002(Indian reprint).

6. Michael B. Histand and David G.Alciatore, " Introduction to Mechatronics andMeasurement Systems ", McGraw Hill International Editions, 1999.
7. HMT Ltd., " Mechatronics ", Tata McGraw Hill Publishing Co. Ltd., 1998.
8. D.A.Bradley, D.Dawson, N.C.Buru and A.J.Loader, " Mechatronics ", Chapman and Hall, 1993.
9. K.Ram, " Fundamentals of Microprocessors and Microcomputers ", Dhanpat RaiPublications, Fourth Revised Edition, 1999.
10. Ramesh S. Gaonkar, " Microprocessor Architecture ", Programming and Applications,Wiley Eastern, 1997.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.706.15 EXPERIMENTAL METHODS IN ENGINEERING 3-1-0 4 Credits

MODULE I

Pressure measurement devices – U tube manometer – Well type manometer – Different types of manometers. Elastic pressure transducers – Bourdon tubes – Diaphragms – Bellows. Capacitance pressure gauge. Diaphragm type strain gauge pressure pickup. LVDT diaphragm differential pressure gauge. High-pressure measurement – very high-pressure transducer. Low-pressure measurement – Mc Leod-gauge pirani thermal conductivity gauge – Knudsen gauge – lonization gauge. Dead weight tester for static calibration of pressure gauges.

Methods for flow measurement – Positive displacement methods – rotary vane flow meter – Lobed impeller flow meter. Flow obstruction methods – Venturi – flow nozzle – orifice. Practical considerations for obstruction flow meters. Recommended proportions for venturi tubes, flow nozzles and orifices. Flow measurement by drag effects – rotameter – turbine meter – vortex shedding flow meter. Hot wire and hot film anemometers. Thermal mass flow meter. Magnetic flow meter. Pressure probes – pitot tube – pitot static tube – Kiel probe. Yaw angel – yaw angle characteristics of various static pressure probes. Fluid factors, application factors and installation factors of different types of flow meters.

MODULE II

Temperature measurement by mechanical effects – mercury in glass thermometer – bimetallic strip type – fluid expansion thermometers. Temperature measurement by electrical effects – electrical resistance thermometer. Methods of correction for lead resistance – Siemens three lead arrangement – callender four lead arrangement and floating-potential arrangement. Thermostats. Temperature measurement due to thermo-electric effects – thermocouples – different types and its range – law of temperature – emf vs temp relationships for different thermocouples – sensitivity of thermocouples – thermopile and its practical application – installation of thermocouple on a metal plate – Thin foil thermocouples for rapid transient response. Temperature measurement by radiation – optical pyrometer.

Thermal conductivity measurement – guarded hot plate apparatus – measurement of thermal conductivity of metals. Thermal conductivity of liquids and gases – guarded hot plate apparatus – concentric cylinder method – apparatus for determination of thermal conductivity of gases at high temperatures. Measurement of viscosity – rotating concentric cylinder apparatus – Saybolt viscometer. Gas diffusion – measurement of diffusion coefficients in gases. Convection heat transfer measurements – forced convection heat transfer coefficients in smooth tubes. Humidity measurements. Heat flux meters.

MODULE III

Elastic elements for force measurements – simple cantilever and thin ring elastic elements – Proving ring. Torque measurements – hollow cylinder for torque measurement – Prony brake – hydraulic dynamometer – Cradled dynamometer. Strain measurements – electrical resistance strain gauges- different types – characteristics of strain gauge materials. Temperatures compensation for electrical resistance strain gauges strain gauge rosettes – bonded and unbounded resistance strain gauges.

Cantilever beam used as a frequency measurement device. Principles of seismic instrument – practical considerations for seismic instruments – electrical resistance strain gauge seismic instrument – piezoelectric transducer type seismic instrument. Sound measurements – microphones – characteristics of microphones. Psychoacoustics factors – sound level meter – acoustic properties of materials – sound absorption coefficient – noise reduction coefficient. Air pollution measurement – units for pollution measurement – air pollution standards – Air sampling train.

REFERENCES:

1. Experimental Methods for Engineers : J.P. HOLMAN

2. Measurement System – application and Design : ERNEST O. DOEBELIN
3. Industrial Instrumentation : DONALD P. ECKMAN

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.707 Thermal Engineering Lab 0-0-2 2 Credits

2. **Performance analysis of parallel flow, Counter flow and cross flow heat exchangers.**
3. Determination of heat transfer coefficients using forced and free convection apparatus.
4. Conduction heat transfer analysis of
   a) Plane composite walls
   b) Cylindrical composite walls
5. Determination of emissivity
6. Study and Performance Analysis of
   a) Reciprocating compressor
   b) Rotary compressor
   c) Blowers
7. Test on refrigeration and air conditioning equipment.
8. Thermocouple calibration and working
9. Pressure gauge calibration
10. Velocity profile using pitot tube.

03.708 Mechanical Engineering Lab(MU) 0-0-2 2 Credits

Metallurgy: Study of Polishing Machines - Metallurgical Microscope – Specimen preparation for Microstructure studies- Microstructure study of Mild steel, Cast iron, High carbon steel, Brass and Aluminium. Grain size measurement

Metrology: Study of different Metrological Measuring Instruments- Study and experiment using profile projector – Surfometer, Comparator, Slip gauge etc. Measurement of screw threads- Flatness testing of surface plates using auto collimator. Angle measurements using sine bar and slip gauges.

Instrumentation : Study and test using tool dynamometers., Study and test using strain gauges, LVDT

CIM: Study of Computer Integrated manufacturing, CNC machines, Robots, FMS Study of EDM & ECM, Rapid prototyping

03.709 Project & Seminar 0-0-2 2 Credits

The Students shall do a project work, which can be the preliminary work of final project, and submit a report at the end of semester.

The students shall present a seminar on a topic which is of high relevance to Mechanical Engineering. A report on seminar also shall be submitted at the end of the semester. 25% credit for Project, and 75% credit for Seminar.

03.801 Energy Conversion & Management 3-1-0 4 Credits

Module I

Energy conversion processes and devices – Energy conversion plants – Conventional (Thermal, Hydro, Nuclear fission) and Non – conventional (Biomass, Fuel cells and Magneto Hydrodynamics) – Energy storage and Distribution – Electrical energy route – Load curves – Energy conversion plants for Base load , Intermediate load, Peak load and Energy displacement – Energy storage plants.

Module II

Energy Management – Definitions and significance – objectives – Characterising of energy usage – Energy Management program – Energy strategies and energy planning – Energy Audit – Types and Procedure – Optimum performance of existing facilities – Energy management control systems – Energy policy in India – Computer applications in Energy management

Module III

Energy conservation – Principles – Energy economics – Energy conservation technologies – cogeneration – Waste heat recovery – Combined cycle power generation – Heat Recuperators – Heat regenerators – Heat pipes – Heat pumps – Pinch Technology

Energy Conservation Opportunities – Electrical ECOs – Thermodynamic ECOs in chemical process industry – ECOs in residential and commercial buildings – Energy Conservation Measures.

References

1. Energy Efficiency for Engineers & Technologists- T.D.Eastop and D.R. Croft by Longman Group Ltd.
2. Handbook of Energy Audits by Albert Thumann, P.E, C.E.M and Wlliam.J.Younger, C E.M by Fairmont Press Ltd.
3. Energy Management Hand book by Wayne.C.Turner by Fairment Press Ltd.
4. Energy Technology by S.Rao and Dr.B.B.Parulekar, Khanna Publishers.
5. Non – conventional Energy Sources by G.D.Rai, Khanna Publishers.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.802 Computer Integrated Manufacturing (MN) 3-2-0 5 Credits

Module I

NC machines- Types – Point- to point, straight cut and continuous path type- Feed back devices- Encoders, Resolvers, Optical grating-Inductosyn- Open and closed loop controls-Accuracy of NC machines- Stick – Slip, Backlash and wind-up. Antifriction bearings- linear guides.

Ball screws, stepper motor, servo meter, I V and PIV drives-CNC and DNC, Adaptive controls.

Part programming.

Module II

CIM- Meaning and scope of CIM, Nature of CIM systems, Types of manufacturing systems-Computers in manufacturing- needs of CIM- CIM software- manufacturing automation protocol (MAP)- Date base technology- basic concepts, requirements, Types-Data base management-DBMS- RDBMS.

CAD-areas of application-benefits, CAE-CAPP-Elements of CAPP system, advantages of CAAP- MRP.

Module III

Group Technology- Cellular manufacturing –FMS- JII- communication networks in manufacturing. Robotics and material handling – Introduction, types- Programming- Robotic controls, Automated guided vehicles- types, Technology- AS/RS.

Role of management in CIM- Expert system, computer vision, concurrent Egineering.

References:

1. CAD/CAM/CIM – Mikell P Groover- PHI
2. CAD/ CAM/CIM—P. Radhakrishnan & S. Subramoniam
3. Principles of CIM—S. Kant and Vajpayeee, PHI
4. Manufacturing Engg & Technology- Kalpakijan.
5. Industrial Robotics Mikell P Groover

University Examination

a. The question paper shall contain two parts. Part A and Part B.
b. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
c. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.803 Automobile Engineering 3-1-0 4 Credits

Module I

Automobiles- Classification of Automobiles- different types of power units. Constructional details of reciprocating type power unit- multi cylinder engines: Cylinder block- crank case- cylinder liners- cylinder head- pistons- piston pins- piston rings- connecting rod, crank shaft- cam shaft- different types of valve operating mechanism- OHV, OHC side valve.

Cooling System: Introduction- requirement of cooling system- direct- indirect cooling- Thermo siphon- pumped circulation- pressurized cooling – Radiator- radiator cap- use of thermostat- water circulating pump- cooling fan- types of fan drive.

Lubrication: Main functions of lubricating system- properties of lubricants- different methods of engine lubrication- Petrol – Splash- pressure – wet sump- Dry sump.

Air- fuel systems: Air filter- fuel filter- mechanical- electrical feed pumps (AC & SU) Carburetor- down- horizontal – up draft- constant and variable choke- simple carburetor with compensator device- modern carburetor- different circuits- Petrol injection system-MPFI-Contact point ignition system-electronic ignition system. Diesel engine fuel circuit- injector pumps- (constant and variable stroke- rotary pump)- CRDI system- fuel injector Electrical systems . Starter motor- different types of starter drive- Bendix- solenoid shift- over running clutch- Ignition system- Magneto coil- battery coil- electronic- spark advance- centrifugal- vacuum- spark plugs – Fuel gauge – direction indicator – wind screen wiper.

Module II

Transmission Systems : Clutch- single plate dry- multiplate wet- Constructional details of single plate dry Clutch- Automatic Clutch- centrifugal – semi centrifugal- magnetic- diaphragm- fluid coupling- Torque converters.

Gear boxes- constant mesh- synchromesh- propeller shaft- front wheel- rear wheel drive- Hook's slip joints- differential unit- hypoid drive- details- non- slip differential – Axles- dead live- different types of rear live axles- semi floating- three quarter floating – full floating – four wheel drive.

Automatic transmission: Epicyclic Gear box- Semi automatic pre-selector gear box- Brog warmer, Hobbs and smiths transmissions- over drive. Variomatic transmission used in two-wheelers.

Module III

Braking System: Mechanical, Hydraulic, Pneumatic brakes- internal expanding shoe- disc breakers- master Cylinder- wheel cylinder – power brakes- Steering systems- Steering Geometry – Castor- camber- king-pin inclination- toe in and toe – out- front wheel steering, rear wheel- four wheel steering, fifth – steering gears- worm and wheel- screw and nut recirculating ball- cam and roller- rack and pinion- power steering.

Chassis and suspension: Construction of chassis- frame – body- suspension- independent- torsion bar- coil spring- leaf spring-chassis lubrication- Types wheels- integrated rim- flat base rim- Tyres.

Exhaust emission- pollution control – low polluting engines- stratified charge engine-method of charge stratification. Hybrid vehicles. Automotive air-conditioning

Text Books

1. Automotive Mechanics, Joseph Hietner, East- West Press Pvt. Ltd, Madras.
2. Practical Automobile Engineering, Station Abby, (Asia Publishing House).
3. Modern Transmission System., A.W. Judge
4. Automotive Emission Control, W. H. Grouse
5. Internal Combustion Engine and Air Pollution, Edward F. Obert.
6. Automobile Engineering- Vol. I & II, Kirpal Singh, Standard Publishers Distributors, Delhi.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.804 Seminar 0-0-3 3 Credits

The Student shall present a Seminar based on industrial visits under taken from V-VII semesters. A minimum of four visits are compulsory. A report on industrial visits shall be submitted.

The institution shall arrange minimum four Seminars on latest topics by experts from Industry.

The student shall be evaluated based on the report on industrial visits, presentation, interaction, performance in the class and general awareness on topics of expert lectures

03.805.1 EXPERIMENTAL STRESS ANALYSIS TECHNIQUES 3-1-0 4 credits

MODULE I

Basic concepts : The generalized basic systems – Definition – Stress at a point - Stress equation of equilibrium – Principal stress – Two dimensional stress systems – Strain and stress relations – Principal strain – Strain compatibility – Plane stress – Plane stress and strain problems –

Photoelastic methods : Behaviour of light – Polarised light – Plane polariser – Wave plate – Conditioning of light by a series combination of linear polariser and a wave plate – Arrangement of optical elements in polariscope . The stress optic law in two dimensions at normal incidence – Plane polariscope – Circular polariscope - Fringes – Moiré techniques – Photo elastic photography – Photo elastic model materials – Properties – Calibration methods – Analysis of photoelastic data – Isochromatics – Isoclinics – Compensation techniques - Application of photo elastic methods .

MODULE II

Electrical strain gauges – Definition of strain and its relation to experimental determination – Strain gauge – Types – Analysis – Strain sensitivity – Gauge construction – Temperature compensation – Rosette analysis – Rectangular Delta - *** Delta – Stress gauge – Strain gauge circuits – Wheatstone bridge – Null Balance recording instruments – Cathode Ray Oscilloscope.

MODULE III

Non Destructive Tests – Need , Types – Visual Examinations , penetrate tests , Hammer tests – Brittle coating techniques – Crack patterns – Types of coatings – Elementary ideas-Holographic non Destructive testing .

REFERENCES

1. Photo elasticity - M.M.Frocht
2. Experimental stress analysis – J.W.Dally and W.P.Railey
3. Applied stress Analysis – Durelli and Philips
4. Experimental stress analysis and Motion Measurement – R.C.Dove and B.H.Adams
5. Moire Fringes Strain Analysis – Pericles Theocaries

University Examination

4. The question paper shall contain two parts. Part A and Part B.
5. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
6. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.805.2 AEROSPACE ENGINEERING 3-1-0 4 credits

Module – I

The atmosphere-characteristics of troposphere , stratosphere , thermosphere , and ionosphere- pressure, temperature and density variations in the atmosphere .

Application of dimensional analysis – aerodynamic force – model study and similitude.

2D aero foils -Nomenclature and classification- pressure distribution in inviscid and real flows- momentum and circulation theory of aerofoil- characteristics.

3D or Finite aero foils – effect of releasing the wing tips- wing tip vortices- replacement of finite wing by horse shoe vertex system- the lifting line theory-wing load distribution – aspect ratio, induced drag- calculation of induced drag from momentum considerations. Skin friction and from drag- changes in finite wing plan shape.

Module II

Propellers – momentum and blade element theories –propeller coefficients and charts.

Aircraft performance-straight and level flight –power required and power available graphs for propeller and jet aircraft-gliding and climbing –rate of climb-service and absolute ceilings-gliding angle and speed of flattest glide-take off and landing performance – length of runway required- aircraft ground run- circling flight – radius of tightest turn-jet and rocket assisted take –off- high lift devices-range and endurance of airplanes-charts for piston and jet engine aircrafts.

Module III

Flight Instruments-airspeed indicator, calculation of true air speed-altimeter-gyro horizon -direction indicator-vertical speed indicator –turn and back indicator-air temperature indicator. (Brief description and qualitative ideas only)

Ideas on stability-static and dynamic stability- longitudinal, lateral and directional stability- controls of an aero plane- aerodynamic balancing of control surfaces- mass balancing (Qualitative ideas only)

Principles of wind tunnel testing –open and closed type wind tunnels-wind tunnel balances- supersonic wind tunnels.
Study of subsonic, Transonic, and supersonic aircraft engines (Description with fig. Only). Elementary ideas on space travel-calculation of earth orbiting and escape velocities ignoring air resistance and assuming circular orbit.

References:

1. Mechanics of flight. A. C. Kermode
2. Aerodynamics for Engineering Student Houghton and brock.
3. Fundamentals of Aerodynamics Anderson
4. Aircraft Instruments and Integrated systems- EHJ Pallett

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.805.3 FACILITIES PLANNING 3-1-0 4 credits

Module I

Design of layout of factories, Office, Storage area etc. on consideration of facilities of working people, Storage facilities and general equipment for amenities of working people – Product, Process and combination layout – Systematic layout planning – Design of Assembly lines, Line balancing methods, Computer applications in layout designs.

Module II

Environmental aspects like lighting, Ventilation, dust control, humidity. Different type of Plant services like steam compressed air etc. – Plant safety, Elements off Industrial safety- Causes and prevention of accidents – Pollution and environmental consideration.

Module III

Material handling system and equipment – Material handling in Plants , Stores and warehouses , Receiving and dispatching area – Choice of material handling equipment – Cost control in material handling.
Equipment replacement – Repair, replacement depends on technical and economical consideration. Use of DCF techniques.

REFERENCE

1. Plant layout and Material Handling- John A Sehbin
2. P L M H - James A Apple
3. P L M H - A W Peymberton
4. FF & Control - G Aysan

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.805. 4 Advanced Decision Modelling 3-1-0 4 credits

MODULE I

Development of operations research as a branch of knowledge since 2nd world war – Fields of application of operations.
Queuing theory – Birth and death processes – Basic queuing process – Single server and multiple server models – Poison input and exponential service – Limited source, limited queue etc. Priority disciplines – Practical applications.
Linear programming – Graphical solutions – Simplex method – Transportation problem –Assignment problem solution to transportation, Assignment and trans-shipment problems – Post optimality analysis – Complications and their resolution – Practical applications and examples.

MODULE II

Network theory – Maximal flow problems – Travelling salesman problems - network with PERT / CPM.
Introduction to dynamic Programming, Stochastic programming and integer programming
Inventory theory – deterministic inventory models.

MODULE III

Decision making – Statistical decision theory. Decision trees . Replacement – replacement in anticipation of failure – Group replacement.

Scheduling on machines 2 job – 2-machine problem – Johnson's algorithm – graphical solution.

Game theory – Practical application of game theory – 2 person zero – Sum games – Solving simple games – Mixed strategy – Graphical solution.

REFERENCE

1. Introductions to operations research – Hillier and Lieberman (Holden day)
2. Introductions to operations research – Wagner and Pranti ,Philips and Ravindran
3. Fundamentals of operations research – Ackeff and Sasionic (Wiley)
4. Operations research - Churchman ,Ackeff and Arneff (Wiley)
5. Operations research - Taha (Mc graw Hill)

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.805.5 NONLINEAR DYNAMICS & CHAOS 3-1-0 4 credits

Module I

Introduction to dynamical systems: discrete time systems - continuous time systems - autonomous and non autonomous systems - phase space and flows - attracting sets - concepts of stability

Equilibrium solutions: fixed points and stability of continuous - time systems - classification and stability of equilibrium solutions - fixed points of maps and their stability - local and global bifurcation of continuous systems - static and dynamic bifurcations - bifurcation of maps

Module II

Periodic solutions - periodic solutions of continuous - time dynamical systems - autonomous and non autonomous systems - limit cycle - floquet theory - poincare' maps - bifurcation - symmetry breaking - cyclic fold - period doubling - transcritical and Hopf bifurcations

Quasiperiodic solutions: Poincare' maps - circle map - construction of quasiperiodic solutions

Chaotic solutions of maps: dynamics of logistic equation - bifurcation diagram of one-dimensional maps - feigenbaum number - Henon map

Chaotic solutions of continuous systems: Duffing's equation - Rossler equations - period doubling and intermittency mechanisms

Module III

Experimental methods in chaotic vibrations: experimental system to measure the Poincare' map of a chaotic physical system

Fractals and dynamical systems: Koch curve - cantor set - fractal dimension - measures of fractal dimension - capacity dimension - correlation dimension and Information dimension - fractal dimension of strange attractors

Tools to identify and analyze motions: time history - state-space and pseudo state space - embedding dimension and time delay - Fourier spectra, Poincare' sections and maps - lyapunov exponents

Text books

1. Nayfeh A.H. & Balachandran B., *Applied Nonlinear Dynamics*, John Wiley
2. Thomson J.M.T. & Stewart H B, *Nonlinear Dynamics And Chaos*, John Wiley
3. Moon F.C., *Chaotic and Fractal Dynamics*, John Wiley

Reference books

1. Wiggins S., *Introduction To Applied Nonlinear Dynamical Systems And Chaos*, Springer Verlag
2. Baker G.L.& Gollub J.P., *Chaotic Dynamics*, Cambridge University Press
3. Peitgens, Jurgens & Saupe, *Chaos and Fractals*, Springer Verlag
4. Scheinerman E.R., *Invitation to Dynamical Systems*, Prentice Hall

03.805.6 DESIGN OF JIGS & FIXTURES 3-1-0 4 credits

Module I

Introduction - purpose of work holding devices - principles of jig and fixture design - construction methods and materials used - process planning and typical operation layout product considerations - pre-design analysis - product analysis - operation analysis - machine analysis - operator analysis and cost analysis - examples of pre-design analysis - principles of locating and positioning - definition of location - basic principles - methods of location - pin and button locators - plane, concentric, spherical, radial and V-locators - redundant locators

Module II

Design and mechanics of clamping devices - principles of clamping - standard fixture components - types of clamps - strap, swing, hinge and two-way (multiple) clamps - wedge, pinch and magnetic clamps - latch and self locking clamps - pneumatic, hydraulic and pneumo-hydraulic clamps - design considerations in work holder design and selection - design calculations of lever type clamp - hook type clamp - wedge type clamp - screw clamps - mandrels and collet - chucks - worked examples

Module III

Fixtures - milling fixtures - slot and key-way milling fixtures - fixture for milling flanges - straddle milling fixtures - indexing fixture - face milling fixture with equalizers - profile milling fixtures - universal fixture for profile milling - boring and lather fixtures - fixture design - examples of design and drawing of milling fixtures for machining of simple components - fixtures for inspection testing and assembly - welding fixtures - economics

Drill Jigs -definition - drill guide bushings - jig feet and legs - types of drill jigs -template -vise - leaf box and tumble jigs - indexing jigs - jaw chucks - drive chucks - magnetic chucking devices -mandrels - machine vices - indexing tables and worktables - examples of design and drawing of drill jig for machining of simple components

Reference books

1. Kempster M.H.A., "*An Introduction to Jig and Tool Design"*, ELBS
2. ASTME, *Fundamentals of Tool Design*
3. Grant H.E., "*Jigs and Fixtures - Non Standard Clamping Devices*", Tata McGraw Hill
4. Goroshkin A.K., "*Jigs and Fixtures Hand Book*", MIR Publishers
5. Wilson & Holt, "*Hand book of Fixture Design*", McGraw Hill
6. Colving & Haas, "*Jigs and Fixtures - A Reference Book*", McGraw Hill
7. Cole B., "*Tool Design*", Taraporevala
8. Donaldson, Lecain & Goold, "*Tool Design*", Tata McGraw Hill

03.805.7 Environmental Pollution Control 3-1-0 4 credits

Module I

Environmental aspects - Impact of environment - Environmental quality - Role of environmental engineer.

Air quantity - Definition, Characteristics and prospective - Types of our air pollutants - effect of air pollution on men and environment - Formation of air pollutants from combustion of fossil fuels and parameters controlling the formation.

Module II

Water pollution from tanneries and other industries - Engineered systems for waste water treatment and disposal - Control systems and instrumentation for pollution control.

Definition, characteristics - Types and sources of solid waste - Solid waste management - generation, collection, storage and processing techniques - Solid waste disposal.

Module III

Methods and equipment's for industrial waste treatment - Pollution thermal power plants and nuclear power plants - Sources and control methods - Emission from SI and CI engines - Evaporative emission control -Exhaust treatment devices - Noise pollution and their control.

Text Book:

1. Howard S. Peavy, Donald R.Rowe, and George Tchobanoglous, " Environmental Engineering ", (1985), Mc Graw Hill, New Delhi.

References:

1. A.C.Stern, H.C.Wonter, R.W. Boubce and W.P.Lowry, "Fundamental of Air Pollution ", (1973), Academic Press.

2. Ikken P.A. Swart R.J. and Zwerves. S, " Climate and Energy ", (1989). Mc Graw Hill, New Delhi.
3. Metcalf and Eddy Inc, " Waste Water Engineering Treatment and Disposal Second Edition ", (1979), Mc Graw Hill, New York.
4. Wark, Kenneth and Cecil F.Warner, " Air Pollution: its Origin and Control ", (1976), Dun Dunnellers, New York.
5. Tchobanoglous.G, H.Theisan and R.Elaisen, " Solid Water: Engineering Principles and Management Issues ", (1977), Mc Graw Hill, New York.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.805.8 MULTI-PHASE FLOW 3-1-0 4 credits

Module I

Basic equations and empirical correlations for multi-phase flow - flow patterns - identification and classification - flow pattern maps and transition - momentum and energy balance - homogeneous and separated flow models - correlations for use with homogeneous and separated flow models - two phase flow through inclined pipes and singularities - void fraction and slip ratio correlations - influence of pressure gradient - empirical treatment of two phase flow - drift flux model - correlations for bubble, slug and annular flows - pressure losses through enlargements, contractions, orifices, bends and values

Module II

Boiling and multiphase heat transfer - vapour-liquid equilibrium mechanisms - pool boiling convective boiling - heat transfer in partial and fully developed sub-cooled boiling - void fraction and pressure drop in sub-cooled boiling - saturated boiling heat transfer - two phase forced convection laminar and turbulent flow solutions for film heat transfer - empirical equations for film boiling and transition boiling - burnout mechanism and correlations - critical coefficient in nucleate and convective boiling

Module III

Condensation - basic processes of condensation - mechanism of evaporation and condensation - film condensation on a planar surface - dropwise condensation - pressure gradient in condensing systems - methods of improving heat transfer coefficient in condensation.

Critical multiphase flows - mathematical models - critical flow criterion - compatibility conditions and their physical interpretation - experimental observations - propagation of small disturbances - pressure drop limitation effect - graphical representation of critical flow conditions

Text books

Collier J.G., *Convective Boiling and Condensation*, McGraw Hill

Reference books

1. Hsu Y.Y. & Graham R.W., *Transport Processes in Boiling and Two Phase Systems*, Hemisphere
2. Ginoux J.J., *Two Phase Flows and Heat Transfer*, Hemisphere, McGraw Hill
3. Tong L.S., *Boiling Heat Transfer and Two Phase Flow*, Wiley
4. Hewitt G., Delhaye J.M. & Zuber N., *Multiphase Science and Technology*, Vol. I., McGraw Hill

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.805.9 WELDING TECHNOLOGY 3-1-0 4 credits

MODULE I

Introduction – Welding as a fabrication process – Advantages and limitations – Principal types of welding and their characteristics .

Soldering and Brazing : Soldering – Silver soldering and aluminium soldering – Brazing of ferrous and non ferrous metals – Different fluxes advantages and limitations of soldering and brazing .

Pressure welding process : Forge welding , spot , seam , projection , percussion welding , butt welding ,flash butt welding .

Fusion welding : Oxy-acetylene welding – Equipments used – Types of flame and adjustments – Welding of ferrous and non ferrous metals and their alloys – Filler material – Fluxes used for gas welding – Edge preparation for rightward and leftward techniques – Safety rules in oxy-acetylene welding.

MODULE II

Electric arc welding : Electric properties of the arc – Welding properties of the arc – Arc welding machines – A.C and D.C types – Advantages and limitations – Application of straight and reverse polarity – Shielded and submerged arc welding process – Carbon arc welding arc and gas welding symbols

Electrode materials – Core wire materials – Coatings and classifications – Purpose of protective fluxes – slags and gases

MODULE III

Special welding process : Electro slag , electron beam , plasma arc , ultrasonic , laser , friction explosion and cold welding process .

Weldability of metals : Weldability and its testing – Weldability of wrought iron – low , medium and high carbon steels – Grey , white mailcable cost irons stainless steels , high speed steels , Aluminium , Magnesium and copper alloys .

Metallurgy of welding : Thermal effects of welding on the welded joints - Heat affected zone – Grain control , Microstructure control – Internal stresses and corrosion control – Concentration and expansion – Absorption of gases by welds .

Testing and inspection : Welding defects – Destructive and non-destructive testing of welds – Repair and salvage of welding – Elementary ideas of welding design – Welding jigs.

REFERENCES

1. Welding Engineering - Rossi
2. Metallurgy of Welding - Udin and others
3. The electric welder - Teo goisky
4. Welding Engineers Hand Book - ASHE Vol . I ,II , III and IV.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.805.10 ADVANCED FLUID MECHANICS 3-1-0 4 credits

MODULE I

Types of motion of fluid elements – Concept of rotational and irrotational flows. Verticity and circulation – Stream function and velocity control .

Stream function and its relation with velocity field . Relation between stream function and stream lines - Relation between stream function and velocity potential for a 2-D irrotational and incompressible flow .

Relation between stream lines and lines of constant potential .

Uniform flow . Two dimensional flow from source or to sink. Source in a uniform flow. The doublet . Flow around a circular cylinder given by a doublet in a uniform stream. Rotating cylinder in a uniform stream.

MODULE II

Complex potential function . Uniform flow , source , voken and doublet . Doublet in a uniform stream . Introduction to conformal transformation . Length rotation between corresponding elements in transformed planes . Velocity ratios between corresponding points .Transformation of a flow pattern . Examples with simple cases .

Dimensional analysis on similitude. Natural dimension analysis. Buckingham Pi-theorem and its applications. Important dimensionless groups in fluid mechanics and their significance. Geometric , kinematic and dynamic similarity . Model study .

MODULE III

Incompressible viscous flow . Concepts of laminar and turbulent flows . Stokes viscosity law. Havier stock's equation and significance (Derivation not necessary) .Simplification of Havier stock equation for steady incompressible flows with negligible body forces . Parallel flow through straight channel and covetto flow . Haagun - Poiseville flow .

Concepts of hydrodynamic boundary layer . Critical Reynold's number . Separation of boundary layers . Displacement thickness , momentum thickness and energy thickness. Techniques of boundary layer control.

REFERENCES

1. Fluid mechanics - V.L.Streetor
2 Elements of fluid mechanics – Vuan
3 Mechanics of fluid - Shames.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.805.11 CONTROLS IN MACHINE TOOLS 3-1-0 4 credits

MODULE-I

Hydraulic control- Hydraulic principles- elements of hydraulic systems- pumps filters, seals, valves, accumulators etc. Study of their functional & design characteristic. Analysis and study of typical hydraulic circuits in machine tools. Design of systems for specific requirements- Introduction to servo systems- maintenance of hydraulic systems- Pneumatic and hydro pneumatic circuits.

MODULE- II

Numerical control: Introduction to numerical control- Application of NC machines – Types of Numerical control- Information flow in NC machine tool- Information carriers- tape reader- interpolator – Measuring devices- analogue, Digital incremental and digital absolute.

MODULE-III

Programming- manual and computer aided programming- Programming languages- APT, ADAPT, EXAPT, Economics of numerically controlled machines, adaptive control principles.

REFERENCES:

1. Industrial Hydraulics- John Pippinger
2. Machine Tools Design—Acherkan
3. CAD/CAM- Mikel P Groover
4. NC Machines & CAM- Kundra. C. K, P. N. Rao, N. K. Temeri.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.805.12 Design of Pressure Vessels & Piping 3-1-0 4 credits

Module I

Methods for determining stresses - Terminology and Ligament Efficiency - Applications.
Stresses in pressure vessels: Stresses in a circular ring, cyclinder - Membrane stress Analysis of Vessel Shell components - Cylindrical shells, spherical sheels, torispherical heads, conical heads - Thermal stresses - Discontinuity stresses in pressure vessels.

Module II

Design of vessels : Design of tall cyclindrical self supporting process columns - supports for short vertical vessels – stress concentration - at a variable thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of reinforcement - pressure vessel design.

Module III

Bucking and fracture analysis in vessels : Buckling phenomenon - Elastic Buckling of circular ring and cylinders under external pressure - collapse of thick walled cylinders or tubes under external pressure - effect of supports on Elastic Buckling of cylinders - Buckling under combined External pressure and axial loading - Control and significance of Fracture Mechanics in Vessels - FEM application.
Piping : Introduction - Flow diagram - Piping layout and piping stress Analysis.

Text Book:

1. John F. Harvey, " Theory and Design of Pressure Vessels ", CBS Publishers and Distributors, 1987.

References:

1. Henry H. Bedner, " Pressure Vessels, Design Hand Book ", CBS Publishers and Distributors, 1987.
2. Stanley, M. Wales, " Chemical Process Equipment, Selection and Design. Buterworths series in Chemical Engineering ", 1988.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.805.13 TRIBOLOGY 3-1-0 4 credits

MODULE I

Friction : Nature of surfaces – Mechanism of friction – Laws of friction and friction theories – Merits and demerits .
Wear : Classification of wear – Theories of wear – Stages of Cohesive wear – Quantitative relationship for abrasive wear – Minor types of wear – Factors affecting wear .

MODULE II

Lubrication : Role of lubrication in present day practice – Fundamentals of viscosity and viscous flow – Flow through capillary tubes – Parallel plates – Radial flow between parallel circular plates – Continuity equation and Raynold's equation .
Viscosity and Viscometers – Starsor Viscometer – Falling sphere viscometer – Saybelt Universal Viscometer – Viscosity index.

MODULE III

Analysis of hydrostatic oil pads – Load carrying capacity – Oil flow – Power loss – Application to thrust bearing , use of restrict hydro static squeeze films .
Analysis and application of Hydrodynamic Lubrication – Load carrying capacity , power loss and friction in ideal journal bearings – Use of linkage factors – Significance of Sommerfeld number – Eccentricity ratio – Unit load .

REFERENCES

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.805.14 VALUE ENGINEERING 3-1-0 4 CREDITS

Module I

Introduction: History, Basic concepts of value engineering, development and scope of value management, value analysis, functions and value-Basic functions, Secondary functions values-Use value, Esteem value, Cost value and Exchange value Costing Vs Value engineering, principles of costing &cost estimation, benefits.
Steps in value engineering process-preparation problem selection, information, evaluation. Creation, selection and presentation, implementation and follow up.

Module II

Selection of project, team members, general phase, information phase, Creation phase, evaluation phase, investigation and implementation phase, audit.Project work: work sheets, objectives, techniques, guidelines, Checklist, cost worth model, role of creativity.
Approaches-job plan, DARSIRI, FAST Diagram as a tool, examples on usage of these tools

Module III

Value Engineering cases: Value Engineering raises production and productivity, Value Engineering is intensive cost search, Value Engineering prevents unnecessary uses of resources. Methodology, Industrial cases - Product manufacturing, Chemical processing, Automated Production, Semi –Automated production.

References:

1. S.S. Iyer, Value Engineering, New Age International (P) Ltd, New Delhi, 2000.
2. A. K. Datta, Materials Management, Inventory Control and Logistics, Jaico Publishing House, Mumbai, 2001.
3. Miles . L. D, Techniques of Value Analysis and Value Engineering, McGraw hill, 2000.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).

3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.805.15 SOFTWARE ENGINEERING 3-1-0 4 credits

Module I

Introduction - FAQs about software engineering - professional and ethical responsibility - system modelling - system engineering process - *the software process* - life cycle models - iteration - specification - design and implementation - validation - evolution - automated process support - *software requirements* - functional and non-functional requirements - user requirements - system requirements - SRS - *requirements engineering processes* - feasibility studies - elicitation and analysis - validation - management - *system models* - context models - behaviour models - data models - object models - CASE workbenches

Software prototyping - prototyping in the software process - rapid prototyping techniques - *formal specification* - formal specification in the software process - interface specification - behaviour specification - *architectural design* - system structuring - control models - modular decomposition - domain-specific architectures - distributed systems architecture

Module II

O*bject-oriented design* - objects and classes - an object oriented design process case study - design evolution - *real-time software design* - system design - real time executives - *design with reuse* - component-based development - application families - design patterns - *user interface design* - design principles - user interaction - information presentation - user support - interface evaluation. *Dependability* - critical systems - availability and reliability - safety - security - critical systems specifications - critical system development - *verification and validation* - planning - software inspection - automated static analysis - clean room software development - *software testing* - defect testing - integration testing - object-oriented testing - testing workbenches - critical system validation -

Module III

S*oftware evolution* - legacy systems - software change - software maintenance - architectural evolution - software re-engineering - data re-engineering

Software project management - project planning - scheduling - risk management - *managing people* - group working - choosing and keeping people - the people capability maturity model - *software cost estimation* - productivity estimation techniques - algorithmic cost modeling, project duration and staffing *quality management* - quality assurance and standards - quality planning - quality control - software measurement and metrics - *process improvement* - process and product quality - process analysis and modeling - process measurement - process CMM - *configuration management* - planning - change management - version and release management - system building - CASE tools for configuration management

Text book

Ian Sommerville, *Software Engineering*, Pearson Education Asia

Reference books

1. Pressman R.S., *Software Engineering*, McGraw Hill
2. Mall R., *Fundamentals of Software Engineering*, Prentice Hall of India
3. Behferooz A. & Hudson F.J., *Software Engineering Fundamentals*, Oxford University Press
4. Jalote P., *An Integrated Approach to Software Engineering*, Narosa

03.805.16 CRYOGENIC ENGINEERING 3-1-0 4 credits

MODULE –I

Introduction to Cryogenic Systems, Historical development, Low Temperature properties of Engineering Materials, Mechanical properties- Thermal properties- Electric and magnetic properties –Cryogenic fluids and their properties. Applications of Cryogenics: Applications in space, Food Processing, super Conductivity, Electrical Power, Biology, Medicine, Electronics and Cutting Tool Industry. Law temperature properties of engineering materials:

MODULE –II

Liquefaction systems ideal system, Joule Thomson expansion, Adiabatic expansion, Linde Hampson Cycle, Claude & Cascaded System, Magnetic Cooling, Stirling Cycle Cryo Coolers.

Gas liquefaction systems: Introduction-Production of low temperatures- General

Liquefaction systems- Liquefaction systems for Neon. Hydrogen and Helium – Critical components of Liquefaction systems.

MODULE –III

Cryogenic Refrigeration systems: Ideal Refrigeration systems- Refrigeration using liquids and gases as refrigerant- Refrigerators using solids as working media;, cryogenic fluid storage and transfer systems: Cryogenic Storage vessels and Transportation, Thermal insulation and their performance at cryogenic temperatures, Super Insulations, Vacuum insulation, Powder insulation, Cryogenic fluid transfer systems

Pressure flow-level and temperature measurements.–. Types of heat exchangers used in cryogenic systems. Cryo pumping Applications.

Text Book:

1. Klaus D.Timmerhaus and Thomas M.Flynn, " Cryogenic Process Engineering " Plenum Press, New York, 1989.

References:

1. Cryogenic systems Randal F.Barron, McGraw Hill, 1986
2. Cryogenic Engineering R. B. Scott
3. Cryogenic Engineering J. H. Boll Jr

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.805.17 BIOMEDICAL ENGINEERING (MNPU) 3-1-0, 4 Credits

MODULE I

Human Anatomy & physiology: Anatomy & Physiology of major systems of the body. Principle of generation and propagation of Bioelectric potentials. Electrical activity of heart, propagation of action potential through nerves, conduction velocity and latency.

Transducers, Leads & Electrodes: Transducers - transducers for biological applications - principles, different types - active and passive transducers, implantable transducers.

MODULE II

Biodynamics:- Mechanics of lower limb during standing and walking, Dynamics and analysis of human locomotion. Orthopaedic mechanics:- Structure, properties and rheology of bone, Cartilage and synovial fluid. Mechanics of lower limb, upper limb and Spine.

Introduction (Brief description only) to Diagnosis and Therapeutic equipments: Diagnosis equipments - BP monitors, ECG machine, EEG machine, EMG machine, PH meter. Therapeutic equipments - Pacemakers, Defibrillator, Heart - lung machine.

MODULE III

Biomaterials:- Different types of biomaterials - metals, polymers, ceramics, glasses, glass ceramics, composites. Material properties, structural mechanics. Reactions to biomaterials - inflammation, wound healing & foreign body response, immunology and compliment system, -, prostheses and orthotics. Artificial bio-implants – Dental implants, heart valves, kidneys, joints.

References

1. Text book of Medical Physiology – C., M. D. Guyton.
2. Biomechanics: Motion,Flow stress and Growth, Y.C. Fung, Springer, New York, 1990
3. Leslie Cromwell, Fred J.Weibell and Erich A.Pferffer. *Biomedical lnstrumentation and Measurements* rentice Hall of India, New Delhi.
4. R.S.Khandpur. *Handbook of Biomedical Instrumentation* , Tata McGraw Hill, New Delhi.
5. Jacob Kline. *Handbook of Biomedical Engineering,* Academic Press Inc.
6. B.D.Ratner and Hoffman. An *Introduction to Materials in Medicine,* Academic Press.
7. John G.Webster. *Medical instrumentation - Application and Design,* Houghton Mifflin company, Boston.
8. John C.Cobbold. *Transducers for Biomedical Measurements,* John Wiley & Sons.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.806.1 Propulsion Engineering 3-1-0 4 credits

Module- I

Fundamentals of Propulsion- Classification types of propulsive devices- Airscrew, Turbojet, Turboprop, turbofan, Turboshaft, Ramjet, Scramjet, Pulsejet and Rocket engines. Comparative study of performance characteristics applications. Theory of propulsion – Thrust, thrust power and efficiencies of turbojet engine. Thermodynamics analysis of turbojet engine cycle.

Module II

Turbojet engine components- air intakes, Compressors, Combustion chambers, turbines, nozzles turbine and compression matching – Thrust- augumentation. Rocket propulsion- general operating principles of chemical, electrical nuclear and solar rockets.

Module- III

Chemical Rockets- Classification. Performance parameters for chemical rockets and their relationship, Energy and efficiencies, simple problems, Solid propellants- Types- burning rate- grain Configurations, Igniters liquid propellants- Classification- Typical fuels and oxidizers, properties and specifications, Selection. Liquid propellant feed systems injectors. Starting and ignition – Precautions in propellant handling- Hybrid Rockets combustion processes in SPR and LPR combustion instability- Control of instabilities – Cooling of Rocket motors Flight Performance- Velocity and attitude in simplified vertical Refractory staging of rockets.

Rocket Testing- Test facilities and safeguards. Measurement System Terminology, Flight Testing.

References.

1. Rocket Propulsion elements- G. P. Sutton
2. Mechanics and Thermodynamics of propulsion- Hill and Peterson
3. Gas Turbines and Jet and Rocket Propulsion- Mathur and Sharma.

University Examination

d. The question paper shall contain two parts. Part A and Part B.
e. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
f. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.806.2 Industrial Refrigeration 3-1-0 4 credits

Module I

Brief Review of the methods of refrigeration – Air vapor compression and vapor absorption refrigeration systems. Review of the components of a vapor compression system.

Methods of Food Preservation :Microbiology of foods. Theories and methods of chilling and freezing.

Temperature – Time graph of Freezing process. Relation between air velocity and freezing time. Calculation of freezing time. Heat velocity of foods. Relation between moisture content and time. Drying during constant and falling the above periods. Refrigeration load in freezers.

Module II

Processing, storage and distribution of chilled and frozen foods. Such as Meat, Poultry, Fish, Eggs, Dairy products, Beverage Products, Fruits, Vegetables, Fruit Juice Concentrates and Bakery products. Food storage requirement. Cold storage, frozen storages. Design of cold storage and frozen stores . Refrigerated warehouse , Refrigerated trucks, trailers and containers. Railway refrigerated cars, marine refrigeration. Refrigeration in Air transport. Refrigeration in chemical Industry.

Module III

Industrial Air conditioning – for different type of Buildings – Hospitals, Computer Centre , Laboratories. Theaters, printing plants, Textile processing etc. Automobile air conditioning Air conditioning for Aircrafts, ships and in space crafts. Heating and cooling loads. System Design – Ventillation requirements. Plant air flow design.duct work design – variation of air pressure along a duct, Duct sizing.

Indroduction to Automatic control systems – components of control systems. Control systems diagram. Heating and vertillating control. single duct variable air temperature and volume controls. Elementary ideas of the controls used in chilled water plants.

References

1. Principles of Refrigeration – Dossat
2. ASHRAE Date Book- (3 Volumes)

University Examination

1. The question paper shall contain two parts. Part A and Part B.

2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.806.3 INDUISTRIAL QUALITY CONTROL 3-1-0 4 credits

Module 1

Basic concepts in Quality control and in quality assurance; SPC, Systematic approach, Process variability and capability. SQC, Process control of Variables and attributes. Quality costs.

Module 2

The concept of Acceptance sampling, Economics of inspections, The Operating characteristic curve, Sampling planes, Sampling tables, Minimum inspection per lot, Formulation of Inspection lots and selection of samples.

Module 3

Designing for Quality,Reliability concepts, Elements of Typical reliability program, Product and System reliability measurements, Prediction evaluation and optimisation, Fault tree analysis , Maintainability. Concepts and principles in Total Quality Management.

References;

1 Statistical Quality control : Grant (TMH)
2 Quality control Handbook ; (TMH)
3 BIS standards on Quality and testing.
4 Industrial Engineering Handbook : Maynard.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.806.4 Design of Heat transfer equipment 3-1-0 4 credits

Module I

Classification and General features of heat Exchangers, Shell and Tube Heat Exchangers, Regenerators and Recuperators- Industrial Applications. Temperature distribution and its implications, Overall heat transfer co-efficient, Counter flow and parallel flow, Logarithmic mean temperature difference (LMTD), Effectiveness. NTU – Effectiveness– Calculation of heat transfer area by different methods – Caloric or average fluid temperature – The pipe wall temperature

Effect of Turbulence, Friction factor, Pressure loss, Channel divergence. Computation of total pressure drop of shell side and tube side for both baffled and unbaffled types – Pressure drop in pipes and pipe annulus- Thermal Stress in tubes, Types of failures.

Module II

Design of double pipe Exchanges – Shell and tube pipe exchangers – The tubular element – Tube pitch – Shells – Tube sheet – Baffles – Tube sheet layout and tube counts (tube matrix) – V-band Exchangers – Shell side film coefficients – Shell side mean velocity – Shell side Equivalent diameter – The true temperature difference in 1-2 Exchanger – Shell side and tube side pressure drips – Fouling factors – Design of a shell and type – Type 1 Exchangers – Extended surface exchangers – Design of a Finned type double pipe exchanger – Longitudinal Fins and Transverse fin.

Module III

Design of Evaporators: Design of Shell and Tube, Plate type evaporators.

Cooling Towers : Packing, Spray design, Selection of pumps, Fans and Pipes, Testing and Maintenance, Experimental Methods.

Condensers – Condensation of a single vapour –Dropwise and film wise condensation – Process applications – Condensation on a surface – Development of equation for calculation – Comparison between horizontal and vertical condensers – The allowable pressure drop for a condensing vapour – Influence of impurities on condensation – Condensation of steam – Design of a surface condenser – Different types of boiling .

Text Book:

1. D.Q.Kern, " Process Heat Transfer ", Tata McGraw Hill, Edition, New Delhi, 1997.

References:

1. Arthur P.Frass, " Heat Exchanger Design ", Second Edition, John Wiley & Sons, New York, 1996.

2. T.Taborek, G.F.Hewitt and N.Afgan " Heat Exchangers ", Theory and Pratice, McGraw Hill Book Co., 1980.
3. Walker, " Industrial Heat Exchangers " - A Basic Guide, McGraw Hill Book Co., 1980.
4. Nicholas Cheremisioff, " Cooling Tower ", Ann Arber Science pub., 1981.
5. Holger Martin, " Heat Exchangers ", Hemisphere Publishing Corporation, London, 1992.
6. A Text book on Heat Transfer – S.P.Sukatme
7. TEMA standards

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.806.5 Creativity and Product Development 3-1-0 4 credit

Module I

The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brain storming - different techniques.

Module II

Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques).

Research and new product development - Patents - Patent search - Patent laws - International code for patents - Intellectual property rights (IPR).

Module III

Design of proto type - testing - quality standards - marketing research - introducing new products.

Creative design - Model Preparation - Testing - cost evaluation - Patent application

References:

1. HARRY NYSTROM, " Creativity and innovation", John Wiley & Sons, 1979.
2. BRAIN TWISS, " Managing technological innovation", Pitman Publishing Ltd., 1992.
3. HARRY B.WATTON, " New Product Planning ", Prentice Hall Inc., 1992.
4. P.N.KHANDWALLA - " Fourth Eye (Excellence through Creativity) - Wheeler Publishing ", Allahabad, 1992.
5. I.P.R. Bulletins, TIFAC, New Delhi, 1997.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.806.6 COMPUTERISED MATERIALS MANAGEMENT 3-1-0 4 credits

MODULE - I

Introduction to Materials management – Importance of material management and its role in industries. The need for the integrated approach in Material management

Demand forecasting – Various qualitative and quantitative methods of demand forecasting – Different type of averaging, Exponentially weighed smoothening, Correction for fluctuations, Time series analysis, Delphi and other Group techniques. Development of simple Computer Programme for forecasting.

MODULE - II

Inventory control – Basic methods in Inventory – Assumptions used in deriving models. Inventory costs and EOQ model. Price breaks and quantities – Effects of variations in lead-time and demand. Effects of shortage cost on EOQ. Systems of Inventory control, Design of Inventory control systems.

Development of Computer Programme for forecasting.

Classification systems and selective Inventory control – ABC, VED, FSN, HML, and MUSIC, 3-D approaches, Coverage analysis in Material management.

Development of Computer Programme for ABC analysis – Codification and standardization Systems and Techniques, Effects in Cost.

MODULE -III

Vendor rating and source selection. Techniques and materials. Use of Indian Standards for Vendor rating. Make or buy decisions – Materials Requirements Planning Concept, methods and illustration examples.

Introduction to JIT philosophy – Features and impact in Materials Management.

Purchasing – Purchase organization – legal aspects of buying – Purchase Procedure. Store and Material control – Receipts and issues – Stores Record. Methods and principles of Storing and retrieving items.

Material handling devices used in stores – Application of Computers in Material handling – Design of informatic systems for procurement and storage using computer.

REFERENCE

1. Scientific Inventory Management - Bnchan & Kbenigsberg
2. Inventory Management - Starr & Miller
3. Materials Management - R.M .Shah
4. Integrated Material management - P.Gopalakrishnan
5. Principles of Inventory management - Tershine

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.806.7 RANDOM VIBRATIONS 3-1-0 4 credits

Module I

Basic probability concepts - events and probability - elements of set theory - simple events and combination of events - Venn diagram - mutually exclusive events and collectively exhaustive events - De Morgan's rule - basic axioms of probability - conditional probability - statistical independence - theorem of total probability - Bayes' theorem - definition of a random variable - probability distribution and probability distribution and probability density of discrete and continuous random variables - main descriptors of a random variable (mean, mode, median, variance, standard deviation, coefficient of variation, skewness and kurtosis) - absolute moments and central moments - moment generating functions, characteristic functions and log characteristic functions

Useful probability distributions - normal distribution - standard normal distribution - lognormal distribution - binomial distribution - geometric distribution - negative binomial distribution - Poisson process and Poisson distribution - hypergeometric distribution - beta distribution - gamma distribution - extreme value distributions - joint and conditional probability distributions - covariance and correlation mean and variance - functions of single random variable - single function of multiple random variables - multiple functions of multiple random variables - moments of functions of random variables

Module II

Random processes - introduction - ensemble averages and correlation functions - time averages and correlation functions - weakly stationary and strongly stationary random processes - ergodic random processes - probability density and distribution functions - properties of autocorrelation functions - Fourier transforms - power spectral density functions - Wiener-Khintchine equations - properties of spectral density functions - spectral classification of random processes (narrow band, wide band, white noise) - level crossing - expected frequency and amplitude of narrow band Gaussian processes - Rayleigh distribution

Module III

Response to random excitations - introduction - impulse response and frequency response function as Fourier transform pair - response of a linear system function to stationary random excitation - response of a single degree of freedom system to random excitation - contour integration - joint probability distribution of two random variables - joint properties of stationary random processes - joint properties of ergodic random processes - cross-correlation functions for linear systems - response of multi-degree of freedom system to random excitations - response of one -dimensional continuous systems to random excitations

Text books

1. Ang A.H.S. & Tang W.H., "*Probability Concepts in Engineering Planning and Design"*, Vol. I, John Wiley
2. Meirovitch L., "*Elements of Vibration Analysis*", McGraw Hill

Reference books

1. Lin Y.K., "*Probability Theory In Structural Dynamics*", McGraw Hill
2. Bendat & Piersol, "*Random Data Analysis And Measurement Procedure*", Wiley Inter Science, John Wiley
3. Papoulies A., "*Probability, Random Variables And Stochastic Processes*", McGraw Hill, Kogakusha Ltd.
4. Rice S.G., "*Mathematical Analysis Of Random Noise", in "Selected Papers on Noise and Stochastic Processes"*, Over Publications
5. Crandall S.H. & Mark W.D., "*Random Vibration in Mechanical Systems*", Academic Press
6. Lutes L.D., Shahram Sarkoni, "*Stochastre Analysis of Structural & Mechanical Vibration"*, Prentice Hall, Inc.
7. Jullius Solnes, "*Stochestic Process & Random Vibration,* John Wiley

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.806.8 MECHANICAL VIBRATIONS AND NOISE CONTROL 3-1-0 4 credits

MODULE I

Introduction – Harmonic motion – Beat frequency – Equations of motion – Concepts of forces and equilibrium – Systems with one degree of freedom – Free and forced vibrations with undamped and damped systems (Review)

Two degrees of freedom systems : Equations of motions for free and forced vibration without and with damping – Use of influence coefficients – The work and energy approach – Solutions to free , forced and damped vibrations and torsional systems – Dynamic absorbers periodic and Non periodic **.**

MODULE II

Vibration – Fourier series representation – Unit impulse step , ramp and arbitrary excitation – Response spectrum – Analog computer set up for solving vibration problems -,Vibration measuring instruments .

Solutions to Differential Equations , Laplace Transforms.

Jump phenomenon – Effect of damping – Self excited Oscillations.

MODULE III

Introduction to sound and vibratic wave motion – One dimensional plane waves – Characteristics impedance – Decibel seats power , density and intensity – Sound transmission through one and two intervening media .

Measurement of Sound – Loud speakers and microphones – Their characteristics , Band pass filters , graphic level recorder , Narrow Band Analysers - Measurement in reverberation and Vachaic chamber –Hearing mechanism of hearing and perception of sound (Description only)

Types of noise : Criteria for evaluation of noise problems – Threshold of hearing – Hearing loss with age – Equal loudness contours loudness and loudness level – Perceived noise level – N.C. curves – Noise and Number index – Noise pollution level – Noise induced hearing loss – Damage risk criteria – Criteria for noise and vibration in community buildings – General principles of noise control – Use of enclosures – Wrappings – Porous materials – Design of Auditorium – Acoustical requirements – Elimination of room acoustical defects – Articulation index – Sound reinforce systems – Design of time delays (Brief description only)

REFERENCES

1. Fundamentals of Vibration - Anderson Roger A
2. Theory of Vibrations - W.T.Thomsom (Tata McGraw Hill)
3. Vibration problem in Engg. – Timosheako
4. Mechanical Vibrations - Tee. Hinkle and Morse
5. Fundamentals of Acoustics – Kinslor and Frey
6. Noise and vibration Control – Beronek .L.L (McGraw Hill)
7. Environmental Acoustic - Doello ,Deslie L
8. Hand Book on Noise control – C.Harris
9. Hand Book of Noise Measurement – General Radio Company .U.S.A

03.806.9 ADVANCED KINEMATICS OF MACHINES 3-1-0 4credits

MODULE I

Kinematics Pairs : Classifications of kinematics pairs – Number of points of support in a plane – Subdivision of higher pairs – Kinematics chains – Classification of Kinematics chains – Coupler curves : Definition and Equation – Roberts law – Cognate linkages – Cognate of the slider crank – Double points of a coupler curve – Coupler curve atlas .

Analytical Design of 4 bar Mechanism for co-ordinated motion of the crank: Fneuden – Steins equations – Sample design – Three co-ordinate crank position – Co-ordinates of the crank velocities and derivatives – Design of a four bar mechanism for constant angular velocity ratio of the cranks – Choice of knecesion points .

MODULE II

The Euler – Savarg equation and its graphical representation – Determination of the Centre of Curvature of the path of a point – Euler savarg equation for points between the instantaneous centre and the inflexion point – General form of the Euler – Savarg equation – Relation between the position of a point in the movable plane and the centre of the curvature of its path – The inflection circle – Envelops and generation curves – Transformation of Euler – Savarg equation – Graphical construction – Construction of the inflexion centre if the centre of the curvature of both centrodes are known .

MODULE III

Kinematics chains of n-links : Number of lines of centres – Kinematics chains with constrained motion – Minimum number of hinges in one link in a closed chain with constrained motion – General analysis of Kinematics chains – Transformation of kinematics chain by the use of higher hinges – Replacement of turning pairs by sliding pairs – Criterion of constrained motion for Kinematic chain with higher pairs .

An Introduction to the Synthesis of mechanism : Two position of link – Three position of a link – The pole triangle and practical application.

REFERENCES

1. Kinematics of Mechanism - Rosenouver and Willis
2. Linkage Design - Jr. Hall

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.806.10 FINANCIAL MANAGEMENT 3-1-0 4 credits

Module I

Introduction - finance and related disciplines scope of financial management - functions - objectives of financial management - an overview on Indian financial system

Financial analysis - financial statement analysis - ratio analysis

Module II

Statement of change in financial position - working capital basis only

Capital budgeting: nature - evaluation techniques - traditional technique - discounted cash flow techniques (NPV & IRR)

Module III

Working capital: nature - determinants - computation of working capital

Sources of corporate finance - capital market - stock exchanges - equity - debt - other financial instruments - foreign investments and financing sources - Euro currency market, Euro issues, GDR, ADR etc.

Reference books

1. Khan & Jain, *"Financial Management"*, TMH
2. Prasanna Chandra, *"Financial Management"*, TMH
3. Shapiro A.C., *"Modern Corporate Finance"*, Max well Macmillan
4. Brealey & Onyers, *"Principles of corporate Finance"*, McGraw Hill
5. Pandey I.M., *"Financial Management"*, Vikas publishers

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.806.11 FLEXIBLE MANUFACTURING METHODS 3-1- 0 4 credits

Module I

Introduction Computer technology - hardware - types of memory - input/output devices – software - mini/micro computers and programmable controllers - computer aided design - fundamentals of CAD - the design process - application of computers for design - manufacturing data base.

Numerical control of machine tools- basic components of NC systems - NC coordinate systems - motion control system - application of numerical control - NC part programming - punched tape - tape coding and format - manual part programming - computer assisted part programming - APT language - NC programming with interactive graphics

Module II

Manufacturing systems - development of manufacturing system - components of FMS - FMS work station - Job coding and classification - group technology - benefits of FMS - tools and tooling - machining centres - head indexers - pallets - fixtures - work handling equipments - system storage - automated guided vehicles - industrial robots - programming of robots - assembly & inspection

Module III

Flexible manufacturing system management - FMS control software - manning of FMS - tool management - controlling precision - simulation and analysis of FMS - approaches to modelling for FMS - network simulation - simulation procedure - FMS design - economics of FMS - artificial intelligence

References books

1. Groover M.P. *"Automation, Production Systems and Computer Integrated Manufacturing*", Prentice Hall of India
2. Groover, Emory & Zimmers, *"CAD/CAM Computer Aided Design and Manufacturing"*, Prentice Hall of India
3. Joseph Talavage & Hannam, "*Flexible Manufacturing Systems in Practice"*, Marcel Dekker Inc.
4. Kant Vajpayee, "*Principles of Computer Integrated Manufacturing*", Prentice Hall of India.
5. Yoram Koren, "*Computer Control of Manufacturing Systems*", McGraw, Hill Book Company.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.806.12 COMPUTATIONAL FLUID MECHANICS 3-1-0 4 credits

Module I

Classification of partial differential equations - system of first and second-order partial differential equations - initial and boundary conditions - finite difference formulations - finite difference equations - finite difference approximation of mixed partial derivatives

Module II

Parabolic partial differential equations - explicit methods - implicit methods - parabolic equations in two-space dimensions - consistency, stability, and error analysis of finite difference equations - artificial viscosity

Elliptic equations - finite difference formulations - solution algorithms - hyperbolic equations - finite difference formulations -splitting methods - multiple-step method

Module III

Scalar representation of the Navier - stokes equations - model equations - numerical algorithms - incompressible Navier - stokes equations - primitive variable and vorticity - stream function formulations - Poisson equation for pressure - numerical algorithms - boundary conditions - staggered grid

Text book

Hoffmann Klaus A., "*Computational Fluid Dynamics for Engineers - Volume I*", Engineering Education System, Wichita

Reference books

1. Patankar Suhas V., "*Numerical Heat Transfer and Fluid Flow*", Taylor & Francis
2. Fletcher C.A.J., "*Computational Techniques for Fluid Dynamics I*, Springer Verlag
3. Anderson Dale A., Tannehill John C. & Pletcher Richard H., "*Computational Fluid Mechanics and Heat Transfer*", Taylor & Francis

University Examination

1. The question paper shall contain two parts. Part A and Part B.

2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.806.13 TECHNOLOGY FORECASTING 3-1-0 4 credits

MODULE I

Introduction and Historical Background – Examples of notable successes and failures.

Epistemology of forecasting : Nature of technological change – ontological and teleological views – Types of forecasts – Exploratory projections – Target projections – Validity criteria .

Dimensions of technological change : Intellectual , Philosophical and cultural factors – Political and international factors – Military and strategic posture – Macro economics – Micro economics – Communications and social feed back – Technological diffusion and innovation .

MODULE II

Forecasting techniques

Morphological analysis : Analysis of functional capabilities - Morphological analysis of future words – Network methods .

Trend extrapolation : Curve fitting – Envelops , constraints and scales – intensive and extensive micro variables – The inertia of trend curves .

Heuristic forecasts : Extrapolation of dependant variables and constrained variables – analogies ,metaphors and structural models – Phenomenological models – Operational models and simulations .

Intuitive methods – Forecasting by experts – Structured interactions – Man – machine interactions.

MDULE III

Policy and strategic planning : Planning as tool for forecasting – Policy – Planning methods – Strategic planning methods – Cast effectiveness – PPOS – Demand oriented planning – Operations analysis and systems analysis .

Introduction to technology assessment . TA and its relevance – History of TA in Government and Industry – Steps in TA – The MITRE Methodology – Brief review of techniques which can be used in TA including cross impact analysis , systems analysis , cost benefit analysis and formal models – Case studies – (Suggested projects : To be a TA project relevant to the Kerala context)

REFERENCES

1. Technology forecasting - Rober U Ayres , Mc Graw Hill
2. Selected readings on Technology assessment – IIT Bombay and Dept. of Science and Technology, N.Delhi.

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

03.806.14 MANAGEMENT INFORMATION SYSTEMS 3-1-0 4 credits

MODULE I

Introduction to Information Systems - Challenges of Information Systems - Contemporary approach to Information systems - Computer based Information Systems - Types and examples of Information systems. OAS, TPS, MIS,DSS and ESS. Information technology Infrastructure- Hardware, Software, Database, People and Procedures -Data Communication network- Modems, Types of Communication Channels, Channel configurations, Channel sharing devices, Types of networks.

System concept: Organisation as a system- The strategic role of information in Organisational Management; Technical foundations of information systems

MODULE II

System Development – system development life cycle – structured methodologies – Prototyping – CASE methodology**.**

System analysis, Need for System analysis, Role of System Analyst in Data processing and User departments. Project selection, Feasibility study. Cost-benefit analysis- System Investigation, Fact finding, Identifying areas for system study, inspection of Documents, Interviewing staff, Tools for determining System requirement, Activities in requirement determination, Identify Data and Information Produced, Development of System Profiles, tools for

Documenting procedures and Decisions. Structured analysis, Documentation tools, Flow charts, Data flow diagram, Data dictionary, Data structure diagram, structure chart, System analysis completion report.

MODULE III

System Design, Structured system design, Input design and control, Output system design, File and data base design, System Development, System control, Documentation, Coding techniques- Detection of errors – verification and validating- System Implementation and control - testing –Software quality assurance-software metrics- Security.

Application of Information Systems: Accounting Information systems and Financial Information System, Marketing Information System, Banking Information Systems.

REFERENCES

1. Management Information Systems – Managing the digital firm, Kenneth C. Laudon and Jane P. Laudon, Pearson education, 2002.
2. Management Information Systems : Conceptual Foundations, structure and Development, Gordon B Davis, McGraw Hill
3. Computers and Information Systems – Robert .A.S, Prentice-Hall
4. Information Systems theory And Practice- Burch John.G Jr and Others, John wiley &Sons
5. Management Information Systems-James A O'Briean, Tata Mc Graw Hill
6. Information Systems – A Management Perspective – Steven Alter, Addison Wesley, 1999.
7. Information Systems for Modern management, Murdick and Ross

03.806.15 Production & Operations Management 3-1-0 4 credits

Module I

Demand forecasting:- basic models, Long and Short-term demand forecasting methods, Regression analysis and smoothing methods, Estimation of trend, cycle, and seasonality components, Analysis of forecast error and computer control of forecasting systems, multi item forecasting, slow-moving item forecasting. Basic inventory models:- assumptions, performance measures, multi-item joint replacement model. Inventory systems under risk:- service levels, safety stock, joint determination of Q and R, time-varying demands. Aggregate inventory management:- Exchange curves, stock out situations, safety stock policies, distribution inventory systems.

Module II

Design of layout of factories, Office, Storage area etc. on consideration of facilities of working people, Storage facilities and general equipment for amenities of working people – Product, Process and combination layout – Systematic layout planning – Design of Assembly lines, Line balancing methods, Computer applications in layout designs. Routing problems:- algorithms, Dispatching

Module III

Aggregate planning:- definition, value of decision rules, aggregate planning strategies, methods. Master production schedule:- bill of material, structuring BOM, disaggregation techniques, managing and maintenance of MPS. Material Requirements Planning:- MRP and MRP II, MRP concepts and advantages, implementation. Capacity planning and control, controlling continuous production, batch processing technique, Just-in-time, KANBAN system. Job Shop production activity planning:- scheduling, shop loading, sequencing, priority rules for dispatching jobs, mathematical programming and heuristics. Introduction to BusinessProcessReengineering, Enterprise Resource Planning, and software packages**.**

Text books:

1. Production Planning and Inventory Control – Narasimhan et al., PHI
2. Facilities Location and Layout – an analytical approach – R. L. White and J. A. White – PHI

Reference:

1. Production and Operations Management – Buffa – John Wiley & Sons
2. Operations Management: Strategy and Analysis – Krajewski LJ – Pearson Education
3. Production systems – James .L. Riggs – John Wiley & Sons
4. Inventory Management and Production Planning and Scheduling – Silver, Pyke & Peterson – John Willey & Sons

03.806.16 Project Management 3-1-0 4 credits

Module I

Project identification and formulation-different types of needs leading to different types of projects under BMRED (Balancing, Modernization, Replacement, Expansion, and Diversification) considerations involved in decision under each of these types. Macro parameters in project selection, different considerations for project under private, public

and joint sectors. Project formulation-preparation of project profile, project report and detailed project report. Broad criteria for pre-investment decisions.

Project appraisal-different types of appraisal-Technical, Economic, Organizational and Managerial, Commercial and Financial- financial techniques for project appraisal and feasibility, discounted cash flow and non-discounted cash flow methods, social cost benefit analysis and economic rate of return. Non-financial justification of projects.

Module II

Project financing-pattern of financing, sources of finance, impact of taxation, public loans, small savings surplus of public enterprises, deficit financing, foreign aid. Public sector project financing. Role of tax planning in project financing.

Project cost systems-project cost accounting and monitoring, appointment of contractor and its problems, labour and equipment costs, accounting, codification, development of cost data, labour time, reporting, direct measurement of work quantities, labour cost analysis, equipment accounting, activity based cost accounting, production rates for estimates, control of cost, computer application to cost control.

Module III

Project administration- progress payments, expenditure planning, project scheduling and network planning, use of Critical Path Method (CPM), schedule of payments and physical progress, time-cost trade off, cash flow preparing, cash forecast and monitoring of fund and resources, control of groups of projects under one administration and associated problems in sharing resources.

Concepts and uses of PERT, cost as a function of time, project evaluation and review techniques/cost mechanisms. Accountant's role in project evaluation and review techniques/cost budgeting. Determination of least cost duration. Post project evaluation.

References:

1. Project planning, analysis, selection, implementation and review – Prasannachandra – Tata McGraw Hill
2. Project Management – the Managerial Process – Clifford F. Gray & Erik W. Larson -McGraw Hill

03.806.17 DESIGN OF I C ENGINES 3-1-0 4 Credits

MODULE 1

Introduction-Basic engine components and nomenclature- First law analysis of engine cycles-engine performance parameters –simple problems.

Review of Air standard cycle(brief description regarding the concepts)-Fuel air cycle and their analysis-dissociation, effects of operating variables like compression ratio, fuel-air ratio on thermal efficiency and power.

Actual cycle and their analysis-time loss factor, heat loss factor, exhaust blow down. Comparison of fuel air cycle and actual cycle.

MODULE II

Two stroke engines-introduction-advantages and disadvantages-Scavenging- various methods of scavenging and charge induction. -Terminologies like reference mass, delivery ratio, scavenge ratio, trapping efficiency, scavenging efficiency, and charging efficiency, relative cylinder charge. Scavenging models-perfect displacement and complete mixing model-scavenging efficiency-simple problems. Supercharging, Design of Intake and Exhaust port calculations (with the help of charts)

Study of transducers for IC engine application (only brief description about various types)

MODULE III

Design of IC engines-Basic decisions, Preliminary analysis, Cylinder number, size and arrangement - Detailed design procedure for piston, connecting rod, crank shaft, poppet valves, cylinder and cylinder head- Materials and manufacturing process of main components of engines.

Measurement aspects related to IC engines-speed measurement, torque measurement (only dynamometers), airflow measurement, exhaust gas measurement and treatment.

REFERENCES:

1 IC Engine theory and practise – C.F Taylor,Vol.1 and Vol.2
2. IC Engines - Lickty
3. IC Engines – Heywood
4. IC Engine design –Richard James
5. Scavenging of 2 stroke engines – Schweitzer
6. Fundamentals of IC Engines- V.Ganesan
7. IC Engines – Shyam K Agarwal

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).
4. Use of standard charts are permitted in the University Examination

03.806.18 Automation and Robotics 3-1-0 4 credits

Module I

Introduction to automation : Basic notions and definitions, technical and economic requisites. Automation as a means of control and inspection- Basic control system concepts - control system analysis, Systems of automatic control.

Sensors: Sensory equipment, Range sensing - Proximity sensing - Touch sensing - Force and Torque sensing. Signal conditioning equipment

Introduction to Machine vision, Sensing and digitizing - Image processing and analysis, Applications

Module II

Introduction to robots: Definition of a Robot - Basic Concepts - Robot configurations - Types of Robot drives - Basic robot motions - Point to point control - Continuous path control.

Components and operations: Basic actuation mechanisms . Robot actuation and feed back, Manipulators – director and inverse kinematics, Coordinate transformation - Brief Robot dynamics. Types of Robot and effectors - Grippers - Tools as end effectors - Robot/End - effort interface.

Module III

Robot Programming: Methods - languages - Capabilities and limitation - Artificial intelligence - Knowledge representation – Search techniques - AI and Robotics.

Industrial Applications : Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading - CIM -Hostile and remote environments. Parts handling automation, Products inspection automation, machine tool automation, In-plant transport automation, Automatic Transfer machines, Assembly automation

Text Book:

1. K.S. Fu., R.C.Gonalez, C.S.G.Lee, " Robotics Control sensing ", Vision and Intelligence, McGraw Hill International Edition, 1987.

References:

1. Mikell P. Groover, mitchell Weiss, " Industrial robotics, technology, Programming, and Applications ", McGraw Hill International Editions, 1986.
2. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, " Robotic engineering- An Integrated Approach ", Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 1989.
3. Industrial Robots, Yu.Kozyrev
4. Fundamentals of Industrial Automation, V.Tergan,I.Andreev, B.Liberman

University Examination

1. The question paper shall contain two parts. Part A and Part B.
2. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40).
3. Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60).

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03.807 Project & Viva voce (MNPU) **0-0-5 5 Credits**

For internal assessment, 75% weightage to be given to the assessment of the guide and 25% to the project presentation.

For University examination a Viva-voce examination shall be conducted. Marks of Viva voce examination shall be based on the overall performance, Project report, Subject knowledge and general awareness in the developments in Mechanical Engineering.