MAHATMA GANDHI UNIVERSITY

B.TECH. DEGREE COURSE

7^{TH} SEMESTER

SCHEME
&
SYLLABUS

2002

MECHANICAL ENGINEERING BRANCH

MECHANICAL ENGINEEING

SCHEME

7TH SEMESTER

Course Code	Course No.	Subject	Teaching Periods			Duration of Uty. Exam. (Hrs.)	Marks			
			Lect.	Tut.	Prac./ Proj.		Sessional	Theory	Practical	Total
A	M 701	Gas Dynamics and Jet Propulsion	2	1	-	3	50	100	-	150
B	M 702	Industrial Engineering	2	1	-	3	50	100	-	150
C	M 703	Refrigeration and Air Conditioning	2	1	-	3	50	100	-	150
D	M 704	Dynamics of Machinery	2	1	-	3	50	100	-	150
E	M 705	Machine Design and Drawing - I	2	-	2	3	50	100	-	150
F	M 706	Elective - I	3	1	-	3	50	100	-	150
G	M 707	Mechanical Engineering Laboratory	-	-	4	3	50	-	100	150
H	M 708	Heat Transfer Laboratory	-	-	4	3	50	-	100	150
I	M 709	Project and Seminar	-	-	2	-	-	-	-	-
		Total	13	5	12	-	400	600	200	1200

At the beginning of the seventh semester, students must submit a brief out line of the proposed project work. They must submit an interim report at the end of the semester. They will complete the project in the eighth semester**.**

SYLLABUS

GAS DYNAMICS AND JET PROPULSION

M 701 **2+1+0**

Module 1

Introduction to gas dynamics: control volume and system approaches acoustic waves and sonic velocity - Mach number - classification of fluid flow based on mach number - mach cone-compressibility factor - General features of one dimensional flow of a compressible fluid - continuity and momentum equations for a control volume.

Module 2

Isentropic flow of an ideal gas: basic equation - stagnation enthalpy, temperature, pressure and density-stagnation, acoustic speed - critical speed of sound-dimensionless velocity-governing equations for isentropic flow of a perfect gas - critical flow area - stream thrust and impulse function. Steady one dimensional isentropic flow with area change-effect of area change on flow parameters-chocking- convergent nozzle - performance of a nozzle under decreasing back pressure -De lavel nozzle - optimum area ratio effect of back pressure - nozzle discharge coefficients - nozzle efficiencies.

Module 3

Simple frictional flow: adiabatic flow with friction in a constant area duct-governing equations - fanno line limiting conditions - effect of wall friction on flow properties in an Isothermal flow with friction in a constant area duct-governing equations - limiting conditions. Steady one dimensional flow with heat transfer in constant area ducts- governing equations - Rayleigh line entropy change caused by heat transfer - conditions of maximum enthalpy and entropy

Module 4

Effect of heat transfer on flow parameters: Intersection of Fanno and Rayleigh lines. Shock waves in perfect gas- properties of flow across a normal shock - governing equations - Rankine Hugoniat equations - Prandtl's velocity relationship - converging diverging nozzle flow with shock thickness - shock strength.

Module 5

Propulsion: Air craft propulsion: - types of jet engines - energy flow through jet engines, thrust, thrust power and propulsive efficiency turbojet components-diffuser, compressor, combustion chamber, turbines, exhaust systems. Performance of turbo propeller engines, ramjet and pulsejet, scramjet engines. Rocket propulsion - rocket engines, Basic theory of equations - thrust equation - effective jet velocity - specific impulse - rocket engine performance - solid and liquid propellant rockets - comparison of various propulsion systems.

References

1. Compressible fluid flow - A. H. Shapiro
2. Fundamentals of compressible flow with aircraft and rocket propulsion - S. M. Yahya
3. Elements of gas dynamics - Liepman & Roshko
4. Aircraft & Missile propulsion - Zucrow
5. Gas dynamics - M.J. Zucrow & Joe D.Holfman

INDUSTRIAL ENGINEERING

M 702 **2+1+0**

Module 1

Introduction: Evolution of Industrial Engineering- Fields of application of Industrial Engineering -Functions of Industrial Engineer-Organisational structure of Industrial Engineering Department.

Production and Productivity: Types of production-continuous production-intermittent production. Productivity-productivity index-factors affecting productivity-techniques for productivity improvement.

Value Engineering: Historical perspective-reasons for poor values-types of values-the different phases of value analysis-applications of value analysis.

Module 2

Plant design: Plant location-factors influencing plant location. Plant layout-types of plant layout-introduction to layouts based on group technology, just in time and cellular manufacturing systems.

Material handling: Principles of material handling-selection of material handling devices-types of material handling equipments.

Maintenance and replacement of equipments: Types of maintenance. Depreciation-methods of calculating depreciation. Selection of equipments-methods for replacement studies.

Module 3

Methods Engineering: Process charts and flow diagrams-Micro motion study-Work measurement techniques.

Job evaluation and merit rating: Objectives of job evaluation-Methods of job evaluation. Objectives and uses of merit rating-Merit rating plans.

Module 4

Industrial relations: Fatigue-Communication in industry-Industrial disputes-Trade unions-Quality circles-BIS-ISO-Labour welfare-Industrial safety-Statutory provisions in labour legislations.

Ergonomics: Objectives and applications.

Module 5

Inventory control: Determination of Economic order quantity and reorder level.

Quality control: Destructive and nondestructive testing methods. Statistical quality control-process control charts-acceptance sampling.
Cost accounting and control: Elements of cost- Selling price of a product-Types of cost-Allocation of overheads.

References

1. Production system - Riggs
2. Production control - Hiejet
3. Human factors in Engg design - Mc Cormic E.J.
4. Industrial Engg & Management - O.P.Khanna
5. Industrial Organisation & Management - Banga & Sarma
6. Industrial Engg - A.P.Verma
7. Value Engg - Mudge
8. Manufacturing organization & Management - Amrine
9. Time & Motion Study - Lowry
10. Quality Control - Hansen

REFRIGERATION AND AIR CONDITIONING

M 703 **2+1+0**

Module 1

Principles of refrigeration: Thermodynamics of refrigeration - Carnot cycle, reversed carnot cycle, heat pump, and refrigerating machine- coefficient of performance - unit of refrigeration - refrigeration methods- conventional refrigeration systems. Air refrigeration system- Bell Coleman cycle - C.O.P. capacity work and refrigerant flow requirements in Bell - Coleman cycle.

Module 2

Vapour compression system: simple cycle -comparison with Carnot cycle - theoretical, actual and reactive - COP effect of operating parameters on COP - wet, dry and superheated compression - under cooling - actual cycle representation on TS and PH diagrams simple problems. Advanced vapour compression systems - multistage vapour compression systems - flash chamber multiple compression and evaporation systems cascading - simple problems.

Module 3

Vapour absorption systems: simple, cycles - actual cycle - ammonia water and lithium bromide water systems - COP - electrolux system. Refrigerant and their properties: Nomenclature - suitability of refrigerants for various applications - unconventional refrigeration methods- Vortex tube, steam-jet, magnetic (cryogenics) refrigeration and thermoelectric refrigeration - applied refrigeration

house hold refrigerators - unit air conditioners and water coolers - ice plant cold storage.

Module 4

Refrigeration system components: condensers - water and air cooled condensers - evaporative condensers - expansion devises - capillary tube- constant pressure expansion valve - thermostatic expansion valve - float valve and solenoid valve - evaporators - natural convection coils - flooded evaporators - direct expansion coils. Reciprocating compressors: single stage and multistage compressors - work done optimum pressure ratio- effect of interfolding - volumetric efficiency -effect of clearance - isothermal and adiabatic efficiency - compressed air motors. Rotodynamic compressors: Screw and vane type compressors - principle of operation - hermetic, semihermetic and open type refrigeration compressors.

Module 5

Principles of air conditioning: Psychrometry and psychrometric chart thermodynamics of human comfort - effective temperature - comfort chart applied psychrometry - sensible heat factor - psychometric process-problems. Winter air conditioning: heating load calculations humidifiers and humidistat. Summer air conditioning: cooling load calculations - year round air conditioning - unitary and central systems - principles of air distribution - design of air duct systems.

References

1. Refrigeration and air conditioning - Ballaney P. L.
2. Refrigeration and air conditioning - Stocker W. F.
3. Refrigeration and air conditioning - Jordan and Protester
4. Principles of Refrigeration - Roy J. Dossat

DYNAMICS OF MACHINERY

M 704 **2+1+0**

Module 1

Balancing: - Balancing of rotating masses, static balancing and dynamic balancing, Balancing of several masses rotating in same plane, Balancing of several masses rotating in several planes, Balancing machines.

Balancing of reciprocating masses: - The effect of inertia force of the reciprocating mass on the engine. Partial primary balance. Partial balancing of locomotive, Hammer blow, Variation of tractive effort, Swaying couple. Coupled locomotives, Balancing of multi cylinder inline engines, v-engines, Radial engines, Direct and Reverse cranks

Module 2

Vibrations: - Definitions, simple harmonic motion.
Single degree freedom systems: -
Undamped free vibrations: - Equations of motion Natural frequency, Energy method, Equilibrium methods, Rayleigh's methods, Equivalent stiffness of spring combinations.
Damped free vibrations: - Viscous damping, Free vibrations with viscous damping, over-damped system, critically damped system, under-damped system, Logarithmic decrement, viscous dampers, coulomb damping.
Forced Vibrations: - Forced harmonic excitation Rotating unbalance, Reciprocating unbalance. Energy dissipated by damping, vibration isolation and Transmissibility. Vibration measuring instruments.

Module 3

Two degree freedom systems: - Principal modes of vibration, Rectilinear and angular modes, systems with damping, vibration absorbers, centrifugal pendulum damper, dry friction damper, untuned viscous damper.
Multi-degree of freedom system: - Free vibrations, equations of motion, Influence coefficients method, lumped mass and distributed mass systems, Stodola method, Dunkerly's method, Holzer's method, Matrix iteration method.
Torsional Vibrations: - Torsionally equivalent shaft, torsional vibration of two-rotor, three-rotor, and geared systems.

Module 4

Critical speeds of shafts: - Critical speed of a light shaft having a single disc without damping. Critical speeds of a light cantilever shaft with a large heavy disc at its end.
Transient vibration: - Laplace transformation, response to an impulsive input, response to a step input, response to a pulse input, phase plane method, shock spectrum.
Non-linear vibrations: - Phase plane, undamped free vibration with non-linear spring forces, hard spring, soft spring, Perturbation method, Forced vibration with nonlinear forces, Duffings equation, self excited vibrations.

Module 5

Noise control: - Sound propagation, decibels, acceptance noise levels, Air columns, Doppler effect, acousticl measurements, microphones and loud speakers, Recording and reproduction of sound, fourier's theorem and musical scale, Acoustics of buildings, Acoustic impedence filters and human ear.

References

1. Theory of Machines - Thomas Bevan
2. Theory of Machines - P.L. Ballaney
3. Mechanical Vibrations, V edition - G.K. Groover
4. Theory of Vibrations with applications, III Edn - W.T. Thomson

5. Mechanical Vibrations - S. Graham Kelly, Schaum's outlines
6. Fundamentals of Vibrations - Leonard Meirovitch, Mac Graw Hill
7. A text book of sound - L.P. Sharma & H.C. Saxena
8. Engineering Noise Control - D.A. Bies & C.H. Hausen.
9. Noise & Vibration Control - Leo N. Beraneck

MACHINE DESIGN AND DRAWING - I

M 705 **2+0+2**

Module 1

Definitions - Design principles – common engineering materials – selection and their properties – general steps in design – design criteria – types of failures - types of cyclic loading.

Stresses in Machine parts – tension, compression and shear –elastic constants-working stress-factor of safety-bending and torsion-combined stresses-stress concentration-fatigue-endurance limit-fatigue diagram-fatigue factors-theories of failure-Goodman and Soderberg lines

Detachable joints-socket and spigot cotter joint, knuckle joint – pins, keys, splines -set screws, threaded fasteners and power screws – Shaft coupling – sleeve coupling – split muff coupling – flange coupling – protected type flange coupling – thick and thin cylinders

Riveted joints: Lap joint – Butt joint – failures of riveted joint – strength of riveted joint – efficiency of riveted joint – design of longitudinal butt joint for boiler – design of circumferential lap joint for boiler – joints of uniform strength – Lozange joint – eccentrically loaded riveted joint.

Module 2

Springs – Classification and uses of springs – design of helical springs – effect of end turns – energy absorbed – deflection – design for fluctuating loads – vibration in springs – buckling of spring materials

Shafts – Torsion and bending of shafts – hollow shafts – design of shafts for strength an deflection – effect of keyways – transverse vibration and critical speed of shafts

Design of IC engine parts – connecting rod – piston – flywheel –

Welded joints: Lap joint – Butt joint – weld symbols parallel and transverse fillet welds – strength of welded joints – axially loaded welded joints – eccentrically loaded welded joints.

References

1. Mechanical Engg. Design – Joseph Shigley
2. Machine Design – Mubeen
3. Machine Design – Black
4. Machine Design – R. K. Jain
5. Machine Design an integral approach – Norton, Pearson

6. Machine Design data hand book – Lingayah Vol I.
7. Elements of Machine Design – Pandya & Shah

Note

For the University Examination 100% choice may be given. i.e. two questions from each module with full choice.

OPTIMIZATION TECHNIQUES (ELECTIVE - I)

CMELRTA 706-1 **3+1+0**

Module 1: Classical optimization techniques

Single variable optimization – Multivariable optimization with no constraints – Hessian matrix – Multivariable saddle point – Optimization with equality constraints – Lagrange multiplier method - Multivariable optimization with inequality constraints – Kuhn-Tucker conditions.

Module 2: **One-dimensional unconstrained minimization**

Elimination methods – unrestricted search method – Fibonacci method – Interpolation methods – Quadratic interpolation and cubic interpolation methods.

Module 3: **Unconstrained minimization**

Gradient of a function – Steepest descent method – Newton's method – Powells method – Hooke and Jeeve's method.

Module 4: **Integer – Linear programming problem**

Gomory's cutting plane method – Gomory's method for all integer programming problems, mixed integer programming problems.

Module 5: Network Techniques

Shortest path model – Dijkstra`s Algorithm – Floyd`s Algorithm – minimum spanning tree problem – PRIM algorithm – Maximal Flow Problem algorithm.

References

1. Optimization theory and application - S.S. Rao, New Age International P. Ltd.
2. Optimization Concepts and applications in Engineering - A.D.Belegundu, T.R. Chandrupatla, Pearson Education Asia.
3. Principles of Operations Researc for Management - F. S. Budnick, D. McLeavey, R. Mojena, Richard D. Irwin, INC.
4. Operation Research an introduction - H. A. Taha, Eastern Economy Edition.
5. Operations Research - R. Panneerselvam, PHI

PLANT ENGINEERING AND MAINTENANCE (ELECTIVE-I)

M 706-2 **3+1+0**

Module 1

Wear and Lubrication: -wear-classification-theories of wear-analytical treatment of wear- stages of wear-effect of moisture, gas and liquid on wear-effects of temperature-corrosive wear- fretting-fatigue-calculation of working life-design considerations.

Module 2

Lubricants: -solid, fluid and semifluid-synthetic lubricant-general properties and uses-tests and classification-aniline point-cloud, pour and flash point-carbon residue-flash and fire points- sulphur content-lubricant additives-lubricant systems-lubrication equipments and components.

Module 3

Maintenance: -Breakdown and preventive maintenance-deterioration and failure analysis- planning, scheduling, and controlling of maintenance work-organisation for maintenance.

Replacement: - causes of deterioration and obsolescence-sudden and gradual obsolescence and deterioration-economic analysis-MAPI method. Evolution of maintenance management-SWOT analysis-subjective methods of evaluation-objective criteria of evaluation.

Module 4

Reliability: -concept and definition-chance of failure-wear and failure application of stochastic model for reliability studies-reliability of series, parallel and stand by systems-estimation of parameters of failure distribution-maintainability and availability-problems.

Module 5

Non destructive testing and diagnostic instruments: - inventory control of spare parts-simple problems.

Safety management: - accident prevention program-designing of safe operation-fire protection –legal provisions for safety in industry.

References

1. Standard Handbook of Plant Engineering - Robert C.Rosder
2. Reliability&Maintainability Management - Balbir S.Shillon
3. Industrial Maintainence Management - Sushilkumar, Srivasthava
4. Handbook of Tribology - Bharat Bhooshan, B.K.Guptha
5. Inspection, Quality control and Reliability - S.C.Sharma
6. Maintenance and Spare parts management - P.Gopalakrishnan, A.K.Banergy.

WELDING TECHNOLOGY (ELECTIVE - I)

M 706-3 **3+1+0**

Module 1

Introduction: - Welding as a fabrication process- advantages and limitations – principal types of welding process and their characteristics.

Soldering & Brazing: -Soldering – principles of soldering, Tin-Lead binary diagram- different types of solders – need of fluxes for soldering and different fluxes used – method of soldering – silver soldering and aluminium soldering – advantages and limitations.

Brazing: - Principle of Brazing – brazing alloys & fluxes- methods of brazing – aluminium brazing – advantages & limitations.

Pressure Welding Process: - Forge welding- spot welding – seam welding – projection welding- butt welding – flash butt welding – welding of tubes & percussion welding.

Module 2

Fusion Welding: Oxy-acetylene welding – chemistry of oxy-acetylene welding flame – type of flames & adjustments – welding set up & arrangements – preparation & storing of acetylene as well as oxygen gases- rightward & leftward welding techniques – filler metals & fluxes used for gas welding – weld movements – welding of: cast iron, stainless steel, aluminium, copper, nickel & magnesium- safety rules in oxy-acetylene welding.

Module 3

Electric arc welding: Electric properties of the arc – arc column theories: ion theory & electron theory- heat distribution in an electric arc – arc welding power sources – their specific characteristics advantages & limitations – arrangements for straight & reverse polarities – striking of an arc – types of weld movements – welding positions – welding symbols – Electrodes – needs & types of electrodes covering – classification of arc welding electrodes.

Arc welding Processes: Carbon arc welding – single & twin carbon arcs – flux shielded metal arc welding – submerged arc welding – TIG & MIG welding and atomic hydrogen welding.

Module 4

Special or Unique welding processes: Various welding processes – their specific applications – neat sketches- advantages & limitations: Electroslag welding – Plasma arc welding – Ultrasonic welding – Electron beam welding – Laser beam welding – friction welding – explosive welding & cold welding processes.

Module 5

Basic metallurgy of welding: Three prominent zones: weld metal zone – heat affected zone & the unaffected zone.

Welding Stresses: causes of development of residual stresses – methods of relieving or controlling of residual stresses in weldments.

Defects: commonly found defects in welded joints.

Inspection & testing of weldments: - Needs of inspection & testing of weldments – the various testing methods – destructive tests such as tensile, bend, impact, neck break & hardness tests – Non destructive tests such as Magnetic particle, Ultrasonic, Dye-penetratant, radiographic & eddy current methods.

References

1. Welding Engineering -Rossi
2. Welding & welding Technology -Little.
3. Metallurgy of welding -Bruckner
4. The Electric Welder -Tse Golsky
5. Welding Engineer's Hand Book Vol 1,2 & 3 (ASME)
6. Welding for Engineers -Udin & Funk
7. A text book of Welding Technology -O.P Khanna
8. Welding Engineering -R.L Agarwal
9. Welding engineering & Technology -R. S. Parmer
10. Welding (10^{th} Edition) -A. C. Davis, Cambridge University Press.

FOUNDRY TECHNOLOGY (ELECTIVE - I)

M 706-4 **3+1+0**

Module 1

Patterns: Different types of patterns – colour codes of patterns.

Moulding sands: Natural and synthetic sand- ingredients of moulding sands- special sand additives sand mixing- general properties of moulding sand – testing of moulding sand - effect of ingredients and Additives on properties of moulding sand- reusability of moulding sands- sand conditioning.

Core and core making: Purpose of cores - core prints – types of cores – core sand ingredients – requirements of core sand- core sand mixing – binding materials – core boxes, core making, baking, coating, reinforcing and venting.

Module 2

Gating and risering: Mechanism of solidification – nucleation and growth – rate of solidification – progressive and directional solidification.

Gates and gating system – functions and types of gates – design of gating system – gating ratios for ferrous and nonferrous castings – risering- functions and requirements of riser – types of risers - theoretical considerations – Chvorinov s rule – riser shape and directional solidification – use of chills, insulators and exothermic compounds

Module 3

Ferrous foundry metallurgy: Gray cast iron – composition – effect of composition in properties – types of graphite in gray cast iron – foundry characteristics of grey cast iron – effect of inoculation and inoculants – low alloy and high alloy cast

iron –malleable iron – white heart and black heart malleable iron – malleablisation – S.G. iron – compositon and properties

Module 4

Non-ferrous foundry metallurgy: Foundry characteristics of copper and aluminium base alloys – degassing and melt treatment.

Melting and pouring: Types of furnaces used for C.I., steel and non-ferrous metals – details and charge calculation in cupola charging

Module 5

Cleaning and inspection: Knock out and fettling – destructive and non-destructive testing- salvaging.

Mechanisation in foundry: Elementary ideas of mechanisation in sand conditioning and supply, moulding, core making, knock out and fettling.

References

1. Principles of Metal Casting - Hine and Rosenthal
2. Foundry Technology - P.R.Beeley
3. Manufacturing Science - Amitabha Ghosh and Ashok Kumar Mallick
4. Manufacturing Engineering and Technology - Kalapakjian and Schmid

ADVANCED OPERATIONS RESEARCH (ELECTIVE - I)

M 706-5 **3-1-0**

Goals: The course is designed to develop an understanding of operation research with particular attention to linear programming, dynamic programming, and integer programming.

Module 1

- **Linear Programming**
    1. Problem Formulation
    2. Graphical Solution
    3. Simplex Method
    4. Revised Simplex Method
    5. Duality Theory
    6. Sensitivity Analysis

Module 2

- **Transportation Model**
    1. North-west corner method
    2. Least cost method
    3. VAM
    4. Test of optimality

Module 3

- **Integer Programming**

    1. Introduction, basic concepts and simple problems
    2. Gomory's all integral cutting plane method

- **Goal Programming**

    1. Application of goal programming
    2. Introduction basic concepts and simple problems

Module 4

- **Dynamic Programming**

    1. Shortest path models
    2. Characteristic of Dynamic Programming
    3. Discrete Dynamic Programming models

Module 5

- **Simulation**

    1. Basic Concepts

Binomial distribution
Poisson distribution
Normal distribution

    2. Monti-cralo simulation
    3. Generation of random numbers
    4. Simulation software

Course Outcomes

1. Students will have a working knowledge of operation research techniques such as linear programming, Integer Programming, Goal Programming and Dynamic Programming.
2. Students will have the ability to analyze and perform sensitivity analysis on different optimum solutions generated.
3. Students will have the ability to tackle real life optimization problems.

References

1. Hamda & Taha, Operations Research - 7th edn; Pearson
2. Ravindran and Philips Operations Research – Principles and Practice.
3. Ronald L.Rardin, Optimisation in Operation Research, Pearson Education
4. Verma A.P., Operation Research, S.K.Katharia & Sons

MARKETING AND SALES MANAGEMENT (ELECTIVE - I)

M 706-6 **3+1+0**

Module 1

Marketing: Definition- Marketing concepts- Market segmentation- Market demand- Product- Value and satisfaction- Exchange and transactions- Marketing channels- Competition- Marketing environment- Marketing mix.

Marketing Management: Functions-Sales forecasting-Pricing-Distribution-Advertising- Sales promotion- Marketing research.

Module 2

Strategic Planning: Strategic business unit (SBU)- Business strategic planning-SWOT analysis. Marketing decision support system.

Module 3

Product life cycle: Marketing strategies in the different stages of product life cycle.

New product development: Idea generation- Concept development and testing-conjoint analysis.

Introduction to Relationship marketing, International marketing and on line marketing.

Module 4

Consumer behaviour: Major factors affecting consumer buying behaviour-Consumer decision making process.

Organisational buying behaviour: Buying situations- the buying center-Purchasing process.

Module 5

Sales management: Evolution of Sales management- Objectives of Sales management- Personal selling situations- Theories of selling- Basic selling styles-Recruitment, selection and training of sales personnel-Sales territory-Sales quotas.

References

1. Marketing Management - Philip Khotler
2. Sales Management - Richard, Edward & Norman
3. Industrial Engg & Management - O.P.Khanna
4. Industrial Organisation & Management - Banga & Sarma
5. Organisational Behaviour - Fred Luthans
6. Consumer Behaviour - Schifman & Kanuk
7. Basic marketing - Gundiff
8. Marketing Management for small units - Jain
9. Sales Engg - Lester
10. Salesmanship concept - Thomson

COMPUTATIONAL FLUID DYNAMICS (ELECTIVE - I)

M 706 -7 **3+1+0**

Module 1

Basic concepts: -conservation principles-mass, momentum energy-conservation of scalar quantities-dimensionless form of equations-simple mathematical models for incompressible, inviscid, potential and creeping flows-approximations of hyperbolic, parabolic, elliptic, and mixed flows- introduction to numerical methods, advantages and limitations-components of numerical solution methods and properties.

Module 2

Finite difference methods: - concept-approximation of first derivative, second derivative and mixed derivative-boundary conditions, errors, spectral methods, examples-finite volume method, approximation of surface and volume integrals, boundary conditions-examples.

Module 3

Solutions of Linear Equations: - direct methods-Gauss elimination method-LV decomposition- tridiagonal system-cyclic reduction-iterative methods-conyergence-conjugate gradient- multigrid methods-non linear equations-deferred correction approaches, methods for unsteady problems, two level Runge Kutta predictor corrector methods-explicit, implicit methods.

Module 4

Solutions of Navier Stokes equations: -choice of variable arrangement on grid-calculation of pressure-other methods-solution methods for Navier Stokes equations.

Module 5

Turbulent flows: - direct numerical solution-large eddy simulation, RANS models, Reynolds stress models- compressible flows (introduction only)-pressure correction models-simple examples.

References

1. Computational methods for Fluid Dynamics -Joel H.Ferziger & Miloven Peric. (Springer Werlag Publishers)
2. Computational Fluid Dynamics (The basics with applications) -John D.Anderson (Mc Graw Hill Pub.)
3. Numerical methods for Scientific& Engineering Computations - M.K.Jain & R.K.Iyengar (WileyEastern)
4. Introduction to Numerical Analysis - F.B.Hilderbrand. (Tata Mc GrawHill)

MECHANICAL ENGINEERING LABORTAORY

M 707 **0+0+4**

Tests on reciprocating air compressor
Tests on blowers and rotary compressors
Vibration of springs – free and forced vibrations.
Whirling of shafts.
Balancing of reciprocating and revolving masses – balancing machines.
Tests on universal governor apparatus.
Tests on gyroscope.
Friction in hydrodynamic bearings – bearing testing machines.
Metallurgical analysis of specimens using metallurgical microscope.
Testing of foundry sands for strength, moisture content, permeability etc.
Determination of minimum fluidizing velocity in a conventional fluidized bed.

HEAT TRANSFER LABORTAORY

M 708 **0+0+4**

Tests on refrigeration equipment.
Tests on air conditioning units.
Determination of thermal conductivity of conducting and insulating materials.
Determination of emissivity of surfaces
Heat flow through lagged pipes.
Heat flow through composite walls.
Determination of overall heat transfer co-efficient of a heat exchanger.
Free and forced convection.