M.E. 3.1 ENGINEERING MATHEMATICS

Course Objectives: To equip students with adequate knowledge of mathematics that will enable them in formulating problems and solving problems analytically.

Instructional Objective: The course will enable students in handling linear systems using matrices. Use tools like Laplace transforms, Fourier transforms and Fourier series in formulating and solving problems.

No of Lectures per week : 3 hours
No. of tutorials per week : 1 hour
Duration of theory examination : 3 hours
Max. Marks for theory paper : 100
Max. Marks for sessionals : 25
Total Marks : 125
Total no. of modules : 4
No of questions from each module : 2
Total No. of questions to be answered : 5 (at least one question from each module)

MODULE – 1 **(11)**

Matrices : Types of matrices, Determinant inverse of matrix, Elementary transformations, Elementary matrices, Rank of matrix, Reduction to normal form, Canonical form, Rank using elementary transformation, Linear independence and dependence of vectors, System of the form AX = 0, and AX = B, and their solutions, Eigen values, Eigen vectors with properties, Cayley-Hamilton theorem with its applications, minimal polynomial, Diagonazation.

MODULE – 2 **(11)**

Fourier Series : Periodic functions, Trignometric series, Euler's formulae, Drichlet's condition, Even and odd functions, Half range series, Parseval's identity.
Fourier Transformations: Fourier transform, inverse Fourier transforms, applications, convolution theorem.

MODULE – 3 **(11)**

Laplace Transforms: Definition. Existence conditions, properties, inverse Laplace transforms. Laplace transform of periodic functions, Convolution theorem, Laplace transform of Dirac-Delta function, Application of Laplace transforms in solving linear differential equations with initial conditions and system of linear simultaneous differential equations.

MODULE – 4 **(12)**

Partial Differential Equations : Classification of partial differential equation, solution of Partial differential equation by method of separation of variables.
Wave Equation: Derivation and solution of one dimensional wave equation using separation of variable method.

Heat Equation: Derivation and solution of one-dimensional wave equation using separation of variable method.

Text

1. Grewal B. S., Higher Engineering Mathematics, Khanna Publications, New Delhi.
2. Veerarajan, Engineering Mathematics, Tata McGraw Hill Publications.

References

1. Erwin Kreyzing, Advanced Engineering Mathematic, New International Limited.
2. Kandasamy, P. Engineering Mathematics, Chand & Co., New Delhi.
3. Baphana, R. M., Applied Mathematics III, Technova Publication.

M.E 3.2 MACHINE DRAWING

Course Objective: Machine drawing is an art and science which aids visualization, manufacture, inspection and documentation of machine parts and components for usage by engineers involved in design and manufacture.
Instructional Objective: This course will help students to study and draw assemblies and disassemblies of various mechanical components, to understand the working and use of various permanent and fixed fasteners, to learn and draw free hand sketches missing views, and computer aided drafting of commonly used mechanical parts.

No. of lectures per week: : 1
No. of tutorials per week: : 1
No. of practicals per week: : 3
Max Marks for theory paper: : 100
Max marks for sessionals: : 25
Total no of modules: : 4
Duration of theory examination : 4 hours

Weightage of marks:
Module I : Two questions of 15 marks each
Module II : Two questions of 15 marks each
Module III : One question of 35 marks
Module IV : One question of 35 marks
Module III and Module IV are compulsory. Answer one question each from Module I and Module II

MODULE 1 (1)

Introduction to machine drawing. Conventional representation of basic components

Limits, Fits and Tolerances: Introduction to limits, fits, tolerances. Methods of placing limit dimensions. Geometric tolerancing. Datum line and tolerance build up. Machining grades. Types of fits, selection of fits and their use in drawings.

Screw Fasteners: Screw thread nomenclature, forms of screw threads, Thread series, Thread profiles, Multi-start threads, right and left hand threads, bolted joints, studded joints, foundation bolts. Locking devices for nut. Limits and fits for threads.

Welded joints: Types of welded joints, representation of welds on drawings.

Riveted joints: Introduction, classification and terminology of riveted joints. Caulking and fullering for rivets

MODULE 2 (1)

Keys, cotter and pin joints: Types of keys, cotter and pin joints.
Shaft couplings: Rigid coupling, flexible coupling, flexible coupling, non-aligned coupling disengaging coupling.
Pipes and pipe joint: Joints for steam pipes and hydraulic pipes, union joint and expansion joint.
Free hand sketches: Free hand sketches of different joints and couplings.

MODULE 3 (1)

Assembly Drawings with Bill of Materials
(Part Drawings with dimensions should be given)

-Screw Jack
-Lathe Tail Stock
-Steam stop valve
-Machine vice
-Feed check valve
-Blow off cock
-Lathe tool post
-IC engine connecting rod

MODULE 4 (2)

Disassembly Drawings with Bill of Materials
(Pictorial view with dimensions should be given)

-Drill Jig
-Connecting rod
-Stuffing box
-Footstep bearing
-Eccentric
-Crane hook
-Tail stock of milling machine
-Plummer block

Assignments

At least THREE sheets on assembly and THREE sheets on disassembly should be done during the practical sessions. Among which at least TWO sheets on assembly and TWO sheets on disassembly should be done using the drafting software.

TEXT BOOKS

1. Siddheshwar N: Machine Drawing, Tata McGraw Hill Publications
2. Bhatt.,N.D.: Machine Drawing, Charotar Publications

REFERENCES

1. Gill P.S.: Machine Drawing, Tata Mc Graw Hill Publications
2. Parkinson A.C: Intermediate Drawing
3. SP: 46-1988.
4. Gopal Krishna: Machine Drawing, Subhash Publications

M.E. 3.3 APPLIED THERMODYNAMICS

Course Objective: This course aims at to provide a good platform to mechanical engineering students to understand and appreciate concept of dynamics involved in thermal energy transformation and prepare them to carry out experimental investigation and analysis at later stages of graduation.
Instructional Objective: To help students to gain understanding of fundamentals of thermodynamics and to realize and appreciate the application of the concepts and laws from experimental and engineering background.

Lecturer per week : 3 hour
Tutorial per week : 1 hour
Max. marks for theory paper : 100
Max. marks for sessionals : 25
Duration of the paper : 3 hour
Total no of modules : 4
No. of question from each module : 2
Total no of question to be answered : 5 (at least one question from each module)

MODULE – 1 (4+5+2=11)
LAWS OF THERMODYNAMICS

1.1. I Law of thermodynamics : Introduction, overview of basic concepts, statement of I law of thermodynamics-corollaries including PMM – 1, establishment of standard reversible processes, application and analysis of I law on non –flow and flow processes, transient and steady state flow processes, common flow devices, problem & solution techniques.
1.2. II Law of Thermodynamics: Introduction, Statements, COP & efficiency, observations including PMM-II Carnot theorems, thermodynamic temperature scale, Claussius theorem, entropy, change in entropy in irreversible process, lost work principle of increase of entropy, problem & solution techniques,
1.3. III Law of Thermodynamics: Introduction to statistical thermodynamics, statement concept (preliminary treatment only)

MODULE – 2 (3+5+3=11)
WORK POTENTIAL

2.1. Thermodynamic Relations: Introduction, Maxwell, Tds, Clapeyron equations-establishment and derivations only, Helmholt's and Gibb's functions.
2.2. Measure of Work Potential: Introduction, Availability, Irreversibility for flow and non flow cases- establishment and derivation, seconds law efficiency, quality of energy excergy, problems & solution techniques
2.3. Real Gas: Introduction, equation of state- Vanderwaal's, viral, law of corresponding states, problem & solution techniques.

MODULE – 3 **(3+4+4=11)**

WORKING FLUID

3.1. Properties of Pure Substance : Introduction, Definition, P-V-T surface, methods to determine mass function of steam, problem & solution techniques using steam table and Mollier chart.

3.2. Gasesous Mixture : Introduction, Dalton and Amagat's law, determination of properties of compositions, gravimetric and Volumetric analysis of mixture, problem & solution techniques.

3.3. Principles of Psychometry : Introduction, humidity, adiabatic saturation process, dew point, wet bulb temperature (WBT), psychometric chart, basic air condition process (preliminary treatment only), problems & solution techniques.

MODULE – 4 **(5+5+2=12)**

CYCLES

4.1. Air Standard Cycles: Introduction, air standard assumption, an overview of reciprocating engines, Otto, Diesel and Dual cycles-establishment, comparative analysis, application; problem & solution techniques.

4.2. Vapour Power Cycles : Introduction , Rankine, reheat and regenerative cycles- ideal and with component efficiency and losses, establishment, comparative analysis application; problem & solution techniques.

4.3. Refrigeration Cycles : Introduction. Reversed Brayton cycle, Vapour compression refrigeration cycle, analysis of cycles with out P-h charts properties of refrigerants.

TEXT

1. Wan Wylen , G.J. Sonnatag, R.E. and Borgnakke , C. (1996), Fundamentals of classical thermodynamics, John Wiley & Sons, Inc Singapore.
2. Nag, P.K. (1996), Engineering Thermodynamics, Tata McGraw Hill Pub., New Delhi.
3. Cengel Y.A, and Boles M.A.(2003), Thermodynamics – An Engineering Approach, Tat a McGraw Hill Pub., New Delhi.

REFERENCES

1. Rao, Y.V.C. (2003). Theory and problems of thermodynamics, Universities Press (India) Pub., Hyderabad.
2. Spalding D.B. and Cole, E.H. (1979), Engineering thermodynamics, The English Language Book Society, London.
3. Rogers, G.F.C. and Mayhew, Y.R. (1980), Engineering Thermodynamics, Longman Pub., Hongkong.

ME 3.4 ENGINEERING MATERIALS SCIENCE

Course Objective: To impart knowledge about different properties of wise range of metals in view of manufacturing process.

Instructional Objective: To give familiarity with various characteristics and structutasl property relationships, as well, as processing techniques of materials an to provide proficiency and confidence to the engineering graduates in making judicial material choices.

Lecturer per week	: 3 hour
Tutorial per week	: 1 hour
Max. marks for theory paper	: 100
Max. marks for sessionals	: 25
Duration of the paper	: 3 hour
Total no of modules	: 4
No. of question from each module	: 2
Total no of question to be answered	: 5 (at least one question from each module)

MODULE – 1 **(4+7=11)**

1.1. Crystal Structure and Defects: Unit cell, space lattices and crystal structures, crystal directions and planes. Point defects-vacancy, interstitial and foreign impurities, Schottky and Frenkel defects. Line defects- edge and screw dislocations, burgers vector, Surface defects- low and high angle grain boundaries, tilt, twist and twin boundaries.

1.2. Dislocation Theory and Plastic Deformation : Dislocation loop, dislocation motion, intersection of dislocations, jogs, dislocation sources, multiplication of dislocations, energy of dislocations. Deformation by slip, slip in a perfect lattices, slip by dislocation movement, critical resolved shear stress for slip, deformation by twinning, deformation by bands, yield point phenomena, strain hardening , strain aging, recovery, recrystallisation and grain growth.

MODULE – 2 **(3+3+1+4=11)**

2.1. Fracture: Types of fracture in metals, ductile fracture, theoretical cohesive strength of metals, Griffith theory of brittle fracture, ductile-brittle transition temperature, fracture toughness.

2.2. Mechanical Testing of Materials: Tensile, impact, hardness, fatigue, creep and formability tests.

2.3. Phase Diagrams : Constitution of alloy, phase rule, binary phase diagrams, lever rule.

2.4. Iron-Carbon Phase Diagrams : Phases in iron-carbon diagram, definition of structures, invariant reactions, changes in microstructure during slow cooling, critical temperature lines, isothermal transformations diagram, transformation on continuous cooling.

MODULE – 3 (4+3+2+2=11)

3.1. Heat Treatment: Heat treatment of steels - annealing, normalizing, hardening, tempering, hardenability, Jominy end quench test. Case hardening of steels - carburizing, cyaniding, nitriding, induction and flame hardening. Heat treatment of steels of non-ferrous metals and alloys, age hardening, thermo-mechanical treatment of steels.

3.2. Metallography: Metallography of steel, cast iron, brass and bronze, sample preparation, etching, optical microscope, TEM and SEM.

3.3. Power Metallurgy : Powder manufacture, blending or mixing, compacting, sintering, secondary operations, applications, advantages and limitations.

3.4. NDT TECHNIQUES: Radiography, magnetic particle inspection, fluorescent penetrant test, ultrasonic inspection, eddy current inspection.

MODULE – 4 (4+4+3=11)

4.1. Composite Materials : Classification, strengthening, mechanism in particulate, dispersion strengthened and fibre reinforced composites, characteristics of fibre reinforcing composites, elastics modulus under iso-stress and iso-strain condition.

4.2. Alloy Steels and Cast Irons : Purpose of alloying, effect of alloying elements, effect of common alloying element and their applications. Tool steels- classification, properties and typical applications. Classification, properties and applications of stainless steels and cast irons.

4.3. Non Ferrous Alloys: Composition, properties and applications of typical brassses and bronzes and aluminum alloys.

TEXT

1. Sydney H. Aver: Introduction to physical metallurgy, TMH, II Edition.
2. George E.Dieter, Mechanical Metallurgy , THM.

REFERENCES

1. Raghavan V: Elements of material science and engineering, PHI, IV Edition.
2. William D. Callister: Elements of material science and engineering, John Wiley & Sons, New York, IV Edition.

M.E. 3.5 FLUID MECHANICS

Course Objective : The study of fluid mechanics involves statics, kinematics and dynamics aspects of fluid. Some of the notable applications are in design of dams, flow of water in pipes, measurement and analysis of various parameters like pressure velocity. The course tries to cover the important aspects of Fluid mechanics and its application.
Instructional Objective: The course aims that students understand basic theory and numerical problems involved in various topics of Fluid mechanics. The course aims at the following:
1. The student should have knowledge of different properties of fluids.
2. They should know different pressure, velocity, discharging measuring instruments.
3. They should have knowledge of hydrostatic forces on surfaces.
4. They should understand the various concepts involved in dynamics, kinematics and turbulent flow.
5. They should understand boundary layer phenomenon.
6. They should have basic idea of Dimensional analysis and Modeling & analysis.

No of Lectures per week : 3 hours
No. of tutorials per week : 1 hour
Max. Marks for theory paper : 100
Max. Marks for sessionals : 25
Duration of theory examination : 3 hours
Total no. of modules : 4
No of questions from each module : 2
Total No. of questions to be answered : 5 (at least one question from each module with two compulsory question from any one module)

MODULE – 1 (2+4+5=11)

1.1.Properties of Fluids : Basic concepts and definitions, Classification and properties of fluids-surface tension and capillarity, compressibility and bulk modulus.
1.2. Fluid Statics: Liquid pressure and its types. Pascal's law of pressure, pressure variation in a static fluid, Measurement of pressure – Manometers: Simple U-Tube, Differential manometers, and Mechanical Gauges. Pressure at a point in a Compressible Fluid
1.3.Hydrostatic Forces on Surfaces: Total pressure and center of pressure on Vertical, Horizontal and inclined plane surfaces submerged in liquid.

MODULE – 2 (3+4+4=11)

2.1.Fluid Kinematics: Types of Fluid Flow, Discharge, Continuity equation, Lines of flow types of velocity potential function for 2-D Flow, Relationship between them and flow nets.
2.2.Fluid Dynamics : Equations of motion, Euler's equation. Bernoullis equation Practical application of Bernoullie's equation - horizontal and inclined venturimeter, Pitot tube. Impulse momentum equation, Kinetic energy & momentum correction factor.
2.3. Flow Through Pipes: Loss of head in pipes - major & minor losses, Hydraulic gradient and total energy line, Flow through siphon, Equivalent pipe -series &parallel pipes, Flow through nozzle, water hammer in pipes.

MODULE – 3 (6+5=11)

3.1.Turbulent Flow : Definition , Reynolds experiment, Darcy-weisbach's equation, Prandtl's mixing length theory, universal velocity distribution equation, Hydrodynamatically smooth & rough boundaries, Velocity distribution for turbulent flow in smooth & rough pipes.

3.2. Compressible Flow: Thermodynamics properties, Basic equation of compressible flow, Velocity of sound for adiabatic & isothermal process. Mach number & its variations, Mach angle, Zone of action, Zone of silence. Subsonic & Supersonic nozzle, stagnation properties

MODULE – 4 **(6+6=12)**

4.1. Dimensional Analysis: Dimensional of physical quantities, dimensional Homogenity, Buckinghams-π Theorem , Rayleigh'smethod, important dimensionless numbers.

4.2. Boundary Layer: Definitions: Laminar & turbulent boundary, boundary layer thickness & energy thickness. Total drag due to laminar & turbulent layers. Boundary layer separation & its control.

TEXT

1. Dr. R.K Bansal: A Text Book of fluid Mechanics and Hydraulic mechanics, Laxmi publications, New Delhi 2002.
2. Kumar D.S: Fluid Mechanics and Fluid Power Engineering S.K.Kataria & Sons
3. Modi P.N,.Seth S.M: Hydraulic &Fluid Mechanics Standard Book House

REFERENCES

1. Streeter V. I &. Wylie E. B "Fluid Mechanics" Mc Garw Hill
2. Jagdish Lal "Fluid Mechanics and Hydraulics" Metropolitan book company Pvt. Ltd.
3. R.K.Rajput "A Text book of Fluid Mechanics and hydraulic machines", S.Chand Company Ltd, New Delhi 2003.

ME 3.6 DIGITAL ELECTRONICS & MICROPROCESSORS

Course Objective: This course aims to help students to understand electronic control of mechanical parts.

Instructional Objective: To help students gain an understanding of the working of basic digital electronic circuits and microprocessor-based circuits.

Lecturer per week	: 3 hour
Tutorial per week	: 1 hour
Max. marks for theory paper	: 100
Max. marks for sessionals	: 25
Duration of the paper	: 3 hour
Total no of modules	: 4
No. of question from each module	: 2
Total no of question to be answered	: 5 (at least one question from each module)

MODULE – 1 (4+1+4+2=11)

1.1.Study of Number Systems & Codes :Unsigned binary numbers, signed binary numbers, Binary arithmetic- Addition & subtraction using 1's complement & 2's complement method. Introduction to Decimal, Binary, Octal & Hexadecimal number systems & their conversion from one form to another. Introduction to Gray codes, Excess-3 codes & ASCII codes.

1.2.Study Of Logic Circuits: Study of basic NOT, AND, OR, NAND, NOR,XOR & NOR gates with schematic symbol & truth table.

1.3.Study Of Boolean Algebra :Laws, rules & theorems of Boolean algebra, Sum of products form (SOP), products of sum form (POS) of Boolean functions. Study of Karnaugh Maps (K-maps) for 2, 3 & 4 variables only.

1.4. Combinational Logic: Analysis of Half Adder, Full Adder, Encoders and Decoders; Multiplexers and Demultiplexers,

MODULE 2 (3+2+6=11)

2.1. Study of Flip Flops: Study of clocked Set-Reset (SR) flip flop, JK flip flop, Toggle (T) flip flop, Delay (D) flip flop & Master slave JK (MSJK) flip flop with their schematic symbol, truth table & excitation table.

2.2.Study of Shift Registers: Study of Serial in serial out (SISO), Serial in parallel out (SIPO), Parallel un serial out(PISO), Parallel in parallel out (PIPO) shift registers.

2.3. Study of Counters : Study of Asynchronous counters with circuit diagram, truth table & waveforms (up counters m down counters & up/down counters). Study & design of Synchronous counters (up counters, down counters & up/down counters) using D or T flip flops only, & study of Ring counters.

MODULE 3 (5+6=11)

3.1. Microprocessor Architecture & Microcomputer Systems: Introduction to microprocessors, microcomputers, organization of a microprocessor based system, 8085 bus structure, Microprocessor architecture & Pin diagram of 8085. Timing Diagrams.

3.2. Semiconductor Memories & Interfacing : Basics, memory addressing, Types of memories (RAM & ROM) & Interfacing with 8085 & Interfacing of memory along with I/P, O/P devices & peripherals.

MODULE 4 (7+5=12)

4.1. 8085 Instruction Set: Data transfer instructions, Arithmetic instructions , Logical , Branch & machine control instructions , Conditional call & Return Instructions. Writing of simple assembly language programs, concept of stacks & subroutines.

4.2. Study Of Microprocessor Applications:- Designing scanned displays, Interfacing a matrix keyboard, Memory & Stepper motor.

TEXT

1. Malvino & Leach : Introduction to Digital Electronics, Tata McGraw Hill,.
2. Morris Mano : Digital Logic & computer Design, PHI, India.
3. Gaonkar R.S.: Microprocessor Architecture, Programming & Application, Wiley Eastern

REFERENCES

1. Mathur A.P : Introduction to Microprocessors, Tata Mc Graw Hill,.
2. Millman & Halkias :Integrated Electronics , Tata Mc Graw Hill,.
3. Floyd :Digital fundamentals ,.

M.E. 3.7. PRACTICALS IN APPLIED THERMODYNAMICS

Practical per week : 2 hours
Max marks for practical exam : 25
Duration of the practical exam : 2 hours

Course Objective : To learn to carry out experimental investigation on systems interacting with work and heat and to practically conform how they obey laws of thermodynamics.
Instructional Objective: To help students to gain hands-on experience on how to conduct experimental investigation and procedure a technical report based on the investigation.

List of Experiments
A. To investigate and ascertain the conformance of :
1. The first law of thermodynamics on petrol engine.
2. The second law of thermodynamics on petrol engine.
3. The first law of thermodynamics on diesel engine.
4. The second law of thermodynamics on diesel engine.
5. The first and second law analysis on air conditioning system.

B. Determination of mixture properties
6. To find the composition of exhaust of petrol engine (gravimetric/volumetric)
7. To find the composition of exhaust of diesel engine (gravimetric/volumetric)

C. Cycle analysis
8. On gas turbine

At least six experiments from the above list are to be conducted and an appropriate journal reporting the experiments is necessarily to be submitted.

List of Apparatus Required

Sr. No.	Equipment description	Quantity
1	Petrol engine	1
2	Diesel engine	1
3	Air conditioning test rig	1
4	Exhaust gas analyzer	1
5	Nozzle flow devices	1

Other Requirement:
A standard laboratory manual encompassing all the features of a technical report.

M.E. 3.8. PRACTICALS IN ENGINEERING MATERIAL SCIENCE

Practical per week : 2 hours
Max marks for practical exam : 25
Duration of the practical exam : 2 hours

List of experiments in Material Science and metallurgy

1. To draw the stress-strain curve and calculate (a) the elastic limit (b) yield strength (c) ultimate tensile strength (d) % of elongation (e) % of reduction in area (f) toughness (g) resilience of the given metal.
2. To measure the hardness of the given material using Brinell/ Rockwell/ Vicker's Hardness tester.
3. To measure the impact strength and notch sensitivity of the given metal.
4. To determine the capacity of the material to withstand repeated cyclic stress.
5. To determine the continuing change in the deformation of the material at elevated temperature below the yield point.
6. To determine the ductile - brittle transition temperature of the given metal.
7. To find the ability of the given metal to be formed into different shapes.
8. To study the microstructure of (a) mild steel (b) brass (c) cast iron.
9. To detect the presence of cracks/flaws in the given metal piece by magnetic particle crack detection method.
10. To detect the presence of cracks/flaws in the given metal piece by dye penetrant test.
11. Joining End Quench test.
12. With the help of muffle furnace to carry out annealing, normalizing, hardening, operation.

At least six experiments from the above list are to be conducted and an appropriate journal reporting the experiments is necessarily to be submitted

M.E. 3.9. PRACTICALS IN FLUID MECHANICS

No of hours per week : 2 hours
Duration of examination : 2 hrs.
Max. marks for practical : 25

List of experiments in Fluid Mechanics Laboratory

1. Verification of Bernoulli's theorem.
2. Calibration of a Venturimeter.
3. Calibration of a orificemeter
4. Calibration V-notch
5. Calibration of rectangular notch
6. Friction in pipes-Determination of coefficient of friction for a G.I. pipe
7. Frictional loss in pipe due to bend and nozzle
8. Reynold's Experiment.: Demonstration of Laminar and turbulent flow.

At least six experiments from the above list are to be conducted and an appropriate journal reporting the experiments is necessarily to be submitted.

M.E. 3.10. PRACTICALS FOR DIGITAL ELECTRONICS AND MICROPROCESSOR APPLICATIONS

Course Objective : To learn how digital circuits can be designed and implemented with and without microprocessors.

Instructional Objective : To help students to gain hands-on experience in designing, assembling, analyzing and debugging basic digital electronic circuits, and how to program a microprocessor circuit.

Practicals per week : 2 hours
Max. Marks for practical exam : 25
Duration of the practical exam : 2 hours

List of Experiments :
1. Performance of Logic Gates
2. Boolean Equation
3. De Morgan's Theorems
4. Performance of Universal Gates
5. Parity Generators and Checkers
6. Reduction using Boolean Algebra
7. Reduction using Karnaugh Map
8. RS Flip-Flop
9. JK Flip-Flop
10. Performance of Counters
11. Design of Course
12. Performance of Shift Registers
13. Parity Generators and Checkers
14. Simple Programs for the 8085 Microprocessor

At least six experiments from the above list are to be conducted and an appropriate journal reporting the experiments is necessarily to be submitted

List of Apparatus Required:
1. Bread boards
2. I.C.s
3. L.E.D.s
4. Wires
5. DC Power supply

Other Requirement:
A standard laboratory manual encompassing all the features of a technical report.

M.E.4.1 THEORY OF MACHINES-1

Course Objectives : This is an introductory level course, mainly dealing with kinematic analysis of linkages and the direct contact mechanisms. Basics on mechanism synthesis are also included. The course aims at initiating, mechanical engineering students, in the area of Synthesis and analysis of the mechanisms, In the process they will learn to analyze mechanical systems, in general.

Instructional Objective : The expected outcome is an ability to analyse mechanisms, get acquainted with the basics of synthesis process and develop appreciation for advanced topics in the field of Mechanisms and Machines.

Lectures per week : 3 hours
No. of practicals per week : 2 hour
Max. Marks for theory paper : 100
Max. Marks for sessionals : 25
Duration of theory examination : 3 hours
Total no. of modules : 4
No of questions from each module : 2
Total No. of questions to be answered: 5 (at least one question from each module)

MODULE 1 (2+6+3=11)

Introduction: Basic terminology, mobility criterion, four-bar, slider crank and Double slider crank chains and their inversions, Grashoff's linkage.

Kinematic of Particle and Rigid Body : Position displacement, velocity and acceleration of particle, intrinsic co-ordinates and path curvature, motion relative to a moving frame, Coriolis acceleration, Newton's law in nib-internal frame, Motion of a rigid body, angular velocity pf a rigid body: a vector, chassel's theorem.

Description of Some Common Linkages: Exact and approximate straight-line mechanism, steering gears, pantograph and universal joint.

MODULE 2 (11)

Velocity And Acceleration Analysis of Mechanisms : Analysis of mechanisms, having higher and lower pairs, by graphical; and analytical methods. Instantaneous centre of velocity, Arnhold-Kennedy theorem, body centrode and space centrode and their application.

MODULE 3 (5+6=11)

Kinematics Synthesis of planar mechanism : Task of synthesis and it's classification, synthesis of mechanism for three accuracy points using graphical and analytical techniques, Freudenstein's equation, Four bar coupler curves, Cognate linkages, Bloch's synthesis method, Practical consideration in mechanism synthesis.

CAMS : Different types of CAMS and followers and terminology for Cam- follower Mechanisms: follower motions : uniform, uniform acceleration and retardation , SHM, cycloidal their comparison, graphical synthesis of cam profile for a given follower and it's motion, polynomials cam, synthesis of follower motion from the given follower

acceleration variation with cam angle, pressure angle, and size of a cam, radius of curvature of the cam profile with roller follower to avoid undercutting, circular arc cam and tangent cams.

MODULE 4 **(6+2+2+2=12)**

TOOTHED GEARING :

Motion transmitted two curved surfaces in direct contact, law of gearing , classification of gears, involute and cycloidal gears, spur gear terminology, involumentry , path of contact , interference and undercutting, method of avoiding interference , non- standard gears.

Helical Gears: Terminology , Contact in two helical gears , contact ratio, comparison with spur gears.

Spiral Gears : Centre distance, velocity ratio, velocity of sliding , efficiency.

Worm and worm wheel: Terminology , application , efficiency.

Bevel Gears : Terminology , Tredgold's approximation.

Gear Trains : Analysis of Simple , Compound and epicyclic gear trains, automobile differential.

TEXT

1. Hamilton H. Mabie and CFharles F. Mechanism and dynamics of machinery, Rainholtz, john Wiley & Sons.
2. Jospeh Edward Shigley and John Jospeh Uicker Jr. Theory of machines and Mechanisms, Mc Graw , Hill International edition.
3. J. S. Rao and Dukkipati, Mechanism and Machine Theory , Wiley Eastern Limited.

REFERENCES

1. Irving H. Shames, Engineering Mechnaics, Prentice Hall of India Pvt. Ltd.
2. George H. Martin, Kinematics and Dynamics of Machines, McGraw-Hill international Book Company.

M.E.4.2 MECHANICS OF SOLIDS

Course Objectives : The objective of this course is to introduce students to the strength of Materials approach to analyze simple structural elements, subjected direct Tension/compression, Bending, Torsion and combination of these loads. This will help them to take up, at a later stage, design of machine elements and simple structures.

Instructional Objective : The course should prepare students to take up design of machine elements and further study in Theory of Elasticity and related topics.

Lectures per week : 3 hours
No. of Tutorials per week : 1 hour
Max. Marks for theory paper : 100
Max. Marks for Sessional : 25
Duration of theory examination : 3 hours
Total no. of modules : 4
No of questions from each module : 2
Total No. of questions to be answered : 5 (at least one question from each module)

MODULE 1 **(4+4+3=11)**

Introduction: Review of mechanics, static analysis of rigid systems. Stress. Strain. Hook's law, Poisson's ratio, modulus of rigidity, bulk modulus, relation between constants.

Uniaxial Deformation : Uniaxial tension/ compression, temperature stresses, statistically indeterminate problems.

Stress And Strain Analysis: 2-D stress and strain analysis, Mohr's circle, strain gage rosettes.

. **MODULE 2** **(4+7=11)**

Properties Of Areas: Centroid, Moment of inertial, principal axis of inertia, parallel axes of theorem and polar moment of inertia

BEAMS: Bending moment and shear force, relation between them, sign convention, Flexure formula, asymmetric bending, curved beams, stresses due to shear force, Shear stresses in beams of thin walled open cross sections, shear center for thin walled open sections such as "T" , channel, angle section, semi-circular section , (built-up section not include), deflection of beams, statistically in determine beams.

MODULE 3 **(4+7=11)**

Torsion: Torsion of circular shafts, close and open coil springs.

Struts And Columns: Struts and core of section, stability of columns , euler's critical load, for different end conditions of column , empirical formulas for bucking load.

Members Subject to Combined Loading : Shafts subjected to bending movement and twisting movement, members subjected to bending and directed tension/ compression.

MODULE 4 **(5+4+3=12)**

Introduction of Energy Methods: Strain energy under different loading conditions, Maxwell's theorem, Catigliono's theorems, deflection of structures using virtual load method.

Thick And Thin Cylinders: Thin cylinders subjected to internal pressure, thick cylinders, Lamme's equation.

Theories Of Failure: Various theories of failures and their limitations comparison and application .

TEXT

1. Gere James M., Timoshenko Stephen P., Mechanics of Materials, CBS.
2. Popv Egor P. Pearson Education (Singapore) Pvt. Ltd.

REFERENCES

1. Beer Ferdinand, Johnson E. Russel, Mechanics of Materials, Mc Graw Hill Book.
2. S. Ramamrutham, Strength of Materials, Dhanpat Rai Publishing Co. (P) Ltd.

ME 4.3 NUMERICAL TECHNIQUES & COMPUTER PROGRAMMING.

Course objective: To introduce students to various numerical techniques, enabling to solve problems which may not be intractable analytically. Implement the algorithm using C language.

Instructional Objective: to build ability to solve numerically linear system of equations, algebraic and transcendental equations, differential equations and evaluate integrals. Using C language implement the algorithm.

Lecture per week : 3hrs.
Practicals per week : 2hrs
Tutorials per week : 1hr
Max marks for theory paper : 100
Max marks for Sessional : 25
Duration of examination : 3hrs
Total no of modules : 4
No of questions from each module :2
Total no of questions to be answered :5(At least one question from each module)

MODULE 1 (5+4+2=11)

Solutions Of Equations: Solutions of non-linear equations of single variable using bisection method, false position method, Newton-raphson's method, secant method, (problem solving, algorithm and computer programming) order of convergence of these methods. Comparison of these methods.

MODULE 2 (5+6=11)

Finite Difference And Interpolation: Forward , Backward, Central , Divided differences, Difference tables. Lagrange's interpolation, Taylor's operator -d, Shift operator ‘e, averaging operator, derivations. difference of polynomials factorial polynomials. Newton's forward & backward difference interpolation, Newton's divided difference interpolation.(derivation, problem solving, algorithm and computer programming) Stirling's and Bessel's interpolation formula.

MODULE 3 (6+5=11)

Numerical Solution Of Differential Equations: Picard's methods, Taylor's series method, Euler's method, Modified Euler's method, Runge Kutta methods, Milne’s predictor - corrector method.(problem solving, algorithm and computer programming)

Numerical solution of Partial Differential equations: Solution of Laplace equation, heat equation and Wave equation by finite difference method.

MODULE 4 (6+6=12)

Numerical Integration : Newton- Cote’s Quadrature formula , trapezoidal rule, Simson's 1/3 and 3/8 rules,Weddle’s rule (problem solving, algorithm and computer

programming). Romberg's integration (Richardson's Extrapolation).Comparison of the above methods and their error estimation.

Solution of linear algebraic equation; Gauss Elimination method, Gauss Jordan method, Jacobi's method, gauss-Siedel iterative method (problem solving, algorithm and computer programming). Concept of ill conditioned and well conditioned system comparison of the above method.

TEXT

1. Grewals B. S. : Numerical Methods, Khanna publications
2. Kandasamy P : Numerical Methods S. Chand and Co, New Delhi
3. Dr. D.S.C. Engineering Mathematics Part III

REFERENCES

1. E. Balaguruswamy : Numerical Methods
2. S.S.Sastry : Introduction Method of Numerical Analysis
3. V.Rajaraman : Computer Oriented Numerical Methods

ME 4.4: ELECTRICAL TECHNOLOGY

Course objective: to familiarize with electrical machines, which mechanical engineers are to deal with in their fields
Instructional Objective: to impart concepts of electrical machines

Lecture per week	: 3hrs.
Practical per week	: 2hrs
Max marks for theory paper	: 100
Max marks for sessionals	: 25
Duration of the paper	: 3hrs
Total number of modules	: 4
No of questions from each module	: 2

Minimum number of questions to be answered from each module:1
Total no of questions to be answered : 5
All module carry equal weightage

MODULE 1 (6+5=11)

Principles of electromechanical energy conversion: DC machine-Construction & emf equation.

DC Motor: principles, torque-equations voltage equation, torque-equations, motor characteristics, speed control, starting

Three Phase Induction Motor: Principle, construction, slip, torque-slip characteristics, starting, speed control.

MODULE 2 (3+3+3+2=11)

Single phase Induction Motor: Principle of operation of split phase type, capacitor start motors.
Stepper Motors: Types, principle of operation.
Synchros: Construction, principle of operation and applications.
Servomotors: DC servomotor, two-phase ac servomotor.
Drives: Concept of an Electrical Drive, Classification, characteristics and braking of dc motors.

MODULE 3 (4+4+3=11)

Working principle, construction, torque equations of the following analog instruments (a) PMMC (b) Moving iron (c) Electrodynamometer types, Shunts and multipliers for PMMC type instruments and extension of range.

Electrodynamometer Wattmeter: construction, torque equation.

Induction type Energy meter: construction, torque equation. Measurement of power and energy.

MODULE 4 (4+4+4=12)

Potentiometers: DC potentiometer: slide wire type and Laboratory type (Crompton's Potentiometer), applications.

AC Potentiometer: Drysdale Polar type Potentiometer.

AC bridges : For measurement of inductance, capacitance and frequency: Maxwell Bridge, Wagner's Earth bridge.

Illumination: Definitions, laws of Illumination

Electrical heating: advantages, principle of resistance heating, high frequency eddy current heating, dielectric heating.

TEXT

1. A Text Book of Electrical Technology-- B.L Theraja.(Vol II)
2. A Course in Electrical and Electronics Measurement and Instrumentation---A.K. Sawhney

REFERENCE

1. Electrical Power : J.B. Gupta
2. A First Course on Electrical Drives: S.K. Pillai

M.E.- 4.5 : MANUFACTURING TECHNOLOGY - I

Course Objective: This subject covers the basic processes followed for manufacturing different products. Basically this subject cover casting, metal forming, welding and plastic processing. After studying this subject student will be able to understand how the different products are manufactured, their process details, and process parameters. Understanding of this subject is perquisite for mechanical engineering subjects like machine design, production planning and control, process engineering, etc.

Instructional Objective: To impart knowledge on basic manufacturing processes, which will be essential to understand advanced courses being offered in the area of manufacturing.

No of Lectures per week	: 3 hours
No. of tutorials per week	: 1 hour
Max. Marks for theory paper	: 100
Max. Marks for sessionals	: 25
Duration of theory examination	: 3 hours
Total Marks	: 125
Total no. of modules	: 4
No of questions from each module	: 2

Total No. of questions to be answered : 5 (at least one question from each module)

MODULE I (11)

Casting- Advantages, basic steps in making sand casting.

Pattern , Functions, types, pattern making allowances

Core Functions, types, core boxes, core making, core print, chaplet.

Moulding , Moulding sand in-gradients, general properties of moulding sand, sand testing (analytical treatment), green sand moulding, dry sand moulding

Cupola furnace , construction, operation, charge calculation (analytical treatment).

Special Moulding Processes , CO_2 Moulding, Shell Moulding, Plaster mould casting, investment casting, centrifugal casting- true, semi and centrifuging.

Permanent mould casting (Die casting) , advantages, limitations and applications.

Pressure die casting , hot chamber, cold chamber.

Casting Design , Pouring and feeding, progressive and directional solidification, typical gating system and its elements; Gates, Risers, design calculation (analytical treatment).

Casting defects, inspection and testing of casting

MODULE II (11)

Welding advantages, classification, types of welds, edge preparation for butt welds, weldability and metallurgical aspects of welding.

Thermit welding , thermit crucible, thermit pressure (plastic), thermit non-pressure (fusion) welding.
Gas welding, Oxy-acetylene gas welding, types of flames, welding techniques, welding equipments.
Arc Welding , Submerged Arc Welding (SAW), Tungsten inert gas welding (TIG), Metal inert gas welding (MIG), Metal active gas (CO_2) welding (MAG), Electroslag welding (ESW)
Resistance welding , spot, seam projection, upset butt, flash butt, percussion, high frequency
Brazing and soldering
Solid state welding , smith, cold pressure, friction, explosive, ultrasonic, diffusion
Radiant energy welding , laser beam welding (LBW), electron beam welding (EBW)

MODULE III **(11)**

Metal forming , classification of forming processes , hot and cold working, based on stress, primary and secondary, strain hardening
Rolling , types of rolling mills, roll product terminology, force and geometrical relationships, force and power calculation. (Analytical treatment)
Forging advantages, classification- open die forging and closed die forging, hammer and press forging, hand and machine forging; equipments used, force calculation (analytical treatment).
Extrusion , Direct, Indirect, hydrostatic, impact extrusion, equipment used Rod / Wire drawing , principle, rod drawing, tube drawing, wire drawing, drawing die and its construction, equipments used, preparation of rod for wire drawing, heat treatment of wire, protective metallic coatings.

MODULE IV **(12)**

Fabrication of plastics , casting, compression moulding (hot), transfer moulding, cold moulding, injection moulding, extrusion, thermoforming, foam moulding, machining of plastics, finishing and assembly operation.
Processing of rubbers and elastomers.
Processing of ceramics , fabrication, machining, joining.
Fabrication of composite materials , laminar composites, fiber reinforced composites, lamination and lamination type processes

TEXT BOOKS

1. P.N. Rao , Manufacturing Technology (Casting, forming and welding), TATA McGraw Hill (TMH).
2. Suresh Dalela, R. Shankar , A text book of production Technology, Galgotia Publications Pvt. Ltd.

3. G.K. Lal, S.K. Chaudhary , Fundamentals of Manufacturing Processes, Narosa Publishing House

REFERENCES

1. E. Paul DeGarmo, J.T. Black, Ronald A. Kohser-Materials and processes in Manufacturing, Prentice Hall India (PHI).
2. Roy A. Lindberg - Processes and Materials of Manufacture, Prentice Hall India (PHI).
3. J.S. Campbell - Principles of Manufacturing Materials and Processes, TMH
4. Amitabha Ghosh, Asok Kumar - Manufacturing Science, East West Press Pvt. Ltd. New Delhi.
5. Hiene, Loper, Rosenthall - Principles of Metal Casting, TMH.
6. O.P. Khanna - A Text Book of Foundry Technology, Dhanpat Rai Publication.
7. P.L. Jain - Principle of Foundry Technology, TMH.
8. G.E. Dieter - Mechanical Metallurgy, McGraw Hill International.
9. R. Narayana Samy - Metal Forming Technology, Ahuja Book Publisher.
10. A.C. Davies - Welding, Cambridge
11. O.P. Khanna - A Text book of Welding Technology, Dhanpat Rai Publication.

ME 4.6 ENERGY CONVERSION

Course objective: this course aims to provide all the core concepts of energy conversion and allied applications. This provides a platform to pursuer to understand and appreciate the real life applications of energy conversion. At the end of the course the pursuer will be in a position to carryout experimental investigation on prim-movers. With the associated practical slots the students will get a complete exposure on Internal Combustion engines.

Instructional Objective: to help students to build theory with analytical ability in the area of energy conversion. To enable students to carryout experimental investigation on Internal Combustion engines and thereupon to draw proper conclusions. To know the fundamentals of jet propulsion with theory of gas turbine.

Lecture per week : 3hrs.
Tutorials per week : 1hr
Max marks for theory paper : 100
Max marks for sessionals : 25
Duration of examination : 3hrs
Total no. of modules : 4
Total no. of questions from each module :2
Total no. of questions to be answered :5(At least one question from each module)

MODULE-1 (1+4+2+2+2=11)

1. CYCLE ANALYSIS AND PREPARATORY SYSTEMS

1.1 Basics : Introduction, overview of working principles of I.C.Engines, overview of ideal cycle and comparison.

1.2 Fuel Air Cycles & Their Analysis : Introduction, Fuel Air Cycles & their significance, Variable Specific heat, Dissociation, Effect of no. of moles, Comparison of Air Standard & Fuel Air Cycles, Effect of operating Variables, Problem and Solution Technique.

1.3 Actual Cycles & Their Analysis : Introduction, Comparison of thermodynamic & Actual Cycles, various losses.

1.4 Carburetion : Introduction, air-fuel requirement, carburetion, simple carburetor-air feel ratio derivation, compensating devices, demerits, multi-point fuel injection (MPFI) system, simple problems and solution technique

1.5 Fuel Injection System : Introduction, injection system with schematic diagram (elementary treatment only)

MODULE-2 (1+2+3+3+2=11)

2. Fuels and Combustion

2.1 Ignition System : Introduction, circuitry, description (elementary treatment only)

2.2 Combustion In Spark Ignition Engines : Introduction, Stages of combustion in S.I. Engines, Flame front propagation, factors influencing the flame speed, Abnormal combustion, the phenomenon of knock in S.I. Engine, Effect of Engine variables on Knock.

2.3 Combustion In Compression Ignition Engines : Introduction, Stages of Combustion C.I. Engine, Factors affecting the Delay period, the phenomenon of knock in C.I. engines, Comparison of knock in S.I and C.I. Engines.

2.4 Super Charging : Introduction, Supercharging Systems, Turbo-charging, Characteristics of Supercharged Engines, Method of Super Charging, Limits of Supercharging.

2.5 Fuels : Important qualities of Engine fuels, rating of C.I. and S.I. Engine fuels. Alternative fuel renewal sources (preliminary treatment only)

MODULE-3 (5+5+2=12)

3. Testing and Performance

3.1 Measurement : Introduction, Measurement of frictional power , Willian's line method, Morse test, Retardation test, indicated power-indicated diagram, Brake power , Prony Brake, Rope Brake, Eddy Current, Swinging field Dynamometer, Measurement of Fuel Consumption, Air Consumption-air box method, Speed, Exhaust & Coolant Temperature.

3.2 Thermal Calculations :Load, speed and performance characteristics, Engine power, Engine Efficiencies, Variables affecting performance characteristics, Heat balance with dry and wet exhaust calculations, performance Maps.

3.3 Emission and its control: SI CI engine emissions and their comparison, environmental effect of air pollution.

MODULE-4 (3+3+5=11)

4.1 Lubrication Systems : Introduction, Lubrication Systems types and working principles with schematic diagram (theoretical treatment only)

4.2 Cooling Systems: Introduction, types and working principles with schematic diagram (theoretical treatment only)

4.3 Jet Propulsion : Introduction, air standard cycles, types, deviations, thrust and propulsive power and efficiency calculations, problem and solution technique, rocket propulsion (theoretical treatment only)

TEXT

1. Ganesan V. (2003): Internal Combustion Engines Tata McGraw Hill, New Delhi
2. Gill. P.W, Smith J.H. and Ziurjs E.J. (1974), Fundamentals of Internal combustion engines as applied to reciprocating gas turbine and jet propulsion power plants, Oxford & IBH pub. New Delhi
3. Pulkrabek W.W. (2002), Engineering fundamentals of Internal combustion engine Prentice Hall of India Pub.,New Delhi

REFERENCES

1. Mathur M.L &. Sharma R.P: A Course in Internal Combustion Dhanpat Rai & sons.
2. Domkundwar V.M: I.C. Engines Dhanpat Rai & co.
3. Taylor: The Internal Combustion Engines Vol. I & II

ME 4.7 PRACTICALS IN NUMERICAL TECHNIQUES & COMPUTER PROGRAMMING.

No. of Practicals per week: 2 hrs.
Max. marks for practicals : 25
Duration of examination : 2 hrs

1. Solution of non-linear equations using bisection method
2. Solution of non-linear equations using bisection method
3. Newton forward difference interpolation formula
4. Lagrange's interpolation formula
5. Solution of differential equations using Euler's method
6. Solution of differential equations Runge-Kutta fourth order method
7. Numerical integration using Simpson's 1/3 rule
8. Numerical integration using Weddle's rule

ME 4.8 PRACTICALS IN ELECTRICAL TECHNOLOGY

No. of Practicals per week: 2 hrs.
Max. marks for practicals : 25
Duration of examination : 2 hrs

List of Experiments to be carried out as practicals in the Laboratory

1. Speed control of DC shunt / compound motor.
2. Ward Leonard method of speed control of DC motors
3. Study of 3paint starter
4. To find out various parameters of induction motars by direct load test
5. Study of DOL and star delta starter.
6. Measurement of power by two wattmeter methods
7. Measurement of energy by 1-Ø energy meter
8. Measurement of unknown resistance by Kelvity bridge
9. Measurement of insulation resistance by Megger
10. Study of DC potentiometer
11. Direct load test on 1-Ø Induction motor
12 Study of Temperature control in electric heater

At least six experiments from the above list are to be conducted and an appropriate journal reporting the experiments is necessarily to be submitted.

ME 4.9 PRACTICALS IN MANUFACTURING TECHNOLOGY - I

No. of Practicals per week: 2 hrs.
Max. marks for practicals : 25
Duration of examination : 2 hrs

List of Practicals on :

1. Preparation of sand mould.
2. Preparation of casting
3. Smith forging
4. Arc / gas welding

Practical as above are to be conducted and the jobs are to be submitted for assessment

ME 4.10 PRACTICALS IN ENERGY CONVERSION

No. of Practicals per week: 2 hrs.
Max. marks for practicals : 25
Duration of examination : 2 hrs

Course Objective :

- To carry out tests to investigate the performance of prime movers.
- To impart how to measure important performance parameters of experimental investigation on prime movers.

Instructional Objectives:

- To help students to gain hands-on experience on how to conduct experimental investigation on prime movers.
- To impart how to draw conclusions from appropriate measures base on the graphical plots in conjunction with the concept learnt the theory.
- To prepare a technical report based on the experiments conducted.

List of Experiments

A. To investigate the behaviour of prime movers by:

- Load test on Spark and compression Ignition Engine.
- Speed test on Spark and compression Ignition Engine.
- Performance test and draw heat balance sheet.
- Performance test on Gas Turbine.

B. Determination of :

- Effect of compression ratio on engine performance
- Frictional Power using:
  - Willan's line
  - Morse test
  - Retardation test
  - Motoring test
- Air fuel requirement in SI engine
- Fuel and exhaust gas analysis
- Composition of pollutants.

At least six experiments from the above list are to be conducted and an appropriate journal reporting the experiments is necessary to be submitted.

List of Apparatus Required

Sr. No	Equipment Description	Quantity
1	Petrol engine multi-cylinder	1
2	Diesel engine multi-cylinder	1
3	Variable compression ratio engine test rig	1
4	Exhaust gas analyzer	1
5	Gas turbine test rig	1

Other requirements:

A standard laboratory manual encompassing all the features of a technical report