DEPARTMENT OF MECHANICAL ENGINEERING

COLLEGE OF TECHNOLOGY

COURSE OUTLINE & CATALOGUE DESCRIPTION

UG COURSES

DEPARTMENT OF MECHANICAL ENGINEERING

Name of the course : **Thermodynamics & Heat Engines**
Course Numbers : TME-101
Credit Hours : 4(3-1-2)
Pre-requisite : Nil

CATALOGUE DESCRIPTION

System and properties,concept of energy, temperature & heat,equation of State, first Law for closed & open systems, pure substance & properties, second law of thermodynamics & entropy Boilers,mountings and accessories, boiler efficiency, steam engines, Rankine cycle, indicator diagrams, steam turbines.Internal Combustion engines, Air standard Otto, Diesel, Dual and Joule Cycle.

Lectures	Topics
1.6	Introduction: Engineering system of units; system and their properties, concept of energy, temperature work and heat, Zeroth law of thermodynamics; Equation of state for an ideal gas.
7-10	Pure substance; phase diagrams; tabulated properties, property charts and their use.
11-14	First law of thermodynamics and Engg. applications; Flow and non-flow processes; General energy equation for steady flow; Analysis of constant volume, constant pressure,isothermal and adiabatic processes, reversible and irreversible processes.
15-20	Introduction and definition of second law of thermodynamics, Carnot cycle; definition and concept of entropy, the change of entropy. The change of entropy for gas.
21-24	Steam boilers; types of boilers, high pressure boilers,mounting and accessories; equivalent evaporation; boiler efficiency, boiler trial.
25-30	Steam engines; Rankine cycle; construction and working of steam engine; indicator diagrams; work output; steam consumption and efficiency.
31.36	Steam turbine; construction and working of steam turbines;impulse and reaction turbines; velocity diagrams; work output and efficiency; compounding of steam turbines.
37-40	Air standard cycles; Otto,Diesel,Joule Dual Stirling and Atkinson etc.
41-45	I.C. engines; Classification; construction and working of two stroke and four stroke; C.I. engine work output; efficiency and mean effective pressure calculations; ignition system.

TEXT BOOK: 1.Engg. Thermodynamics by Gupta & Prakash.
2.Engg. Thermodynamics by P.K. Nag.

Marks Distribution
Ist Prefinal - 20%
2nd Prefinal - 20%
Lab.assignment - 20%
Final - 40%

Course : **Machine Drawing**
Course No. : TME-231
Credit Hours : 2 (0-0-4)
Pre requisite : TCE-101 Engineering Drawing

CATALOGUE DESCRIPTION:

Drawing of Machine Elements, Rivets and riveted joints. Threaded fasteners. Assembly and working drawings of Cotter joints, Bearings, plumber blocks, couplings, Brackets, Connecting rod, Stuffing Box, Eccentric, stop valves, safety valves, Lathe tail stock, screw Jack and piping joints.

Weeks	Topic
1-2	Layout of drawing sheet, Conventional Representation of common eatures.
3-5	Orthographic projection- Ist angle and 3rd angle Projections Missing line problems, Isometric views.
6-7	Rivet heads and riveted joints
8	Nuts and Bolts. Nut, bolt and washer assembly.
9	Sectioning methods and types. Sectioning problems for Footstep earing, Cone pulley and stepped pulley.
10-14	Assembly drawings of Footstep Bearing, Knuckle Joint,Plumber Block, Eccentric, Cotter Joint, Stuffing Box, Screw Jack, Connecting rod, Couplings, Brackets, Stop valves, Lathe Tail Stock, piping Joints.

TEXT BOOKS:
1.Machine Drawing by Sadhu Singh and Sah,P.L.

REFERENCE BOOKS:
1.Machine Drawing by N.D. Bhatt and V.M. Panchal
2.Text Book of Machine Drawing by Laxminarayana and M.L. Mathur
3.Engineering Drawing by A.C, Parkinson
4.Elementary Engg. Drawing by N.D. Bhatt
5.Machine Drawing by N. Sidheswar, Kannaiah and Sastry.

Name of the Course : **Kinematics of Machines c**ourse No.: TME-241
Credit Hours : 3(2-1-2) Pre-requisite : Nil

Lectures	Topics
1-8	Introduction: Aims & scope of the course & Basic concepts of Mechanisms, Basic definitions, Difference between structure & Machine, Links & their types, Types of constrained motion, Kinematic pair & their classification, Grubler's mobility criteria,Inversion of a kinematic chain, Inversion of Four bar chain, Slider crank mechanism and Double slider crank mechanism ,Problems on kinematic chains.
9-14	Velocity diagram of Mechanisms: Location of Instantaneous Center and its properties, Body Centroid and space Centroid, Number of Instantaneous center in a mechanism and their types, Special cases of location of Instantaneous center, Kennedy three centers in line theorem, Method of locating Instantaneous center in a Mechanism, Methods for the velocity of a point on a link by instantaneous center method, Velocity of a point on a link by relative velocity method, Velocities in slider Crank and Four bar mechanism, Rubbing velocity at a pin joint. Problems based on the application of above methods.
15-17	Acceleration Diagram of Mechanism: Acceleration Diagram for a link, Acceleration of points on link in Four bar chain and slider crank mechanism. Problems based on the application of above methods.
18-22	Belt Rope and Chain Drives: Types and materials of belts, Types of flat belt drives ,Determination of velocity in case of simple and compound belt drive Slip of belt,Creep of belt,Length of an open belt drive and length of a cross belt drive. Power transmitted by a belt,Ratio of driving tension for flat belt. Determination of angle of contact, Centrifugal tension in belts or ropes, Maximum tension in belts, Conditions for transmission of maximum power in case of flat belt drive, Initial tension in the belt,Effect of initial tension on transmission of maximum power for flat belt drive, Design of belt dimension, V-Belt Drive, Advantages & Disadvantages of V-belt drive over flat belt drive, Ratio of driving tension for V-belt and Rope. Chain drive, Advantages and Disadvantages of chain drive over belt or rope drive, Pitch and pitch circle diameter in case of chain Drive and relation between them. Problems based on the application of above theory.
23-28	Brakes & Clutches:Types of braking systems their force & torque analysis, Friction clutches, Disk or pate clutches & its analysis for torque transmitted based on uniform pressure & Uniform wear theory. Cone clutches and its analysis for torque transmitted based on uniform pressure and uniform wear theory. Problems based on the application of above theory.
29-32	Gears & gear Trains: Some basic definitions, Types of gears and gear trains and their analysis.Experiments concerning linkages, mechanism, simple machines and geared systems. Problems based on the application of above theory.

TEXT BOOK: Theory of Machines By Thomas Bevan

REFEREMCE BOOK:

Kinematics	By H.N. Tyson
Theory of Machines	By J.E. Shingley
Theory of Machines	By S.S Rattan

Prefinals marks distribution

I Hourly	20 Marks	II Hourly	20	Missed Hourly	20	Lab	20
Final	40	Total	100				

Name of the course : **Theory of Fluid Flow**
Number of the course : TME-211
Credit : 3(3-1-0)
Pre-requisite : Nil

CATALOGUE DESCRIPTION:

Concept of basic principles of Fluid Flow, Kinematics of Fluid Flow, Dynamics of Fluid Flow, Incompressible Flow Principles, Boundary Layer Theory, Application of Hydrodynamics, Compressible Flow Principles, Mach Number, Flow Regimes, Normal shock,shock wave, Measurement of Compressible Flow.

Lectures	Topics
1.5	Introduction Definition of Fluid, Properties of Fluid,Types of Fluids,Fluid Particle,No Flow, Basic Equations, Methods of Analysis, Dimensions and Units.
6-10	Fundamental Concepts. Continuum, Velocity Field, Surface and body forces,Point Force, Line Force, Forces Influencing Hydraulic Phenomena- Inertia Force, Viscous Force, Gravity Force, Pressure Force, Elastic Force, Surface Tension Force,Stress at a point, Description and Classification of Fluid Flows-Steady and unsteady Flow, Ideal and Real Flow, Rotational and Irrotational Flow, one,two and three- dimensional Flows, Pressure and Pressureless Flow,Sub Critical,Critical, and Super Critical Flow, Isothermal, Adiabatic, and Isentropic Flow.
11-14	Kinematics of Fluid Motion Methods of describing Fluid Motion, Lagrangian Method,Eulerian Method,Total Derivative(Material Change), Equation for acceleration, Components of Acceleration in Cartesian Coordinates and Cylinderical Coordinates, Tangential and Normal Components of Acceleration, Lines of Flow-Streamlines, Pathlines and Streak lines, streamtube,Different Types of Displacement of Fluid Particle, Circulation, Vorticity, Vorticity Components in Cartesian,Cylindrical, polar, and Curvilinear orthogonal coordinates, Irrotational and Rotational Flow.
15-21	Flow of an Incompressible Fluid Differential Form of General Continuity Equation in Cartesian and Cylindrical Coordinatesl,Reynolds Transport Theorem, Integral Form of Continuity Equation, Velocity Potential Function & Stream Function in Cartesian and Polar Coordinates, Relation Between Stream Function and Velocity Potential Function, Steam Surface, Flow Net, Equation of Motion, Euler's Equation of Motion; Bernoulli's Equation, Applications of Bernoulli's Equationl, Linear Momentum Equation, Energy Equation, Vortex Flow, Vortex Lines, Vortex Tube, Free Vortex and Forced Vortex.
22-30	Flow of a Real Fluid Reynolds' Experiments and their Significance, Lift and Drag, Pressure Drag, Skin Friction Drag, Flow Around a Circular Cylinder,Concept of boundary layer; boundary layer along a thin flat plate, boundary layer Equation in 2-D Flow;Boundary layer thickness and Displacement thickness,Momentum thickness;Momentum Correction Factor, Energy thickness; Momentum Equation for boundary layer by Von-Karmann; Laminar boundary layer, Turbulent Boundary Layer; Boundary Layer Separation, Internal and External Flow.
31-40	Flow of a Compressible Fluid

Introduction, Controlling Parameters in Compressible Fluid Flow, Basic Equations Governing Compressible Fluid Flow,Energy Equation, Flow regimes, Propagation of an Elastic Wave, Velocity of Sound, Mach Cone and Mach Angle, Stagnation point and Stagnation Properties, Isentropic Nozzle Flow, Euler's Equation of Motion(Momentum Equation), Subsonic and Supersonic Nozzle and Diffuser,Flow through a Convergent nozzle; Choked Flow, Convergent-Divergent Nozzle, Flow Variables in terms of Mach Number,Effect of Irreversible and reversible adiabatic Flow, Shock Wave, Normal Shock, Shock Strength, Note on Oblique Shock Wave, Flow through a Convergent-Divergent Nozzle, Flow of Compressible Fluid through a Venturimeter.

41-48 Basic Flow Fields-Rectilinear Flow, Source and Sink Flow, Combining flows by Superposition, Rankine method of Constructing Streamlines, Combined Flow Fields-Source in a Rectilinear Flow, Source and Sink pair Flow, Source and Sink Pair in a Uniform Flow, Doublet (Dipole), Doublet in a Uniform Flow, Doublet and Free Vortex in Uniform Flow, D'Alembert Paradox, Kutta-Joukowski Theorem and Magnus Effect, Flow in a porous medium.

Text Books

1. Engineering Fluid Mechanics by Dr. D.S. Kumar.
2. Fluid Mechanics by Dr. S.S.Rattan

Reference Books:

1. Introduction to Fluid Mechanics by Fox and Mcdonald.
2. Mechanics of Fluids by I.H. Shames
3. Fluid Mechanics by Yuan

Ist prefinal	=	25
IInd prefinal	=	25
Viva	=	10
Final Exam	=	40
	Total=	100

Name of the course : **Material Science**
Course No. : TME-251
Credit Hours : 4(3-1-2)
Pre-requisite : Nil

Catalogue Description:

Introduction, structure of metals and non-metals. Structural imperfections: Solid solutions: Diffusion.mechanical, electrical and thermal properties of materials.
Introduction to phase-diagram. Iron-Carbon system,heat treatment, T-T-T- curves. Cast iron; Non-ferrous metals and their alloys. Powder metallurgy. Mechanical metallurgy.metallography and mix-examination.

Lecture Nos.	Topics
1.	Introduction, Aims and scope of the course
2-4	Crystalline and non crystalline structures; Unit cells,Bravais space lattices, cubic and hexagonally closed packed structures, co-ordination no.,packing factor.Miller indices, crystallographic planes and directions.
5-7	Structural imperfections- point,line,planer and,volume defects. Dislocations energy of dislocations,structural sensitive & insensitive properties,structure property relationship.
8-10	Mechanical properties and their evaluation-elasticity, stiffness, plasticity, resilience, toughness, ductility and malleability, hardness, brittleness, strength, creep and fatigue.
11-13	Plastic deformation, twining, slip, Frank Reed source of dislocation multiplication, strain hardening effects, slip systems.
14-15	Solid solutions, types of solid solutions.
16-17	Alloys; definition, types and utility.
18-19	Diffusion, fick's laws of diffusion,practical examples.
20-21	Fatigue; S-N curve, mechanism of fatigue, factors affecting fatigue, examples.
22-23	Creep; creep curve, factors effecting creep, practical examples.
24-25	Thermal properties, coeff. of linear expansion, thermal diffusivity, thermal conductivity.
28-29	Composite materials, definition, types, advantages and applications of composite materials.
30-31	Gibb's phase rule,Unary and binary phase diagram, lever rule.
32-34	Iron-Iron Carbon phase diagram. Phase transformation,Nucleation and growth.
35-37	T-T-T- curve, Martensite transformation crystal growth and zone refining.
38-40	Precipitation hardening, Recrystallization, Grain growth. Glass transition.
41.44	Powder Metallurgy, Cast iron and steel, Non-ferrous.

41.45 Glass Transition , Smart Material and Nano scale material

TEXT Books

1. Elements of Material Science by Vaan Vlack
2. First course in Materials Science by Raghvan

REFERENCE BOOKS

1. Introduction to physical Metallurgy by Avner
2. Mechanical Metallurgy by George E. Dieter
3. The structure & Properties of Materials (Vol. 1-IV) by Hayden, Moffat and Wulff.

Break up of Marks:

Ist pre-final examination	20 marks
IInd pre-final examination	20 marks
Practical Examination	20 marks
Final Examination	40 marks
Total :	100 marks

Name of the course : **Heat and Mass Transfer**
Number of the course : TME-301
Credit Hours : 4(3-1-2)

CATALOGUE DESCRIPTION :

Modes of heat transfer, One and two dimensional steady state heat conduction, heat transfer from extended surface, Unsteady state heat conduction, Numerical solution of steady state and unsteady state heat conduction problems, Natural and forced convection, hydrodynamic and thermal boundary layers, heat transfer with phase change, heat exchanger, radiation properties and laws, diffusive and convective mass transfer.

Lecture No.	Topic
1-2	Introduction, Concept of Thermodynamics & heat Transfer Modes of Heat Transfer, Basic law, Thermal Conductance and Resistance.
3-6	General heat conduction equation. Radial heat conduction through tubes and spherical shells Composite structures. Critical Insulation thickness.
7-10	Heat source systems. Heat transfer from extended surfaces.
11-14	Heat Conduction in rectangular and semi-infinite plates. Numerical solution of steady state problems.
15-20	Unsteady state heat conduction, heating or cooling of bodies with known temp. distribution, Heating or cooling of bodies whose internal thermal resistance is known. Transient heat conduction charts, Numerical solution of unsteady state problems.
21-26	Convection Heat Transfer,Introduction, viscous and Inviscid flow, hydrodynamic and Thermal boundary layer, Forced and natural convection, Empirical relations.
27-32	Radiation properties and law. Radiation heat exchange between black surfaces and grey surfaces. Radiation shields, Electrical Network method for solving radiation problems.
33-38	Heat exchangers, classification, Overall heat transfer co-efficient, LMTD Heat Exchanger effectiveness NTC-Method.
39-41	Heat Transfer with phase change, phenomenon of condensation film and Dropwise condensation, Film Condensation on a vertical surface, phenomenon of boiling, Regimes of pool boiling.
42-44	Mass transfer, Fick's law of Diffusion, Diffusion in gases, Isothermal evaporation of water into air, Mass transfer co-efficient.

Text Books:

1.Engineering Heat Transfer By C.P. Gupta & Prakash
2.Heat Transfer By J.P. Holman

Reference Books:

1. Heat & Mass Transfer by Incroper & De Witt, Pub.John Wiley & Sons (Asia) Pte.Ltd.
2. Heat Transfer by Bejan

Distribution of marks:
Pre-finals: 40
Laboratory: 20
Final : 40
Total : 100

Name of the Course : **Fluid Machinery and Systems-I**
Course No. : TME-310
Credit Hours : 4(3-1-2)
Pre-requisite : TME-211 Theory of Fluid Flow 3(3-1-0)

Catalogue Description:
Entire spectrum of fluid machines, linear momentum and angular momentum theorems, Dynamic action of fluid on stationary and moving vanes; units and specific quantities, whirling of fluids; Airfoils, Lift and Drag, Blades cascade, Lift in ideal and real fluid flows, Hydro-electric power development, Impulse Turbines, Reaction turbines, Governing and performance of turbines, Centrifugal pumps, Reciprocating pumps, Cavitation, Hydraulic Systems like Hydraulic lift, Ram, Crane, Press etc., Hydraulic Coupling, Torque Converters. Lab Experiments based on the above.

Lectures	**Out line of the course**
1-2	Entire spectrum of Fluid Machines
3-7	Dynamic Action of Fluid Linear momentum and angular momentum equations, Dynamic force exerted by a jet on stationary flat and inclined plates, on curved plates/vanes, Force on moving flat, inclined plates,and curved vanes; Force on series of flat plates; series of curved vanes and series of radial curved vanes; Euler's Equation of Fluid Machines; Degree of Reaction; Principle of jet propulsion and propulsion of ships.
8-11	Wirling of Fluids Types of fluid motion, rectilinear motion, Radial flow, Rotary or vortex motion, Free and Forced vortex, cylindrical and spiral vortex, flow along a curved path; Mathematical Analysis.
12-13	Unit and specific quantities__Unit Quantities as unit discharge, unit force, unit power, unit speed, unit torque etc., specific Quentities; specific speed of pumps and of turbines
14-16	Classification and types of Turbines : Head, Losses and efficiencies of hydraulic turbines
17-19	Impulse Turbines Main components; their functions; guide Mechanism; buckets and runner; casing; Hydraulic brake, speed ratio, jet ratio, Different layouts; Design of components of a Pelton turbine; Turbine power; Efficiencies; velocity triangles etc.
20-26	Francis and Deriaz Turbines Types of Francis Turbines-closed and open flume types; main components of modern Francis turbines; Guide Mechanism, Draft tube; types of Draft tubes; Draft tube theory; Design of components of Francis Turbine, shapes of Francisunner, Cavitation; Methods to avoid cavitation, Selection of speed. Runaway speed. Deriaz turbine; Influence of variable pitch on hydraulic performance; Force, Torque; power and efficiencies.
27-29	Propeller and Kaplan Turbines: Components; Turbine proportions; Adjustments of Kaplan blades; Performance at part loads
30-32	Governing of Water turbines Function of a water turbine governor; Types of governors; Outlines and Working of oil pressure governors, Governing of Impulse and Reaction Turbines etc.
33-37	Centrifugal Pumps Principle of operation; Classification; Layout; Head of a pump; Theory of C.F. pumps; workdone and manometric efficiency; Pressure rise, Manometric head; Efficiencies; Shapes of blades; Axial thrust; cavitation in pumps; Priming; Multi-stage Pumps; NPSH, Selection of C.F. pumps.
38-41	Reciprocting Pumps Classification, slip and coefficient of discharge; Indicator diagrams; velocity and acceleration of water in reciprocating pumps; Air vessels; Saving in work by air vessels; Theory of working of air vessels.
42-43	**Characteristics of water turbines and centrifugal pumps**
44-45	**Aerofoil theory.**
46-50	Hydraulic System Hydro-static and Hydro Kinematic systems;constant and variable delivery systems; hydraulic lift; Hydraulic crane; Pressure accumulator; intensifier; fluid couplings; Hydraulic torque coverters etc.

Text Books:

1. Hydraulic Machines - Dr.Jagdish Lal
2. Hydraulic Machines - S.S. Rattan

Referemce Books:
1. Hydraulics & Fluid Machines - Modi and Seth

2. Fluid Flow Machines - Govinda Rao

Experimental Work:

Lab Experiments based on the above
(Hydraulics Laboratory, Civil Engineering Department)

Name of the course : **Internal Combustion Engines**
Course No. : TME-212
Credit Hours : 4(3-1-2)
Pre-requisite : TME-101 Thermodynamics and Heat Engine

CATALOGUE DESCRIPTION:

Two and four stroke engines; air standard cycles; fuels and combustion; fundamental of ignition systems; performance and rating of engines; combustion characteristics and combustion chamber for S.I and C.I engines, supercharging.

Lecture No.	Description
1-8	Classification of I.C. Engines, Nomenclature, Four stock, two-stroke cycles and its comparison, valve timing diagram;first law analysis of engine cycle; energy balance; air-Standard cycles; Otto, Diesel, Dual cycle, Comparison of cycles, mean effective pressure.
9-13	Fuels-petroleum base liquid fuels-Rating and qualities of S.I. and C.I. engine fuels cetane and octane numbers; combustion equations-Air-fuel requirement volumetric and gravametric analysis.
14-20	Carburetor; functions air-fuel mixture requirement,distribution system; ignition system; battery ignition system; magnet ignition system;spark plugs; combustion in S.I. engine, flame front propagation, factors affecting flame speed, abnormal combustion, pre-ignition;detonation; variables affecting detonation, combustion chamber design; requirement of diesel injection systems;types of injection systems fuel pump,Type of fuel injectors and nozzles.
29-36	Combustion in C.I. engine;ignition delay; knocking;variables affecting ignition delay;combustion chambers for C.I. engine; variable affecting C.I. engine performance;engine performance curves.
37-41	Cooling of engine; air cooling and water cooling system; super charging,objects; methods of improving engine performance for C.I. and S.I. engine. Supercharging methods for C.I. and S.I. engines.
42-44	Air pollution;pollutants; exhaust emissions and emission control devices.

Text Books:

1. Internal Combustion Engine by Obert Edward F.
2. A Course in I.C. Engine by Mathur and Sharma
3. Internal Combustion Engine by Maleev or Litchy

Reference Books:

1. Internal Combustion Engines by V.Ganeshan

Name of the course : Fluid Machinery & Systems-II

Course No. : **TME-313**
Credit Hours : **4(3-1-2)**
Pre-requisite : **TME-211 Theory of Fluid Flow**

CATALOGUE DESCRIPTION:

Thermodynamics of Turbo-machines, Gas Turbines and jet propulsion, Centrifugal and axial flow compressors, fans and blowers, propellers, wind Tunnels.

Lectures	**Topics**
1-4	Introduction, Classifications of Turbines,applications,General Characteristics of Turbomachines, Euler's Turbine equation.Thermodynamics of Turbo-machines
5-11	Ideal gas turbine cycles, Practical gas turbine cycles, Types of turbines. Turbine work and efficiencies, Polytropic efficiency Effect of operating variables on the performance. Applications of gas turbines.
12-15	Jet Propulsion-Performance of Turbojet engines; Introduction to rocketry engine.
16-21	Axial flow compressors-flow analysis, Stage pressure rise and efficiency, degree of reaction, efficiency of blade rows, compressor blade cascade, efficiency, free & forced vortex blades.
22-25	Propellers-Froude's momentum theory, Air screw coefficients and efficiency, Helicopter Rotor, Hovercraft.
26-30	Types of wind tunnels, wind tunnel instruments, Flow Visualisation, Testing of turbine & Compressor blade cascades.
31-38	Centrifugal Compressors pressure rise slip factor & evaluation, degree of reaction, Non dimensional quantities used for plotting compressor characteristics.
39-44	Fans & Blowers- Fan Laws, performance coefficients, centrifugal & axial fans, Series Parallel operation; applications, general design principles.

Text Book "Turbomachines" by Dr. S.M. Yahya
Ref. Books:

1. "Gas-turbine theory" Cohen and Rogers.
2. Turbo-blowers Stepanoff.
3. Jet Propulsion and gas turbines by M.I. Zucrow.
4. Fans by William C. Osborne
5. E.T. Vincent "Theory & Design of gas turbine and jet engines"

Name of the Course : **M/C, Element Design**
Course Number : TME-232

Credit Hours : 3(2-0-3)
Pre-requisite : Nil

CATALOGUE DESCRIPTION:

Principle of Design, factor of safety, and working stress, Design of Joints and fasteners,shafts, springs, couplings, belts, ropes, chains, bearing, and gears.

LECTURE	TOPICS
1-2	Principles of Design, General definitions, materials
3-5	Types of Loads, Types of Static loading, Types of dynamic loadings, Types of fatigue loading.
6-7	Stresses and strains, Definitions, Direct and bending stresses, stresses produced in case of gradual, sudden impact and shock loading. Torsional stresses, combined stress.
8-10	Factor of safety, stress concentration factor, Theories of failures.
11	Working stresses.
12-15	Design of joints and fasteners,Design of riveted joints
16-18	Design of shaft, Design on the basis of strength,Design on the basis of rigidity, Design of keys, Effect of keyways.
19-21	Design of springs,
22-24	Design of couplings, Design of rigid couplings, Design of flexible couplings.
25-27	Design of belts, ropes and chains.
28-30	Design of gear : spur gear.
31-35	Design of bearings; Design of rolling bearings, Design of slender bearings.

TEXT BOOKS:
1. Machine Design by Dr. Sadhu Singh.

REFERENCE BOOKS

1. M/C Design by Sharma & Agarwal.
2. M/C Design by J.E. Shigley.
3. Design of M/C. Elements by M.F. Spotts.
4. Elements of M/C. Design by Pandya & Shah.

Name of the Course : **Machine Design - I**
Course number : TME-333

Credit Hours : 4(3-0-2)
Pre-requisite : TME-231, Machine Drawing

CATALOGUE DESCRIPTION

Principles of machine design; Selection of material, fits and tolerances, computation of stress in machine parts, Theories of failure, design consideration; Design of joints and fasteners, Sshafts, couplings, levers, power screws, belts, ropes. and chains; Pulleys and Fly-wheels, springs, brakes and clutches.

LECTURE	TOPICS
1.	Introduction
2-4	Principle of Design, Selection of Materials General Definition, Types of Loads etc.
5-8	Computation of stresses in Machine parts.
9-13	Theories of failures, factor of safety, fatigue stresses. Stress concentration etc.
14-20	Design of Joints and fastness. Rivets Joints, Bolted Joints, Cotter and knuckle joints.
21-24	Design of shafts, Strength and rigidity Criteria.
25-29	Design of levers, Couplings etc.
30.33	Design of springs-coil and leaf springs.
34-38	Design of power screws, Pulleys and fly-wheels.
39-45	Design of belts, ropes, brakes and clutches.

TEXT BOOK
1. M/C Design by J.K.Shigley.

REFERENCE BOOKS

1. Design of M/C Elements by M.F. Spotts.
2. Machine Design by Khurmi.
3. M/C Design by Black & Adam.
4. Elements of M/C Design by Pandya and Shah.
5. M/C Design by Sharma & Agarwal
6. Pro Engineer : Instructor by Keley (Tata Mc Graw Hill)

Name of the Course : **Theory of Machines**
Course Number : TME-342

Credit Hours : 4(3-0-2)
Pre-requisite : TME-241, Kinematics of Machines

CATALOGUE DESCRIPTION

Analysis of cam and follower motion, Intermittent and straight line motions, Theory of gearing, Advanced problems on gear trains, Inertia forces in reciprocating parts, Gyroscope, Flywheel, Balancing of rotating and reciprocating masses, Hook's Joint and steering Mechanisms, Governors.

Lecture No.	Topics
	Introduction
2-8	Analysis of cam and follower motion, Classification of cams and followers Terminology, Types of follower motion,Velocity and acceleration diagrams,Construction of various cam profiles and complex design
9-10	Intermittent and straight line motion. Various intermittent motion mechanism, Different types of straight line motion mechanism.
11-14	Theory of Gearing: Classification of gears and terminology Law of gearing , systems of gears teeth,Interference and efficiency of gears, Application of gears.
15-18	Advanced problems of Gear Trains: Epicyclic gear train, Compound and epicyclic gear train, Torque analysis and various applications of complex gear trains.
19-24	Inertia Forces in reciprocating parts: Resultant effect of a system of forces acting on a rigid body, 'D' Alemberts principle, Klien's construction, Bennett's construction, Analytical method for velocity and acceleration of the piston, angular velocity and acceleration of connecting rod, Force analysis of reciprocating engine mechanism and inertia torque calculations.
25-30	Introduction to gyroscope, precessional motion and definitions, Effect of gyroscope couple in aeroplane, Effect of gyroscopic couple on naval ship during steering, Pitching and rolling, Stability of four-wheel and two wheel vehicle during turning, Gyroscopic stabilization.
31-34	Flywheel: Fluctuation of energy and speed, Application of flywheel to various operations and mechanisms of machine
35-41	Balancing of rotating and reciprocating masses: Different methods of balancing of rotating masses,Primary and secondary unbalanced forces of reciprocating masses and partial balancing, Method of direct and reverse crank, Balancing machine.
42-43	Hook's joint & steering mechanism; Analysis of Hooks'joint motion mechanism, Davis and Ackerman Steering Gear Mechanism.
44-48	Classification of governors and terminology, Functions and working of various types of governors and Analytical analysis

TEXT BOOKS:

1. Theory of Machines - Thomas Bevan

REFERENCE BOOKS:

1. Theory of Machines - Pandya & Shah
2. Theory of Machines - J. Lal and Shah

Name of the course : **Mechanical Vibrations**
Course No. : TME-343
Credit Hours : 3(2-1-2)
Pre-requisite : Nil

CATALOGUE DESCRIPTION:

Static force analysis, dynamic force analysis, Vibration of single and two degrees of freedom system. Undamped, damped and forced vibrations. Vibration absorbers and vibration isolation. Vibration of may degree of freedom system. Exact analysis and
numerical methods.

Lecture No.	Topics
1-2	Periodic and harmonic motions, harmonic analysis. Vector method of representing vibrations. Superposition of simple harmonic motions. Work done in harmonic motion.
3-6	Free vibrations without damping. Equilibrium method, energy method and Rayleigh's method. Effect of mass of spring and shaft.
7-10	Free vibrations with viscous and Coulomb damping.
11-14	Forced vibrations with and without viscous damping.
15-18	Reciprocating and rotating unbalance.
19-20	Vibration isolation and transmissibility.
21-22	Vibration measuring instruments.
23-24	Whirling of light flexible shafts with an unbalanced disc at the centre and without damping. Critical speed.
25-26	Normal mode vibrations. Torsional systems, Combined rectilinear and angular vibrations, Vehicle suspension. vibration absorbers.
27-28	Free and forced vibrations of multi degree systems without damping. Method of influence numbers. Holzer's method. Raleigh's method, Dunkerley's Formulae

Text Books

1. Tse, Morse and Hinkle, "Mechanical Vibrations" Prentice-Hall

Reference Books:

1. Church, A.H. "Mechanical Vibration"
2. Thomson, W.T. "Vibration Theory and Applications" Prentice Hall
3. Grover, G.K. "Mechanical Vibration" Nem Chand Publishers, Roorkee.
4. Rao, S.S. "Mechanical Vibrations, Addison-Wesley.

Name of the Course : **Strength of Material**
Course Number : TME-351

Credit Hours : 3(3-1-0)
Pre-requisite : Nil

CATALOGUE DESCRIPTION

Stress & Strain at a point, Mohr's circle 3-D Stresses, Elastic strain energy, Castigliano's theorem & Energy theorems, Theories of elastic failures, shear centre. Unsymmetrical bending, curved beams, Torsion of Non-circular bars, Analysis of springs, Thick cylinder and spherical sheel, Rotating Disc, and cylinders.

LECTURE	TOPICS
1-6	Stress and strain at a point. Cartesian stress components. notation and sign convention. Principal stresses in three dimensions. Mohr's circle in three dimension.
7-9	Strain displacements, rectangular strain components Interpretation of xy, yz, zx as shear strain component
10-12	Theories of failures, significance of theories of failure.
13-17	Elastic strain energy and Energy methods, Elastic strain energy due to normal and shearing stresses, dilations and distortions strain energy, strain energy due to bending & torsional load, stresses due to suddenly applied loads, Strain energy theorem. Castigliano's theorem, reciprocal theorem. Application of energy methods for determining slope, and deflection in beams.
18-20	Unsymmetrical bending.
21-22	Shear center.
23-27	Curved beams; Bending of beams having initial curvature beams of large initial curvature, location of neutral axis Distribution of stresses across cross section having rectangular, Circular & trapezoidal shapes. Analysis of springs, Torsion of non circular section.
28-35	Symmetric problems; Stresses and displacements in thick cylinder, spherical shell, rotating disc, cylinders.

TEXT BOOKS:
1.Adv. Mech. of solids By L.S. Srinath

REFERENCE BOOKS:
1.Adv. Mech. of Mat. By Boresi, Stdebottom
2.Strength of Mat. By Dr. S. Singh
3.Stress analysis By Dr. S. Singh
4.Mechanics of Mat. By E.J. Hearn Vol. I & II

Name of the Course : **Planning and Design of Refrigeration Systems**
Course Number : TME-405
Credit Hours : 3(3-2-0)
Pre-Requisite : TME-302 Refrigeration and Air-Conditioning

Lectures	Topic
1-6	Review of vapor compression refrigeration cycle. Multistage or compound compression. Flash gas removal and intercooling. Complete multistage compression system, Multi-evaporator systems, Cascade systems, Dry ice and its manufacture.
7.8 7.9 7.10	Performance characteristics of reciprocating compressors, rotary compressors, screw compressor,centrifugal compressors.
11-14	Condensers, types, Heat transfer in condensers, Wilson Plot
15-18	Expansion valve, types, application of Thermostatic Expansion External equalizer, Cross charged expansion valve, thermostatic charge & Fade out point, capillary tube characteristics.
19-21	Evaporators, types, heat transfer in evaporators,cooling & dehumidifying coils.
22-24	Complete vapour compression system performance characteristics of the condensing unit;Graphical method.
25-30	Psychrometric processes in Air-conditioning Equipment bypass factor, cooling and Dehumidifying coils, heating coil, Adiabatic dehumidifier, water & steam injection, Summer air conditioning, ADP, Summer A/c with and with out by pass of ventilation air.
31-37	Heat transfer in building structure, periodic heat transfer through walls & roofs; methods for evaluation of heat transfer through walls & roofs,Decrement factor and time lag method; ETD method; infiltration, stack effect, wind action.
38-45	Load calculations and applied psychrometrics; system heat gains, cooling & heating load estimates,RSHF, GSHF, ESHF, ADP and dehumidified air quantity, Design and selection of equipment for air conditioning systems.

Books

C.P. Arora, "Refrigeration and Air-Conditioning"
Stoecker W.F. "Refrigeration and Air Conditioning"
ASHRAE HAND BOOK - Fundamentals

Name of the course : **Fuels and Combustion**
Number of the course : TME-406
Credit Hours : 3(3-2-0)
Pre-requisite : Nil

CATALOGUE DESCRIPTION

Different types of fuels, solid fuels, liquid fuels, gaseous fuels and their properties. Introduction to the combustion of fuels. Fundamental of chemical kinematics and kinetic of chemical chain reactions. Thermodynamics of combustion, laminar flame propagation, Burning velocity, Turbulent flame propagation, flame stability, Diffusion flames, Detonation wave, self ignition and its limit, construction0on of liquid and solid fuels.

lectures	Topic
1.	Introduction
2-3	Energy sources of present and future
4-6	Different types of fuels, solid liquid and gaseous fuels and their properties.
7-9	Introduction to combustion of fuels and flue gas analysis.
10-13	Fundamental of chemical kinetics and kinetics of chemical chain reactions
14-18	Thermodynamics of combustion, combustion process and the First law, Adiabatic flame temperature, equilibrium composition of gaseous mixture
19-21	Laminar and turbulent flame propagation, determination of burning velocities
22-25	Flame stability, characteristics stability diagram,mechanism and flame stretch theory. Diffusion flames, Detonation waves
26-28	Process of self-ignition, limits of self-ignition and factors affecting self-ignition.
29-30	Forced ignition
31-33	Combustion of liquid and solid fuels

Text Books:
1. Fuels and Combustion by S.P.Sharma & Chandra Mohan
2. Fuels and Combustion by M.L. Smith & K.W.Stinson

Reference Books:
1. Fuels by J.S.S. Brame & King J.G.
2. Combustion Engineering & Fuel Tech by A.K.Sahas
3. Fuels by Francis Wilfrid
4. Energy and Atmosphere by Campbell, Ian. M.

Name of the course : **Design of Rotodynamics pumps**
Number of the course : TME-417
Credit Hours : 3(3-2-0)
Pre-requisit : TME-311

CATALOGUE DESCRIPTION

Types of pumps, classification, specific speed, simplicity, Lows and dimensionless numbers, Basic equation in pump design.Power losses and efficiencies, pump characteristics, Design feature of rotodynamic pumps, Design of centrifugal, mixed flow and axial flow pumps for varied applications, Design of pump impellers, volute casings, diffuser rings (vaneless and vaned), suction and delivery pipes etc. Aerodynamic theory for the design of aerofoil shaped blades, Layout of pumping units, Axial and radial thrust, Cavitation check, Shaft vibrations, Materials used in pumps construction

Lectures	Topic
1-7	Introduction classification of pumps. working principle, operation; Types of impellers; casings, multistaging flow-direction; shaft disposition; liquid type
8-16	Basic theory of pumps velocity diagram; Ideal head & torque equations; Degree of reaction; Pre-rotation; Friction; Turbulence; Disc friction; Leakage, Mechanical losses; Coefficients and efficiencies; performance curves virtual head- capacity curves. Effect of speed changes on performance curves;Diffusers.
17-25	Specific speed and performance curves Specific speed; Dimensionless numbers; specific speed in terms of wheel dimensions; specific speed applied to pump classification;Model tests; performance curves for various types of pumps; Effect of speed viscosity and impeller changes on performance curves
26-33	Design of Radial Flow Pump Stage Introduction; pipe connections and velocities; Impeller inlet dimensions and vane angle; Impeller outlet dimensions and vane angle; Design of vanes Design of volute; Design of diffuser; Dise friction; Multistaging; Design of suction and delivery pipes
34-42	Constructional Details Shaft and sleeves; Bearing; packing glands wearing rings; selection of materials; Axial thrust; Radial thrust; Priming; cavitation; NPSH; Available and required suction head;shaft vibrations .
42.48	Design of Mixed-flow and Axial-Flow pump Impellers Design of Francis-type or mixed-flow impeller; Design of propeller pump impeller; Design of aerofoil shaped blades.

Lazarkiewtex & Trooko Lanski, Impeller Pump's Pergmon Press, 1965. Anstin church & Jagdish Lal," C.F. Pumps & Blowers, Metrapolitan Books,Co. (P) Ltd.,Delhi-6,1973.

Name of the course : **Design of Blowers & Rotary Compressors**
Number of the course : TME-418
Credit Hours : 3(3-2-0)
Pre-requisite : TME-313

CATALOGUE DESCRIPTION

Introduction, Concept from gas dynamics, Fundamentals of theory of centrifugal and axial flow turbomachines, Flow of gas through a blower/compressor stage, Energy losses, performance at varying loads, Step coefficient, Balji, Stanitz's and Stodola formulae, Compressor blade cascade, blade forces, Free vortex and forced vortex blades, Vane shape and stresses, Vane shape and characteristics, compressibility and pre-whirl, Performance characteristics of centrifugal and axial flow blowers and compressors, Design and construction details and blowers and compressors, material selection, Special features.

Lectures	**Topics**
1-4	Introduction, Concept from Gas dynamics. Fundamental theory of centrifugal & axial Flow turbo machines.
5-8	Flow of gas through a blower. Centrifugal compressor stage, compressor power, calculation of stage. Compressor construction
9-13	Energy losses in compressor, performance at varying loads step coefficient, Balji, Stanitz's and Stodala formulae performance of centrifugal compressor.
14-17	Multistage compressor blade cascade, blade forces supersonic compressor, cooling multistage compressor
18-21	Stage of Axial flow compressor, Axial Flow compressor designs, Calculation of main dimensions of compressor stage, examples of compressor designs, performance of Axial flow compressor
22-25	Free vartex and forced vartex, Vane shape & stresses, compressively & pre-whirl
26-28	Compressor construction, power & efficiency, energy balance of compressor
29-34	Design of blower, Design of compressor, Dynamics Compressor characteristic, compressor control
35-38	Material Selection, economy of compressor performance special features.

Text Books:

1. Reciprocating and Rotary Compressors
   by: V.Chlumsky Pub.SNTL Publisher, Czechoslovakia

Name of the course : **Power Plant Engg. and Energy Conversion**
Course Number : TME-421
Credit Hours : 4(3-0-2)
Pre-requisite : TME-101, Thermodynamics and Heat Engines

CATALOGUE DESCRIPTION

Type of power plants, steam Nozzles; Impulse turbines; Impulse Reaction turbines; Internal Losses; Governing of turbines; Boilers; Draught, Heat Balance; Condensers, Diesel power plant, Nuclear Power plant, Power plant Economics. Introduction to Renewable Energy Sources.

LECTURE	**TOPICS**
1.5.1	Introduction-Energy, Power, Sources of Energy, Direct Energy Conservation Methods. Power Cycles.
6-10	Steam Nozzles Types of nozzles, isentropic flow through nozzles; Effect of friction; Nozzle efficiency, Critical pressure ratio Maximum discharge; Throat and exit areas; super saturated flow.
11-18	Type of Steam turbine and application; Impulse turbine velocity and pressure compounding. Velocity diagrams for single and multistage turbines;Work output and losses; Degree of reaction Internal losses in steam turbines;stage point locus and reheat factor; efficiency; Constructional features of blades;Governing of turbines.
19-23	Boilers and classification; Different types of low pressure and high pressure boilers; Boiler Rating; Boiler Mounting and accessories; Boiler drought and draught equipment; boiler trial and heat balance.
23-27	Condensers and advantages of steam Condensers; Elements of steam condensing plant; Types Air leakage and its effect on the performance of Condenser; Vacuum efficiency.Cooling Towers, Types of Cooling Towers
28-31	Diesel Power Plant Introduction Different types of engines and their working; Thermodynamic cycles and cycle analysis. Different System of Diesel Power Plant. Supercharging of Diesel engines; advantages & Disadvantages.
32-36	Nuclear Engineering Basic terms and definitions; Gener ation of nuclear energy by fission, Nuclear Fuels,Components of Nuclear Power Plant; Nuclear Reactors- types and applications Radiation Hazards, Shielding, Safety aspects.
37-41	Power Plant Economics Plant investment costs; fixed charges; Operation Costs; Comparison of fixed and operating Costs; Capacity factor; Utilization factor and diversity factor; Selection of unit Sizes.
42-45	Direct Energy Conservation Methods-Fuel Cells, MHD Generation,Thermoelectric Power Generation and other methods.

Text Books

1.Power Plant Engg. – P.K.Nag
2.Thermal Engg. by Domkundwar Kotandaraman

Reference Books

1.Power Plant Engineering - Arora & Domkundwar
2.Steam turbine theory & Practice - W.J. Kearton

Marks:

First prefinal	20
Second prefinal	20
Assignments/practical/Viva	20
Final	40

Name of the course : **Nuclear Engineering**
Number of the course : TME-425
Credit Hours : 3(3-2-0)
Pre-requisite : Nil

CATALOGUE DESCRIPTION

Cross section, Co-ordinate system, diffusion theory; Slowing down and moderation, Fermi Age equation, Criticality conditions,Reflectors, Reactivity, Reactor control concept, Design parameters, Temperature distribution along coolant path, Liquid metal heat transfer, Burn out conditions, Heat exchanger design, pressure drop, material consideration, system design concept. Parametric design, Mechanical design, Shielding and fuel management, steam turbines for nuclear power stations, simulation of nuclear reactor on an analog computer, Radiation protection.

Lecture **Topic**

1-3 Introduction, Chemical and nuclear reactions, Nuclear fission and chain reaction.

4-7 Nuclear cross-sections, newtron flux and reaction rates, co-ordinate systems, diffusion theory.

8-13 Slowing down and moderation, moderating power and moderating ratio, variation of newtron cross-sections with newtron Energy newtron life cycle, Fermi Age Equation, Criticality conditions.

14-18 Reflectors, Heat transfer and fluid flow in nuclear reactors, Reactivity, Reactor control concept, Design parameters.

19-25 Heat conduction in Fuel elements, Axial temperature distribution of coolant and fuel elements, Liquid metal heat transfer, Burn out conditions.

26-30 Heat Exchanger design, pressure drop, material consideration, system design concept, parametric design, mechanical design

31-35 Safety measures for nuclear power plants, shielding and fuel management, Radiation protection.

36-42 Steam turbines for nuclear power station, simulation of nuclear reactor on an analog computer.

Text Books:

1. Introduction to Nuclear Engineering K.S. Ram

Reference Books:

1. Power Plant Engineering Morse
2. Power Plant Engineering(steam & Nuclear) P.K. Nag

Name of the course : **Solar Thermal Processes**
Number of the course : TME-426
Credit Hours : 3 (3-2-0)
Pre-requisite : Nil

CATALOGUE DESCRIPTION

Solar radiation, Relevant topic in heat transfer, Radiation characteristics of opaque materials, Transmission of radiation through partially transparent media, Flat plate collectors, theory and performance of solar water and air heaters, Focussing collectors, Thermal energy storage, Elements of solar thermal power plants, Working fluids for solar power and refrigeration system, Solar powered refrigeration and space conditioning systems.

Lectures	Topic
1.	Historical background, importance and application of solar Energy
2-7	The sun, solar constant spectral distribution of extraterrestrial radiation; earth sun angles; angle of incidence of beam radiation, pyranometers and pyrheliometer measurement of duration of sunshine; solar radiation data, attenuation of solar radiation by the atmosphere.
8-11	Electromagnetic radiation; black and grey body concept, Planck's law and wien's displacement law sky radiation,heat transfer coefficients, optical properties of materials.
12-15	Absorptance and emittance; Kirchoff's law reflection from surfaces, relationship among absorptance emittance and reflectance; selective surfaces
16-19	Reflection of radiation; absorption of radiation optical properties of cover systems, transmittance of diffuse radiation, transmittance-absorptance product; absorbed solar radiation
20-27	General description of flat plate collectors Basic energy balance equation, temperature distributors in flat plate collectors; Overall heat transfer coefficient temperature distribution between tubes and collector, efficiency factor, collector heat removal factor, collector geometric collector performance; method of testing

28-31 Collector configurations, concentration ratio orientation and suntracking systems, characteristics of focusing collectors, thermal performance of focusing collectors

32-35 Types of energy storage, characteristics and capacity of storage systems, solar ponds

36-39 Introduction, principles of solar thermal power generation solar thermal power generation using Stirling cycle, Brayton cycle

40-42 Solar refrigeration and air conditioning various methods of power generation

Text Books:

1. Solar Engineering of Thermal Processes by J.A.Duffic & W.A.Beckman, Pub.John Wiley & Sons
2. Solar Energy by H.P.Garg & J.Prakash, Pub.Tata Mc Graw Hill

Reference Books:

1. Principles of Solar Engineering by F.Kreith & J.F.Kreider
2. Pub. Mc Graw Hill Book Comp.
3. Solar Energy by S.P.Sukhatme, Pub: Tata Tc Graw Hill.

Name of the course : **Non Conventional Energy Sources and Systems**
Number of the course : TME-427
Credit Hours : 3(3-2-0)
Pre-requisite : Nil

CATALOGUE DESCRIPTION

Conventional sources of commercial energy fossil fuels, their consumption rates, energy reserves and estimate of time for which conventional energy sourceswill last, Alternate energy sources, Introduction to photovoltaic and thermoelectric conversion, Introduction to MHD power fuel cells.

The solar-option direct and indirect applications, availability of solar radiation., Energy collection and concentration for photothermal applications. Thermal storage Wind energy, types of wind mills, elementary design principle, Ocean thermal energy conservation, Geothermal energy systems,
extent of available resources. Heat transport in geothermal systems. Introduction to tidal and wave energy

Lecture	Topic
1	Conventional sources of energy; fossil fuels and hydro power etc availability in future present status
2-4	Solar Radiations; Solar constant spectrum, radiation geometry, Beam and diffuse radiations, radiation intensity at tilted surface
5-7	Electromagnetic radiation black and grey body concept sky radiating characteristics of absorber surfaces, convection and radiation in collectors, heat transfer coefficient
8-9	Flat plate collects and concentrating collector.
10-11	Energy storage; hot water, rocked and Latent heat storage
12-14	Water heating, space heating and cooling. Introduction to photovoltaics

15-20 Mechanism of wind, Type of wind mills, elementary design principles, power in the wind (calculations) power coefficient.

21-23 Introduction, to Ocean thermal electric conversion system; open cycle, closed and hybrid cycle

24-27 Energy from tides; Basic principle of tidal power, Tidal basin, power generation

28-29 Wave energy: Introduction, advantages and disadvantages of wave energy

30-34 Geothermal energy:
Geothermal field, Sources: Hydrothermal, vapour dominated liquid dominated systems, Geopressured resources, Hot dry rocks, magma resources, advantages and disadvantages of Geothermal energy.

35-37 Introduction to Magneto Hydro Dynamics (MHD) power and fuel cells.

38-42 Introduction, Biomass conversion technologies, Bio gas generation, Types of biogas plants anaerobic digestion.

Text Books:

1. Energy Conversion Systems by Rakosh Das Begamudre, Pub: New Age Int.(P) Ltd.
2. Renewable Energy Sources & Conversion Tchnology by N.K.Banoal, M.Kleeman & M.Meliss

Reference Books:

1. Non-Conv.Energy Source by G.D.Rai,
2. Solary Energy by H.P. Garg & J.Prakash

Name of the course : **Machine Design-II**
Course Number : TME-434
Credit Hours : 4(3-0-2)
Pre-requisite : TME-231 Machine Drawing
TME-333 Machine Design-I

CATALOGUE DESCRIPTION:

Design of Gears-Straight spur gears,helical gears, bevel gears, Worm gears, Gear tooth failures, Gear Lubrication, Hertz contact stresses, Design of bearing-Sliding bearings, Antifriction bearings Hydrodynamic lubrication, Thrust bearings, Design of Clutches, Design of I.C. Engine parts- Connecting rods, Crank shafts etc.

Lecture Nos.	Topic
1	Introduction
2-3	Gear Nomenclature, Tooth profiles, systems of gear teeth, Gear materials.
4-7	Design of straight spur gears, Design considerations. Lewis and Buckingham equations.
8-9	Design of spur-helical gears
10-12	Selection of pinion teeth, Hertz contact pressure, Interference
13-15	Design of Bevel gears, Properties of Bevel gears, Force analysis
16-18	Design of worm gears, Designation of worm gear drive, Forces on worm gears, Alternate methods of Design.
19-24	Design of Journal bearings, hydrodynamic lubrication, Heat generation in sliding bearings
25-28	Antifriction bearings- selection of ball and roller bearings, Thrust ball bearings, design calculation.
29-32	Design of clutches, plate and cone clutches, Dissipation of heat.

33-37 Design of I.C. Engine parts. connecting rod design., Center crank shaft design, Miscellaneous exercises.

Text Book:

1. Machine Design by Shigley	Tata Mc Graw Hill
2. Machine Design by Bharday	

Reference and Text books

1.Machine Design by P.C. Sharma & D.K. Agarwal
2.Machine Design by Black and Adames
3. Design of Machine Members by Vallance & Doughtic
4. Machine Design by Khurmi
5. Practical gear Design by Dudley
6. Design Data Book (PSG) for practical class

Name of the Course : **Measurement & Control**
Course Number : TME- 435
Credit Hours : 4(3-1-2)
Pre-requisite : Nil

CATALOGUE DESCRIPTION:

Principles of measurement, accuracy, errors, measurement, velocity, acceleration, pressure, temperature, flow etc. Measuring instruments,physical systems, Laplace transformation and block diagram, methods of analysis, Application of practical problems, elements, frequency and time response, basic concept of stability.

LECTURE	TOPICS
1-3	Introduction-Measurement & Control, Measurement, basic definitions accuracy, precision, repeatability,reproduce ability, reliability, maintainability, sensitivity, span, zero drift, ageing.
4-6	Transducers-Mechanical, electrical; basic requirements for transducers, Calibration-definition, steps in calibration, Standards-primary, secondary, reference and working standards and gauges.
7-8	Errors, types of errors-applicational, operational errors, dynamic errors environmental error, absolute & relative errors random errors, uncertainty.
9-11	Measurement system-basic components, types of measurement direct & indirect active and passive transducers,digital and analog system null and deflection type instrument.
12-15	Displacement, force and torque measurements temperature measurements, Measurement of fluids-flow and pressure measurements.
16-17	Study of working of Bourdon tube pressure gauge, LVDT,Cathode Ray Oscilloscope.
18-20	Strain guage-working principle, materials, transverse sensitivity, wheatstone bridge, Full, half, and quarter bridge circuit strain rosette.

21-22 Control-definition, elements of control system-open loop and closed loop system. Concept of feedback control system.

23-24 Block diagram representation, simplification and reduction.

25-26 Transfer function, Laplace transformation, transfer function of various systems analogous system- mechanical and electrical analogy. Test signals- step ramp, parabolic and impulse signals.

27-29 Time response for Ist order system,2nd and higher order system basic definition relating to 2nd & higher order systems.

30-31 Basic concept of stability, Routh's criteria

32-35 Root locus technique, curve plotting for various control systems.

36-37 Frequency response- Bode plot, Polar plot

Text Books

Control System Engg.- Nagrath & Gopal
Engineering Control System - K. Ogata
Mechanical Measurement - Buck & Beckwith
Mechanical Measurements - System and Design Deobelin

Reference Book

Instrumentation- Sharma, Rangan & Mani
Physical Measurement & Analysis Cook & Rabnowicz

Name of the course : **Bearing & Lubrication**
Course Number : TME-436
Credit Hours : 3(3-2-0)
Pre-requisite : Nil

CATALOGUE DESCRIPTION:

Hydrodynamic Bearing and boundary lubrication; Lubricant and their properties, Newtonian & non-Newtonian lubricant Rheology of lubricants. Hydrostatic and flexible hydrostatic bearing. Design of rigid and flexible hydrostatic Bearing. Restricter and their use. Dynamics of bearing Roter Frequency of whirl, Threshold speed and whirl frequency ratio. Stiffness & Dumping coefficent and entire journal mass Gas bearing and MRD bearing

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Lecture No. **Topics**

1-2 Introduction

3-4 Types of Lubricant

5-6 Types of Lubricants & their properties

7-8 Newtonian & Non-Newtonian models & Rheology

9-12 Design of hydrodynamic Bearing. Reynolds Equation

13-15 Design of hydrostatic Bearing

16-18 Restrictors & types and role in compensated Bearings

19-20 Flexible Bearing

21-23 Static characteristics of the bearing flow and attitude angle

24-26 Dynamic characteristics of the bearing

27-30 Threshold speed, frequency of whirl, entire journal mass, Stiffness coefficient & damping coefficent.

31-34 Gas bearing/MHD bearing

35-37 Hybrid bearing

38-40 Bearing materials.

Name the course : **Pressure Vessel Design**
Course Number : TME-437
Credit Hours : 3(3-2-0)
Pre-requisite : Nil

CATALOGUE DESCRIPTION

Preliminary considerations, Design considerations and feature, Stress analysis of thin and thick vessels, Jacketed cylinders, wire wound vessels, Effects of prestressing and autofrettage, Effect of ends and openings, Compensated opening, material selection. IBR, Design of boiler shell, Welded and riveted pressure vessels, Economics of design, Pressure vessels testing & inspection

Lecture No.	Description

1. Introduction to the subject.

2. Preliminary considerations.

3. Design considerations and salient features.

4-8 Thin pressure vessels.

9-14 Thick pressure vessels.

15-16 Jacketed cylinders.

17-18 Wire-wound vessels.

19-22 Prestressing and autofrettage.

23-26 Ends and openings in vessels.

27-30 Compensated openings.

31-33 Design of pipes.

34- Material selection and fabrication methods.

35-37 Design of a boiler shell. IBR.

38- Welded and riveted consternation.

39-40 Pressure vessel testing and inspection.

Suggested Books

1. Pressure Vessel Design by Harvey.
2. Pressure Vessel Design Handbook by Bednar.
3. Strength of Materials.
4. Machine Design --------by Dr. S. Singh

Name of the course : **Gas Dynamics & Jet Propulsion**
Number of the course : TME-450
Credit Hours : 3(3-2-0)
Pre-requisite : TME-211

CATALOGUE DESCRIPTION

Steady one dimensional isentropic flow, adiabatic flow with friction, flow with heat transfer; Normal shocks; Nozzle flow with shocks, oblique shocks; Aero-thermodynamics of Jet engines; Axial flow compressors and turbines; Rocket propulsion engines.

Lecture Topic

Basic Gas Dynamics

1-7 Introduction; Dynamics of fluid flow; Continuity equation; Conservation of energy (1 Low of thermodynamics); Momentum Equation; Propagation of small disturbance, velocity of sound; Mach Number; Mach waves; Mach cone; Mach angle; Total or stagnation properties.

8-19 Horse Flow
One dimensional adiabatic flow; Isentropic flow through a passage of varying cross-sectional area; choking in isentropic flow; Operation of nozzles under varying pressure ratios; Converging nozzles; Reynolds Number; Adiabatic

flow with friction in constant area ducts; Fanno relations for perfect gases.

20-31 Flow with Normal/oblique shock waves
Normal shock; Equations with normal shocks; Governing equations; Strength of shock wave, shocks, in a converging- diverging Nozzle; Nature of flow through oblique shockwaves.

32-48 Jet Propulsion
Introduction; Thrust; Thrust horsepower; Efficiencies; Trust equation; Turbojet; Thrust augmentation; Turboprop, Turbofan engines; Ramjet; Pulse jet engines; Ram Rocket; Comparison of various propulsion devices; Effect of forward speed and attitude.

Text Books:

Fundamentals of Compressible Flow
By S.M.Yahya, Pub.Wiely Eastern Ltd.New Delhi-1991

Name of the course : **Experimental Stress Analysis**
Number of the course : TME-453
Credit Hours : 3(3-2-0)
Pre-requisite : Nil

Catalogue Description
Light optics; Relative retardation; Photo-elasticity; Stress-optic law; Plane and circular polariscopes; Isochromatics and isoclinics; Compensating and colour matching techniques; Calibration of models, model materials, model laws; Stress freezing method; Photoelastic coating; Reflection polariscope;
Grid method; Moir'e fringe method; Brittle lacquer method; Strain gauges and strain rosettes.

Lecture No.	Topic
1-3	Light optics; Preliminary optics, formation of fringe pattern, Stress optic raw, Direction of secondary principal stresses
4-7	Establishing the boundary retardation; scattered light technique for two dimensional problems, scattered light polariscope.
8-11	Photoelasticity ; Two dimensional photoelasticity; Natural double refraction, Temporary double refraction, Stress optic law.
12-15	Basic elements of a polariscope, Effect of stress Model in a plane polariscope, Effect of stressed mode in circular polariscope.

16-20 Isochromatics Isodinics and their properties; compensating techniques; Babiney compensation method,Tension or compression strip method, Tary method of compensation.

21-24 Colour Matching technique; Calibration of Models; Simple tensile specimen Beam under pure bending, circular disc under diametral compression

25-27 Separation of Principal stresses; Methods based on equilibrium equation oblique incidence methods, model materials; Model laws;

28-31 Photoelastic coatings; Theory of photoelastic watings;stress and strains in watings, stress optic law, coating sensitivity.

32-34 procedures for fringe measurement Brittle lacquer method; laequer selection, lacquer application method, Test procedure,e Calibration method.

35-38 Moir'e fringe method; Fundamental properties of Moir'e fringes, Moir'e fringes analysis techniques.

39-41 Grid Method; Principle of the method, strain Displacement Relation for large strains, Application of Grid.

42-45 Strain gauges and strain Rosettes;

46.48 Reflection Polariscope; stress Freezing

TEXT BOOKS

1. Experimental stress analysis by Dr. S. Singh

REFERENCE BOOKS

1. Experimental stress Analysis & Motion measurement by Dove & Adams

Course Title : **Automobile Engineering**
Course No. : TME-460
Credit Hours : 3(3-2-0)
Pre-requisite : TME-212, I.C. Engines

CATALOGUE DESCRIPTION:

Introduction classification and engine terminology; Automobile chassis and frames; Vehicle suspension system, Springs, dampers and shock absorbers; Brakes-types and functioning; Steering mechanism, front-end geometry, power transmission system, Gear box torque converters, Drive line, differential and axles; vehicle dynamics and Emission control systems.

Lecture No. Topic

1-2 Automobile and society, Scope of the course and automobile industries, Engine classification, Basic engine terminology.

3-4 Automobile chassis, Main and sub frames, chassis lubrication, body-alignment and instruments used.

5-7 Car body, springs and dampers. Suspension system for front and rear wheels, shock absorbers.

8-11 Brakes; Function and methods of braking, types of brakes; Semi servo brakes, servo and power operated braking systems and hydraulic mechanism.

12-16 Steering mechanisms; power steering, front axle steering mechanism and working. Front end geometry and alignment Caster and camber angles king-pin inclination, too-in and too-out. Cam and lever steering gear, Steering geometry, Ackerman's principle.

17-21 Transmission requirements; clutches of various types like friction, centrifugal, magnetic etc. Types of transmissions levers, Linkages etc.Fluidcouplings.

22-26 Gear Box: Function of gear box and determination of over all gear ratios, synchronus, epicyclic and pre selector gear box, Torque convertors.

27-29 Universal joint and its purpose; Differential, Front and rear axles. Rear drive shafts and operation, Front wheel drive system.

30-33 Vehicledynamics,Air,Gradient and rolling esistance, total resistance, Variation of tracative efforts with speed,constant power tractive effort and maximum engine horse power curves against speed.

34-36 Pollution in our society, Types of pollutants, controlling pollution, and Road performance.

Books Recommended

1. The motor vehicle by Newton & W. Steeds
2. Automotive Mechanic By R. Crouse and D.L. Anglin
3. Automotive Chasis & Body by W.H. Crouse
4. Automotive Mechanics by Anthony E. Schwalle

Name of the Course : **Refrigeration and Air Conditioning**
Course Number : TME-302
Credit Hours : 4(3-0-2)
Pre-requisite : TME-101 Thermodynamics & Heat Engine

CATALOGUE DESCRIPTION

Basic vapour compression refrigeration cycle; influence of operating conditions on cycle performance; Multistage and multi evaporator system; Cascade systems; Refrigerants, Thermodynamic, Chemical and physical requirements, Lubricants in refrigeration systems.

Introduction to vapour absorption system, air cycle, steam jet refrigeration systems.

Refrigeration compressors, types, thermodynamic processes, volumetric efficiency, performance characteristics of reciprocating compressors, properties of moist air use of psychrometric charts, Psychrometry of air-conditioning processes sensible, Latent and Total heat processes, SHF, Bypass factor, Air washers, Simple summer air conditioning system, Comfort air conditioning and effective temperature; cooling load calculations.

Lecture No. Topics

1-2	Review of Basic Laws of Thermodynamics, methods for production of cold.
3-7	Vapour compression refrigeration cycle, comparison with reversed Carnot cycle, standard rating cycle and effect of operating conditions; evaporator pressure, condenser pressure, suction vapour superheat & liquid subcooling on cycle performance, actual cycle.
8-11	Refrigerant compressors, types thermodynamic processes, Volumetric efficiency, principal dimensions performance characteristics.
12-15	Multistage & multi evaporator systems, Cascade systems.
16-17	Refrigerants, characteristics, Thermodynamic physical, Chemical requirements, effect of moisture and lubricating oil, mixed refrigerants, Binary Mixtures.
18-23	Thermodynamic properties of moist air; adiabatic saturation process; psychrometric chart.
24-30	Psychrometry of air conditioning processes, simple air-conditioning system & state & mass-rate of supply air.
31-32	Design conditions; Inside & Outside design conditions, comfort air conditioning and effective temperature.
33-37	Heat-transfer in building structures, Sol-air temperature, methods to evaluate heat-transfer through walls & roofs.
38-42	Load calculations & applied psychromatrics Internal & system heat gains, Ventilation load & RSHF, cooling load estimate.
43-46	Miscellaneous, Refrigeration systems; Introduction to Absorption refrigeration, Steam jet refrigeration, air-cycle refrigeration & thermoelectric cooling.

Text Book : Refrigeration and Air conditioning by C.P. Arora

Reference Books:

1. Thermal Environmental Engineering by J.L. Threlkald
2. Refrigertation and Air Conditioning by W.F.Stoecker
3. Principles of Refrigeration by Dossat Roy J.
4. Refrigeration and Air Conditioning by R.C. Jordan & G.B. Priester.

Distribution of Marks:

Prefinals	40%
Final	40%
Lab.	20%

Name of the Course : **Refrigeration and Air Conditioning (Ag.Engg.)**
Course Number : TME-202
Credit Hours : 3(2-0-2)
Pre-requisite : TME-101 Thermodynamics and Heat Engine

CATALOGUE DESCRIPTION

Analysis of vapour compression refrigeration cycle and its modifications, absorption refrigeration, Air cycle and ejector refrigeration, Heat pumps, mechanical refrigeration equipment, Psychometric properties, air conditioning processes, Cooling load calculations.

Lecture No.	Topics
1-2	Review of Basic Laws of Thermodynamics, methods for production of cold.

3-7	Vapour compression refrigeration cycle, comparison with reversed Carnot cycle, standard rating cycle and effect of operating conditions; evaporator pressure, condenser pressure, suction vapour superheat & liquid subcooling on cycle performance, actual cycle.
8-10	Refrigerant compressors, types thermodynamic processes, Volumetric efficiency, principal dimensions performance characteristics.
11-12	Refrigerants, characteristics, Thermodynamic physical, Chemical requirements, effect of moisture and lubricating oil, mixed refrigerants, Binary Mixtures.
13-16	Thermodynamic properties of moist air; adiabatic saturation process; psychrometric chart.
17-22	Psychrometry of air conditioning processes, simple air-conditioning system & state & mass-rate of supply air.
23-24	Design conditions; Inside & Outside design conditions, comfort air conditioning and effective temperature.
25-28	Load calculations & applied psychromatrics Internal & system heat gains, Ventilation load & RSHF, cooling load estimate.
29-33	Miscellaneous, Refrigeration systems; Introduction to Absorption refrigeration, Steam jet refrigeration, air-cycle refrigeration & thermoelectric cooling.

Text Book : Refrigeration and Air conditioning by C.P. Arora

Reference Books:

1. Thermal Environmental Engineering by J.L. Threlkald
2. Refrigertation and Air Conditioning by W.F.Stoecker
3. Principles of Refrigeration by Dossat Roy J.
4. Refrigeration and Air Conditioning by R.C. Jordan & G.B. Priester.

Distribution of Marks:

Prefinals	40%
Final	40%
Lab.	20%

Name of the Course : **Kinematics of Machines**
Course Number : TME-241
Credit Hours : 3(2-1-2)
Pre-requisite : Nil

CATALOGUE DESCRIPTION

Basic concept of mechanisms kinematic constraints and degree of freedom: Motion of porticle and rigid body. Analysis of velocity and acceleration diagrams of

simple and complex mechanisms and Mechqanisms containing higher pairs. Belt, rope and chain drives, Brakes and clutches, Introduction to gears and simple gear trains, Experiments concerning linkages, mechanisms, simple machine and geared systems.

Lecture No.	Topic
1.	Introduction: Aims and scope, kinematic links; rigid and resistive bodies.
2-5`	Kinematic pairs, simple and compound kinematic chains, Inversions of mechanisms, Degrees of freedom.
6-8	Examples of inversions; Four bar chain; Slider crank chain; Double slider crank chain.
9-10	Velocity of a point on a kinemati clink and drawing of velocity diagram of a link, Instantaneous center of rotation.
11-12	Velocity determination of mechanisms by instantaneous center method, Arnhold-Kennedy Theorem of three centers; Velocity determination by relative velocity method.
13-14	Acceleration of a point on a kinematic link and acceleration diagram of a mechanism, coriolis component of acceleration. Acceleration diagram for a link and points on a link.
15-17	Klien's construction, Ritterhaus's construction and Bennett's construction.
18-21	Belts, ropes and chain drives, ratio of tensions; velocity ratio; power transmitted and effect of centrifugal tension and initial tension of power transmitted.
22-25	Clutches and brakes, Types and Analysis Friction of pivot and collar bearing. Flat pivot bearing, Flat collar bearing. Conical pivot Bearing, Friction clutches, plate clutches.
26-27	Gear Nomenclature, Basic definitions, types of gears.
28-36	Fundamental law of gearing, simple and compound gear trains, Reverted gear train. Simple epicyclic gear train.

Name of the Course: **Computer Aided Design(CAD**)
No. of Course : TME-462
Credit Hour : 3(3-2-0)
Pre-requisite : M/c Drawing

Catalogue description.

Introduction of CAD ,the design process ,the application of computer for design ,creating the manufacturing data box, benefits of computer aided design, examples. Hardware in Computer Design; the design work station, the graphic terminals, operator input devices, plotters and other output devices, the central processing unit, secondary storage, problems, computer graphic software.

The software configuration of a graphic station, function of graphic package, construction of geometry, transformation, data base structure and content, other CAD feature and CAD/CAM interaction, application to modeling application, the use of 3-D modeling for 2-D representation. Three dimensional modeling for geometric problem solving, examples of 3-D modeling. Introduction to Information Technology and finite element methods.

Lecture No.	Topic
1	Introduction to CAD
2-6	Application of Engineering Graphics in Design and creating the manufacturing database.
7-8	Benefits of Computer-Aided Design and examples.
9-11	Hardware in computer Aided Design Workstation, Graphic Terminals.
12-15	Input output devices.
16-17	The Central Processing Unit, Secondary Storage problems.
18-19	Computer Graphics Software.
20-22	Software Configuration of a graphic station and function of graphics.
23-27	Graphics Standard for CAD, Graphics and Computing Standards-GKS-Bitmaps-Open GL-Data exchange standards-IGES-STEP-CALS-DXF, Communication Standards – WAN-LAN.
28-31	Construction of geometry, transformation, data base structure and content. - Representation of Curves-Beizer curves, Cubic spline curve, B-spline curves. Surface Modeling techniques- surface patch, coons patch, bi-cubic patch- Bezier and B- spline surfaces. Volume Modeling-Boundary Models and CSG Modeling techniques. -
32-34	Other CAD features and CAD/CAM Interaction.
35-38	Application in Modeling use of 3-D Modeling for 2D representation. 3-D Modeling for Geometric problem solving and examples of 3D-Modeling.
39-40	Introduction to Information Technology and Data Base.
41-42	Introduction to Finite Element Method.

Books recommended:

(A) Text Books

1. "CAD/CAM" by Mikell P. Groover and E.W. Zimmers. Prentice hall India Ltd.
2. Computer Graphics by Hearn and Baker

(B) Reference Books

1. Computer Aided Manufacturing by P.N. Raop, N.K. Tiwari and Kundra
2. Computer aided analysis and deign by Wselfendate butleworth publication.
3. Basant, C.B. and Lui, Ghol K. "Computer-Aided Design and computer-Aided manufacturer, 3rd Edition.
4. Davis, B.L. Robothom, A.J. aid yer wood, "A Computer Aided Drawing and Design" Chapman of Hall (1991)
5. Engineering Graphics with Auto CAD-2002 by Bethume (PHI)

Name of the Course : **Introduction to Finite Element Methods in Engineering**
Course Number : TME- 404
Credit Hours : 3(2-1-0)
Pre-requisite : BPM-132 Engineering Maths-II

Catalogue Description:

Fundamental Concepts, Matrix Algebra, Finite Element Formulation, One-Dimensional Problems, Two-Dimensional Problems, Axisymmetric Problems, Two-Dimensional Isoparametric Elements, Scalar Field Problems, Dynamic Analysis, Examples, Overview of a Commercial Finite Element Code: ANSYS

LECTURE TOPICS

1-5 **Fundamental Concepts:** Introduction, Historical Background, Stresses and Equilibrium, Boundary Conditions, StrainDisplacement Relations, Stress-Strain Relations, Rayleigh-Ritz Method, Galerkin Method, Saint Venant's Principle

6-7 **Matrix Algebra:** Basic Matrix Operations, Basic Types of Matrices, Eigenvalues and Eigenvectors

8-10 **One Dimensional Problems:** Finite element Modeling, Coordinates and Shape Functions, Potential Energy Approach, Galerkin Approach, Assembly of the Global Stiffness Matrix and Load Vector

11-13 **Two Dimensional Problems:** Finite Element Modeling, Constant Strain Triangle (CST), Problem Modeling and Boundary Conditions

14-16 Axisymmetric Solids subjected to Axisymmetric Loading: **Axisymmetric Formulation, Finite Element Modeling: Triangular Element, Problem Modeling and Boundary Conditions**

17-19 **Two-Dimensional Isoparametric Elements:** Four-Node Quadrilateral, Numerical Integration, Higher-Order Elements

20-23 **Scalar Field Problems:** Steady-State Heat Transfer, Torsion, Potential Flow, Electric and Magnetic Fields

24-26 **Dynamic Analysis:** Formulation, Element Mass Matrices, Evaluation of Eigenvalues and Eigenvectors

27-28 **Overview of a Commercial Finite Element Code: ANSYS**

Suggested Books

1) Introduction to Finite Elements in Engineering by T.R. Chandrupatla and A.D. Belegundu, Prentice-Hall of India

REFERENCE BOOKS

1) Finite Element Procedures in Engineering Analysis by K.J. Bathe, Englewood Cliffs, Prentice-Hall
2) Concepts and Applications of Finite Element Analysis by R.D. Cook, Wiley
3) Introduction to the Finite Element Method by C.S. Desai and J.F. Abel, Van Nostrand Reinhold
4) The Finite Element Method – Linear Static and Dynamic Finite Element Analysis by T.J.R. Hughes, Englewood Cliffs, Prentice-Hall
5) The Finite Element Method in Engineering by S.S. Rao, Pergamon.
6) An Introduction to the Finite Element Method by J.N. Reddy, McGraw-Hill
7) An Analysis of the Finite Element Method by G. Strang and G.J. Fix, Englewood Cliffs, Prentice-Hall
8) The Finite Element Method by O.C. Zienkiewicz, McGraw-Hill

Name of the Course : **Numerical Methods for Mechanical Engineers**
Course Number : TME- 213
Credit Hours : 2(2-1-0)
Pre-requisite : BPM-132 Engineering Maths-II

Catalogue Description:

Introduction, Solution of Equations of One Variable, Solution of Systems of Linear Algebraic Equations – Direct Methods and Iterative Methods, Function Approximation, Interpolation, Numerical Differentiation and Integration, Numerical Solutions of Ordinary and Partial Differential Equations, Applications in Mechanical Engineering

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LECTURE TOPICS

1-4 **Introduction:** Objectives, Matrix Algebra, Error Measures, Significant Digits and Precision, Introduction to computing Package MATLAB

5-6 **Solution of Equations of One Variable:** Bisection Method, False Position Method, Secant Method, Newton's Method

7-10 **Solution of Systems of Linear Algebraic Equations: Direct Methods:** Gauss Elimination, Gauss Elimination with Pivoting, LU Factorization, Tridiagonal-Matrix Systems, Cholesky Method

11-13 Solution of Systems of Linear Algebraic Equations: Iterative Methods: **Jacobi Method, Gauss-Siedel Method, Successive Over Relaxation Method**

14-15 Function Approximation: **Least Square Approximation, Point Approximation**

16-17 Interpolation: **Polynomial Interpolation, Spline Interpolation**

18-21 **Numerical Differentiation and Integration:** Difference Approximations, Trapezoid Rule, Simpson's Rule, Romberg's Integration, Gauss Quadrature

22-25 **Numerical Solutions of Ordinary Differential Equations and Partial Differential Equations:** Initial Value Problems (Taylor, Euler, Heun), Boundary Value Problems (Shooting, Finite Difference, Superposition Methods), Liebmann's Method, Crank-Nicholson Method

Suggested Books

1) *Numerical Methods* by E. Balagurusamy, Tata Mcgraw-Hill

REFEREMCE BOOKS

1) *Numerical Methods for Engineers* by Steven C. Chapra and Raymond P. Canale, McGraw-Hill
2) *MatLab 6 Student Edition* by The Mathworks
3) *Introduction to Matlab 6 for Engineers* by William Palm III, McGraw-Hill
4) *Numerical Recipies : The Art of Scientific Computing* by W.H. Press, B.P. Flannery, S.A. Teukolsky, and W.T. Vetterling, Cambridge University Press
5) *Introduction to Applied Mathematics* by Gilbert Strang, Wellesley-Cambridge Press
6) *Introduction to Scientific Computing: A Matrix-Vector Approach using* MATLAB by Van Loan and Charles F
7) *Numerical Methods* by S.S. Sastry, PHI

गोविन्द वल्लभ पंत कृषि एवं प्रौद्योगिकी विश्वविद्यालय
G. B. PANT UNIVERSITY OF AGRICULTURE & TECHNOLOGY
1960
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