Rajiv Gandhi Technological University, Bhopal (MP)

B.E. (ME) Mechanical Engineering

Revised Syllabus and Scheme of Examination Effective from July 2007

THIRD SEMESTER

S. No	Course Category	Course Code (New)	Subject	Periods Per week				Distribution of Marks				
				L	T	P	C	Theory	Practical	Internal Assessment		Total
										MST	TW	
1	BS-5	BE 301	Mathematics - III	3	1	0	4	100	-	20		120
2	DC 1	AU/IP/ME 302	Strength & Mechanics of Materials	3	1	0	4	100	-	20		120
3	DC 2	AU/IP/ME 303	Production Processes	3	1	2	6	100	50	20	30	200
4	DC 3	AU/IP/ME 304	Thermodynamics	3	1	2	6	100	50	20	30	200
5	DC-4	AU/IP/ME 305	Machine Drawing and Design	3	1	2	6	100	50	20	30	200
6	IT-3	CS/ IP/ME 306	Java	0	0	4	4		50		50	100
7	NECC -1	ME307	Self Study	0	0	1	1				30	30
8	NECC -2	ME308	Seminar and Group Discussion	0	0	1	1				30	30
Total				15	5	12	32	500	200	100	200	1000

BS	Basic Sciences	HS	Humanity Sciences
DC	Department Core	DID	Department Inter Disciplinary
IT	Information Technology subjects	NECC	Non Exam Credit Course
MST	Mid Semester Test	TW	Term Work (Session/ Practical)
C	Credits	L	Lecture Hrs
P	Practical Hrs	T	Tutorial Hrs

Rajiv Gandhi Technological University, Bhopal (MP)

B.E. (ME) Mechanical Engineering

Revised Syllabus and Scheme of Examination Effective from July 2007

FOURTH SEMESTER

S.No	Course Category	Course Codes (New)	Subject	Periods Per week				Distribution of Marks				
								Theory	Practical	Internal Assessment		Total
				L	T	P	C			MST	TW	
1.	DC-5	IP/ME 401	Material Science & Metallurgy	3	1	-	4	100	-	20	-	120
2.	HS2	IP/ME 402	Energy Environment Ethics and Society	3	1	-	4	100	-	20	-	120
3.	DC-6	IP/ME 403	Theory of Machines and Mechanisms	3	1	2	6	100	50	20	30	200
4.	DC-7	IP/ME 404	Thermal engg and gas dynamics	3	1	2	6	100	50	20	30	200
5.	DID 1	ME405	Fluid Mechanics	3	1	2	6	100	50	20	30	200
6.	IT-3	ME406	Dot.Net	0	0	4	4	-	50	-	50	100
7.	NECC-3	ME407	Self Study	0	0	1	1	-	-	-	30	30
8.	NECC-4	ME408	Seminar and Group Discussion	0	0	1	1	-	-	-	30	30
Total				15	5	12	32	500	200	100	200	1000

BS	Basic Sciences	HS	Humanity Sciences
DC	Department Core	DID	Department Inter Disciplinary
IT	Information Technology subjects	NECC	Non Exam Credit Course
MST	Mid Semester Test	TW	Term Work (Session/ Practical)
C	Credits	L	Lecture Hrs
P	Practical Hrs	T	Tutorial Hrs

COURSE CONTENTS

Category	Title	Code	Credits-4C			Theory Papers
Basic Sciences BS-5	Mathematics-III	BE 301	L	T	P	Max Marks-100
			3	1	0	Min Marks-35
						Duration-3 Hrs

Unit 1 Functions of Complex Variables: Analytic functions, Harmonic Conjugate, Cauchy - Riemann Equations, Line integral, Cauchy's theorem, Cauchy's Integral formula, Singular points, Poles and Residues, Residue theorem, Evaluation of Real Integral, Bilinear Transformation.

Unit 2 Numerical Analysis: Difference operators, Errors and Approximations, Interpolation, Inverse interpolation, Numerical differentiation, Numerical Integration by using Simpson's method, Weddel's rule and Gauss legendre open quadrate formula.

Unit 3 Solutions of algebraic and transcendental equations(Regular False, Newton-Raphson, Iterative, Graffe's root squaring methods), Solutions of simultaneous algebraic equations, Solutions of ordinary differential equations (Tailor's Series, Picard's Method, Modified Euler's method, Runge Kutta Method, Predictor-Corrector Method), Solution of Partial differential equation.

Unit 4 Introduction to optimization by linear programming, only two variable problems solution by graphical and simplex method, concept of degeneracy and duality; simple three variable transport and assignment problems and modeling into LPP.

Unit 5 introduction to Q theory and Markovian process, time independent property of exponential distribution, solution of only M/M/1 (∞/∞/FCFS) Queues; introduction to design of experiments, factorial design, sampling methods, Taguchi Loss Function, robust design methods, variance reduction and six (±3)σ outliers in quality.

References:

1. Kreyszig E; Advanced Engineering Mathematics; Wiley Eastern Limited.
2. Ramana BV; Higher Engineering Mathematics; TMH
3. Grewal BS; Higher Engineering Mathematics; Khanna Publisher.
4. Taha H; Operations Research an Introduction; PHI
5. Ross; Taguchi techniques for Quality engineering, TMH
6. Spiegel; Theory and problems of probability and statistics; TMH
7. Chandrasekharaiah DS; Engineering Maths Part II & III; Prism Books Pvt.
8. Johnson; Miller and Freund's Probability and statistics for Engineers; PHI.
9. Jaggi, Mathur; Engineering Mathematics; Khanna Publisher.

Course Contents

Category	Title	Code	Credit-4C			Theory Paper
DC1	Strength & Mechanics of Materials	AU/IP/ME 302	L	T	P	Max.Marks-100 Min.Marks-35 Duration-3hrs.
			3	1		

UNIT I Mechanical properties of materials: Ductility, malleability, hardness, toughness, fatigue, creep; behavior of materials under tension, compression, bending, shear; ductile and brittle materials, failure of MS and CI in tension and torsion
Stress and strain: stresses in members of a structure, axial loading, normal stress, shear stress, bearing stress, analysis of simple structures, stress on oblique plane under axial loading, stepped rods, members in series and parallel: stress strain diagram, Hooke's law, modulus of elasticity, elastic and plastic behavior of materials, deformation under axial loading, statically indeterminate problems, stress due to temperature, Poisson's ratio, Bulk modulus, shear strain, relation among elastic constants, residual stress, fiber reinforced composite materials

UNIT II Transformation of stress and strain, principal stresses, normal and shear stress, Mohr's circle and its application to two and three dimensional analysis, ductile and brittle failures, transmission shaft under combined bending and torsion; stresses in thin walled pressure vessel

UNIT III Torsion in shafts: stresses in a shaft, deformation in circular shaft, angle of twist, stepped-hollow, thin walled-hollow transmission shafts
Leaf springs; Helical springs, open and closed coil, stress in spring wire, deflection of helical spring, springs in series and parallel.

UNIT IV Bending: pure bending, symmetric member, deformation and stress, bending of composite sections, eccentric axial loading, shear force and BM diagram, relationship among load, shear and BM, shear stresses in beams

UNIT V Theories of failures: maximum normal stress & shear stress theory; maximum normal and shear strain energy theory; maximum distortion energy theory; application of theories to different materials and loading conditions
Columns: stability of structures, Euler's formula for columns with different end conditions, Rankin's formula.

References:

1. Beer FP, Johnson ER, Dewolf JT : Mechanics of Materials; TMH
2. Rattan; Strength of materials; TMH
3. Nash William; Schaum's Outline of Strength of Materials; TMH.
4. Negi ; strength of materials; TMH
5. Singh Arbind K; Mechanics of Solids; PHI
6. Strength of Materials, Sadhu Singh,
7. Kamal K and Ghai RC; Advanced Mechanics of Materials; Khanna Pub.

Course Content

Category	Title	Code	Credits-6C			Theory Papers
DC –2	Production Process	AU/ME 303	L	T	P	Max.Marks-100
			3	1	2	Min.Marks-35 Duration-3hrs.

Unit I Metrology: Standards of Measurements, Linear and angular instruments; slip gauges, comparators, sine bar, angle gauges, clinometers, tape gauge, screw thread measurements limit gauging, Gauge design; fits and tolerance. Rolling: General description of machines and process; Rolling of structural sections plates and sheets; construction of halls; hot and cold rolling techniques.

Unit II Metal cutting : Principles of metal cutting, tool geometry ,Tool life plots , Mach inability, Tool wear , Cutting force analysis ,Cutting tool materials & Cutting fluids ,Economics of metal machining .

Unit III Pattern Making: Pattern and pattern making, pattern allowances; pattern design considerations, core, core boxes, types of patterns.
Foundary: Moulding and core sands and their properties moulding machines, centrifugal casting, dye casting shell moulding; cupola description and operation. Lost wax moulding; continuous casting.

Unit IV Forging: Theory and application of forging processes description; principle of toleration of drop and horizontal forging machines; General principle of designs.
Press working: Description and operation of processes, process of shearing, punching, piercing, blanking, trimming, perfecting, notching, lancing, embossing, coining, bending, forging and drawing press, tool dies, auxiliary equipment, safety devices, stock feeders, scrap cutters, forces, pressure and power requirements, requirements of stock material.

Unit V Welding: Gas welding, Electric arc welding, A.C. and D.C. welding machines and their characteristics. Flux, Electrodes, Pressure welding, electric resistance welding spot, seam and built welding, submerged arc welding. Thermit and TIG & MIG Welding, Brazing Gas cutting
Spinning: Introduction of spinning.

References:

1. Anderson and Tetro; Shop Theory;TMH
2. Kaushik JP; Manufacturing Processes; PHI
3. Bawa; Manufacturing Processes; TMH
4. Rao PN; Manufacturing Tech- Foundry, forming welding; TMH
5. Rao PN; Manufacturing Tech- Metal cutting and machine tools; TMH
6. Chapman; Workshop Technology :
7. Begeman; Manufacturing Process : John Wiley
8. Raghuvanshi; Workshop Technology :; Dhanpat Rai.
9. Ravi B; Metal Casting- CAD analysis; PHI.
10. Hajra Choudhary; Workshop Technology:, Vol I
11. Pandya & Singh;Production Engineering Science:.

List of Experiments (Expandable)

1. Study and use of various gauges
2. Jobs made in pattern shop
3. jobs made in metal cutting shop.
4. Jobs made in welding shop.

Course Contents

Category	Title	Code	Credits-6C			Theory Papers
			L	T	P	
DC -4	Thermodynamics	AU/IP/ME 304	3	1	2	Max Marks-100 Min Marks-35 Duration 3 Hrs

Unit I Basic concepts: Thermodynamics, Property, Equilibrium, State, Process, Cycle, Zeroth law of thermodynamics, statement and significance, concept of an Ideal gas, Gas laws, Avogadro's hypothesis, Heat and work transfer. First law of thermodynamics- Statement of first law of thermodynamics, first law applied to closed system, first law applied to a closed system undergoing a cycle, processes analysis of closed system, flow process, flow energy, steady flow process, Relations for flow processes, limitations of first law of thermodynamics.

Unit II Second law of thermodynamics, heat engine, heat reservoir, Refrigerator, heat pump, COP, EPR, Available energy, Carnot's theorem, Carnot's cycle, efficiency of Carnot's cycle, statement of second law Reversible and irreversible processes, consequence of second law, Entropy, Entropy change for ideal gas, T-S diagrams, Availability and Irreversibility. Gibbs and Helmholtz functions

Unit III Real gas, Deviation with ideal gas, Vander-wall's equation, evaluation of its constants, limitations of the equation. The law of corresponding states Compressibility factor, Generalized compressibility chart, P-V-T surface of a Real gas, Thermodynamics relations, Maxwell relations and there applications.

Unit IV Pure Substance, Phase, Phase-transformations, formation of steam, properties of steam, PVT surface, HS,TS,PV,PH,TV diagram, processes of vapor measurement of dryness fraction, Use of steam table and Mollier chart.

Unit V Air standard cycles, Carnot, Otto, Diesel, Dual cycles and there comparison, two stroke and four stroke engines, Brayton cycle, non reactive gas mixture, PVT relationship, mixture of ideal gases, properties of mixture of ideal gases, internal energy, Enthalpy and specific heat of gas mixtures, Enthalpy of gas- mixtures.

References:

1. P.K.Nag; Engineering Thermodynamics; TMH
2. Van GJ; Thermodynamics; John Wylen
3. Cengel Y; Thermodynamics; TMH
4. Arora CP; Thermodynamics; TMH
5. Thermal Engineering by R Yadav
6. Engineering Thermodynamics by Omkar Singh New Age International.
7. Engineering Thermodynamics by Ratha Krishanan PHI India Pvt. Ltd.
8. Engineering Thermodynamics by M. Achuthan, PHI India.

Theory classes must to be supplemented with laboratory classes.

List of Experiments (Expandable):

1. To find mechanical equivqlent of heat using Joules apparatus
2. To study working of impulse and reaction steam turbine by models.\
3. To study working of Gas turbines by models and to identify various processes of Brayton Cycle.
4. To calculate COP of vapour compression refrigeration system and to plot on T-s, p-H diagrams.
5. To plot specific fuel consumstion versus rpm diagrams for diesel and petrol engines

Course Contents

Category	Title	Code	Credit-6C			Theory Paper
DC3	Machine Drawing and Design	AU/IP/ME 305	L	T	P	Max.Marks-100 Min.Marks-35 Duration-3hrs.
			3	1	2	

UNIT I: Drawing conventions; drawing and dimensioning IS codes, sectional views and sectioning, surface finish and tolerances, representation of machine parts such as external and internal threads, slotted heads, square ends, and flat radial ribs, slotted shaft, splined shafts, bearings, springs, gears, s: Rivet heads and Riveted joints, types of welded joints and representation.

UNIT II: Assembly Machine Drawing: Cotter and Knuckle joints, pedestal and footstep bearings, IC engines, parts, piston and connecting rods.

UNIT III CAD Software for 2D and 3D Modeling: Basic concept, plotting technique, assembly and blow up of parts, bill of materials, product data and product life cycle management

UNIT IV: Basic design concepts, design process, stages/phases in design, flowchart, problem formulation, design considerations (strength, manufacturing, maintenance, energy, environment, economics and safety); design for recycle and reuse, Design and safety factors, standardization in design, selection of materials

UNIT V: Design of components subject to static loads: riveted joints, welded joints , threaded joints, knuckle and cotter joints.

References:

1. Bhat, ND; Machine Drawing; Charotar
2. Singh A; Machine Drawing; TMH
3. Agarwal and agrawal; Engineering Drawing; TMH
4. Shigley JE et al; Mechanical Engineering Desing, TMH
5. Kulkarni SG, Machine Design; TMH
6. Mubeen and Mubeen; Machine Design.
7. Luzzader WJ, Duff JM; Fundamental of Engg Drawing and Interactive Graphics; PHI.

List of Experiments:

Design and drawing of parts contained in the syllabus

Course Contents

Category	Title	Code	Credits-4C			Practical
IT-2	JAVA	AU/CS/CE/ IP/ME 306	L	T	P	Max. Marks-50
			0	0	4	Min. Marks-25
						Duration-

UNIT-I Basic Java Features - C++ Vs JAVA, JAVA virtual machine, Constant & Variables, Data Types, Class, Methods, Objects, Strings and Arrays, Type Casting, Operators, Precedence relations, Control Statements, Exception Handling, File and Streams, Visibility, Constructors, Operator and Methods Overloading, Static Members, Inheritance: Polymorphism, Abstract methods and Classes

UNIT–II Java Collective Frame Work - Data Structures: Introduction, Type-Wrapper Classes for Primitive Types, Dynamic Memory Allocation, Linked List, Stack, Queues, Trees,
Generics: Introduction, Overloading Generic Methods, Generic Classes, Collections: Interface Collection and Class Collections, Lists, Array List and Iterator, Linked List, Vector.
Collections Algorithms: Algorithm sorts, Algorithm shuffle, Algorithms reverse, fill, copy, max and min Algorithm binary Search, Algorithms add All, Stack Class of Package java. Util, Class Priority Queue and Interface Queue, Maps, Properties Class, Un-modifiable Collections.

UNIT–III Advance Java Features - Multithreading: Thread States, Priorities and Thread Scheduling, Life Cycle of a Thread, Thread Synchronization, Creating and Executing Threads, Multithreading with GUI, Monitors and Monitor Locks. Networking: Manipulating URLs, Reading a file on a Web Server, Socket programming, Security and the Network, RMI, Networking, Accessing Databases with JDBC: Relational Database, SQL, MySQL, Oracle

UNIT–IV Advance Java Technologies - Servlets: Overview and Architecture, Setting Up the Apache Tomcat Server, Handling HTTP get Requests, Deploying a web Application, Multitier Applications, Using JDBC from a Servlet, Java Server Pages (JSP): Overview, First JSP Example, Implicit Objects, Scripting, Standard Actions, Directives, Multimedia: Applets and Application: Loading, Displaying and Scaling Images, Animating a Series of Images, Loading and playing Audio clips

UNIT–V Advance Web/Internet Programming (Overview): J2ME, J2EE, EJB, XML.

References:

1. Deitel & Deitel, ”JAVA, How to Program”; PHI, Pearson.
2. E. Balaguruswamy, “Programming In Java”; TMH Publications
3. The Complete Reference: Herbert Schildt, TMH
4. Peter Norton, “Peter Norton Guide To Java Programming”, Techmedia.
5. Merlin Hughes, et al; Java Network Programming , Manning Publications/Prentice Hall

List of Program to be perform (Expandable)

1. Installation of J2SDK
2. Write a program to show Concept of CLASS in JAVA
3. Write a program to show Type Casting in JAVA
4. Write a program to show How Exception Handling is in JAVA
5. Write Program to show Inheritance and Polymorphism
6. Write a program to show Interfacing between two classes
7. Write a program to Add a Class to a Package
8. Write a program to demonstrate AWT.
9. Write a program to Hide a Class
10. Write a Program to show Data Base Connectivity Using JAVA
11. Write a Program to show “HELLO JAVA ” in Explorer using Applet
12. Write a Program to show Connectivity using JDBC
13. Write a program to demonstrate multithreading using Java.
14. Write a program to demonstrate applet life cycle.

Course Content

Category	Title	Code	Credits-4C			Theory Papers
DC –5	Material Science & Metallurgy	IP/ME 401	L	T	P	Max Marks-100
			3	1	0	Min Marks-35
						Duration 3 Hrs

Unit I Crystal Atoms of Solid: Structure of atom binding in solids metallic, Vander walls, ionic and covalent, Space lattice and crystal system arrangement of atoms in BCC, FCC and HCP crystal.
Manufacture of Refractory and Ferrous Metals: Properties uses and selection of acid, basic and natural refractory, metallurgical coke, Properties, types, uses and brief description of the manufacturing processes for iron and steel making.

Unit II Plastic deformation of Metals: Point and line defects in crystals, their relation to mechanical properties, deformation of metal by slip and twinning stress strain curves of poly crystalline materials viz. mild steel cast iron and brass yield point phenomenon.
Cold and hot working of metals and their effect on mechanical properties, annealing of cold worked metals, principles of re-crystallization and grain growth phenomenon, fracture in metal and alloys, ductile and brittle fracture, fatigue failure

Unit III Alloy Formation and Binary Diagram: Phase in metal system solution and inter-metallic compounds. Hume-Rottery's rules, solidification of pure metals and alloy equilibrium diagrams of isomorphous, eutectic peritectic and eutectoid system, non-equilibrium cooling and coring iron, iron carbon equilibrium diagram.

Unit IV Heat Treatment of Alloys Principles of Heat Treatment of Steel: TTT curves heat treating processes, normalizing, annealing spheroldizing, hardening, tempering, case hardening, aus-tempering, mar-tempering, precipitation hardening process with reference to Al, Cu alloys

Unit V Properties of Material: Creep Fatigue etc., Introduction to cast iron and steel, Non Ferrous metals base alloys, Bronze, Brasses, Duralumin, and Bearing Metals.
Plastics, Composites and ceramics: Various types of plastics, their properties and selection. Plastic molding technology, FRP, GRP resins adhesive, elastomers and their application.
Powder Metallurgy: Property and Applications of Powder Metallurgy, Various process and methods of making products by powder Metallurgy techniques.

References:

1. Narula GK, KS and GuptaVK; Material science; TMH
2. Raghavan V; Material Science and Engineering, PHI Publication.
3. Raghavan V; Physical Metallurgy Principles and Practice; PHI
4. Rajendran V and Marikani; Material science; TMH
5. Sriniwasan R; Engineering materials and Metallurgy; TMH
6. Navneet Gupta, Material Science & Engineering, Dhanpat Rai.
7. B. K. Agrawal, Introduction to Engineering Materials, TMH.

COURSE CONTENTS

Category	Title	Code	Credits-4C			Theory Papers
Humanities and Science HS 2	Energy Environment Ethics and Society	AU/CE/CM/FT/IP/ ME/TX 402	L	T	P	Max Mark-100
			3	1	0	Min Mark-35
						Duration-3Hrs

Unit 1 Energy: linkage with development, world energy scenario, fossil fuel resource- estimates and duration, India's energy scenario; Finite/ depleting energy resources, coal, oil, gas, nuclear fission, promises and present status of nuclear fusion energy; Renewable energy, solar, hydro, wind, biomass, ocean, tidal, wave and geothermal. Synergy between energy and environment, global environment issues, greenhouse gas emission, global warming, green energy solutions.

Unit 2 Society and environment: exponential growth in population, environmentally optimum sustainable population, free access resources and the tragedy of commons; environment problems and impact of P.A.T (Population, Affluence and Technology), environmentally beneficial and harmful technologies; environment impact assessment policies and auditing interaction between environment, life support systems and socio-culture system.

Unit 3 Ecosystem: definition, concepts, structure, realm of ecology, lithosphere, hydrosphere, biosphere, atmosphere-troposphere-stratosphere; energy balance to earth, matter and nutrient recycling in ecosystems; nitrogen, oxygen, carbon and water cycles, food producers, consumers and decomposers, food chains; biodiversity, threat and conservation of biodiversity. Worldviews and environmentally sustainable economic growth, introduction to Design For Environment (DFE), product lifecycle assessment for environment and ISO 14000; triple bottom-line of economic, environment and social performance; environmental ethics, its world impact and challenges.

Unit 4 (a) Air pollution-primary, secondary; chemical and photochemical reactions, effects of CO, NO, CH and particulates, acid rain, Ozone depletion; monitoring and control of pollutants
(b) Noise pollution-sources and control measures.
(c) Water pollution, analysis and management, heavy metals- and nuclear pollutions; industrial pollution from paper, pharmacy, distillery, tannery, fertilizer, food processing and small scale industries.

Unit 5 Ethics and moral values, ethical situations, objectives of ethics and its study, role morality and conflicts; values, policies and Organization Culture; Non-professional, quasi- and hard-professionals; preventive, personal, common and professional ethics; different ethical value criteria like utilitarian, virtue, right and duty ethics with discussion on the case of priority for improvement of urban (high traffic) or rural (low traffic) intersections causing equal number of fatalities; codes of ethics and their limitations; Institute of engineers code for corporate member, IEEE and ACM professional-code.

References:

1. Miller G. T Jr; Living in the environment; Cengage Publisher.
2. Cunningham W; Principles of Environmental Science: TMH
3. Harris CE, Prichard MS, Rabins MJ, Engineering Ethics; Cengage Pub.
4. Martin; Ethics in Engineering; TMH
5. Govindrajan, Natrajan, Santikumar; Engineering Ethics; PHI pub.
6. Rana SVS;Essentials of ecology and environment; PHI Pub.
7. Gerard Kiely, Environmental Engineering; TMH
8. Khan BH; Non Conventional energy resources; TMH Pub.
9. Raynold G.W. "Ethics in Information Technology; Cengage

COURSE CONTENTS

Category	Title	Code	Credits-6C			Theory Papers
DC-6	Theory of Machines and Mechanisms	IP/ME 403	L	T	P	Max.Marks-100
			3	1	2	Min.Marks-35
						Duration-3hrs.

Unit I: Mechanisms and Machines: Mechanism, machine, plane and space mechanisms, kinematic pairs, kinematic chains and their classification, degrees of freedom, Grubler's criterion, kinematic inversions of four bar mechanism and slider crank mechanism, equivalent linkages, pantograph, straight line motion mechanisms, Davis and Ackermann's steering mechanisms, Hooke's joint.

Unit II: Kinematic analysis of plane mechanisms using graphical and Cartesian vector notatins: Planar kinematics of a rigid body, rigid body motion, translation, rotation about a fixed axis, absolute general plane motion. General case of plane motion, relative velocity method, velocity and acceleration analysis, instantaneous center and its application, Kennedy's theorem, relative motion analysis using rotating axis, Coriolis component of acceleration.

Unit III: Friction: Frictional torque in pivots and collars by uniform pressure and uniform wear rate criteria. Boundary and fluid film lubrication, friction in journal and thrust bearings, concept of friction circle and axis, rolling friction.
Clutches: Single plate and multi plate clutches, Cone clutches.
Brakes: Band brake, block brakes, Internal and external shoe brakes, braking of vehicles.
Dynamometer: Different types and their applications.

Unit IV :Gears: Classification of gears, nomenclature, involutes and cycloidal tooth profile properties, synthesis of tooth profile for spur gears, tooth system, conjugate action, velocity of sliding, arc of contact, path of contact, contact ratio, interference and undercutting, helical, spiral, bevel and worm gears.

Unit V: Cams: Classification of followers and cams, radial cam nomenclature, analysis of follower motion (uniform, modified uniform, simple harmonic, parabolic, cycloidal), pressure angle, radius of curvature, synthesis of cam profile by graphical approach, cams with specified contours.
Gear Trains: Simple, compound, epicyclic gear trains; determination of gear speeds using vector, analytical and tabular method; torque calculations in simple, compound and epicyclic gear trains.

References:

1. Rattan SS; Theory of machines; TMH
2. Ambekar AG; Mechanism and Machine Theory; PHI.
3. Sharma CS; Purohit K; Theory of Mechanism and Machines; PHI.
4. Thomas Bevan; Theory of Machines; CBS PUB Delhi.
5. Rao JS and Dukkipati; Mechanism and Machine Theory; NewAge Delhi.
6. Dr.Jagdish Lal; Theory of Machines; Metropolitan Book Co; Delhi –
7. Ghosh,A,.Mallik,AK; Theory of Mechanisms & Machines, 2e,; Affiliated East West Press, Delhi.

List of experiments (expandable)

1. To study all inversions of four-bar mechanisms using models
2. Draw velocity and acceleration polygons of all moving link joints in slider crank mechanism.
3. To study working of cone and screw plate clutch using models
4. To study working of differential gear mechanism.
5. To study working of sun and planet epicyclic gear train mechanism using models
6. To plot fall and rise of the follower versus angular displacement of cam and vice versa.

Course Contents

Category	Title	Code	Credits-6C			Theory Papers
Departmental Core DC -6	Thermal Engg and gas dynamics	IP/ME 404	L	T	P	Max.Marks-100 Min.Marks-35 Duration-3hrs.
			3	1	2	

Unit I

Steam Generators: Classification, Conventional boilers, High-pressure boilers-Lamont, Benson, Loeffler and Velox steam generators, Performance and rating of boilers. Equivalent evaporation, Boiler efficiency, Heat balance sheet. Combustion in boilers,super critical boilers, fuel and ash handling, Boiler draught, overview of boiler codes.

Unit II

Phase Change Cycles: Vapor Carnot cycle and its limitation, Rankine cycle, Effect of boiler and Condenser pressure and superheat on end moisture and efficiency of ranking cycle, Modified Rankine cycle, Reheat cycle, Perfect Regenerative cycle, Ideal and actual regenerative cycle with single and multiple heaters, open and closed type of feed water heaters, Regenerative-Reheat cycle, Supercritical pressure and Binary-Vapour cycle, Work done and efficiency calculations.

Unit III

(A) Gas Dynamics:

Speed of sound, in a fluid Mach number, Mach cone, Stagnation properties, one-dimensional Isentropic flow Of ideal gases through variable area duct-Mach number variation, Area ratio as a function of Mach number, Mass flow rate and critical pressure ratio, Effect of friction, velocity coefficient, coefficient of discharge. Diffusers, Normal shock.

(B) Steam Nozzles:

Isentropic flow of vapors, flow of steam through nozzles, Condition for maximum discharge, Effect of friction, Supersaturated flow.

Unit IV

Air Compressors: Working of reciprocating compressor, work input for single stage compression different, compression processes, effect of clearance, Volumetric efficiency Real indicator diagram, isentropic & isothermal and mechanical efficiency, Multi stage compression, Inter -cooling, Condition for minimum work done, Classification and working of Rotary Compressors.

Unit V

Steam Condensers, Cooling Towers and Heat Exchangers: Introduction, Types of Condensers, back pressure and its effect on plant performance Air leakage and its effect on performance of condensers . Various types of Cooling Towers , Design of Cooling Towers .Classification of heat exchangers , recuperates and regenerators .parallel flow ,counter flow and cross flow exchangers , fouling factor , introduction to LMTD approach to design a heat exchanger .

References:

1. Nag PK; Power plant Engineering; TMH
2. Thermodynamics by Gordon J. Van Wylen
3. P.K.Nag; Basic and applied Thermodynamics; TMH
4. Ganesan; Gas turbines; TMH
5. Heat Engines by V.P. Vasandani & D. S. Kumar
6. R. Yadav Steam and Gas Turbines
7. R.Yadav Thermal Engg.
8. Kadambi & Manohar; An Introduction to Energy Conversion – Vol II. Energy conversion cycles

List of Experiments (Expandable)

1. Study of working of some of the high pressure boilers like Lamont or Benson
2. Study of Induced draft/forced and balanced draft by chimney
3. Determination of Calorific value of a fuel
4. Study of different types of steam turbines
5. Determination of efficiencies of condenser
6. Boiler trail to chalk out heat balance sheet
7. Determination of thermal efficiency of steam power plant
8. Determination of Airflow in ducts and pipes.
9. To find out efficiencies of a reciprocating air compressor and study of multistage Compressors .
10. Find Out heat transfer area of a parallel flow/counter flow heat exchanger

Course Contents

Category	Title	Code	Credits -6			Theory Papers
DID	Fluid Mechanics	AU/CE/CM/IP /ME 405	L	T	P	Max.Marks-100
			3	1	2	Min.Marks-35
						Duration-3hrs.

Unit-I Review of Fluid Properties: Engineering units of measurement, mass, density, specific weight, specific volume, specific gravity, surface tension, capillarity, viscosity, bulk modulus of elasticity, pressure and vapor pressure. Fluid Static's : Pressure at a point, pressure variation in static fluid, Absolute and gauge pressure, manometers, Forces on plane and curved surfaces (Problems on gravity dams and Tainter gates); buoyant force, Stability of floating and submerged bodies, Relative equilibrium.

Unit-II Kinematics of Flow : Types of flow-ideal & real , steady & unsteady, uniform & non-uniform, one, two and three dimensional flow, path lines, streaklines, streamlines and stream tubes; continuity equation for one and three dimensional flow, rotational & irrotational flow, circulation, stagnation point, separation of flow, sources & sinks, velocity potential, stream function, flow nets- their utility & method of drawing flow nets.

Unit-III Dynamics of Flow: Euler's equation of motion along a streamline and derivation of Bernoulli's equation, application of Bernoulli's equation, energy correction factor, linear momentum equation for steady flow; momentum correction factor. The moment of momentum equation, forces on fixed and moving vanes and other applications. Fluid Measurements: Velocity measurement (Pitot tube, Prandtl tube, current meters etc.); flow measurement (orifices, nozzles, mouth pieces, orifice meter, nozzle meter, venturimeter, weirs and notches).

Unit-IV Dimensional Analysis and Dynamic Similitude: Dimensional analysis, dimensional homogeneity, use of Buckingham-pi theorem, calculation of dimensionless numbers, similarity laws, specific model investigations (submerged bodies, partially submerged bodies, weirs, spillways, rotodynamic machines etc.)

Unit-V Laminar Flow: Introduction to laminar & turbulent flow, Reynolds experiment & Reynolds number, relation between shear & pressure gradient, laminar flow through circular pipes, laminar flow between parallel plates, laminar flow through porous media, Stokes law, lubrication principles.

References: -

1. Modi & Seth; Fluid Mechanics; Standard Book House, Delhi
2. Som and Biswas; Fluid Mechnics and machinery; TMH
3. Cengal; Fluid Mechanics; TMH
4. White ; Fluid Mechanics ; TMH
5. Essential of Engg Hyd. By JNIK DAKE; Afrikan Network & Sc Instt. (ANSTI)
6. A Text Book of fluid Mech. for Engg. Student by Franiss JRD
7. R Mohanty; Fluid Mechanics By; PHI
8. Fluid Mechanics; Gupta Pearson.

List of Experiment (Expandable):

1. To determine the local point pressure with the help of pitot tube.
2. To find out the terminal velocity of a spherical body in water.
3. Calibration of Venturimeter
4. Determination of Cc, C_v, C_d of Orifices
5. Calibration of Orifice Meter, Nozzle meter and Mouth Piece
6. Reynolds experiment for demonstration of stream lines & turbulent flow
7. Determination of metacentric height
8. Determination of Friction Factor of a pipe
9. To study the characteristics of a centrifugal pump.
10. Verification of Impulse momentum principle.

Course Contents

Category	Title	Code	Credit-4			Practical
IT-3	Dot.Net	CS/IT /EE/EX406	L	T	P	Max. Marks-50 Min. Marks: 25
			-	-	4	Duration: 3 hrs.

UNIT I Introduction .NET framework, features of .Net framework, architecture and component of .Net, elements of .Net.

UNIT II Basic Features Of C# Fundamentals, Classes and Objects, Inheritance and Polymorphism, Operator Overloading, Structures. **Advanced Features Of C#** Interfaces, Arrays, Indexers and Collections; Strings and Regular Expressions, Handling Exceptions, Delegates and Events.

UNIT III Installing ASP.NET framework, overview of the ASP .net framework, overview of CLR, class library, overview of ASP.net control, understanding HTML controls, study of standard controls, validations controls, rich controls. **Windows Forms:** All about windows form, MDI form, creating windows applications, adding controls to forms, handling Events, and using various Tolls

UNIT IV Understanding and handling controls events, **ADO.NET-** Component object model, ODBC, OLEDB, and SQL connected mode, disconnected mode, dataset, data-reader **Data base controls:** Overview of data access data control, using grid view controls, using details view and frame view controls, ado .net data readers, SQL data source control, object data source control, site map data source.

UNIT V XML: Introducing XML, Structure, and syntax of XML, document type definition (DTD), XML Schema, Document object model, Presenting and Handling XML. xml data source, using navigation controls, introduction of web parts, using java script, Web Services

References:

1. C# for Programmers by Harvey Deitel, Paul Deitel, Pearson Education
2. Balagurusamy; Programming in C#; TMH
3. **Web** Commerce **Technology** Handbook by Daniel **Minoli**, Emma **Minoli** , TMH
4. Web Programming by Chris Bates, Wiley
5. XML Bible by Elliotte Rusty Harold ,
6. ASP .Net Complete Reference by McDonald, TMH.
7. ADO .Net Complete Reference by Odey, TMH

List of Experiments/ program (Expandable):

1. Working with call backs and delegates in C#
2. Code access security with C#.
3. Creating a COM+ component with C#.
4. Creating a Windows Service with C#
5. Interacting with a Windows Service with C#
6. Using Reflection in C#
7. Sending Mail and SMTP Mail and C#
8. Perform String Manipulation with the String Builder and String Classes and C#:
9. Using the System .Net Web Client to Retrieve or Upload Data with C#
10. Reading and Writing XML Documents with the XML Text-Reader/-Writer Class and C#
11. Working with Page using ASP .Net.
12. Working with Forms using ASP .Net
13. Data Sources access through ADO.Net,
14. Working with Data readers , Transactions
15. Creating Web Application.