MAHATMA GANDHI UNIVERSITY

B.TECH. DEGREE COURSE

3rd SEMESTER

SCHEME & SYLLABUS

2002

MECHANICAL ENGINEERING BRANCH

MECHANICAL ENGINEEING

SCHEME

3RD SEMESTER

Course Code	Course No.	Subject	Teaching Periods			Duration of Uty. Exam. (Hrs.)	Marks			
			Lect.	Tut.	Prac.		Sessional	Theory	Practical	Total
A	CMEL PA 301	Engineering Mathematics - II	3	1	-	3	50	100	-	150
B	M 302	Machine Drawing - I	-	-	4	3	50	100	-	150
C	M 303	Fluid Mechanics	2	2	-	3	50	100	-	150
D	M 304	Metallurgy & Material Science	3	1	-	3	50	100	-	150
E	M 305	Thermodynamics	2	2	-	3	50	100	-	150
F	M 306	Strength of Materials and Structural Engg.	3	1	-	3	50	100	-	150
G	M 307	Fluid Mechanics Laboratory	-	-	3	3	50	-	100	150
H	M 308	Strength of Materials Laboratory	-	-	3	3	50	-	100	150
		Total	13	7	10	-	400	600	200	1200

SYLLABUS

ENGINEERING MATHEMATICS - II

CMELPA 301 **3+1+0**

Module 1 Vector Differential Calculus

Differentiation of vector functions - scalar and vector fields – gradient, divergence and curl of a vector function – their physical meaning – directional derivative – scalar potential, conservative fields – identities – simple problems.

Module 2 Vector Integral Calculus

Line, surface and volume Integrals – work done by a force along a path – Application of Green's theorem, Stokes theorem and Gauss divergence theorem.

Module 3 Function of Complex Variable

Definition of analytic functions and singular points – derivation of C.R. equations in Cartesian co-ordinates – harmonic and orthogonal properties – construction of analytic function given real or imaginary parts – complex potential – conformal transformation of function like z^n, e^z, $1/z$, $\sin z$, $z+k^2/z$ – bilinear transformation – cross ratio – invariant property – simple problems.

Module 4 Finite Differences

Meaning of Δ, ∇, E, μ, δ - interpolation using Newton's forward and backward formula – central differences – problems using stirlings formula – Lagrange's formula and Newton's divided difference formula for unequal intervals.

Module 5 Difference Calculus

Numerical differentiation using forward and backward differences – Numerical integration – Newton – Cote's formula – trapezoidal rule – Simpson's $1/3^{rd}$ and $3/8^{th}$ rule – simple problems. Difference equations – Solution of difference equations.

References

1. Advanced Engg. Mathematics - Erwin Kreyszig, Wiley Eastern Ltd.
2. Higher Engg. Mathematics - Grawal B.S., Khanna Publishers
3. Numerical Methods in science & Engg. -M.K.Venkataraman, National Publishing Co
4. Numerical Methods - S.Balachandra Rao and G.K.Shantha, Uty. press
5. Advanced Engg. Mathematics - Michael D.Greenberg, Prentice-Hall
6. Theory and Problems of Vector analysis - M.R.Spiegel, Schaum's outline series, McGraw – Hill

MACHINE DRAWING - I

M 302 **0+0+4**

Conversion of pictorial views into orthographic views-dimensioning techniques-preparation of drawing- screw threads-different forms-conventional representation-sketching-orthographic views of hexagonal bolts and nuts-dimensional drawing-squareheaded bolts and nuts-sketching of different types of lock nuts and locking devices and foundation bolts.

Forms of rivet heads-rivetted joints-lap and butt joints with single and multiple riveting in chain and zig-zag arrangements-dimensional drawing. Sketching of conventional representation of welded joints.

Fully dimensioned and sectional drawings of the following: -
Joints-cottered joints (spigot and socket, sleeve and cotter, gib and cotter) - knuckle joint. Shaft couplings - types of keys - plain and protected types of flanged couplings - bushed pin type flexible coupling - Oldhams coupling.

Pipe joints-spigot &socket joint - flanged joint - union joint –Amstrong (hydraulic) joint.
Shaft bearings and supports - journal bearing, plummer block - footstep bearing-wall bracket - ball bearings.

Steam engine parts - stuffing box - cross head - connecting rod - eccentric.
I.C.Engine parts-piston, connecting rod.

References

1. Machine Drawing - N.D.Bhatt
2. Machine Drawing - P.I.Varghese
3. Machine Drawing - P.S.Gill

FLUID MECHANICS

M 303 **2+2+0**

Module 1

Introduction-Proprties of fluids- pressure, force, density, specific weight, compressibility, capillarity, surface tension, dynamic and kinematic viscosity-Pascal's law-Newtonian and non-Newtonian fluids-fluid statics-measurement of pressure-variation of pressure-manometry-hydrostatic pressure on plane and curved surfaces-centre of pressure-buoyancy-floation-stability of submerged and floating bodies-metacentric height-period of oscillation.

Module 2

Kinematics of fluid motion-Eulerian and Lagrangian approach-classification and representation of fluid flow- path line, stream line and streak line. Basic hydrodynamics-equation for acceleration-continuity equation-rotational and

irrotational flow-velocity potential and stream function-circulation and vorticity-vortex flow-energy variation across stream lines-basic field flow such as uniform flow, spiral flow, source, sink, doublet, vortex pair, flow past a cylinder with a circulation, Magnus effect-Joukowski theorem-coefficient of lift.

Module 3

Euler's momentum equation-Bernoulli's equation and its limitations-momentum and energy correction factors-pressure variation across uniform conduit and uniform bend-pressure distribution in irrotational flow and in curved boundaries-flow through orifices and mouthpieces, notches and weirs-time of emptying a tank-application of Bernoulli's theorem-orifice meter, ventury meter, pitot tube, rotameter.

Module 4

Navier-Stoke's equation-body force-Hagen-Poiseullie equation-boundary layer flow theory-velocity variation- methods of controlling-applications-diffuser-boundary layer separation –wakes, drag force, coefficient of drag, skin friction, pressure, profile and total drag-stream lined body, bluff body-drag force on a rectangular plate-drag coefficient for flow around a cylinder-lift and drag force on an aerofoil-applications of aerofoil- characteristics-work done-aerofoil flow recorder-polar diagram-simple problems.

Module 5

Flow of a real fluid-effect of viscosity on fluid flow-laminar and turbulent flow-boundary layer thickness-displacement, momentum and energy thickness-flow through pipes-laminar and turbulent flow in pipes-critical Reynolds number-Darcy-Weisback equation-hydraulic radius-Moody;s chart-pipes in series and parallel-siphon losses in pipes-power transmission through pipes-water hammer-equivalent pipe-open channel flow-Chezy's equation-most economical cross section-hydraulic jump.

References

1. Hydraulics and Fluid Mechanics - Lewitt
2. Fluid Mechanics - I.H.Shames
3. Fluid Mechanics - B.S.Massey
4. Fluid Mechanics - K.L.Kumar
5. Hydraulics and Fluid Mechanics - R.K.Bhansal
6. Hydraulics and Fluid Mechanics - Mody and Seth

METALLURGY AND MATERIAL SCIENCE

M 304 **3+1+0**

Module 1

Crystallography: Crystal structural determination, crystallographic directions and planes, miller indices, packing of atoms in solids, atomic packing factor, co-ordination number- A*morphous structure*, glass transition temperature -- Effects

of crystalline and amorphous structure on mechanical and optical properties -- *Mechanism of crystallization:* Homogeneous and heterogeneous nuclei formation, dendritic growth and grain boundary irregularity, grain size effects on mechanical & optical properties - *Changes within solid materials*: *Structural imperfections:* Point defects - line defect: edge, screw dislocation, burgers vector, forest of dislocations, role of dislocation in the deformation of metals - Surface imperfections: role of surface defect on crack propagation etc – *Mode of* p*lastic deformation*: mechanism of slip & twinning, dislocation climb & cross slip, dislocation sources, frank-read source – D*iffusion* in solids, fick's laws, applications.

Module 2

Cold working, strain hardening, recovery, re-crystallization, grain growth, grain size and its effects on mechanical properties-- Hot working, super plasticity – Reasons for alloying, phase transformation phase rules, single phase, multi phase equilibrium diagrams, solid solutions, inter metallic compounds – Equilibrium diagram reactions: monotectic, eutectic, eutectoid, peritectic, peritectoid -- Polymorphism – Detailed discussion of Iron-Carbon diagram with microstructure changes in ferrite, austenite, cementite, graphite, pearlite, martensite, bainite.

Module 3

Definition and aims of *heat treatment*- Annealing, spheroidizing, normalizing, hardening, tempering, austermpering, martempering with microstructure changes -- *Surface treatment*: Diffusion methods: carburizing, nitriding, cyaniding -- Thermal methods: flame hardening, induction hardening – Deposition methods: hot dipping and coating, impregnation, metal spraying, metal cladding – *Various strengthen mechanisms in metals:* work hardening, grain boundary hardening, grain size reduction, solid solution hardening, dispersion hardening.

Module 4

Alloy steels: Effects of alloying elements on: dislocation movement, polymorphic transformation temperature, formation and stability of carbides, grain growth, displacement of the eutectoid point, retardation of the transformation rates, improvement in corrosion resistance, mechanical properties -- Nickel steels, chromium steels, etc – Effects on steels, containing molybdenum, vanadium, tungsten, cobalt, silicon, copper and lead – high speed steels - - *Cast irons:* classifications, gray, white, malleable and spheroidal graphite cast iron, composition, microstructure, properties and applications - *Principal non ferrous alloys* like aluminum, beryllium, copper, magnesium, nickel, study of composition, microstructure, properties and applications- Reference shall be made to the phase diagrams whenever necessary.

Module 5

Fracture: Bonding forces and energies, cohesive strength of metals - Griffith theory –- Crack initiation, growth and crack arrest – Effect of plastic deformation on crack propagation – Factors leading to crack propagation - Cleavage, intercrystalline, brittle, ductile fracture -- Influence of slip on fracture – Effect of impact loading on ductile material and its application in forging etc.-- *Fatigue:*

stress cycles – Effects of stress concentration, size effect, surface texture on fatigue – Corrosion and thermal fatigue – Mechanism of fatigue failure -- *Creep:* Creep curves – Structural change – Mechanism of creep deformation.

References

1. Avner S.H. – Introduction to Physical Metallurgy – McGraw Hill.
2. Callister William. D. – Material Science and Engineering. – John Wiley.
3. Guy A.G. – Essentials of material science. – McGraw Hill.
4. Dieter George E. – Mechanical Metallurgy. – McGraw Hill.
5. Higgins R.A. – Engineering Metallurgy part-I. – ELBS.
6. Mans Chandra – Science of Engineering Materials Vol. 1, 2, 3. – Macmillan.
7. Reed Hill E. Robert – Physical Metallurgy Principles. – East West Press.
8. Richards C.W. – Engineering Material Science.
9. Van Vlack – Elements of material Science. Addison – Wesley.
10. www. msm. com. ac. uk / online teaching.

THERMO DYNAMICS

M 305 **2+2+0**

Module 1

Fundamental concepts-Scope and limitations of thermo dynamics- Thermo dynamic systems – different types of systems-macroscopic and microscopic analysis-continuum-Properties-State-Processes- -Thermo dynamic equilibrium-Equation of state of an ideal gas-PVT system-Real gas-Real gas relations-Compressibility factor-Law of corresponding states.

Module 2

Laws of thermo dynamics-Zeroth law of thermo dynamics-Thermal equilibrium-Concept of temperature –Temperature scales-Thermometry-Perfect gas temperature scales. Work and Heat-First law of thermo dynamics-concept of energy-first law for closed and open systems-specific heats- internal energy and enthalpy- Steady flow energy equation- Joule Thompson effect.

Module 3

Second law of thermo dynamics-Various statements and their equivalence-Reversible process and reversible cycles – Carnot cycle-Corollaries of the second law-Thermo dynamic temperature scale- Clausius inequality-Concept of entropy-Calculation of change in entropy in various thermo dynamic processes-Reversibility and irreversibility-Available and unavailable energy – Third law of thermo dynamics.

Module 4

Thermo dynamics relations-Combind first and second law equations-Helmholtz and Gibbs functions – Maxwell relations- equations for specific heats, internal

energy, enthalpy and entropy – Clausius- Clapeyron equation – applications of thermo dynamic relations.

Module 5

Properties of pure substances – PVT, PT and TS diagrams,Mollier diagrams-Mixture of gases and vapours-mixture of ideal gases-Dalton's law-Gibbs law – Thermo dynamic properties of mixture-mixtures of ideal gases and vapours-Psychrometic principles-Psychrometic chart-Applications.

References

1. Engineering Thermodynamics - P.K.Nag
2. Thermodynamics - J.F.Lee and F.W.Sears.
3. Engineering Thermodynamics - Spalding and Cole
4. Engineering Thermodynamics - M.Achuthan
5. Thermodynamics - Keenan
6. Thermodynamics - Obert
7. Thermodynamics - Holman
8. Heat and Thermodynamics - M.N.Zemansky
9. Thermodynamics - Rogers, Pearson

STRENGTH OF MATERIALS AND STRUCTURAL ENGINEERING

M306 **3+1+0**

Module 1

I Stress and strain - Bars of varying cross - sections – composite sections - temperature stresses. Principal stresses and planes-Mohr's circle representation of plane stress.

Module 2

Shear force and bending moments -Cantilever-simply supported and overhanging beams-concentrated and U. D. loadings analytical method. Relation between load. SF and BM. Theory of simple bending- bending and shear stress distribution rectangular, circular and 1-sections.

Module 3

Slope and deflection of simply supported beams and cantilevers- Double integration- Macaulay's Method-moment area method- conjugate beam method.

Module 4

Torsion of circular shafts-solid and hollow shafts- power transmitted by shafts. Close-coiled and open coiled spring- leaf spring. Thin cyliders and jhick cylinders subjected to internal and external pressures- compound pipes -wire wound pipes-strain energy-axial loads, gradually and suddenly applied load-impact loads.

Module 5

Columns and sturts- short and long columns-Euler's theory-Ran kine's theory - Eccentrically Loaded columns-column with initial curvature. General description only of simple and compound steel, beams, columns and column foundation-principle of reinforced concrete. Reinforcements detailing in R. C. Slabs, beams, columns & footings (No problem expected)

References

1. Timoshenko.S.P, Strength of Materials, Part 1,D.Van Nostrand company, Inc.Newyork.
2. Popov E.P., Engineering Mechanics of solids, Prentice Hall of India, New Delhi.
3. Punmia B.C, Strength of Materials and Mechanics of structures, Vol 1,Lakshmi Publications, New Delhi.
4. Vazirani V.N., Ratwani N. M, Analysis of Structures, Vol 1, Khanna Publishers, New Delhi.
5. Kazimi S.M.A., Solid Mechanics, Tata Mc Graw Hill.
6. William A Nash, Strength of Materials, Mc Graw Hill.
7. Ryder G.H., Strength of Materials, ELBS.
8. Arthur Morley, Strength of Materials, ELBS, Longman's Green& Company.

FLUID MECHANICS LABORATORY

M 307 **0+0+3**

1. Study of plumbing tools and pipe fittings
2. Study of taps, valves, gauges, pitot tubes, watermeters and current meters
3. Determination of metacentric height and radius of gyration of floating bodies.
4. Hydraulic coefficients of orifices and mouthpieces under constant head method and time of emptying method.
5. Calibration of venturimeter, orifice meter and water meter
6. Calibration of rectangular and triangular notches
7. Determination of Darcy's and Chezy's constant for pipe flow
8. Determination of critical velocity in pipe flow.
9. Determination of minor losses in pipe flow
10. Experimental verification of Bernoulli's theorem
11. Determination of Chezy's constant and Mannings number for open channel flow.
12. Determination of discharge coefficient for Plug-Sluices

STRENGTH OF MATERIALS LABORTAORY

M308 **0+0+3**

1. Tests on springs (open and close coiled)
2. Bending Test on Wooden Beams using U. T. M. '
3. Verification of Clerk. Maxwell's Law of reciprocal deflection and determination of E for steel.
4. Torsion Pendulum (M.S. wires. Aluminum wires and brass wires)

5. Torsion test using U. T. M. on M. S. Rod, torsteel and High Tensile steel.
6. Torsion Test on M. S, Road
7. Shear Test on M.S. Rod.
8. Fatigue Test
9. Impact Test (Izod and Charpy)
10. Hardness Test (Brinell, Vicker's and Rebound)
11. Strut Test.

Note

All tests should be done as per relevant BIS