

**MAHATMA GANDHI
UNIVERSITY**

B.TECH. DEGREE COURSE

6TH SEMESTER

**SCHEME
&
SYLLABUS**

2002

**MECHANICAL
ENGINEERING BRANCH**

MECHANICAL ENGINEERING

SCHEME

6TH SEMESTER

Course Code	Course No.	Subject	Teaching Periods			Duration of Uty. Exam. (Hrs.)	Marks			
			Lect.	Tut.	Prac.		Sessional	Theory	Practical	Total
A	M 601	Mechanics of Materials	2	2	-	3	50	100	-	150
B	M 602	Metrology and Instrumentation	3	1	-	3	50	100	-	150
C	M 603	Thermal Engineering - II	2	2	-	3	50	100	-	150
D	M 604	Heat and Mass Transfer	2	2	-	3	50	100	-	150
E	M 605	Principles of Management and Engineering Economics	3	1	-	3	50	100	-	150
F	M 606	Computer Aided Design and Manufacturing	3	1	-	3	50	100	-	150
G	M 607	Heat Engines Laboratory	-	-	3	3	50	-	100	150
H	M 608	Advanced Machine Tool Laboratory	-	-	3	3	50	-	100	150
		Total	15	9	6	-	400	600	200	1200

SYLLABUS

MECHANICS OF MATERIALS

M 601

2+2+0

Module 1

Definition of stress and strain – components of stress and strain – Hook’s law – Plane stress and strain – stress at a point – measurement of strain – strain rosette – Mohr’s circle of strains – differential equations of equilibrium – boundary conditions – compatibility equations – stress functions – 2D problems in rectangular co-ordinates – solutions by polynomials of various degrees and effects – Saint Venant’s principle – determination of displacements.

Module 2

3D stress and strain – principal stresses – strain ellipsoid and director surfaces – stress invariants – determination of maximum and minimum shearing stress – homogeneous deformation – strain at a point – principal axes of strain – principal strain and invariants of strain – differential equations of equilibrium – boundary conditions – conditions of compatibility – determination of displacements – strain energy – uniqueness of solutions.

Module 3

2D problems in polar co-ordinates – general equations in polar co-ordinates – stress distribution symmetrical about an axis – pure bending of curved bars – strain components in polar co-ordinates – displacements for symmetrical stress distributions – rotating disk with and without central hole – disk of uniform strength.

Module 4

Thick cylinders – spherical shells – compound cylinders – rotating rims and cylinders – long cylinders.

Module 5

Curved beams – bending by eccentric loading – crane hooks – c clamp – chain link – columns of machine tools. Photo elastic techniques of study of stress – description only.

References

- | | | |
|--|---|-----------------------|
| 1. Theory of Elasticity | - | Timoshenko & Goodyear |
| 2. Advanced Mechanics of Materials | - | Seely & Smith |
| 3. Advanced mechanics of Solids | - | L.S.Srinath |
| 4. Mechanics of Solids | - | Lardner & Archer |
| 5. Introduction to Mechanics of Solids | - | Ezer P.Popov |
| 6. Mechanics of solids | - | Mubeen, Pearson |

METROLOGY AND INSTRUMENTATION

M 602

3+1+0

Module 1

General measurements concepts: Principles for achieving accuracy; Methods for estimating accuracy and precision, precision Vs accuracy, systematic and constant errors; progressive, random, erratic, drunken errors; statical concepts in metrology, statistical analysis of measurement data, control chart techniques – comparators – *General principle of measurements:* line & end measurements, standards; linear measurements, basic units, and quantities for displacement, mass, time, temperature & optics; systems of limits and fits; selecting & assigning of fits, tolerances for linear dimensions.

Module 2

Gauges: classification, design of gauges, gauge maker's tolerances, wear allowance, gauges materials & gauge manufactures. *Form measurements:* straightness, flatness, squareness, circularity & cylindricity – Measurement of angles & tapers: sine bars, angle gauges: auto collimator, clinometer & spirit level; taper gauges, bevel protractors.

Module 3

Measurement of surface finish: surface structure, integrity, texture, roughness, waviness, lay, cut off, RMS & CLA values, roughness values produced by machining processes, instruments for different surface finish measurements, concept of apparent to real area of contact of mating surfaces, applications in clutch plate surface, brake liner, inner race of a bearing, cylinder liner, machine tool guide way, surface to be painted etc & importance of surface finish on crack initiation. *Optical measuring instruments:* interferometry, optical flats, optometers, and optical projectors, tool maker's microscope, limitations, SEM & TEM.

Module 4

Advanced measuring devices: Laser interferometry, applications – computer controlled co-ordinate measuring machine; machine vision & non contact CMM - *Gauging and measurements of screw threads:* Gauging methods for manufacturing, screw thread terminology, standard specification, and formulae, tolerance, thread gauge measurement, measuring equipment, application of thread gauges – *Measuring of gears:* Measuring methods for runouts, pitch profile, lead, backlash, tooth thickness, composite elements, inspection equipment.

Module 5

Generalized measurement system: measurement terminology, input, output configurations, static characteristics, errors in measurement, drift, noise, accuracy, precision static sensitivity and resolution, loading effects on instruments- *Detector transducer elements:* principles of calibration, applications in measurement of strain, types of strain gauges, application in measurement of load & torque, measurement of force and torque, hydraulic, pneumatic & strain gauge type load cells, hydraulic & electric dynamometers, measurement of vibration, vibrometers

& accelerometers, theory of seismic instruments - *Temperature measurement:* Use of Bi metals, pressure thermometer thermocouple, optical & radiation pyrometer – magnetic flow meter – thermal conductivity gauges.

References

1. ASME - Hand book of industrial Metrology
2. *Beckwith* - *Mechanical measurements, 5/e, Pearson*
3. Doebelin - Measurement systems, 4/e, McGraw- Hill
4. Hume - Metrology, McDonald
5. Sharpe - Metrology, ELBS
6. Taher - Metrology, ELBS

THERMAL ENGINEERING - II

M 603

2+2+0

Module 1

Working of two stroke & four stroke - Petrol and Diesel Engines (Review Only) - valve timing diagrams - Fuels - Chemical structure - qualities, ratings of fuels - Alternative fuels, Alcohol, vegetable oils, biogas.

Types of Engines - Wankel E/n, Stirling E/n, Stratified charge e/n, VCR E/n, free piston E/n. Fuel air cycle (actual) for petrol and diesel engines - variation of specific heats - heat losses - Dissociation

Module 2

Carburation - Air fuel mixture requirements - stoichiometry and excess air calculations - types of carburetors - Fuel injection systems - classifications - fuel injection pump - nozzle - direct and indirect injection - Injection in S. I. Engine - M. P. F. I. System - Ignition system - Battery & Magneto type - firing order - Ignition timing and spark advance - Lubrication systems - types - properties of lubricants - additives for lubricants - Heat rejection and cooling - Theory of engine heat transfer - types of cooling system - Air and liquid system - Super charging & turbo charging.

Module 3

Combustion in S. I. E/n - Ignition limits - stages of combustion - combustion quality - Ignition lag - Flame propagation - Abnormal combustion - detonation - effects - Theory, chemistry and control - flash point, fire point & viscosity index - combustion chamber design considerations.

Module 4

Combustion in C. I. Engines - Air Fuel ratio in C. I. Engines - Ignition Lag - diesel knock - Controlling Methods - Various stages of combustion - vaporization of fuel droplets and spray formation - Air motion - Swirl - combustion chamber - design considerations.

Module 5

Pollutant formation and control in S. I. And C. I. Engine, Nox, CO, Unburned hydro Carbon and particulate - Exhaust gas treatment - catalytic converter - Thermal reaction - Particulate Trap.

Engine operating characteristics - Testing of I. C. Engines - Indicated power - Brake power - Volumetric Efficiency - Heat balance Test - Morse Test - Measurement of exhaust smoke and exhaust emission.

References

1. Internal Combustion Engine Fundamentals - John B. Heywood
2. Internal Combustion Engine and Air Pollution - Obert E. F.
3. Internal Combustion Engine - Lichty L. C.
4. Internal Combustion Engine - V. Genesan
5. A course in internal combustion Engine - Mathur and Sharma.

HEAT AND MASS TRANSFER

M 604

2+2+0

Module 1

Introduction to basic modes of heat transfer - Scope and application of heat transfer principles in engineering practice. Conduction Fourier law - thermal conductivity of solids, liquids and gases - factors affecting thermal conductivity. Thermal heat, conducting equation in Cartesian, cylindrical and spherical coordinates - one dimensional steady state conduction with and without heat generation - unsteady state conduction. Conduction through homogenous and composite surfaces plane wall cylindrical and spherical - variable thermal conductivity shape factors - heat flow through corners and edges.

Module 2

Convection - Newton's law - concept of boundary layer - significance of Prandtl number - boundary layer equation - flat - plate heat transfer equations by integral method Laminar and turbulent flow of heat transfer in tubes - Forced convection in turbulent flow - Reynolds analogy. Application of dimensional analysis in forced and natural convection. empirical relations, Combined effect of convection and conduction. Overall heat transfer coefficient - critical radius of insulation.

Module 3

Heat Exchangers type of heat exchangers. Log mean temperature difference. Design of shell and tube exchangers - NTU method of evaluation of heat exchangers - heat exchange - effectiveness - application of straight rectangular and triangular fins effectiveness of fins.

Module 4

Radiation - Nature of thermal radiation - Definitions and concept - Monochromatic and total emissive power - Absorptivity - Reflectivity

transmissivity, Black Grey and Real surfaces. Concept of Black body Planks distribution law - Kirchoffs law Wein's displacement law-Geometric factors of simple configuration. Heat exchange by radiation between black surfaces - Large parallel black plate - equal parallel and opposite black squares, discs, black rectangles perpendicular to each other having a common edge-heat exchange by radiation between large parallel planes of different emissivity (no derivations - simple problems with the use of chart and equations)

Module 5

Mass transfer - introduction to mass transfer - Pick's law of diffusion in gases. Diffusion coefficient. Analogy between the phenomena of heat transfer and mass transfer. Elementary problems. Condensation and boiling - film Drop-wise condensation-film boiling and pool boiling. Bubble growth and collapse-empirical relations for heat transfer with change of phase (description only) Numerical methods in conduction (finite difference and finite element methods description only).

References

1. Elements of Heat Transfer - Jacob Hawkins
2. Principles of Heat Transfer - Krieth
3. Heat and Mass Transfer - Fckert & Drake
4. Heat transfer - Holmann
5. Engineering Heat & Mass Transfer - R.K. Rajput.
6. Engineering Thermodynamics and Heat Transfer - Gupta and Rajendra Prasad

PRINCIPLES OF MANAGEMENT AND ENGINEERING ECONOMICS

M605

3+1+0

Part A – Principles of Management

Module 1

Functions of management: planning, organizing, staffing, directing, motivating, communicating, controlling and coordinating – Organizational structure-line, staff and functional relationship-span of control and delegation.

Module 2

Organisational behaviour: stress, meaning, causes, effects, strategies for coping with stress-motivation-types of motives, theories of work motivation-group dynamics-nature of work group, group cohesiveness, group performance, group norms. Marketing management: identification of products, pricing, promotion and distribution channels.

Module 3

Formation of companies: proprietary and partnership-joint stock, private limited, public limited companies-private sector, public sector, joint sector and co-operative sector.

Wages and incentives: Time and piece rate system, bonus, incentives-monetary and non-monetary Total quality management-re-engineering-management by objectives

Part B – Engineering Economics

Module 4

Basic concepts: Theory of demand and supply-price mechanism-factors of production-land, labour, capital and organization-national income-difficulties in estimation-taxation-direct and indirect-progressive and regressive-black money-inflation-demand pull and cost push-effects of price increases.

Module 5

Indian financial system: Reserve bank of India-commercial bank system-public sector banks-development financial institutions-IDBI, ICICI, SIDBI, IRBI-investment institutions-UTI-insurance companies-stock market-functions-problems faced by the stock markets-role of the public sector-privatisation-multinational corporations and their impact on the Indian economy.

References

1. Benga & Sharma – Industrial Organisation and Management
2. Fred Lufthans – Organisational Behaviour
3. Keith Davis – Human Behaviour at Work
4. Philip Kotler – Marketing Management
5. K.K.Dewett – Modern Economic Theory
6. A.N.Agarwal – Indian Economy
7. Kargaweski – Operation management, Pearson
8. Mazda – Engineering management, Pearson
9. O.P.Khanna - Industrial Engineering & Management

COMPUTER AIDED DESIGN AND MANUFACTURING

M 606

3+1+0

Module 1

Evolution of CAD/CAM and CIM segments of generic CIM, computers and workstation, elements of interactive graphics, input/ out put display, storage devices in CAD - an overview of CIM software - 2D Graphics: line drawing algorithms, DDA line algorithm – circle drawing, bressnham's circle drawing algorithm– 2D translation, rotation, scaling – clipping -3D Graphics (basic only).

Design process – CAD process: wireframe, surface, solid modeling; Engineering analysis; design review & evaluation, automated drafting – CAD hard ware, software, data presentation, CAD software packages

Module 2

Numerical control: Need - advantages & disadvantages – classifications – Point to point, straight cut & contouring positioning - incremental & absolute systems – open loop & closed loop systems – DDA integrator & Interpolators – resolution – CNC & DNC.

Programmable logic controllers (PLC): need – relays- logic ladder program – timers - Simple exercises only.

Devices in N.C. systems: Driving devices - feed back devices: encoders, moire fringes, digitizer, resolver, inductosyn, tachometer.

Module 3

NC part programming: part programming fundamentals - manual programming – NC co-ordinate systems and axes – tape format – sequence number, preparatory functions, dimension words, speed word, feed world, tool world, miscellaneous functions – programming exercises.

Computer aided part programming: concept & need of CAP – CNC languages – APT language structure: geometry commands, motion commands, postprocessor commands, compilation control commands – programming exercises – programming with interactive graphics.

Module 4

Automated process planning: Process planning, general methodology of group technology, code structures of variant & generative process planning methods, AI in process planning, process planning software.

Module 5

Robotics: Industrial robots and their applications for transformational and handling activities, configuration & motion, actuators, sensors and end effectors, feature like work envelop, precision of movement, weight carrying capacity, robot programming languages.

Vision systems: introduction to intelligent robots.

References

1. Craig john - Introduction to Robotics
2. Groover M.P. - CAD/CAM, PHI.
3. Hearn & Baker - Computer graphics (in C version), Prentice Hall.
4. New man & Sproull - Principles of interactive Graphics, McGraw – Hill.
5. Petruzella Frank.D. - Programmable logic controllers.
6. Yoram koren - Numerical control of machine tools, McGraw-Hill
7. Jonn Craig - Introduction to Robotics

HEAT ENGINES LABORATORY

M 607

0+0+ 3

Study of systems and components of IC Engines and automobiles - study of dynamometers used in engine testing - study of IC Engine repairs and maintenance. Study of boilers, boiler mountings and accessories - study of steam engine parts and systems.

Testing of IC engines • Performance analysis of IC engine using computerized test rig-Load test on petrol and diesel engines- determination of indicated and brake thermal efficiencies - mechanical efficiency - relative efficiency - volumetric efficiency - air-fuel ratio and compression ratio - valve timing diagram - retardation test - Morse test - heat balance - effect of varying the rate of cooling water and varying the speed on the performance characteristics of engines. Testing of steam boiler - boiler trial - steam calorimeters and steam nozzles - performance test on steam engines - performance test on steam turbines.

Testing of fuels and lubricants - determination of flash and fire points of petroleum products - determination of kinematics and absolute viscosity of lubricating oils - determination of calorific

ADVANCED MACHINE TOOL LABORATORY

M 608

0+0+3

Study of Vibration: two and multi degree freedom systems, signature analysis and preventive maintenance, noise control. Study of Automated process planning: process planning, general methodology of group technology, code structures variant generative process planning methods, AI in process planning.

Study of Quality circle concepts – ISO 9000, ISO 4000 series, QS 9000 – quality system standards, TQM, - SQC, control charts for inspection, charts for variables, R charts, six sigma concepts – Taguchi methods.

Study of Fundamentals of Numerical control: principles of NC - incremental & absolute positioning, PTP, straight & contouring machining, open & closed loop system - DDA integrator & different interpolators - feed back devices - lead screw - stepper motor - advantages & disadvantages - NC, CNC and DNC - punched tapes – manual part programming, preparatory function, G codes, speed word, feed word, M codes, tool word etc, computer aided part programming, APT languages – tooling for CNC, tooling systems, automatic tool changing tool magazines etc - principles, need of machining centers. *Study of Programmable logic controllers (PLC):* need – relays- logic ladder program – timers; on & off delay timers, cascading & retentive timers – counters; cascading counters. *Study of Tolerance charting techniques:* operational sequences for typical shaft type components, preparation of process drawing for different operation, tolerance worksheets and centrality analysis. *Study of Design of jigs and fixtures:* degree of freedom - principles of location and clamping - principles of jig design – fool proofing - elements of jigs - design of jigs for drilling, reaming – principles of fixture design, locators and different types of clamps – elements of fixture – provision for tool setting – design of fixture for milling, turning, boring, and grinding operations, inspection of assembly fixtures – modular fixturing – concepts and applications – use of software for building fixture – tool design for forging, drop forging dies and auxiliary tools – upset or forging machine dies. *Study of Design of sheet metal blanking and piercing dies:* Die design – power press types – die clearances – cutting forces – punch and die mountings – types of construction – fine blanking – die design fundamentals – materials for dies & allied elements – multiplexing of tools.

Experiments

Key way slotting, side & face milling of a rod to make square head – 5mm material removal by Shaping – Drill 10.5 mm. CBR 16 mm, 10 mm deep – Surface grinding, cylindrical grinding and tool grinding - Vibration study of machine tools with an analyser. Preparation of process plans using CAPP software –Planning of experiments for process improvement using software – simulation of factory layout - facilities layout analysis – line balancing – materials requirement planning – inventory analysis – quality assurance using control charts – preparation of process sheet for manufacturing of spindle like & housing type component – preparation of process plan & cost estimation for the manufacture of typical product like submersible pump, three phase motor etc.

Preparation of CNC programs for drilling, grooving, parting, linear interpolation, circular interpolation, etc. – Simulate and produce a component has valley shaped undercuts along its length, etc. PLC operated solenoid valves. Design of a jig and a fixture for drilling & milling operation - Design of assembly, inspection, fixtures - Design of sheet metal working dies: feed strip layout design, force calculations, press tool design (forming & cutting), assembly & dismantling of simple die casting dies - Design & fabrication of simple bending dies – Design of forging dies: product requirement & design of forging dies – study of analysis software for mould flow, melt flow, metal forming.

Student's assessment, continuous evaluation, awarding of sessional marks, record bonafides, oral examination etc and university examination shall be done by Faculty members.

References

1. Acharkan. N. - Machine Tool Design Vol.1 to 4, MIR Publication.
2. HMT - Production Technology, TMH.
3. Petruzella Frank. D - Programmable logic controllers.
4. Yoram Koren - NC machines tools, McGraw Hill.

