ME010 601 Mechanics of Machines

(Common with AU010 601)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- To understand the method of static force analysis and dynamic force analysis of mechanisms
- To understand the principles of governors and gyroscopes.
- To understand the design of flywheel
- To understand the working of different types of brakes and dynamometers

Module I (14 hours)

Force analysis of machinery - static and dynamic force analysis of plane motion mechanisms - graphical method - principle of superposition –matrix methods - method of virtual work.

Module II (12 hours)

Governors: - terminology; Watt, Porter, Proel, Hartnell, Hartung, Wilson-Hartnell, and Pickering governors-spring controlled governors of gravity type-effort and power-controlling force diagram-quality of governors-effect of friction-insensitiveness-stability-inertia governors- governor speed, torque characteristics of an engine-governor and flywheel.

Module III (12 hours)

Turning moment diagram and Flywheel: - coefficient of fluctuation of energy and speed- energy saved in a flywheel-punching press-dynamically equivalent two mass system-centre of percussion-kinetic equivalence-reversed effective force analysis-piston effort-crankpin effort- crank effort-turning moment diagrams for I.C. engines.

Module IV (10 hours)

Gyroscope: - Principle-Angular acceleration-Effect of gyroscopic couple on bearings, airplanes, and ships-stability of automobile and two wheel vehicles-Gyroscopic stabilization of sea vessels and grinding mills-Rigid disc at an angle fixed to a rotating shaft

Module V (12 hours)

Brakes and clutches: Shoe, double block, long shoe, internally expanding shoe, band, band & block, hydraulic, mechanical, air and power brakes-braking of a vehicle-cone, single plate, multiple, centrifugal clutches.
Dynamometers: Pony brake. rope brake, epicyclic train, belt transmission and torsion dynamometers-effort and power.

Reference Books

1. R L Norton, Kinematics and Dynamics of Machinery, 1st ed., *Tata McGraw Hill Education Private Limited*, Delhi, 2009
2. J. E. Shigley, J. J. Uicker, *Theory of Machines and Mechanisms*, McGraw Hill
3 S .S Rattan Theory of Machines, 3rd ed., *Tata McGraw Hill Education Private Limited*, Delhi, 2009
4 A. Ghosh, A. K. Malik, *Theory of Mechanisms and Machines*, Affiliated East West Press
5. C. E. Wilson, P. Sadler, *Kinematics and Dynamics of Machinery*, 3rd edition, Pearson Education.
6. Holowenko, Dynamics of Machinery, John Wiley

ME010602: Heat and Mass Transfer

(Common with AU010 602)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To provide a useful foundation and basic knowledge of the subject required for innovative work and advanced studies.*
- *To motivate the students and to develop interest in the subject by providing information along with practical application of different formulae from an engineering point of view.*

Module I (12 hours)

Scope and application of heat transfer principles in engineering practice. Introduction to basic modes of heat transfer

Conduction: Fourier law-thermal conductivity of solids, liquids and gasses-factors affecting thermal conductivity-common conducting and insulating materials. General heat conduction equation in Cartesian, cylindrical and spherical co-ordinates- one dimensional steady state conduction with and without heat generation-conduction through homogeneous and composite surfaces-plane wall, cylinders and spheres-concept of thermal resistance-contact resistance-variable thermal conductivity-critical thickness of insulation-overall heat transfer coefficient-heat transfer through corners and edges-conduction shape factor.

Module II (12 hours)

Convection: Elementary ideas of hydrodynamic and thermal boundary layers-Newton's law of cooling-factors affecting heat transfer coefficient in forced and natural (free) convection heat transfer-application of dimensional analysis to free and forced convection-significance of Prandtil number, Reynold's number, Grashof number and Nusselt number. Forced convection: Laminar and turbulent flow heat transfer in a circular pipe- Laminar and turbulent flow heat transfer in flow over a flat plate-flow across a cylinder. Natural convection: Natural convection heat transfer from a plate kept vertical and horizontal- cylinder kept vertical and horizontal-description of natural convection heat transfer from enclosed spaces. (Problems limited to using important empirical relations available in data book)

Module III (12 hours)

Heat transfer from extended surfaces: Governing equation and boundary conditions-straight rectangular fin-pin fin of uniform cross sectional area-circumferential fin-fin effectiveness-fin efficiency-solving problems using data book.

Heat exchangers: General classification of heat exchangers according to type of energy transfer, according to flow arrangement and according to area to volume ratio-Log Mean Temperature Difference (LMTD) for parallel flow, counter flow and cross flow arrangements-calculation of heat exchanger size and flow rates from known temperatures. Effectiveness_NTU method of evaluation-solving problems using data book.

Module IV (12 hours)

Radiation: Nature of thermal radiation-definitions and concepts-monochromatic and total emissive power-absorptivity, reflectivity and transmissivity-definition of black, grey and real surfaces-concept of a black body-Plank's law, Kirchoff's law, Wein's displacement law and Stefan-Boltzmann law-geometric factor (shape factor or configuration factor) of simple geometries. Heat exchange by radiation between black surfaces of equal, parallel and opposite black squares and discs-black rectangles perpendicular to each other having a common edge-heat exchange between infinite parallel planes of different emissivity-radiation shield (no derivation)-simple derivations and simple problems using data book.

Module V (12 hours)

Mass Transfer: Introduction to mass transfer-Fick's law of diffusion-steady state mass diffusion of gasses and liquids through solids-convective mass transfer (elementary concepts and definitions)-analogy between heat and mass transfer-elementary problems.

Condensation and boiling: Laminar film condensation on a vertical plate and horizontal tubes. Pool boiling-different regimes of pool boiling-flow patterns in flow boiling in a vertical tube.

Two dimensional steady state heat conduction-governing equation and boundary conditions-application of finite difference method in solving two dimensional steady state heat conduction through a rectangular slab (method of discretisation of nodal equations only)

Data Book:

1. C. P. Kothandaraman, S. Subramanyan, *Heat and Mass Transfer Data Book*, 5th ed., New Age International Publishers.
2. A. V. Domkundwar, Dr. V. M. Domkundwar, *Heat and Mass Transfer Data Book*, 3rd ed., Danapat Rai & Co.

References:

Text Books

1. S. P. Sukhatme, *A Text Book on Heat Transfer*, 4th ed.,Universities Press, Hydrabad, 2005
2. S. K. Som, *Introduction to Heat Transfer*, PHI Learning pvt.ltd,New Delhi, 2008
3. P. K. Nag, *Heat Transfer*, 1st ed., Tata McGraw-Hill

Reference Books

1. Frank P. Incropera, David P. Dewitt, *Fundementals of Heat and Mass Transfer*, 5th ed., John Wiley & Sons
2. J. P. Holman, *Heat Transfer*, 9th ed., Tata McGraw Hill Education pvt.ltd., New Delhi, 2010
3. M. Necati Ozisick, *Heat Transfer A Basic Approach*, McGraw Hill Book Company
4. Frank Kreith, Mark S. Bohn, *Principles of Heat Transfer*, 5th ed , PWS Publishing Company
5. S. P. Venkateshan, *A First Course in Heat Transfer*, Ane Books, Chennai

ME010 603 Thermal Systems and Applications

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic concepts of different types of engines*
- *To develop an idea about various thermal systems..*

Module I (12 hours) Steam Engineering: Properties of steam - wet, dry and superheated steam - dryness fraction - enthalpy and internal energy - entropy of steam - temperature entropy diagram - process - Mollier chart - Rankine cycle for wet, dry and superheated steam. Steam Generators - classification - modern steam generators - boiler mountings and accessories.

Module II (12 hours) Steam nozzles - Mass flow rate - throat pressure for maximum discharge - throat area - effect of friction - super saturated flow.
Steam turbines: velocity triangles, work done, governing, and efficiencies.

Module III (12 hours) Gas turbine Plants - Open and closed cycles - thermodynamics cycles - regeneration, re heating - inter cooling - efficiency and performance of gas turbines. Rotary Compressors - Analysis of rotary compressors - centrifugal and axial compressors and reciprocating compressors. Combustion - combustion chambers of gas turbines - cylindrical, annular and industrial type combustion chamber - combustion intensity - combustion chambers efficiency - pressure loss combustion process and stability loop.

Module IV (12 hours) Introduction to solar energy - solar collectors - Liquid flat plate collectors - principle - thermal losses and efficiency - characteristics - overall loss coefficient - thermal analysis - useful heat gained by fluid - mean plate temperature - performance - focussing type solar collectors - solar concentrators and receivers - sun tracking system - characteristics - optical losses - thermal performance - solar pond - solar water heating - solar thermal power generation (Description Only)

Module V (12 hours) Thermal power plants: layout and operation of steam and diesel power plants - coal burners - stockers - cooling ponds & towers - chimneys - draught - dust collectors - precipitators - feed water heaters - evaporators - steam condensers - coal handling - ash handling.

Text Books

1. E. L. Wahid , *Power plant technology*
2. Mathur and Mehta, *Thermodynamic and heat power engineering*, Jain Brothers.
3. P. L. Ballaney , *Thermal Engineering*, Khanna publishers

Reference Books

1. Cohen & Rogers, *Gas Turbine Theory*
2. G. D. Rai, *Solar Energy Utilization*
3. R.K. Rajput, *Thermal engineering*, Lakshmi publications

ME010 604: Metrology and Machine Tools

(Common with AU010 604)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *Understand and appreciate the importance of basic principles of traditional material removal processes.*
- *Understand the application of those principles in practice.*
- *To understand the principles of metrology and measurements, methods of measurement and its application in manufacturing industries.*

Module I (12 hours)

Conventional Machining Processes Turning machines:- Types - method of holding work and tool, accessories, attachments-operations and types of tools for each operation - tool room lathe - duplicating lathe - Capstan and Turret lathe – knurling - Drilling:- types of drilling machines - types of drills - nomenclature of drill point - drill wear - types of chip breakers - cutting forces in drilling - Boring:- types of boring machines, tool geometry - counterboring, spot facing, countersinking, trepanning – Reaming:- types of reamers - tool nomenclature - cutting forces - tool materials and surface roughness obtainable in each operations.
Shaping, planing and slotting machines**:-** Types and specifications - quick return motion - hydraulic feed and its advantages - automatic feed-speed, feed and depth of cut -work holding devices - types of operation and examples of work done - shaping of V-blocks, planing of guide gibs, slotting of keyways – Broaching:- - basic process - different cutting elements – force required for broaching and strength of broach – tool materials and surface roughness obtainable in each operations.

Module II (12 hours)

Milling operations:- different types milling machines **-** Different methods of milling - nomenclature of milling cutters – cutting forces in milling – different types of milling cutters – attachments for milling:-vertical milling and universal milling attachment, high speed milling attachment, rack milling and slot attachments, parking bracket, rotary table, universal dividing head, vices, arbors, adaptors and collet chucks – tool materials and surface roughness obtainable in milling – machining centers: applications and advantages - Grinding**:** - types of machines - Grinding mechanisms:- grinding debris, grinding force power, specific energy - Grinding wheels:- different types of abrasives, grain size, different types of bond, grade, structure – marking system of grinding wheels - Grinding fluids – Truing and dressing of grinding wheels - Grinding temperature, thermal damage and surface roughness obtainable.
Horning**:** Types of machines, methods of honing – types honing stones – honing conditions - cutting fluids - surface roughness obtainable - Lapping**: -** types of hand lapping - types of lapping machines - surface roughness obtainable – Burnishing**:-** processes and surface roughness obtainable.

Module III (12 hours)

Gear cutting process**: -** Gear milling: - gear milling machines and different gear milling operations - Gear hobbing: - principle of the hobbing process and hobbing machines, basic types of hobbing machines, different hobbing techniques, nomenclature of hob, hob wear, spur gear hobbing, helical gear hobbing - gear shaping**: -** principle of gear shaping process - gear finishing - gear errors - Thread production process: - different thread production processes: screw cutting on lathe, thread milling, thread whirling, die threading, tapping, thread rolling, and thread grinding.

Module IV (12 hours)
Engineering Metrology

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 - Fits and tolerances:- types of fits: hole and shaft basis system – limit gauges:- gauge tolerance, presentation of gauge tolerances – Taylor'**s** theory of gauging – limit gauges for screw threads - Design and operation of linear measurements:- Principle of alignment (Abbe's**)**, accuracy and precision etc. – Principle of kinematics: complete constraints, one degree of freedom – Gauge blocks:- gauge materials, accuracy and standards, effect of temperature, surface roughness and manufacturing of gauge blocks – Comparators:- mechanical, mechanical-optical, pneumatic and horizontal length comparator – Angle measurements:- three disc, sine bar and dial gauge – measurement of taper plug ring gauges and taper bores – Precision levels, clinometer – Optical instruments for angle measurements:- optical principles of projector, microscope, telescope, collimator, auto collimator - optical flat and optical parallel applications – auto collimator, angle dekkor, combination of angle gauges, optical flat.

Module V (12 hours)

Tool makers microscope – profile projector – optical microscope, SEM and TEM - straight edge – surface plate – measurement of squareness:- squareness testing with dial gauge, tilting bar, optical square, checking an internal right angle - Measurement of surface roughness: meaning of surface texture and causes – stylus probe instrument, RMS, CLA, peak to valley, R_a, R_t, R_z etc. – stylus, skid, effect of sampling length, magnification, cut-off, evaluation length etc. – comparison of surface roughness of different machining process – 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, significance of surface roughness in crack initiation – assessment of roundness errors:- least square reference circle, minimum circumscribed circle, minimum zone reference circle and maximum inscribed circle – roundness parameters:- eccentricity, concentricity and runout – three wire system of thread pitch diameter measurement - gear tooth measurement by vernier caliper, pin method of measuring gear teeth – Alignment tests for machine tools:- test for level installation of a lathe bed – spindle tests of concentricity and alignment with guide ways – tests for straightness and flatness of a lathe bed guide ways – test for squreness of a drilling machine spindle with table – CMM, laser interferomerty and applications.

Text Books

1. S. Haykin and B. V. Veen, *Signals and Systems*, John Wiley & Sons, N. Y., 2002
2. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, *Signals & Systems*, 2nd ed., Prentice Hall of India, New Delhi, 1997

Reference Books

1. C. L. Philips, J. M. Parr, E. A Riskin, *Signals, Systems and Transforms*, 3rd ed., Pearson Education, Delhi, 2002
2. R. E. Zeimer, W. H. Tranter, and D. R. Fannin, *Signals and Systems: Continuous and Discrete*, 4th ed., Pearson Education, Delhi, 1998
3. M. J. Roberts, *Signals and Systems: Analysis using Transform methods and MATLAB*, Tata McGraw Hill, New Delhi, 2003

ME010 605 Mechatronics and Control systems

(Common with AU010 605)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart basic concepts of mechatronics and control systems.*

Module 1 [12 Hours]

Introduction:-Scope of Mechatronics-Systems-Microprocessor based controllers-mechatronic approach-sensors-transducers-force-velocity-displacement-temperature-inputting data by switches-signal conditioning-operational amplifiers-filtering-multiplexers-data acquisition-modulation. Data presentation systems:- Displays-measurement systems-calibration-pneumatic and hydraulic systems-control valves-actuators-mechanical and electrical activation systems-relays and solenoid switches-proximity pickups.

Module 2 [12 Hours]

Input/output Systems:-Ports, interface requirements, adaptors-programmable logic controllers-data handling digital communications-system, networks, protocols, interfaces, fault finding- design and mechatronic design solutions. Electromechanical systems:-CD, DVD Rom, OCR, Printers.

Module 3 [12 Hours]

Introduction to Control Systems Engineering:-Concept of automatic control-open loop and closed loop systems-servomechanisms-Block diagrams-transfer functions-Representation of control components and systems-Translational and rotational mechanical components –series and parallel combinations-comparators ,integrating devices, hydraulic servomotors, temperature control systems, speed control systems.

Module 4 [12 Hours]

System Response:-First and second order system-Response to step, pulse, ramp and sinusoidal input-systems with distance, velocity lag. Control System Analysis:-Transient Response of simple control systems –Stability of control systems –Routh Stability criteria –Error Analysis.

Module 5 [12 Hours]

Frequency Response Analysis :- Polar ,Rectangular and Logarithmic plots – Experimental determination of frequency response -Bode and Nyquist stability criteria – Gain and phase margin. Root locus of simple transfer function.

Text Books

1. Mechatronics-W.Bolton-Pearson
2. Control Systems- A. Nagoor Kani

References

1. Mechatronics-A.Smaili&F.Mrad-Oxford
2. Control Systems Engg –T .J. Nagrath & M .Gopal.
3. Automatic Control Theory-Ravan.
4. Modern Control Engg.-K. Ogatta
5. Control Systems Engg -Benjamin C Kuo

ME010 606L01 Computational Fluid Dynamics

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To introduce the primary components of learning and practicing CFD*
- *To develop an understanding of solution methods for fluid motion and energy transfer equations*

Module 1 (15 hours)
Basic concepts: conservation principles – derivation of transport equations: control volume – Langangian and Eulerian approach- mass conservation equation-momentum conservation equations-stress laws-mass transfer equation-energy equation-rate change-convection and conduction-volumetric generation-work done by surface and body forces- dimensionless form of Navier-Stokes equations- introduction to numerical methods, advantages and limitations.
Module 2 (10 hours)
One dimenensional conduction: The governing equation- grid layout-discretisation-stability and convergence-explicit, implicit and semi-implicit procedures-methods to handle non-linearities- Solution methods-Gauss-Siedel method and TDMA-Simple problems.
Module 3 (10 hours)
One dimensional conduction-convection: exact solution-discretisation- central difference scheme-upwind difference schemes- numerical false diffusion-stability of unsteady equation-exact solution-explicit finite difference form-implicit finite difference form.
Module 4 (10 hours)
Two dimensional boundary layers: governing equations- descretisation method- symmetry, wall and free stream boundary conditions- dealing with source terms –defining initial conditions-choice of grid size and iterations-applications (excluding turbulence)
Module 5 (15 hours)
Two dimensional Convection-Cartesian Grids: simple mathematical models for incompressible, in viscid, potential and creeping flows-approximations of hyperbolic, parabolic, elliptic, and mixed flows. Solution strategies for 2D convection problems- SIMPLE algorithm-descretisation- pressure correction equation- solution procedure- Solution methods: iterative solvers-evaluation of residuals-under relaxation-boundary conditions - simple description on treatment of turbulent flows - applications (laminar flows only).

Text Books

1. Anderson J.D., *Computational Fluid Dynamics,* McGraw- Hill Co.
2. Joel H. Ferzigerand Peric M., *Computational methods for Fluid Dynamics,* Springer Werlag Publishers

Reference Books

1. Patankar S.V., *Numerical Fluid Flow and Heat Transfer* , Hemisphere, New York
2. Anil W. Date, *Introduction to Computational Fluid Dynamics,* Cambridge University Press
3. Hiderbrand F.B., *Introduction to Numerical Analysis* , Tata McGraw- Hill

ME010 606 L02: Composite Materials Technology

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives: To understand the concept of composite materials

Module I (12 hours)

Fibers**:** introduction – glass fibers: fabrication, structure, properties and applications – Boron fibers: fabrication, structure, morphology, properties and application – Carbon fibers: Different preparation methods, structural change during preparation, properties and application – Aramid fibers: fabrication, structure, properties and applications – Ceramic fibers: Alumina and silicon carbide fibers – metallic fibers.

Module II (12 hours)

Matrix materials: Polymers and its characteristics – Metals: fiber reinforcement of metals - Ceramic matrix materials: bonding and structure, effect of flaws on strength and common ceramic matrix materials.

Interfaces**:** wettability and bonding interface in composites – types of bonding at interface – tests for interfacial strength.

Module III (12 hours)
Metal Matrix Composites (MMC)**:-** Different fabrication methods of MMC – interface in MMC – discontinues reinforcement of MMC – detailed discussion on mechanical properties – applications.

Module IV (12 hours)
Ceramic Matrix Composites (CMC)**:-** Different fabrication methods of CMC – interface in CMC – detailed discussion on properties – toughness of CMC - applications.
Carbon fiber composites: fabrication – properties – interface.

Module V (12 hours)

Micromechanics of composites: Maximum stress and strain criterion, Tsai-Hill and Tsai-Wu failure criterion (derivations) - mechanics of load transfer from matrix to fiber (description only).
Polymer matrix composites**:** properties and engineering applications **–** processing of PMC: hand lay-up, spray up, compression molding, reinforced reaction injection molding, resin transfer molding, pultrusion, filament winding, injection, vacuum bag molding process.

Text Books

1. S. Haykin and B. V. Veen, *Signals and Systems*, John Wiley & Sons, N. Y., 2002
2. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, *Signals & Systems*, 2nd ed., Prentice Hall of India, New Delhi, 1997

Reference Books

1. C. L. Philips, J. M. Parr, E. A Riskin, *Signals, Systems and Transforms*, 3rd ed., Pearson Education, Delhi, 2002
2. R. E. Zeimer, W. H. Tranter, and D. R. Fannin, *Signals and Systems: Continuous and Discrete*, 4th ed., Pearson Education, Delhi, 1998
3. M. J. Roberts, *Signals and Systems: Analysis using Transform methods and MATLAB*, Tata McGraw Hill, New Delhi, 2003

ME010 606L03: AUTOMOBILE ENGINEERING

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart the basic concepts of Automobile parts and its working*
- *To develop an idea about the fundamentals on modern vehicle technologies.*

Module 1 (12 hours)

Engines: Types of engines in automobiles-classifications-engine components-working of various systems-present and future vehicles, engine construction- intake and exhaust systems. Different combustion chambers, carburetors, diesel fuel pumps, injectors, single point and multi point fuel injection-MPFI and CRDI systems - lubricating and cooling systems.

Vehicle performance-resistance to the motion of vehicle-air, rolling, and radiant resistance-power requirement-acceleration and gradeability-selection of gear ratios.

Module 2 (12 hours)

Transmission: prime movers- clutch-principle of friction and cone clutches – centrifugal clutches, diaphragm clutches and fluid couplings-Gear box-necessity and principle. Constant mesh, sliding mesh, synchromesh gear boxes and epicyclic gearbox –overdrives. Hydraulic torque converters-semi and automatic transmission systems - constant velocity and universal joints. Final drive-front wheel, rear wheel and four wheel drives-transfer case-Hotchkiss and torque tube drives-differential-non-slip differential-rear axles-types of rear axles.

Module 3 (12 hours)

Steering and Suspension: Different steering mechanisms- Ackermann Steering mechanism. Steering gear boxes- power steering –types. Suspension systems-front axle, rigid axle and independent suspensions-anti-roll bar-coil spring and leaf spring - torsion bar -Macpherson strut- sliding pillar- wish bone- trailing arm suspensions-Shock absorbers -hydraulic and gas charged shock absorbers-air suspensions

Front axle types-front wheel geometry-castor, camber, king pin inclination, toe-in toe-out , wheel balancing- wheel alignment.

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Module 4 (12 hours)

Chassis, Brakes and Tyres: Types of chassis and body constructions-crumble zones, air bags and impact beams. Braking mechanism and convectional brakes- Drum brakes and Disc brakes. Vacuum booster, hydraulic and power brakes, components and attachments of mechanical, hydraulic and pneumatic brakes-Master cylinder-Tandem cylinder- working. Anti-lock braking systems-Wheels and Tyres- tubeless tyres-ply ratings- radial tyres. Different tyre wears- causes

Module 5 (12 hours)

Electrical systems - Battery ignition system circuit- electronic ignition system alternators - voltage regulators starting system- bendix and follow through drives – automotive lighting, accessories and dashboard instruments- head light and horn with

relays-circuit diagrams. Automotive air conditioning Preventive and breakdown maintenance- engine testing, servicing-engine overhaul- engine tuning.

Text Books

1. Kripal Singh , *Automobile Engineering (Vol. 1 & 2)*
2. V.A.W Hillier & Peter Coombes, *Hillier's Fundamentals of Motor Vehicle Technology*. New Age International.

Reference Books

1. K.M.Guptha , *Automobile Engineering (Vol. 1 & 2)*
2. Joseph Heitner, *Automotive Mechanics*
3. Harbans Singh Reyd, *Automobile Engineering*
4. William H. Course, *Automotive Mechanics*

ME010 606L04:Advanced Strength of Materials

(Common with PE 010 606L05)

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Objectives

- *To analyse the stresses and deformations through advanced mathematical models.*
- *To estimate the design strength of various industrial equipments.*

Module 1 (12 -hours)

ANALYSIS OF PLATES Mathematical modeling of plates with normal loads – Point and Distributed Loads – Support conditions – Rectangular plates - Stresses along coordinate axes – Plate deformations – Axi-symmetric plates – Radial and tangential stresses – plate deflections.

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Module II (14-hours)

THICK CYLINDERS AND SPHERES Equilibrium and compatibility conditions - Lame's Theorem – Boundary conditions – distribution of radial and tangential stresses – compound cylinders – Interference fits - Stresses due to temperature distributions. piston, oscillating motor-characteristics.

Module III (12 -hours)

ROTATING DISCS Lame-Clayperon Theorem – radial and tangential stresses in discs due to centrifugal effects – boundary conditions – solid and hollow discs – Interference fit on shafts –Strengthening of the hub – residual stresses – Autofrettege – Discs of variable thickness – Disc profile for uniform strength.

Module IV (12 - hours)

BEAMS ON ELASTIC FOUNDATION Infinite beam subjected to concentrated load – Boundary Conditions – Infinite beam subjected to a distributed load segment – Triangular load – Semi infinite beam subjected to loads at the ends and concentrated load near the ends – Short beams.

Module V (10 - hours)

CURVED BEAMS AND CONTACT STRESSES Analysis of stresses in beams with large curvature – Stress distribution in curved beams – Stresses in crane hooks and C clamps – Contact Stresses – Hertz equation for contact stresses – applications to rolling contact elements.

Text Books

1. Boresi A.P., Schmidt R.J., "Advanced Mechanics of Materials", John Wiley and Sons, Sixth edition, 2003.
2. Dally J.W. and Riley W.F, "Experimental Stress Analysis", John Wiley and Sons 2003

Reference Books

1. Burr A. H., CheathAm J.B., "Mechanical Analysis and Design", Prentice Hall of India, Second edition, 2001.
2. Den-Hartog J.P., "Strength of Materials", John Wiley and Sons..

ME010 606L05: Industrial Hydraulics

(Common with PE 010 606L05)

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart the basic concepts of Fluid properties, hydraulic machines and pumping machinery*
- *To develop an idea about pressure measurements working and properties of hydraulic machines and various types of pumping machineries.*

Module 1 (14 -hours) Introduction to hydraulic / pneumatic devices. Symbols and nomenclature. Power transmission, Hydraulic pumps-classifications, characteristic **C**omparison of electric, hydraulic and pneumatic devices. Hydraulic accumulators.

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Module II (14-hours) Pumps and motors: Principle of working. Hand pumps-single acting, double acting, multi- displacement. Gear pumps- internal, external and gear ring. Screw, vane, piston pumps – axial piston pump, swash pump, bent axis pump radial and series pumps. Types of hydraulic motors, gear motors, vane motors, piston motors- radial piston, rolling vane, ball piston, oscillating motor-characteristics. Telescopic cylinder, cylinder cushion**.**

Module III (12 -hours) Hydraulic valves: Directional control valve, shuttle valve, pressure control valve Stop valve- non return valve-relief valve-sequence valve-counter balance valve- pressure reducing valve – flow control valve –direction control valves- throttling, non throttling- open centre and closed centre and tandem centre valves- their principle of operation.

Module IV (12 - hours) Hydraulic Circuits and Circuit fundamentals. Flow divider and combiner. Piping terminology, control terminology, flow control of hydraulic pump, velocity control- characteristics. Different types of switching and its merits Meter in and meter out. Applications of unloading valve. Application of pressure reducing and pressure sequence valve.

Module V (8 - hours) Properties of commonly used hydraulic fluids-Typical hydraulic circuits used in machine tools –Rivetter- pneumatic Hammer, hydraulic press, and power steering

Text Books

1. S.R.Majumdar, *Oil Hydraulics and Systems-Principles and maintenance*, TMH
2. John Pippenger & Tyler Hicks - *Industrial Hydraulics*

Reference Books

1. Daniel Bonteille -*Fluid Logic and Industrial automation*.
2. Pneumatic Systems –*Principles and Maintanance by S.R Majumdar*, TMH
3. Esposito- *Fluid power with applications*.

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ME010606 L06 Project Management

Teaching scheme **Credits:** 4
2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart the basic concepts of Project selection.*
- *To develop an understanding of tools, techniques and software available for Project Management.*

Module 1 (10 hours)
Introduction, Capital Investments, Phases of Capital Budgeting, Project Characteristics, Taxonomy of Projects, Project Identification and Formulation. 7-S of Project Management. Project feasibility Analysis- Market and Demand Analysis, Technical Analysis, Financial Analysis, Ecological Analysis, Social Cost Benefit Analysis.

Module 2 (15 hours)
Cost of the Project, Means of Finance, Financial Evaluation of projects- Pay back period method, Accounting Rate of Return method, Net Present Value method, Internal Rate of Return method, Benefit Cost Ratio method, etc., Simple Problems.

Module 3 (10 hours)
Risk Analysis-risk in economic analysis-measuring risk in investment; Sources, Measures and Perspectives on Risk, Techniques used for risk analysis – Decision trees, Simulation, Break-even Analysis etc., Techniques for Managing Risk.

Module 4 (15 hours)
Project Scheduling- PERT and CPM techniques, Estimates -time, cost, resources (man, material, tool), Crashing of Projects, Project scheduling with constrained resources, resource leveling, resource Allocation.

Module 5 (10hours)
Computer Aided Project management, Essential Requirement of Project Management Software, MS Project 2010 software, Features and Facilities in Project 2010, Types of Reports available in Project 2010 etc. Project Management Information Systems (PMIS), PMIS sotware, Web- Enabled Project Management.

Text Books

1. Prasanna Chandra, *Projects*, Tata McGraw Hill.
2. Nagarajan K, *Project Management 4th edition*, New Age International (P) Ltd.

Reference Books

1. Nicholas J. M. & Steyn H., *Project Management*, Elsevier.
2. Brian Kennemer and Sonia Atchison, *Using Microsoft Project 2010*, Que Publishing.
3. Harvey Maylor, *Project Management*, Pearson Education.
4. Panneerselvam & Senthilkumar, *Project Management*, PHI

ME010 607: HEAT ENGINES LABORATORY

(Common with AU010 607 and AN010 607)

Teaching scheme **Credits:** 2
3 hours practical per week

Objectives

- *To provide experience on testing of IC engines performance.*

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 values

Internal Continuous Assessment *(Maximum Marks-50)*

50%-Laboratory practical and record
30%- Test/s
20%- Regularity in the class

End Semester Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
30% - Viva voce

ME010 608 Machine Tool Laboratory

(Common with AU010 608)

Teaching scheme **Credits:** 2

3 hours practical per week

List of Experiments

1. Study of precision tools used in machine tool laboratory: – Vernier caliper, micrometers, surface plates, surface gauges, gauge block, straight edges, dial gauge, plug and ring gauges, slip gauges, sine bar, care of tools and gauges. – **2 practices**.
2. Study of lathe tools and accessories: - Selection of tool for different operations - tool materials: high carbon steel, HSS, cemented carbides, coated WC, indexable inserts, alumina, cBN, diamond etc. - tool nomenclature and attributes of each tool angles on cutting processes – effect of nose radius, side cutting edge angle, end cutting edge angle and feed on surface roughness – tool grinding and safe working practices. - 1 **practice.**
3. Selection of speeds, feeds and depth of cut – selection of cutting fluids – different methods of holding work. **- 1 practice.**
4. Experiment on arc and gas welding: - butt welding and lap welding of M.S. sheets. **- 1 practice.**
5. (a) Measurement of cutting forces in turning process using dynamometers.
   (b) Experiment on lathe:- Facing, plain turning, step turning and parting - groove cutting, knurling and chamfering - form turning and taper turning - eccentric turning.
   (c) Measurement of flank wear in turning process using tool makers microscope.
   - 3 practices.
6. Experiment on thread cutting: - single and multistart external and internal threads, square and V-threads. **- 1 practice.**
7. Disassembly and assembly of small assemblies such as tail stock, bench vice, screw jack etc. **- 1 practice.**
8. Experiment on drilling machine: - drilling, boring, reaming and counter sinking – taping – study of reamers and taping. **- 1 practice**.
9. Study and demonstration of N.C. machines:- CNC machines components - Point to point, straight cut and contouring positioning - incremental and absolute systems – open loop and closed loop systems – DDA integrator and interpolators - part programming fundamentals - manual programming – tape format – sequence number, preparatory functions, dimension words, speed word, feed world, tool world, miscellaneous functions – Computer aided part programming:- APT language structure: geometry commands, motion commands, postprocessor commands, compilation control commands – programming, simulation and demonstration exercises involving plane taper and form turning etc.
   - 3 practices.

Besides to the skill development in performing the work, prepare the control charts and oral examination should also be carried out. Observation and record books are to be maintained.

The student's assessment, continuous evaluation, awarding of sessional marks, record bonafides, oral examination etc and University examination shall be carried out by the faculty members (lecturer and above).

TEXT BOOKS:

1. Acharkan. N., Machine Tool Design Vol. 1 to 4, MIR Publication.

REFERENCE BOOKS:

1. Chapman, Workshop Technology, Vol II, ELBS.
2. HMT, Production Technology, Tata McGraw Hill.
3. Yoram Koren, Numerical Control of Machine Tools, McGraw-Hill.