IEI-IIMT combine certificate project course - Mechanical

1. Engineering mechanics

Friction :Introduction , Laws of coulomb friction, equilibrium of bodies involving dry friction, belt friction, Inclined plane - Friction of screw and nuts - Pivots and collars - uniform pressure, uniform wear - friction circle and friction axis: lubricated surfaces - boundary friction - film lubrication, Clutches, Single plate, multi plate, cone clutch, centrifugal clutches.

Brakes And Dynamometers: Simple block brake - Internal expanding brake band brake of vehicle. Dynamometers - absorption and transmission types, General description and methods of operation.

Centre of gravity: centroid, Moment of Inertia : Centroid of plane, curve, area ,volume & composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principal moment inertia, mass moment of inertia of circular ring, disc, cylinder, sphere and cone about their axis of symmetry.

Kinematics of rigid body: Introduction, plane motion of rigid bodies, velocity & acceleration under translation & rotational motion, Relative velocity, projectile motion, force, mass & acceleration, work & energy, impulse & momentum, D'Alembert principles & dynamic equilibrium. Virtual work.

2. Fluid Mechanics

Unit - I

Introduction and types of fluids, Types of fluid flows(Fluid kinematics), Pressures and Head, Static Forces on Surface and Buoyancy, Motion of Fluid Particles and Streams, Static Forces on Surface and Buoyancy, The Energy Equation and its Application, Euler's equation, Bernoulli's equation.

Unit - II

Measurement of Pressure: PASCAL's law, Types of pressure, Pressure measurement devices, Hydrostatic force on plane and curved surface, total pressure and center of pressure. Flow through pipes, Stokes' law, transition from laminar to turbulent flow, types of turbulent flow, isotropic, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and pipe networks.

Unite III

Measurement of discharge- Venturimeter, Orificemeter, Nozzlemeter, Rotometer. Measurement of velocity-Pitot tube. Orifice-classification. Flow through reservoir opening i.e. orifice, trajectory of free jet, hydraulic coefficients, Experimental determination of hydraulic coefficients, Small and large orifice, Time of emptying a tank with orifice. Mouthpiece- classification, External cylindrical mouthpiece, Convergent –divergent mouthpiece, Borda's mouthpiece. Notches and weirs-discharge over rectangular notch and triangular notch. Velocity of approach, End Contractions. Cippoletti notch. Time of emptying a tank with notch or weir, Ventilation of weir, Sutro weir.

Unit - IV

Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub-layer, separation and its control, Drag and lift, drag on a sphere, a two dimensional cylinder, and an aerofoil, Magnus effect. Introduction to compressible flow. Compressible Flow :Basic equations, Mach number, Mach cone, Area-velocity relationship, Propagation of sound wave, Stagnation properties.

3. Machine design

Unit I Mechanical Engineering Design:

Technical Drawing Standard, Design methods, Aesthetic and Ergonomics consideration in design, Material properties and their uses in design, Manufacturing consideration in design, Fits And Tolerances, Design considerations of casting and forging, Basic principles of Machine Design, Modes of failures, Factor of safety, Design stresses, Principal stresses and strains, Theories of failures Standards, I. S. codes, Preferred Series and Numbers.

Unit II Machine design 2

Thick cylinders: Design of thick cylinders-Lame's equation. Design of :Cotter joint, knuckle joint, Turn Buckle.Power Screw - Screw Presses, C- Clamps along with the Frame, Screw Jack.
Design for Fluctuating Loads: Variables stresses, reversed, repeated, fluctuating stresses. Fatigue Failure, Endurance limit, Design for finite and infinite life.
Design of shaft - power transmitting, power distribution shafts, Module (excluding crank shaft) under static and fatigue criteria.
Keys - Types of Keys and their selection based on shafting condition.
Couplings Design of Split muff couplings, Flange couplings, Bush pin flexible couplings, Design of Springs.
Design of gear tooth: Lewis and Buckingham equations; wear and dynamic load consideration. Design & force analysis of spur, helical, bevel & worm gears.
Design of sliding & journal bearing: method of lubrication, hydrodynamic, hydrostatic, boundary etc. Minimum films thickness & thermal equilibrium.

Unit III Machine design 3

Design of I .C. Engine components:
general design consideration, design of cylinder, cylinder liner, cylinder head, pistons, connecting rod, crank shaft, valves gears mechanism, flywheel.
DESIGN OF MATERIAL HANDLING EQUIPMENTS:
Lifting Equipments: classification and selection and design of hooks, sheaves, drums and grab buckets. Classification of cranes, construction working of different types of conveyors, feeders and elevators.
Conveying equipments: classification construction and working of different types of conveyors, feeders and elevators. Design of belt conveyors, screw conveyors.

4. Material science & metallurgy

Unit I Basics,
Mechanical Behavior of materials, Introduction to Crystal Structure, Diffusion, Fick's laws of diffusion, Factors affecting diffusion.

Unit II
Solidification
Mechanism of solidification, Homogenous and Heterogeneous nucleation, crystal growth, cast metal structures. Phase Diagram I: Solid solutions Hume Rothary rule substitution, and interstitial solid solutions, intermediate phases, Gibbs phase rule.
Phase Diagram II : Construction of equilibrium diagrams involving complete and partial solubility, lever rule. Different types invariant reactions – Eutectic, Eutectoid, Peritectic, Peritectectoid reactions etc.
Iron carbon equilibrium diagram. Heat treating of metals.

Unit III

Extractive Metallurgy: Minerals of economic importance, combination techniques, size classification, Flotation, gravity and other methods of mineral processing; agglomeration, pyrohydro- and electro-metallurgical processes; material and energy balances; principles and processes for the; iron and steel making – principles, role structure and properties of slags, metallurgical coke, blast furnace, direct reduction processes, primary and secondary steel making, ladle metallurgy operations including deoxidation, desulphurization,

sulphide shape control, inert gas rinsing and vacuum reactors; secondary refining processes including AOD, VAD, VOD, VAR and ESR; ingot and continuous casting; stainless steel making, furnaces and refractories.

Unit IV
fracture – Griffith theory, basic concepts of linear elastic and elasto-plastic fracture mechanics, ductile to brittle transition, fracture toughness; failure analysis; mechanical testing – tension, compression, torsion, hardness, impact, creep, fatigue, fracture toughness and formability.

5. Manufacturing

Unit I

Basic manufacturing process & Machines

Manufacturing Processes, Theory of metal cutting, Metal Casting Processes, Metal Joining Processes, Foundry Technology, Metal Shaping and Forming, Plastic, Ceramic and Glass Processing. Super Surface finishing process.

Lathe, Shaper, Planer & Slotter, Drilling, Milling, Grinding, gear cutting machines, abrasive process and broaching, CNC machining.

Unit II

Advance manufacturing

Computer Aided Manufacturing, NC/CNC Machine Tools, Programmable Logic Controllers, Group Technology and CAPP, Flexible Manufacturing System, Robot Technology, Integrated Production Management System.

6. Kinematics of Machinery/ Dynamics of Machinery

KOM

Unit I-Introduction of Mechanisms and Machines:

Planar and Spatial Mechanisms, Kinematic Pairs, Kinematic Chains, Kinematic Diagrams, Kinematic Inversion, Four bar chain and Slider Crank Mechanisms and their Inversions, Degrees of Freedom, range of movement - Kutzbach and Grubler's criterion, Number Synthesis, Grashof's criterion.

Unit II- Synthesis and Analysis of Mechanisms:

Position analysis (Analytical Techniques) Dimensional Synthesis: four bar and slider crank mechanism. Velocity and cceleration Analysis: Velocity and Acceleration Diagrams, Instantaneous Centre of Velocity, Rubbing Velocity, Velocity and Acceleration Images, Corioli's component of acceleration. Special Mechanisms: Straight line mechanism, Indicator diagrams, Hooke's Joint, Steering Mechanisms.

Unit III Gears and Gear Trains:

Gears: Terminology, Law of Gearing, Characteristics of involute and cycloidal action, Interference and undercutting, centre distance variation, minimum number of teeth, contact ratio, spur, helical, spiral bevel and worm gears, problems. Gear Trains: Synthesis of Simple, compound & reverted gear trains, Analysis of epicyclic gear trains.

Unit IV Cams and Followers:

Introduction: Classification of cams and followers, nomenclature, displacement diagrams of follower motion, kinematic coefficients of follower motion.

DOM

UNIT - I: Gyroscopes

UNIT - II: Flywheels,

Governors- Watt, Porter and Proell governors- Spring loaded governors - Hartnell and Hartung with auxiliary springs

UNIT - IV: Balancing: Balancing of rotating masses- Analytical and graphical methods. Unbalanced forces and couples. "V" and multi cylinder inline and radial engines-primary and secondary balancing.

UNIT - V: Vibrations: Free Vibration of mass attached to vertical soring - oscillation of pendulums- Transverse loads - vibrations of beams with concentrated and distributed loads. Dunkerly's method - Raleigh's method. Whirling of shafts - critical speed - torsional vibrations - one, two and three rotor systems

.

7. Applied Thermodynamics

Thermodynamic systems; States, processes, heat and work; Zeroth law; First law; Properties of pure substances and steam, Mollier diagram; Second law, Carnot cycle, entropy, irreversibility and availability, energy analysis; Thermodynamic relations; Properties of mixtures of ideal gases; Thermodynamic cycles - Otto, Diesel, dual and Joule, Third Law of Thermodynamics

Heat & Mass transfer

Unit I Introduction

Mechanism of Heat Transfer, Conduction, Convection and Radiation,

Unit II Conduction

Fourier Law of Conduction-General Differential equation of Heat Conduction in Cartesian, Cylindrical and spherical coordinates, Conduction through Plane Wall, Conduction with Internal Heat Generation, Extended Surfaces

Unit III Convection

Basic Concepts , Heat Transfer Coefficients, Boundary Layer Concept, Types of Convection, Dimensional Analysis, Flow over Plates, Cylinders and Spheres, Combined Laminar and Turbulent, Flow over Bank of tubes

Unit IV Radiation

Laws of Radiation, Stefan Boltzman Law, Kirchoffs Law, Black Body, Radiation, Grey body radiation , Shape Factor Algebra, Electrical Analogy Radiation Shields.

Unit III Heat Exchangers

Nusselts theory of condensation-pool boiling, flow boiling, correlations in boiling and condensation. Types of Heat Exchangers, LMTD Method and NTU, Overall Heat Transfer Coefficient, Fouling Factors.

Unit V Mass Transfer

Diffusion Mass Transfer, Fick's Law of Diffusion, Steady state

Molecular Diffusion, Convective Mass Transfer, Convective Mass Transfer Correlations

8. Refrigeration and air-condition.

Unit-I:

Vapor Compression System, Vapor Absorption System, Aircraft Refrigeration, Steam Jet Water Vapour System, Thermoelectric Refrigeration System, Vortex Refrigeration System, Pulse Refrigeration.

Industrial Refrigeration, Chemical And Process Industries, Diary Plants, Petroleum Refineries, Refrigerants.

UNIT - I:

Psychrometry- Important Psychrometric Properties, Psychometric Process In Air Conditioning Equipment, Bypass Factor And Sensible Heat Factor.

Applied Psychrometry: Use Of Effective And Grand Sensible Heat Factor, Selection Of Air Conditioning Equipment For Cooling And Dehumidification. High Latent Cooling Load Applications, All Outdoor Air Applications.

Unit Comfort Air Conditioning

Thermodynamics Of Human Body. Body Regulation Process Against Heat And Cold. Comfort & Comfort Chart, Effective Temperature, Factors Governing Optimum Effective Temperature, Design Consideration. Selection Of Outside And Inside Design Conditions, Air Conditioning Control Systems, Basic Elements Of The Control System, Temperature, Humidity & Pressure Controls, Refrigeration, Room Thermostat.

Unit Heating System

Building Survey-Location Of Equipment. Heat Gain Through Glass-Calculation Of Solar Heat Gain Through Ordinary Glass Tables-Shading Devices-Effect Of Shading Devices. Thermal Resistance Of Various Building Materials. Periodic Heat Transfer Through Walls And Roofs. Empirical Methods To Calculate Heat Transfer Through Walls And Roofs Using Decrement Factor And Time Lag Method. Equivalent Temperature Difference Method. Infiltration Tack Effect-Wind Effect.

Heating Load Calculations: Winter Heating Load Calculation-Heat Losses Through Structure-Heat Losses Due To Infiltration. Effects Of Solar Radiation And Internal Heat Sources On Heating Loads. Methods For Estimating Energy Requirements For Heating.

Air Heating System, Hot Water Heating System Or Hydraulic Heating System,

Unit: Theories And Method Of Chilling

processing of meat products, processing of meat products, dairy products, refrigerated warehouse, refrigerated trucks, trailers, container.

9. Automobile engineering

Introduction to Automobile & Automobile Performance, Chassis, Frame & Body, Transmission System: Clutch, Gear Box, Automatic Transmission, Propeller Shaft, Differential, Final Drive and Rear Axle, Axle, Suspension and Steering System, Front Axle, Suspension System, Steering System, Brakes, Wheels & Tyres , Battery, Lighting System , Accessories and Safety System Automobile garage for maintenance and repair, Regulation and Standardization of Vehicles, Modern Vehicles.