ANNEXURE – II

Mechanical Engineering Syllabus.

Paper-I

1. Theory of Machines:- Kinematic chain, Mechanisms and inversions, Motor Vehicle steering gears, Hookes' Joint, Toothed gears, Tooth profiles, Interference, Gear Trains, Compound gears, Differential, Cam profiles, Displacement, velocity and acceleration of cam followers, Flywheel and Turning moment diagram.

Governors, Stability, Sensitivity, Isochronism and hunting, Governor effort and power, Controlling force and effect of friction, Balancing of revolving masses.

Balancing of single and multicylinder engines, Friction and lubrication, Hydrodynamic theory of lubrication, Linear free and forced vibration of single and two degree freedom mechanical systems with or without damping, Critical speeds and whirling of shafts, Vibration of beams, Torsional vibration.

2. Machine Design:- Design of Joints: Cotters, Keys, splines, welded joints, threaded joints, threaded fastners, joints formed by interference fits, Design of friction drives: coupling and clutches, belt and chain drives, power screws.

Design of power transmission systems: gears and gear drives shaft and axle, wire ropes, Design of bearings: hydrodynamic bearings and rolling element bearings.

3. Mechanics of Solids:- Stress and strain for materials in tension, compression and shear, Relation between elastic constants for an isotropic, linear elastic and homogeneous materials, Uniaxial Loading, Thermal stresses, Stress-strain diagrams for ductile and brittle materials, Stress and strain in two dimensions, Principal planes, Mohr's circle, Strain rosette. Bending moment and shear force diagrams. Composite beams. Bending stresses, Shear stress distribution. Slope and deflection in beams. Torsion of circular shafts. Helical springs. Combined stresses. Theories of failure. Thick and thin walled pressure vessels, shrink-fit. Struts and columns. Energy principles. Strain energy due to bending, twisting and axial load. Castigliano's theorem. Reciprocal Theorem. Slope and deflection by energy methods.

4. Engineering Materials:- Basic concepts on structure of solids, Crystalline materials, Defects in crystalline materials, Alloys and binary phase diagrams, structure and properties of common engineering materials. Iron-carbon equilibrium diagram, TTT-diagram. Heat treatment of steels, Plastics, Ceramics and composite Materials, Common applications of various materials.

5. Manufacturing Science:- Basic principles of forging, drawing, extrusion and rolling, Pattern, Gating and risering system, casting defects, special casting process, welding: Gas welding, arc welding, resistance welding, thermit welding. Cutting tool materials, Tool geometry and nomenclature ASA, ORS and NRS, types of chips, cutting variables, Chip reduction coefficient, Merchant's force diagram, velocity relationship and Kronenberg's relationship. Ernest & Merchant angle relationship, Lee-shafer relationship-cutting fluid, Tool wear, Taylor's tool life equation, Drilling, Milling and boring, Gear Manufacturing, Economics of metal machining, Jigs and fixtures. Fits and Tolerances, NC, CNC, ECM, EDM, AJM, USM, LBM, Plasma machining, High energy rate forming.

6. Manufacturing Management:- Production Planning and Control, Forecasting-Moving average, exponential smoothing, Operations scheduling; assembly line balancing. Product development. Breakeven analysis, Capacity planning. PERT and CPM. Control Operations: Inventory control-ABC analysis. EOQ model. Materials requirement planning. Job design, Job standards, work measurement, Quality management-Quality control. Operations Research: Linear programming Graphical and Simplex methods. Transportation and assignment models. Single server queuing model. Value Engineering: Value analysis for cost/value. Total quality management and forecasting techniques. Project management.

Paper-II

1. **Thermodynamic Cycles:-** Basic concepts. Open and closed systems, Applications of laws of Thermodynamics, (Zeroeth, First and Second Laws), Gas equations, Clapeyron equation, Availability, Irreversibility and Tds relations, reciprocating air compressors.

2. **I.C. Engines, Fuels and Combustion:-** Spark ignition and compression ignition engines, Two stroke and Four stroke engines, mechanical, thermal and volumetric efficiency, Heat balance. Combustion process in S.I. and C.I. engines, preignition detonation in S.I. engine, Diesel knock in C.I. engine, Choice of engine fuels, Octane and Cetane ratings. Alternate fuels, Carburetion and Fuel injection, Engine emissions and control. Solid, liquid and gaseous fuels, stoichometric air requirements and excess air factor, fuel gas analysis, higher and lower calorific values and their measurements.

3. **Heat Transfer, Refrigeration and Air Conditioning:-** One and two dimensional heat conduction, Heat transfer from extended surfaces, Heat transfer by forced and free convection. Heat exchangers. Overall heat transfer coefficient, Fundamentals of diffusive and convective mass transfer, Radiation laws, heat exchange between black and non black surfaces, Network Analysis. Heat pump, refrigeration cycles (Air refrigeration, vapour compression and absorption refrigeration) and systems, Condensers, evaporators and expansion devices and controls. Properties and choice of refrigerant, Refrigeration Systems and components, psychometrics, comfort indices, cooling load calculations, solar refrigeration.

4. **Fluid Mechanics:-** Properties and classification of fluids, Manometry, Forces on immersed surfaces, Center of pressure, Buoyancy, Elements of stability of floating bodies, Kinematics and dynamics: Continuity, Momentum and Energy Equations, Irrotational flow and incompressible, Inviscid flow, Velocity potential, Pressure field and forces on immersed bodies, Bernoulli's equation, Fully developed flow through pipes, Pressure drop calculations, Measurement of flow rate and Pressure drop, Elements of boundary layer theory, Integral approach, Laminar and turbulent flows, Separations, Flow over weirs and notches, Open channel flow, Hydraulic jump, Dimensionless numbers, Dimensional analysis, Similitude and modelling, One-dimensional isentropic flow, Flow through convergent-divergent ducts. Adiabatic and Isentropic flow, fanno lines, Rayleigh lines.

5. **Fluid Machineries and Power Plants:-** Theory and design of axial flow turbines and compressors, Reciprocating and centrifugal pumps, Impulse and Reaction turbines, Specific speed, Classification, Energy transfer, Flow through turbo-machine blades, cascades, centrifugal compressor. Dimensional analysis and modelling. Steam generators, Fire-tube and water tube boilers, Flow of steam through nozzles and diffusers, wetness and condensation, various types of steam and gas turbines, Selection of site for steam, hydro, nuclear and stand-by power plants, Selection base and peak load power plants, Modern High pressure, High duty boilers, Draft and dust removal equipment, Fuel and cooling water systems, heat balance, station and plant heat rates, operation and maintenance of various power plants, preventive maintenance, economics of power generation.

Distribution of Marks for Mechanical Engineering

Paper-I

Number of multiple choice questions to be prepared:

1. Theory of Machines: 30
2. Machine Design: 30
3. Mechanics of Solids: 30
4. Engineering Materials: 30
5. Manufacturing Science: 30
6. Manufacturing Management: 30

Total number of questions: 180, Time: 3 Hours, Each question carries one mark. **Negative marking system with deduction of 0.25 mark for every wrong answer.**

Paper-II

Number of multiple choice questions to be prepared:

1. Thermodynamics Cycles:	10
2. I.C. Engines, Fuels and Combustion:	30
3. Heat Transfer, Refrigeration and Air Conditioning: (10+10+10)	60
4. Fluid Mechanics:	40
5. Fluid Machineries and Power Plants:	40

Total number of questions: 180, Time: 3 Hours, Each question carries one mark. **Negative marking system with deduction of 0.25 mark for every wrong answer.**

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