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Mechanical Engineering Syllabus for Uttarakhand State Civil Services Main Exam-2011

MECHANICAL ENGINEERING

PAPER-I

PART-A

1. Theory of Machines: Kinematics and dynamic analysis of planar mechanisms. Belt and chain drives. Gears and gear trains. Cams. Flywheel. Governors. Balancing of rotating and reciprocating masses: single and multi cylinder engines. Free, forced and damped vibrations (single degree of freedom). Critical speeds and whirling of shafts. Automatic controls.

2. Mechanics of Solids: Stress, strain relationship and analysis (in two dimensions). Strain energy concepts. Theories of failure. Principal stresses and strains. Mohr's consruction. Uniaxial loading. Thermal stresses. Beams-bending moment, shear force, bending stresses, deflection. Shear stress distribution. Torsion of shafts. Helical springs. Thin and thick walled pressure vessels. Shrink fits. Columns. Rotating discs.

3. Engineering Materials: Structure of solids-basic concepts. Crystalline materials. Imperfections. Alloys and binary phase diagrams. Structures and properties of common engineering materials and applications. Heat treatment of steels, Polymers, Ceramics, Composite materials.

PART-B

4. Manufacturing Science: Manufacturing processes-basic concepts-Mechanics of metal cutting. Merchant's force analysis. Taylor's tool life equation; Machinability, Economics of machining, Automation, NC and CNC. Recent machining methods- EDM, ECM, EMB, LBM, PAM and USM. Analysis of forming processes. High energy rate forming, Jigs and fixtures. Cutting tools & cutting tool materials, Gauges. Inspection of lengths, angles and surface finish. Geur manufacturing methods, thread cutting and thread rolling methods. System of limits, fits & tolerances.

5. Manufacturing Management: Product development. Value analysis. Break even analysis. Fore-casting techniques. Operations scheduling. Capacity planning. Assembly line balancing. CPM and PERT. Inventory control. ABC analysis-EOQ model. Material requirement. Planning. Project appraisal & Project financing. Cost benefit analysis. Cash Flow analysis. Job design, Job standards. Method study and work measurement. Quality management. Quality analysis. Control charts, Acceptance sampling. Total quality management. Operations research-liner programming. Graphical and simplex method. Transportation and assignment models. Single server quenching model.

6. Elements of Computation: Computer organization. Flow charting features of common computer languages. Fortran, Dbase, Lotus 1-2-3, C. elementary programming.

PAPER-II

PART-A

1. Thermodynamics: Basic concepts, First law and its application. Second law, its corollaries and applications. Maxwell and T-ds equation. Clapeyron equation. Availability and irreversibility.

2. Heat Transfer: Laws of heat transfer. One and two dimensional steady state heat conduction. Heat transfer from extended surfaces. One dimensional unsteady state heat conduction. Free and forced convective heat transfer. Dimensional analysis. Heat exchangers. Radiation laws. Shape factors. Heat exchange between black and non-black surfaces. Network analysis.

3. Refrigeration and Air-conditioning: Vapour compression, absorption, steamjet and air refrigeration systems. Properties of refrigerants. Compressors. Condensers. Expansion valve and evaporators. Psychrometric processes. Comfort zones. Cooling load calculations. All the year round air conditioning systems.

PART-B

4. Internal Combustion Engines: SI and CI engines. Four stroke and two stroke engines. Valve timing diagrams. Combustion phenomena in SI and CI engines. Detonation and knocking. Choice of engine fuels. Octane and cetane ratings. Combustion of fuels. Engine emission and controls. Engine trail.

5. Turbomachines: Classification of turbomachines. Continuity, momentum and energy equation. Adiabatic and isentropic flow. Flow analysis in axial flow compressors and turbines. Flow analysis in centrifugal pumps and compressors. Diemensional analysis and modeling. Performance of pumps, compressors and turbines.

6. Power Plants: Selection of site for steam, hydro, nuclear and gas power plants. Modern steam generators, Draft and dust removal equipments. Fuel and cooling water systems.

Thermodynamic analysis of steam power plants. Governing of turbines. Thermodynamic analysis of gas turbine power plants. Non-conventional power plants-solar, thermal, geo-thermal and wind generator. Economics of power generation. Thermo-electrical and thermoionic convertors, Biomass, Environmental and social constraints.