

Technical Syllabus for Exam Group – Mechanical & Allied Engineering

Below is the Syllabus for Mechanical & Allied Engineering Exam Group:

- **Engineering Mechanics**– Resolution of forces, Equilibrium and Equilibrant, parallelogram law of forces, triangle law of forces, polygon law of forces and Lami's theorem, couple and moment of a couple, condition for equilibrium of rigid body subjected to number of coplanar non-concurrent forces, definition of static friction, dynamic friction, derivation of limiting angle of friction and angle of repose, resolution of forces considering friction when a body moves on horizontal plane and inclined plane, calculation of moment of inertia and radius of gyration of : (a) I-Section (b) channel section (c) T-Section (d) L-Section (Equal & unequal lengths) (e) Z-Section (f) Built up sections (simple cases only), Newton's laws of motion (without derivation), motion of projectile, D'Alembert's principle, definition law of conservation of energy, law of conservation of momentum.
- **Material Science**–
 - Mechanical properties of engineering materials – tensile strength, compressive strength, ductility, malleability, hardness, toughness, brittleness, impact strength, fatigue, creep resistance.
 - Classification of steels, mild steel and alloy steels.
 - Importance of heat treatment. Heat treatment processes – annealing, normalizing, hardening, tempering, carburizing, nitriding and cyaniding.
- **Strength of Materials**– Stress, strain, stress strain diagram, factor of safety, thermal stresses, strain energy, proof resilience and modulus of resilience. Shear force and bending moment diagram – cantilever beam, simply supported beam, continuous beam, fixed beam. Torsion in shafts and springs, thin cylinder shells.
- **Machining**– Working principle of lathe. Types of lathes – Engine lathe – construction details and specifications. Nomenclature of single point cutting tool, geometry, tool signature, functions of tool angles. General and special operations – (Turning, facing, taper turning thread cutting, knurling, forming, drilling, boring, reaming, key way cutting), cutting fluids, coolants and lubricants. Introduction to shaper, slotter, planer, broaching, milling and manufacture of gears, heat treatment process applied to gears.
- **Welding**– Introduction, classification of welding processes, advantages and limitations of welding, principles of arc welding, arc welding equipment, choice of electrodes for different metals, principle of gas (oxy-acetylene) welding, equipment of gas welding, welding procedures (arc & gas), soldering and brazing techniques, types and applications of solders and fluxes, various flame cutting processes, advantages and limitations of flame cutting, defects in welding, testing and inspection modern welding methods, (submerged, CO₂, atomic – hydrogen, ultrasonic welding), brief description of MIG & TIG welding.
- **Grinding & Finishing Process**– Principles of metal removal by grinding, abrasives, natural and artificial, bonds and binding processes, vitrified, silicate, shellac rubber, grinding machines, classification: cylindrical, surface, tool & cutter grinding machine, construction details, relative merits, principles of centerless grinding, advantages & limitations of centerless grinding work, holding devices, wheel maintenance, balancing of wheels, coolants used, finishing by grinding, honing, lapping, super finishing, electroplating, basic principles – plating metals, applications, hot dipping, galvanizing tin coating, parkerising, anodizing, metal spraying, wire process, powder process and applications, organic coatings, oil base paint, lacquer base enamels, bituminous paints, rubber base coating.

- **Metrology**– Linear measurement – Slip gauges and dial indicators, angle measurements, bevel protractor, sine bar, angle slip gauges, comparators (a) mechanical (b) electrical (c) optical (d) pneumatic. Measurement of surface roughness; methods of measurements by comparison, tracer instruments and by interferometry, collimators, measuring microscope, interferometer, inspection of machine parts using the concepts of shadow projection and profile projection.
- **Fluid Mechanics & Hydraulic Machinery**–
 - Properties of fluid, density, specific weight, specific gravity, viscosity, surface tension, compressibility capillarity, Pascal's law, measurement of pressures, concept of buoyancy.
 - Concept of Reynold's number, pressure, potential and kinetic energy of liquids, total energy, laws of conservation, mass, energy and momentum, velocity of liquids and discharge, Bernoulli's equation and assumptions, venturi meters, pitot-tube, current meters.
 - Working principle & constructional details of centrifugal pump, efficiencies – manometric efficiency, volumetric efficiency, mechanical efficiency and overall efficiency, cavitation and its effect, working principle of jet & submersible pumps with line diagrams.
- **Industrial Management**–
 - Job analysis, motivation, different theories, satisfaction, performance reward systems, production, planning and control, relation with other departments, routing, scheduling, dispatching, PERT and CPM, simple problems.
 - Materials in industry, inventory control model, ABC Analysis, Safety stock, re-order, level, economic ordering quantity, break even analysis, stores layout, stores equipment, stores records, purchasing procedures, purchase records, Bin card, Cardex, Material handling, Manual lifting, hoist, cranes, conveyors, trucks, fork trucks.
- **Thermal Engineering**–
 - Laws of thermo-dynamics, conversion of heat into work vice versa, laws of perfect gases, thermo-dynamic processes – isochoric, isobaric, isothermal hyperbolic, isentropic, polytropic and throttling, modes of heat transfer, thermal conductivity, convective heat transfer coefficient, Stefan Boltzman law by radiation and overall heat transfer coefficient.
 - Air standards cycles – Carnot cycle, Otto cycle, Diesel cycle, construction and working of internal combustion engines, comparison of diesel engine and petrol engine. Systems of internal combustion engine, performance of internal combustion engines.
 - Air compressors their refrigeration cycles, principle of a refrigeration plant.

**** End of Syllabus - Mechanical & Allied Engineering ****