Syllabus for Written Test for the post of Engineer (Mechanical) against VC No 12/17 in RITES Ltd.)

Metrology:

Limits, fits & tolerance, standards of measurement
Linear measurement: Vernier caliper, micrometer, height gauge, depth gauge, radius gauge, feeler gauge, dial indicators, slip gauges.
Angular measurements: Combination set, vernier bevel protractor, sine bar, taper measurement by rollers.
Surface measurement: straight edge, try square, surface place
Surface finish measurement: of Roughness and waviness, various roughness value – CLS, ms, mean, principle of working of measuring instrument.
Thread measurement: Measurement of internal and external thread, screw pitch gauge, screw thread micrometer, thread limit gauge.
Gear measurement.
Other measuring instrument: autocollimator, Tool maker's microscope, profile projector, coordinate measuring machine.

Testing of material:

Non-destructive testing: Ultrasonic testing, radiography, magnetic particle testing, eddy current testing, dye penetration testing.
Physical testing: Tensile test, % elongation, % reduction in area, hardness (Brinell, Rockwell, Vickers), impact test (Izod, charpy), bend test, shear test, fatigue test, creep test.
Chemical testing ferrous and non ferrous metals
Metallography; micro and macro examination
Testing of paints, rubber, textiles, wood, plastics.

Inspection and quality control:

Probability, frequency distribution, statistical measures, normal curve, binomial curve, Poisson curve, statistical quality control, acceptance sampling (single, double, sequential), ACL, LTPO concepts, AQQL plants, OC curve, control charts, BIS codes.

Manufacturing and Industrial Engineering process:

Foundry technology: Pattern making, sand mould making, sand testing, core marking, gating and risers, melting (including pit furnace, cupola & electric furnace) and pouring, solidification and cooling, finishing & inspection, special casting processes (permanent mould casting, investment casting, die casting, centrifugal casting), casting defects. Welding Electric arc welding, gas welding, gas cutting, resistance welding, TIG & MIG welding, thermit welding, brazing, soldering, welding defects.

Heat treatment: hardening, annealing, tempering, normalizing, surface hardening, case hardening.
Cold and hot working of metals: forging, rolling, extrusion, wire & tube drawing, blanking punching, bending.
Introduction to general machining processes: turning, drilling, boring, reaming, milling, shaping, slotting planning, broaching, grinding, honing, sawing, gear cutting thread cutting, jigs and fixtures, power transmission, coolants & lubricants.

Principles of electroplating, galvanizing, anodizing.

Computer integrated manufacturing: basic concepts of CAD/CAM and their integration tools.
Production planning and control: Forecasting models, aggregate production planning, scheduling, material requirement planning.
Inventory control: various inventory models, safety stock inventory control systems.
Operation Research: Linear Programming, simplex and duplex methods, transportation assignments, network flow models, simple queeing models, PERT and CPM.

Engineering material, material Science, Extraction of material, Mechanics of Solids and theory of Machines.

Engineering Materials:
Caste Iron: Different types of cast iron, their properties, composition and uses.
Wrought iron properties, composition and uses.
Steels: Different types of steel and classification. Properties composition and uses of plain carton, alloy steel, high speed steel, stainless steel, spring steel.
Effect of various alloying element like Cr, Ni, Co, Mo, Mn, S on mechanical properties of steel.
Properties of A1, Cu, Zn, Sn,Pb
Composition properties and uses of duralumin, bras, bronze, gun-metal, German silver, bearing metal, constantan, solder
Plasitics: Sources, classification – thermo plastic and thermo set, plastic coating, organic and inorganic fibreas.
Insulating materials: Various materials and their uses e.g. Asbestos, glass, wool, Cork, china clay, Bakelite, Ebonite, glass wool, rubber, felt.

Material Science:
Properties of material (thermal, chemical, electrical, magnetic, mechanical)
Structure of metals (arrangement of atoms, crystalline & amorphous structure, crystal imperfections), solid solution, diffusion in metals and alloys, deformation of metal, impact of cold & hot working on metals, corrosion, its causes and prevention.

Extraction of material:
Important ores of Fe, A1, Cu, Zn, Sn, Pb
Production of pig iron: Blast furnace operation, coke, slags, flux
Production of wrought iron
Production of steel: Bessemer converter, LD process, open hearth process, electric arc furnace process, induction furnace process, ingot casting and defects, VAD process
Production of ferro silicon and ferro manganese alloys

Mechanics of solids:
Stress, strain and elasticity, Hook's law, strain energy, equations of equilibrium, thermal stress, resilience and shock torsion of circular shafts, shearing force and bending moment in beams, theory of bending, stress in beams, deflection of beams, pipes, cylinders, spheres, discs, flat plates, column and struts, Euler's theory of long column elementary principles of fatigue in metals.

Theory of machines:
Velocity, acceleration, vectors, force, centre of gravity, moment of a couple, moment of inertia, SHM & oscillations, degree of freedom
Simple mechanism: Introduction to link, kinematics pair, lower and higher pair, kinematic chain, straight line mechanism, inversion, mechanical advantages of linkages, cams and followers.
Friction and theory of lubrication, brakes and dynamometer, belts and ropes, gearing and gear trains, flywheels, balancing, inertia forces, governors, gyroscope, free and forced vibrations, clamping, dynamics of reciprocating and rotary systems.

Mechanical design, Fluids mechanics & Thermal engineering

Mechanical Design:
Multifunctional criteria for material selection, designing for strength and rigidity, key & others, riveted joint, welded joint, fastenings, leavers, columns, shafts & couplings, clutches & brakes, vee and flat belt pulley drives, steel wire, ropes & chain drives, flywheels, helical and leaf springs, bearings, gear and gear drives.

Fluid mechanics:
Fluid properties, classification of fluids, fluid statics, linear acceleration and rotation of fluids, type of flow (laminar & turbulent, steady & unsteady, uniform& non-uniform), viscous effect, flow in open channel and closed pipes, fluid kinematics, fluid dynamics, momentum, angular momentum, Bernoulli equation, measurement of fluid flo (pilot tube, venturimeter, orificemeter, rotameter, weirs, manometers etc.), flow though nozzles and diffusers, aerofoil theory, introduction to jet propulsion, introduction to hydraulic turbines (classification and types, head & efficiency, force and torque development, governing, Pelton, Francis, Kaplan), introduction to axial & centrifugal pumps, hydraulic couplings, torque converters, hydraulic brakes.

Thermal engineering:

Work and heat, law of perfect gases, first law, internal energy, entropy, enthalpy, second law, flow of gases, kinetic theory of gases, combustion processes, heat transmission, fuels (solid liquid and gaseous), air cycles (Carnot cycle, otto cycle, diesel cycle, Joule cycle), introduction to steam & gas turbines (operating principles, working cycles, essential components, impulse and reaction steam turbines multi staging, efficiency, governing, performance characteristics), introduction to IC engines (operating principles, essential components, working cycles, power and efficiencies, performance characteristics, valve operating mechanisms, method of governing inlet and exhaust system, two stroke cycle engines, fuel supply mixing and combustion), introduction to refrigeration (principles, methods of refrigeration, units of refrigeration, refrigeration efficiency, reversed Carnot cycle, refrigerants and properties), principles of jet propulsion, introduction to thermal power plant (water boilers, boiler efficiency, steam generators, boiler furnaces.)