DETAILED SYLLABUS FOR THE POST OF INSPECTOR OF FACTORIES AND BOILERS GRADE II IN FACTORIES AND BOILERS) - DIRECT RECRUITMENT - SR FOR : SCHEDULED CASTE/SCHEDULED TRIBE, ASSISTANT ENGINEER (MECHANICAL) IN STATE FARMING CORPORATION OF KERALA LIMITED) - DIRECT RECRUITMENT - DIRECT RECRUITMENT AND INSTRUCTOR GRADE I IN MECHANICAL ENGINEERING IN TECHNICAL EDUCATION - DIRECT RECRUITMENT

(Cat.Nos: 043/2023, 260/2023, 632/2023)

Module I (12 marks)
MECHANICS OF SOLIDS
Stress and strain, stress-strain diagrams, elastic constants, Poisson's ratio, Hooke's law, principal planes and principle stress, Mohr's circle, calculation of stress, strain and change in length in axially loaded members, thermal stress and thermal strain, torsional deformation of circular shafts, power transmitted by shafts, shear force and bending moment diagrams for beams, bending and shear stresses, normal and shear stress in beams, shear stress formula for beams, deflection of beams, strain energy methods, buckling and stability. Euler's theory of columns, critical load, equivalent length, slenderness ratio. Rankine's formula for short columns.

Module II (12 marks)
THERMODYNAMICS
Thermodynamic systems and processes, properties of pure substances, behavior of ideal and real gases, heat and work, zeroth law of thermodynamics, temperature scales, first and second Laws of thermodynamics, reversible processes, entropy, Clausius inequality, entropy changes in various thermodynamic processes, principle of increase of entropy, available and unavailable energy, availability function, availability and irreversibility, third Law of thermodynamics, thermodynamic relations, Helmholtz and Gibb's functions, Maxwell's relations, equations for internal energy, enthalpy and entropy, Clapeyron equation, throttling process, Joule Thomson coefficient, inversion curve, gas mixtures, composition of a gas mixture, mass and mole fraction, Dalton's law, Gibbs – Daltons Law, equivalent molecular weight and gas constant, properties of gas mixtures – specific heats, internal energy, enthalpy and entropy. Air Standard Cycles**,** air standard efficiency of Carnot cycle, Otto cycle, Diesel cycle and dual combustion cycle.

Module III (12 marks)
FLUID MECHANICS AND MACHINES
Fluid properties, types of fluid, fluid pressure and its measurement, forces on submerged bodies, stability of floating bodies, energies in flowing fluid, dynamic, static and total head, continuity equation, Eulers equation, Bernoulli's equation, flow rate measurements - venturi and orifce meters, notches and weirs, pitot tube, Reynolds number, laminar and turbulent flow, Hagen-Poiseuille equation, turbulent flow through pipes, head loss due to friction, Darcy - weisbach equation, Chezy's formula, losses at entry and exit, sudden expansion and sudden contraction, boundary layer, drag and lift on immersed bodies.

Impact of free jets - stationary and moving vanes, flat and curved vanes, series of vanes, work done and efficiency, impulse and reaction turbines – Pelton wheel, Francis turbine and Kaplan turbine, work done and efficiencies, draft tubes, cavitation, governing and specific speed of turbines. Reciprocating pump – air vessels, cavitation, slip, indicator diagram, work required and efficiency. Centrifugal pump - manometric head, efficiency and losses, priming, specific speed, performance characteristics.

Module IV (12 marks)
METALLURGY AND MATERIAL SCIENCE
Classification and properties of engineering materials, metallic bonds, crystal structure, space lattice, types of unit cells, Miller indices, co-ordination number, atomic packing factor, allotropy and polymorphism, imperfections in crystals. elastic and plastic deformation of metals, slip, twinning, dislocation, critical shear stress, Frank-Read source, strain hardening, De-lamination theory, diffusion mechanism, Fick's Laws, theory of alloys, Gibb'phase rule, solid solutions, Hume Rothery's rule, equilibrium diagrams, equilibrium diagram of binary alloys, eutectic, eutectoid, peritectic and peritectoid reactions. iron-carbon equilibrium diagram, isothermal TTT diagrams, critical cooling rate, heat treatment processes, hardenability tests, surface treatments, case hardening, carburising, nitriding, cynading, induction hardening, precipitation hardening, recovery, recrystalisation and grain growth. Properties, composition and uses of various types of cast iron and steels, effect of various alloying elements. Properties, composition and uses of copper, aluminum, titanium and its alloys.

Module V (14 marks)
THERMAL ENGINEERING
 Steam engineering - Rankine cycle, boilers, boiler mountings, boiler accessories, steam engine, steam nozzles, steam turbines, multistage turbines. IC engines - classification, air supply system, fuel supply system, ignition system, performance testing, combustion in SI and CI engines, auto ignition, preignition, detonation, octane and cetane numbers, anti knocking agents. Gas turbines-classification, regeneration, intercooling, reheating, efficiency and work output. Compressors - classification of compressors, uses of compressors, reciprocating compressor - single stage compressor, equations for work, efficiencies, multistage compressor, intercooler, rotary compressors, fans and blowers. Refrigeration - concept of COP, heat pump, reversed Carnot cycle, refrigeration systems. Properties of moist air, psychrometric chart, basic psychrometric processes, air conditioning systems. Heat transfer – conduction, convection and radiation, Fourier's law, thermal conductivity, conduction through plane wall and composite wall, black body concept, Stefan-Boltzman law, gray body concept, Newton Rikhman equation, free and forced convection. Heat exchangers – classification, concept of overall heat transfer coefficient, LMTD. Power plants - hydro electric, thermal, diesel and nuclear power plants.

Module VI (14 marks)
THEORY OF MACHINES AND DESIGN OF MACHINE ELEMENTS
Definitions and basic concepts, kinematic and dynamic analysis of planar mechanisms. Belt, rope and chain drives, ratio of belt tensions, power transmitted. Friction clutches - plate clutches, conical clutches. Brakes and Dynamometers - types of brakes, absorption and transmission type dynamometers. Gears - types of gears, terminology, law of gearing, gear tooth profiles,

interference and under cutting, calculation of minimum number of teeth, contact ratio, path of contact, arc of contact, gear trains, flywheels, governors, gyroscope, balancing of reciprocating and rotating masses. Free and forced vibrations of single degree of freedom systems, effect of damping, vibration isolation and transmissibility, resonance, critical speeds and whirling of shafts.

Design for static and dynamic loading, failure theories, fatigue strength and S-N diagram, principles of design of machine elements such as bolted, riveted and welded joints, design of shafts, spur gears, rolling and sliding contact bearings, brakes and clutches.

Module VII (12 marks)
PRODUCTION TECHNOLOGY
Casting - types of castings, design of patterns, moulds and cores, solidification and cooling, riser and gating design, casting defects. Principles of welding, brazing and soldering, types of welding, weld defects. Plastic deformation and yield criteria, fundamentals of hot and cold working processes - rolling, forging, extrusion, wire drawing, rotary piercing, rotary swaging, metal spinning. Machining and machine tool operations - mechanics of machining, single and multi-point cutting tools, tool geometry and materials, tool life and wear, economics of machining. Basic machine tools - lathe, shaper, milling machine, drilling machine, boring machine, grinding machine, principles of work holding, jigs and fixtures, turret and capstan lathes, NC/CNC machines and CNC programming. Unconventional machining processes – EDM, ECG, ECM, LBM, USM, AJM, EBM and chemical machining. Principles of powder metallurgy.
Metrology and Inspection - Limits, fits and tolerances, linear and angular measurements, Comparators, interferometry, form and finish measurement, alignment and testing methods, tolerance analysis in manufacturing and assembly, concepts of coordinate measuring machine (CMM).
Computer Integrated Manufacturing - Basic concepts of CAD/CAM and their integration tools, additive manufacturing.

Module VIII (12 marks)
INDUSTRIAL ENGINEERING AND MANAGEMENT
Meaning of management, Taylor's scientific management, functions of management, organisational structure, authority, responsibility and span of control, line, line and staff, functional, project and matrix organizations. Formation of companies- proprietary, partnership and joint stock companies, private limited, public limited companies, cooperative organizations and government organizations.
Facilities planning - selection of site, factors to be considered, plant layout - process, product, fixed, group technology layouts, principles of material handling, types of material handling equipments, preventive and break-down maintenance, replacement of equipments.
Work study - analysis of work methods using different types of process chart and flow diagrams, critical examination, micromotion study and therbligs, SIMO chart, principles of motion economy, determination of allowances and standard time, job evaluation and merit rating, wage payment plans.
Production planning and control - importance of planning, forecasting techniques, job, batch and mass production, determination of economic lot size in batch production, functions of production

control, routing, scheduling, dispatching and follow up, Gantt charts, inventory models, determination of EOQ and reorder level, selective inventory control techniques, breakeven analysis.

Quality control and inspection - process capability, statistical quality control, control charts for variables and attributes, acceptance sampling and operating characteristic curves, system reliability, life testing, bath tub curve.

Personal management- objectives and function, recruitment, selection, orientation and training of workers, industrial safety and health, labour welfare, Industrial psychology, labour legislation.

Linear programming – graphical and simplex solution methods, transportation and assignment problems, game theory, simple queuing models, CPM and PERT.

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.