

DETAILED SYLLABUS FOR THE POST OF DEPUTY MANAGER (TECHNICAL) IN TRAVANCORE SUGARS AND CHEMICALS LTD.

(Cat No : 676/2023)

Part I: ELECTRICAL ENGINEERING (50 Marks)

1. Electric circuits (10 marks)

Kirchhoff's laws, Star/Delta transformation. Analysis of coupled circuits - dot polarity convention - sinusoidal steady state analysis of coupled circuits. Alternating voltages and currents - RMS value, average value, peak factor, form factor. AC through series R, L, C circuits - Resonance in Series and Parallel RLC circuits - Quality factor - Bandwidth. Node and mesh analysis. Sinusoidal steady state analysis, Thevenin's, Norton's Superposition and Maximum Power Transfer Theorems, Transient Response of DC and AC Networks, Two Port Network, Three Phase Circuits.

2. DC Generators (10 marks)

Constructional details, working principle - types of DC generators - emf equation - power stages - condition for maximum efficiency. DC motor - armature control and field control. Single phase transformer - working principle, equivalent circuit, losses in a transformer, condition for maximum efficiency. Three phase transformer -construction- difference between power transformer and distribution transformer, all day efficiency. Alternators - constructional details - Performance, Regulation and Parallel Operation of Generators. Synchronous motor - starting methods - synchronous condenser. Three phase induction motor - working principle, constructional details, slip, torque and current equations, torque-speed curve. Starting and Speed Control. Single Phase Induction Motors.

3. Power Systems (10 marks)

Line parameters -resistance- inductance and capacitance. Insulators -string efficiency- corona. Circuit breakers - rating- SF6 circuit breaker. Relays - types. Per unit quantities- symmetrical components - symmetrical and unsymmetrical fault. Power system stability - steady state, dynamic and transient stability-power angle curve.

4. Measurements and Instrumentation (10 marks)

Measurement standards - errors - types of Errors. Ammeters and voltmeters - moving coil, moving iron. Measurement of power- Dynamometer type wattmeter, construction and working, 3- phase power measurement. Measurement of energy - Single phase energy meter - construction and working. Oscilloscopes - principle of operation of general purpose CRO-basics of vertical and horizontal deflection system. LVDT- angular displacement transducers, hall effect transducers.

5. Power Electronics (10 marks)

SCR- Structure, Static characteristics. Fully controlled and half controlled bridge rectifier with R, RL and RLE loads. Voltage Source Inverters- 1- phase half-bridge & full bridge inverter with R and RL loads - Pulse width modulation. Single quadrant, Two quadrant and Four quadrant chopper. Operational Amplifiers - fundamental differential amplifier- Modes of operation. Properties of ideal and practical Op-amp -gain, CMRR and slew rate.

Part 2 : Mechanical Engineering

Total 50 Marks

Module 1

Industrial Management and Industrial Engineering (10 Marks)

Project Management Techniques: Commonly used terms in CPM and PERT, critical path, slack, or float, Comparison between CPM and PERT.

Quantitative techniques in Management: Linear programming – formulation of LPP– transportation problem– Least cost method, North-West corner rule, Vogel's approximation method.

Inventory management – definition and classification – EOQ and ABC analysis. Sales – sales forecasting.

Meaning of the terms production and productivity – types of production – Job production batch production, mass production, continuous production - Plant location and layout, Factors to be considered in locating industrial plants – Types of layouts.

Method Study: Work study – Method study – Process chart symbols – operation process chart, flow process chart, man-machine chart, and SIMO chart, Principles of motion economy, Objectives of work measurement – Procedure of stop watch time study.

Concept of quality and quality control, Control Charts introduction, types of control charts – X-bar, R, P, 100P and C.

Fundamental Statistical Concepts: frequency, frequency distribution and frequency plot– Normal distribution curve – Explanation of the terms mean, mode, median and standard deviation

Module 2

Metallurgy and Machine Tools (10 Marks)

Metals and alloys: Structure of materials – Crystal structure –BCC, FCC and HCP – Ferrous and non-ferrous– Cast iron, Manufacturing of Pig iron – Blast Furnace – Manufacturing of Cast iron – Cupola Furnace – Types of steel – Manufacturing of steel, Steel alloys – Non ferrous metals and alloys–Aluminium, Copper and its alloys–Crucible

furnace.

Properties, testing and inspection of materials: Mechanical properties such as strength, hardness, toughness, brittleness, creep, fatigue, stiffness, ductility, malleability, elasticity and plasticity—Thermal properties such as specific heat, thermal conductivity, thermal resistance, and thermal diffusivity—Destructive tests and Non-destructive tests.

Classification of measuring instruments—precision and non-precision instruments—Direct reading and indirect measuring instruments, classifications of gauges, comparators. Principle of arc welding, selection of welding electrodes, Electrode coatings – Functions of electrode coating, Gas welding, submerged arc welding, tungsten inert gas (TIG) welding, metal inert gas (MIG) welding, Atomic hydrogen welding and thermit welding – Defects in welding – causes and remedies of the defects such as porosity, poor penetration, warping, under cut, distortion crack, poor appearances, soldering, brazing.

Metal Cutting: Orthogonal cutting and oblique cutting, Tool life, Machinability.

Type of lathes, Lathe accessories, Work holding and tool holding devices, Speed, feed and depth of cut – Operations – taper turning methods – Lathe specification.

Drilling Machines: Classification—Work holding devices—Types of drill bits—Tool holding devices— Operations. Shaping Machines: Parts and their functions. Milling Machines: General use of milling machines—Parts of milling machines and their functions—types of milling machines, Milling operations, Types of indexing.

Module 3

Fluid Mechanics, Pneumatic and Hydraulic Machines (10 Marks)

Properties of Fluids: Density—specific weight—specific volume—specific gravity – viscosity – Newton's law of viscosity –types of fluids– compressibility – surface tension – capillarity.

Fluid Pressure and its Measurement: Fluid pressure at a point– Pascal's law – absolute, gauge, atmospheric and vacuum pressures, measurement of fluid pressure – pressure measuring devices.

Types of fluid flow—steady and unsteady flow—uniform and non-uniform flow—laminar and turbulent flow – compressible and incompressible flow – rotational and irrotational flow—continuity of liquid flow – energy of a liquid in motion—Bernoulli's equation—practical applications of Bernoulli's equation.

Impact of Jets: Force exerted by the jet, Impulse turbines – classification – Pelton wheel components. Reaction Turbines: Components – difference between impulse and reaction turbines, classification of Reaction Turbines, specific speed.

Pumps: Types of pumps, centrifugal pumps – efficiencies – discharge –cavitation–priming. Reciprocating Pump – Types – comparison of CP & RP – discharge – slip.

Module 4

Applied Mechanics, Strength of Material and Design of Machine

Elements (10 Marks)

Direct Stresses and Strains: Types of Stresses and strains–tensile and compressive – longitudinal and lateral strain – Poisson’s ratio – stress strain diagram – limit of proportionality – elastic limit –yield point – ultimate stress – working stress – factor of safety – comparison of stress strain diagrams, principle of superposition – stresses in varying section. Shear stress and strain – modulus of rigidity – volumetric strain,bulk modulus. Nature and magnitude of stresses due to change in temperature.

Introduction – type of friction – static friction, dynamic friction, sliding friction, rolling friction, pivot friction, limiting friction, angle of friction, coefficient of friction, cone of friction.

Joints: Riveted Joints – types–lap joint–single riveted, double riveted – failure of riveted joints, Welded Joints: Welding terms, strength of welded joints.

Torsion equation – strength equation for solid and hollow shaft, power equation – polar moment of inertia.

Types of beams – cantilever beam, simply supported beam, overhanging beam, built in beam or fixed beam and continuous beam, types of loading, shear force and bending moment diagrams –maximum bending moment on the section. – deflection of beams. Column, strut, buckling load, equivalent length, slenderness ratio –types of columns– short column, medium size column, long column.

General design procedure–Design stress and working stress–factor of safety–Kinematic link – pair – chain – four bar chain – examples and applications– mechanism– inversion.

Torsional stresses and strains – strength of solid and hollow shaft – design of shaft considering strength and rigidity – comparisons – power transmitted by shaft – solid and hollow shafts in terms of their weight, strength and stiffness. Shaft couplings– requirement– types.

Governors and Flywheels: Functions of the governors – types of governors – flywheels – coefficient of fluctuation of energy.

Gears and Gear Trains: Functions of gears–advantages and disadvantages of a geardrive – spur gear nomenclature – simple gear drive – velocity ratio – gear trains–simple gear train– compound gear train.

Module 5

Thermal Engineering (10 Marks)

Air Standard Cycles: Assumption, Air standard efficiency- derivation of air standard efficiency of Carnot Cycle, Otto cycle, Diesel cycle, dual combustion cycle. Classification of fuels – solid, liquid and gaseous – requirements of a good fuel – Calorific Value – combustion of fuel.

Heat Transfer: Heat Transfer – conduction, convection and radiation – Fourier's law – Thermal conductivity – Conduction through plane wall and composite wall –Black body concept – Stefan-Boltzman law – free and forced convection, Heat exchangers – Classification – regenerative type, parallel flow, counter flow type and cross flow, LMTD.

IC Engine sub-systems: Fuel systems, ignition system, cooling system, lubrication system– quantity governing – quality governing–hit and miss governing.

Definition of refrigeration, concept of C. O. P., unit of refrigeration–reversed Carnot cycle – COP, Application of refrigeration.Principles and working of a vapour compression system.

C.O.P. of vapour compression systems. Compressors – Condensers – Evaporators– Expansion Devices–capillary tube, Thermostatic expansion valve. Definition of refrigerants, primary and secondary refrigerants, desirable properties of refrigerants.

Psychrometry - principles and uses, Sensible heating, sensible cooling–humidifying, dehumidifying.

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
