Tamil Nadu Public Service Commission
Syllabus
Chemical, Electrical, Electronics and Mechanical Engineering
(Degree Standard)

Code:527

Unit I: Chemical Process Calculations, Thermodynamics, Mechanical Operation and Chemical Technology (20 Questions)

Properties of Solid Liquids and gases, liquids and solids, Humidity and saturation, Gas laws, steady state Material and Energy balance, use of tie components, Gibbs Phase rule and degree of freedom analysis. Laws of Thermodynamics and its applications- Thermodynamics functions - Chemical and Phase Equilibrium -Ideal and non-ideal gases and solutions – Equation of state and residual properties, compression of fluids, Second law of the thermodynamics, entropy, Chemical potentials properties of mixtures.

Characteristics of solids, laws of size reduction, free and hindered settling, centrifuge and cyclone, thickeners and classifiers, Mixing and agitation, Filtration, Sedimentation.Conveying of solids.

Acids, Fertilizers, marine Chemicals, Cement, Glass, Ceramic and Refractories,Petroleum Refining Products, Fermentation Products, Oils, Soaps and Detergents, Pulp and paper, Dyes, sugar, leather and rubber, polymer, pharmaceutical and food industries.

Unit II: Fluid Mechanics, Transfer Operations (20 Questions)

Fluid Statics, Newtonian and Non-Newtonian fluids, Types of Manometers, Equation of continuity, Equation of motion, Bernoulli equation, Friction Factor, Dimensional analysis and similitude, Flow through pipes, velocity profiles, flow through fixed and fluidized beds, flow meters, Fans, blowers, pumps and compressors,Energy Equations, Modes of Heat transfers, Heat transfer with phase change, thermal insulation, thermal boundary layer and heat transfer coefficient.

Fick's Law - Diffusion, Mass Transfer Coefficient and theories of Mass Transfer. Momentum, heat and mass transfer analogies, Inter - phase Mass transfer operations, Height Transfer Units (HTU), Number of Transfer Units (NTU) and Height Equivalent to a Theoretical Plate (HETP) concepts, Design of equipment - Distillation column, Extraction, Adsorption, Absorption, Drying, humidification and de-humidification.Crystallization, Membrane separation processes - Separations involving pervaporation and permeation techniques for solids, liquids and gases, supercritical fluid extraction.

Unit III: Chemical Reaction Engineering and Process Design (20 Questions)

Reaction rates - laws - theories and analysis, homogeneous and heterogeneous reactions, single and multiple reactions in ideal reactors.Non ideal reactors - Residence time distribution, Single parameter model - Design of reactors - Isothermal and adiabatic fixed bed reactors, non-isothermal and non-adiabatic fixed bed reactors, fluidized bed reactors.

Laplace transformation, application to solve Ordinary Differential Equations (ODEs). Open-loop systems, first order systems, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag. Closed loop control systems, feed-back control systems, BODE diagram, stability criterion, frequency response, tuning of controller settings, cascade control, feed forward control, control of distillation towers and heat exchangers.

Unit IV: Electrical Circuits, Measurements and Control Systems (20 Questions)

Circuit elements – Kirchoff's Laws – Mesh and Nodal Analysis – Network Theorems and Applications for DC and AC circuits. Three Phase Circuits – Star - delta transformation – real and reactive power – power factor.

Measurement of Current, Voltage, Power, Power – factor and Energy – Indicating instruments – Measurement of Resistance, Inductance, Capacitance and Frequency – Bridge Measurements – Instrument Transformers – Electronic Measuring Instruments – Multi meters – Power Quality Analyser – Transducers and their applications to the Measurement of Non–Electrical Quantities like

Temperature, Pressure, Flow-rate, Displacement, Acceleration, Noise level – Data Acquisition Systems – A/D and D/A Converters – Data Transmission Systems – Programmable Logic Controller (PLC) – smart meters.
Control Systems: Mathematical Modelling of Physical Systems – Transfer Function - Block Diagrams and Signal Flow Graphs and their Reduction using Mason's Rule. PI, PD and PID Controllers – State Variable formulation – state transition matrix.

Unit V: Electrical Machines and Power Systems (20 Questions)

D.C. Machines – Construction, Excitation methods – Characteristics and Performance Analysis – Generators and Motors – Starting, Speed Control and braking – Testing – Losses and Efficiency. Transformers – Types – Construction and Operation – Testing – Equivalent Circuits – Losses and Efficiency – All day efficiency – Regulation – Parallel Operation – Three Phase Transformers – Auto-transformer. Induction Machines – Construction, Principle of operation – Torque – Speed Characteristics, No–load and Blocked Rotor tests, Equivalent Circuit –Starting, Speed Control and braking – Single - Phase Induction Motors – Linear Induction Motors – Permanent magnet brushless dc motor – stepper motor.

Power Systems: Single Line Diagram of Power System – Per Unit Quantities – Different Types of Power Generation - Pumped storage plants – Co-generation –Modelling and performance characteristics of Power transmission lines and Cables – High Voltage Direct Current (HVDC) transmission – Mechanical Design of Transmission Lines - Sag – Insulators - Load flow studies – Power System Protection – Circuit Breakers – Relays classification of protection schemes - overcurrent, distance, differential and carrier – Equipment protection - transformer, generator, motor, busbars and transmission line – AC and DC Distribution – deregulation –energy conservation and energy auditing.

Unit VI: Renewable Energy Sources and Digital Communication (20 Questions)

Renewable Energy – Sources and Features – Solar Radiation Spectrum – Radiation Measurement – Solar Photovoltaic Cell – principle of operation – types – Maximum Power Point Tracking (MPPT) – Microhydel – Operating principle – Wind Energy – Components – Wind power turbine types – MPPT – Site Selection – Types of Wind Generators – smart grid – Electric vehicles –Vehicle to Grid (V2G) and Grid to Vehicle (G2V) – Fuel Cells – Batteries – Types and Characteristics – Super Capacitors.

Embedded processors (ARM and PIC). Data Communication Network - 7-layered OSI Protocol – Internet of Things (IoT) concepts.

Unit VII: Mechanics of Solids and Design (20 Questions)

Statics of Particles, Equilibrium of Rigid bodies, Mechanism of Deformable Bodies, Properties of Surfaces and Solids, Centroid, Centre of Gravity, Dynamics of Particles, Elements of Rigid Body Dynamics, Basics of Mechanisms, Kinematics of mechanisms, gyroscope, Gears and Gear Trains, Fly Wheels and Governors, Balancing of Rotating and Reciprocating Masses, Friction in Machine Elements, Force Analysis, Balancing, Single Degree Free Vibration, Forced Vibration, mechanisms for Vibration Control, Effect of Damping,Vibration Isolation, Resonance, Critical Speed of Shaft.Stress, Strain and Deformation of Solids, Combined Stresses, Theories of Failures, Transverse Loading on Beams, Stresses in Beams, Torsion, Deflection of Beams, Energy Principles, Thin Cylinders and Thick Cylinders, Spherical Shells, Fundamentals of Design for Strength and Stiffness of Machine Members, Design of Shafts and Couplings, Design for Static and Dynamic Loading, Design of Fasteners and Welded Joints, Reverted Joints, Design of Springs, Design of Bearings, Design of Flywheels, Design of Transmission Systems for Flexible Elements, Spur Gears and Parallel Axis Helical Gears, Bevel Gears, Worm Gears and Crossed Helical Gears, Designofsingleandtwostagespeedreducers,Designofcam,Clutchesand Brakes, Design of Piston and Connecting Rods.

Unit VIII: Engineering Materials and Metallurgy (20 Questions)

Constitution of alloys and phase diagrams, Iron – Iron Carbide Phase Diagram - steels, cast iron, phase transformations – diffusion - TTT diagram, ferrous and nonferrous alloys, heat treatment of ferrous and non-ferrous alloys, surface modification techniques, powder metallurgy, non-metallic materials, mechanical properties and testing, crystal defects and strengthening mechanisms, conducting and semi conducting materials, magnetic and dielectric materials, Engineering ceramics, Engineering and commodity polymers, composites, nano-materials.

Unit IX: Production, Industrial Engineering and Management (20 Questions)

Foundry Technology - types of pattern, cores, moulding and casting methods, Solidification, design of castings, defects, Melting Furnaces, Hot and Cold working, Metal Forming Processes - Metal joining processes, Thermo Setting and Thermo Plastic Products, Metal cutting, Cutting Tool Nomenclature, Machine Tool Types and its machining operations - Unconventional machining processes,Micro Manufacturing, CNCmachinetools. Limits, Fits and Tolerance, Linear and angular measurements, Interferometry, laser interferometers - Computer Aided Inspection, Coordinate Measuring Machine (CMM) – Types of CMM, Machinevision, Form measurement – Straightness - Flatness, Roundness, Surface finish measurement, Measurement of power, flow and temperature. Statistical quality control, control charts, acceptance sampling, reliability, Total Quality Management (TQM), 5S, ISO standards.

Work study - Techniques, Method study and work measurements - objectives - basic procedure, machine loading and scheduling, product sequencing, inventory control – Economic Order Quantity (EOQ) - quantity discounts, ABC Analysis material handling systems, operations research, Linear Programming, simplex method, Transportation model, Assignment model Cost Per Mille (CPM) and Program Evaluation and Review Technique (PERT), Queuing Models. Management theory and practice, planning - Decision making, Organising, staffing, Motivation, Leadership, controlling, control techniques. Distributed operating systems – Logical clocks – Vector clocks – File System – Hadoop distributed file system - Shared memory – Distributed Algorithms. TQM Tools and Techniques – Quality Function Deployment (QFD) – Total Preventive Maintenance (TPM) concept – ISO standards - Industrial Safety – Occupation Safety and Health Assessment (OSHA).

Unit X: Industrial Safety (20 Questions)

Industrial hygiene, occupational safety and health in chemical industries, Industrial safety principles, site selection and plant layout, chemical hazards identification and classification, Safety in operations and processes, fire safety, hazard identification techniques, disposal of hazardous and toxic wastes, onsite and offsite emergency preparedness plan, safety audit, work permit system, roles and responsibilities of safety officers and welfare officers, occupational diseases, Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Environmental Legislation, Act, Safety Act - Corporate Social Responsibility.

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