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

### Code: 526

### Unit I: Electrical Circuits and Measurements (20 Questions)

Circuit elements – Kirchoff's Laws – Mesh and Nodal Analysis – Network Theorems and Applications for DC and AC circuits: Thevenin's Theorem, Norton's Theorem, Superposition Theorem, Maximum Power Transfer Theorem –Three Phase Circuits – Star - delta transformation – real and reactive power – power factor - Electric Field and Potential due to Point, Line, Plane and Spherical Charge Distributions.

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 - 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.

### Unit II: Electrical Machines and Control Systems (20 Questions)

D.C. Machines – Construction – Generators and Motor – 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 — Power factor improvement – permanent magnet synchronous motor – Permanent magnet brushless DC motor – stepper motor.

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 – Eigen values and Eigen vectors – free and forced responses of Time Invariant systems – controllability and observability.

### Unit III: Power Systems (20 Questions)

Single Line Diagram of Power System – Power Generation Types -Hydro, Thermal and Nuclear Stations – 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 – Load flow studies – Shunt and Series Compensation – Symmetrical and Unsymmetrical Faults Analysis – Transient and Steady – State Stability of Power Systems – Power System Protection – Circuit Breakers –Relays classification of protection schemes – over current, distance, differential and carrier – Equipment protection-transformer, generator, motor, bus bars and transmission line – AC and DC Distribution – deregulation –energy conservation and energy auditing

### Unit IV: Power Electronics and Drives (20 Questions)

Principle of Operation and Static and dynamic behavior of Power Semiconductor devices – Power Diode, DIAC, SCR, TRIAC, GTO, MOSFET and IGBT – Single and Three Phase AC to DC Converters – uncontrolled and controlled rectifiers – performance parameters – Single and Three Phase AC to AC converters – Switched Mode Power Supplies – buck, boost and buck – boost converter topologies – switching losses – Inverters – Single and Three Phase Inverters – Uninterrupted Power Supplies – Electrical drives – motor load dynamics – load torque characteristics – Speed Control of DC Drives – Converter/Chopper fed dc motor drives – Speed control of AC drives – induction motor drives – stator voltage control and V/f control - Power factor control.

# Unit V: Renewable Energy and Digital Communication System (20 Questions)

Renewable Energy – Sources and Features – Solar Radiation Spectrum – Radiation Measurement – Solar Photo voltaic 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 basics only) - Data Communication Network Topologies – 7 – layer Open System Interconnection (OSI) Protocol – Internet of Things (IoT) concepts

# Unit VI: Engineering Mechanics (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, Friction in Machine Elements, Force Analysis, Balancing, Single Degree Free Vibration, Forced Vibration, mechanisms for Vibration Control, Effect of Damping, Vibration Isolation.

Stress, Strain and Deformation of Solids, Combined Stresses, Theories of Failures, Transverse Loading on Beams, Stresses in Beams, Torsion, Deflection of Beams, 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.

## Unit VII: Fluid Mechanics and Machinery (20 Questions)

Fluid properties, fluid statics, manometry, buoyancy of mass, momentum and energy, fluid acceleration, differential equations of continuity and momentum, Bernoulli's equation, Dimensional Analysis, viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes, bends. Turbo machinery: Pelton wheel, Francis and Kaplan turbines - impulse and reaction principles – pumps and its applications-Valves and Types - Online Continuous Flow Monitoring System.

## Unit VIII: Thermal Engineering (20 Questions)

Basic concepts, Zeroth, First and Second laws of thermodynamics, thermodynamic system and processes, Carnot cycle. Behaviour of ideal and real gases, thermodynamic relations, properties of pure substances, calculation of work and heat in ideal processes, analysis of thermodynamic cycles related to energy conversion, Fuel and combustion, Fuels Characteristics, Emissions and Controls, Renewable sources of Energy.

Modes of heat transfer - one dimensional heat conduction, resistance concept, electrical analogy, unsteady heat conduction, fins dimensionless parameters - Free and forced convective heat transfer, effect of turbulence, radiative heat transfer, black and grey surfaces, heat exchanger performance, Logarithmic Mean Temperature Difference (LMTD) and Number of Transfer Units (NTU) methods. Basic Concepts of Mass transfer, Diffusion Mass Transfer, Fick's Law of Diffusion Steady state Molecular diffusion, Convective Mass Transfer, Radiactive Heat Transfer.

## Unit IX: Materials and Manufacturing Technology (20 Questions)

Constitution of alloys and phase diagrams, Iron – Iron Carbide Phase Diagram - steels, cast iron, phase transformations – diffusion - Time-Temperature Transformation (TTT) diagram, ferrous and nonferrous alloys, heat treatment of ferrous and non-ferrous metal, surface modification techniques, powder metallurgy, non-metallic materials, mechanical properties and testing, nano-materials.

Foundry Technology - types of pattern, cores, moulding and casting methods, Solidification, design of castings, defects, Melting Furnaces, 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, Computer Numerical Control (CNC) machine tools.

Limits, Fits and Tolerance, Linear and angular measurements, Interferometry, laser interferometers - Computer Aided Inspection, Coordinate Measuring Machine (CMM) – Types of CMM, Machine vision, 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.

# Unit X: Computer Aided Engineering and Industrial Engineering (20 Questions)

Fundamentals of Computer Integrated Management (CIM), Production Planning and Control, Computer Aided Process Planning, Cellular Manufacturing, Flexible Manufacturing System and Automated Guided Vehicle System, Group Technology, Production Flow Analysis, Industrial Robotics, Additive Manufacturing, Just in Time (JIT), lean manufacturing, One Dimensional Problems in Finite Element Analysis (FEA), Two Dimensional Scalar Variable Problems, Two dimensional vector variable problems, Isometric Parametric Formulation.

Work study - Techniques, Method study and work measurements - machine loading and scheduling, inventory control – Economic Order Quantity (EOQ) - 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,. Management theory and practice, planning - Decision making, Organising, staffing, Motivation, Leadership, controlling, control techniques, Industrial Safety - Standards – Occupational Safety and Health Administration (OSHA).

Dated:25.03.2025