Annexure-2 to Advt. No. IMU-HQ/R/NT/2023/01 dated 03.02.2023

Syllabus for Domain Knowledge – Assistant Engineer (Electrical)

Electrical Materials:

Electrical Engineering Materials, crystal structures, and defects, ceramic materials, insulating materials, magnetic materials - basics, properties, and applications; ferries, ferromagnetic materials, and components; basics of solid-state physics, conductors: Photo-conductivity; Basics of Nano materials and Superconductors.

Electric Circuits and Fields

Circuit elements, network graph, KCL, KVL, Node, and Mesh analysis, ideal current and voltage sources, Thevenin's, Norton's, Superposition and Maximum Power Transfer theorems, transient response of DC and AC networks, Sinusoidal steady-state analysis, basic filter concepts, two-port networks, three-phase circuits, Magnetically coupled circuits, Gauss Theorem, electric field and Potential due to point, line, plane, and spherical charge distributions, Ampere's and Biot-Savart's laws; inductance, dielectrics, capacitance: Maxwell's equations.

Electrical and Electronic Measurements:

Principles of measurement, accuracy, precision, and standards; Bridges and potentiometers; moving coil, moving iron, dynamometer and induction type instruments, measurement of voltage, current, power, energy and power factor, instrument transformers, digital voltmeters and multimeters, phase, time and frequency measurement, Q-meters, oscilloscopes, potentiometric recorders, error analysis, Basics of sensors. Transducers, basics of data acquisition systems

Basic Electronics Engineering:

Basics of Semiconductor diodes and transistors and characteristics, Junction and field-effect transistors (BJT, FET and MOSFETS), different types of transistor amplifiers, equivalent circuits and frequency response; oscillators and other circuits, feedback amplifiers,

Analog and Digital Electronics:

Operational amplifiers - characteristics and applications, combinational and sequential logic circuits, multiplexers, multivibrators, sample and hold circuits, A/D and D/A converters, Asics of filter circuits and applications. simple active filters: Microprocessor basics- interfaces and applications, basics of linear integrated circuits: Analog communication basics. Modulation, and demodulation, noise and bandwidth, transmitters and receivers, signal to noise ratio, digital communication basics, sampling, quantizing, coding, frequency and time domain multiplexing, power line carrier communication systems.

Systems and Signal Processing:

Representation of continuous and discrete-time signals, shifting and scaling operations, linear, time- invariant and causal systems,

Fourier series representation of continuous periodic signals, sampling theorem, Fourier and Laplace transforms, Z transforms.

Discrete Fourier transform. FFT, linear convolution, discrete cosine transforms, FIR filter, IIR filter, bilinear transformation.

Control Systems:

Principles of feedback, transfer function, block diagrams, and signal flow graphs, steady-state errors, transforms and their applications: Routh-Hurwitz criterion, Nyquist techniques, Bode plots, root loci, lag, lead and lead-lag compensation. stability analysis, transient and frequency response analysis, state-space model, state transition matrix, controllability and observability, linear state variable feedback. PID and industrial controllers.

Electrical Machines:

Single-phase transformers, three-phase transformers - connections. parallel operation, auto-transformer, energy conversion principles, DC machines - types, windings, generator characteristics, armature reaction, and commutation, starting and speed control of motors, Induction motors principles, types, performance characteristics, starting and speed control, Synchronous machines performance, regulation, parallel operation of generators, motor starting, characteristics and applications, servo and stepper motors.

Power Systems:

Basic power generation concepts, steam, gas and water turbines, transmission line models and performance, cable performance, insulation, corona, and radio interference, power factor correction, symmetrical components, fault analysis, principles of protection systems, basics of solid-state relays and digital protection: Circuit breakers, Radial and ring-main distribution systems, Matrix representation of power systems, load flow analysis, voltage control, and economic operation, System stability concepts, Swing curves and equal area criterion. HVDC transmission and FACTS concepts, Concepts of power system dynamics, distributed generation, solar and wind power, smart grid concepts, environmental implications, fundamentals of power economics.

Power Electronics and Drives:

Semiconductor power diodes, transistors, thyristors, triacs, GTOS, MOSFETS and IGBTs static characteristics and principles of operation, triggering circuits, phase control rectifiers, bridge converters - fully controlled and half controlled, principles of choppers and inverters, basic concepts of adjustable speed DC and AC drives, DC-DC switched-mode converters. DC-AC switched-mode converters, resonant converters, high-frequency inductors and transformers, power supplies.