SYLLABUS FOR WRITTEN TEST & TRADE TEST FOR THE POST OF TECHNICAL SUPERINTENDENT (ELECTRICAL ENGINEERING) (Post Code – 5209)

(A) WRITTEN TEST *(60 Marks)*

Signal Processing: Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, frequency response, digital filter design techniques.

Communications: Random processes: autocorrelation and power spectral density; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: Phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER.

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 controllers.

Analog Circuits: Simple diode circuits: clipping, clamping and rectifiers; BJTs and MOSFETs Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers, Op-amp circuits; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation.

Digital Circuits: Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; Embedded Systems: architecture, programming, memory and I/O interfacing.

Electrical Machines: Single phase transformers, three phase transformers - connections, parallel operation, auto-transformer, 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, basis concepts of adjustable speed dc and ac drives, Synchronous machines - performance, regulation, parallel operation of generators, synchronous motors, V and inverted V curves, starting of synchronous motors.

(B) TRADE TEST *(40 Marks)*

The candidate will be allowed to choose one of the following three topics:

1. Electronic systems: System implementation using programming devices such as Arduino, FPGA, microprocessor/microcontroller. System implementation using Sensors and IoT.

2. Communications and Signal Processing: Implementing various modulation/demodulation schemes and systems, and signal processing algorithms for various applications.

3. Power engineering and Control: Power control, transmission system implementation, PID and other controllers.

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