Selection to the post of

Range Forest Officer in Kerala Forest & Wildlife Department.

Syllabus

Subject: Electrical & Electronics Engineering

Total Marks: 200

Modules: 10

1. **Module 1:**

   Electrical Circuits and Networks – 20 Marks

   Circuit Elements: Ideal voltage and current sources, dependent sources, passive elements (R, L, C, Mutual Inductance);

   Circuit Analysis: KCL, KVL, Node and Mesh analysis, Super-mesh and super-node analysis.

   Network Theorems: Thevenin's, Norton's, Superposition and Maximum Power Transfer theorem, Millman's theorem.

   Transient response of DC and AC networks: RC, RL and RLC networks, time constants, s-domain analysis.

   Sinusoidal steady-state analysis: Phasor and s-domain analysis.

   Series and parallel resonance, Q-factor.

   Network Analysis: Two port networks, z, y, h and T parameters.

   Three-Phase circuits, star-delta transformation, complex power and power factor in AC circuits – Neutral-point shift.

2. **Electromagnetic Fields and Magnetic circuits – [15 marks]**

   Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium, Capacitance of simple configurations, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Inductance, Magnetomotive force, Reluctance, Magnetic circuits, Self and Mutual inductance of simple configurations

3. **Analog Electronics – 20 Marks**

   Diode Circuits: Simple diode circuits: clipping, clamping, rectifiers;

Amplifiers: BJT and MOSFET biasing, equivalent circuit and frequency response – Bandwidth, Gain and output impedance. Power amplifiers – efficiency of class A, B, AB and C amplifiers.

Oscillators and feedback amplifiers: Feedback topologies, Voltage and current feedback ; Barkhausen criteria; RC phase-shift, Wein bridge oscillators.

Operational amplifiers: ideal and non-ideal characteristics-Inverting, non-inverting configurations; Applications: Integrator, differentiator, scaling, summing amplifier circuits, instrumentation amplifier, comparators, Schmitt triggers, 555 timer.

4. Digital Electronics – [15 Marks]

Combinatorial and sequential logic circuits, SoP, PoS, Multiplexers, demultiplexers, Flipflops, Counters (Synchronous and Asynchronous), sample and hold circuits, A/D (SAR) and D/A (Binary weighted and Ladder network) converters.

5. Power Electronics – 20 Marks

Devices: Static V-I characteristics and firing/gating circuits for Thyristor, MOSFET, IGBT;

DC to DC conversion: Buck, Boost and Buck-Boost Converters;

AC-DC Converters: Single and three-phase configuration of uncontrolled rectifiers;

Voltage and Current commutated Thyristor based converters;

Bidirectional ac to dc voltage source converters; Magnitude and Phase of line current harmonics for uncontrolled and thyristor-based converters; Power factor and Distortion Factor of AC to DC converters;

Inverters: Single phase and three-phase voltage and current source inverters, Modulation methods: Sinusoidal pulse width modulation.

6. Signals and Systems – [20 Marks]

Representation of continuous and discrete time signals, shifting and scaling properties, linear time invariant and causal systems, Fourier

series representation of continuous and discrete time periodic signals, sampling theorem, Applications of Fourier Transform for continuous and discrete time signals, Laplace Transform and Z transform. R.M.S. value, average value calculation for any general periodic waveform.

7. Control Systems – [20 Marks]

Mathematical modelling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs, Transient and Steady-state analysis of linear time invariant systems, Stability analysis using Routh-Hurwitz and Nyquist criteria, Bode plots, Root loci, Lag, Lead and Lead-Lag compensators; P, PI and PID controllers; State space model, Solution of state equations of LTI systems.

8. Electrical and Electronic Measurements and Instrumentation – 20 Marks

Error analysis, Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers, Digital voltmeters and multi-meters, Phase, Time and Frequency measurement; Oscilloscopes

9. Electrical Power Systems – 25 Marks

Basic concepts of electrical power generation, AC and DC transmission concepts, Models and performance of transmission lines and cables, Economic Load Dispatch (with and without considering transmission losses), Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Per-unit quantities, Bus admittance matrix, Gauss- Seidel and Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over- current, differential, directional and distance protection; Circuit breakers, System stability concepts, Equal area criterion.

10. Electrical Machines -25 Marks

Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three-phase transformers: connections, vector groups, parallel operation; Auto-transformer;

Electromechanical energy conversion principles;

DC machines: separately excited, series and shunt, motoring and generating mode of operation and their characteristics, losses and efficiency, speed control of dc motors;

Three-phase induction machines: principle of operation, types, performance, torque-speed characteristics, no-load and blocked-rotor tests, equivalent circuit, losses and efficiency, starting and speed control; Operating principle of single-phase induction motors;

Synchronous machines: cylindrical and salient pole machines, performance and characteristics, regulation and parallel operation of generators, starting of synchronous motors; Losses and efficiency.