Detailed syllabus for the post of Assistant Professor in

ELECTRICAL AND ELECTRONICS ENGINEERING

(Cat.NMo. 724/2021)

Max Marks 100

Module I - Electric and Magnetic Circuits [12 marks]

Ideal voltage and current sources, dependent sources, R, L, C and M elements; Network solution methods: KCL, KVL, Node and Mesh analysis; Network theorems: Thevenin's, Norton's, Millman's, superposition and maximum power transfer theorem; transient response of dc and ac networks, sinusoidal steady-state analysis, resonance, two port networks, balanced three phase circuits, star-delta transformation, complex power and power factor in ac circuits.

MMF, field strength, flux density, reluctance, electromagnetic induction

Filters - low pass, high pass and band-pass filters

Module II - Field Theory [6 marks]

Gauss's law and applications, electric field, electric potential, electric field lines, electric dipoles, potential gradient, conductors, dielectrics, capacitance, polarisation, method of images, dielectric strength, Biot-Savart's law, Ampere's circuital law, Stoke's theorem, scalar and vector magnetic potential, force between current carrying wires, Maxwell's equation – wave equation – Poynting theorem.

Module III - Signals and Systems [6 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. RMS value, average value calculation for any general periodic waveform.

Module IV - Electrical Machines [12 marks]

Single phase and three phase transformers – leakage reactance, equivalent circuit, losses and efficiency, voltage regulation, OC, SC and Sumpner's tests, Distribution transformer, all day efficiency, autotransformer – saving of copper three phase transformer – connections, vector groupings, parallel operation.

DC machines – Types of excitation, constructional features, characteristics, applications

DC generator – Emf equation, armature reaction & commutation, characteristics, voltage build up, applications.

DC motor – Torque equation, characteristics of shunt, series & compound motors, necessity & types of starters, speed control, applications, Swinburne's test, Hopkinson's test.

Synchronous machines: - constructional features, winding factor, characteristics

Alternator: Types, synchronous reactance, voltage regulation, emf and mmf methods, short circuit ratio, two reaction theory, alternator on infinite bus, power angle characteristics, parallel operation, effect of variation of power input & excitation.

Synchronous motor – principle of operation, methods of starting, hunting & its reduction.

Three phase induction motor – constructional features, types, slip rotor frequency, power flow, Torque – slip curve, effect of rotor resistance, starting methods, speed control.

Single phase induction motor – double field revolving theory, starting methods.

Module V - Power System [12 marks]

Conventional and non-conventional systems of power generation, power plant economics, load factor, demand factor, diversity factor, Transmission line parameters – inductance and capacitance of transmission lines, T and Π models, GMD and GMR, ABCD constants, overhead lines – arrangement of conductors – sag, economic span, choice of transmission voltage, types of insulators, string efficiency, distribution systems – types, comparison of DC and AC single phase and 3 phase systems.

Per unit quantities, formation of Y bus and Z Bus. Load flow studies – Gauss Seidal, Newton Raphson and Fast decoupled load flow methods.

Faults on power systems – LG, LL, LLG and 3 phase faults. Fault analysis using Z Bus.

Power system stability, steady state transient and dynamic stability, equal area criterion, swing curve.

Protective relays: types and operation, protective zones, different protection schemes.

Circuit breakers – types and operations, selection of circuit breakers, calculation of fault KVA, protection against lightning and over voltages.

Electric traction – speed – time curves – mechanics Electric heating – Advantages, types and applications.

Tariff, Corona, UG cables

Module VI - Electrical System Design [4 marks]

Functions of MCB, MCCB, RCCB, necessity of earthing, types of lamps, illumination design.

Module VII - Control System [12 marks]

Open loop and closed loop system – transfer function, force-voltage & force-current analogy, block diagrams, signal flow graphs – Mason's gain formula – characteristic equation, time domain analysis – transient & steady state responses – time domain specifications & steady state error. Concept of stability – Routh's stability criterion – Root locus – effect of addition of poles and zeros. Frequency domain analysis – Nyquist & Bode plots, gain margins and phase margin, lag, lead and lag-lead compensators and their design using Bode plot.

State space analysis of system – state space models, state transition matrix, relationship between state equations and transfer function, controllability and observability.

Nonlinear system – characteristics, types of non-linearities, describing functions, analysis – concept, singular points – focus, centre, node and saddle points – limit cycle.

Types of signals and systems, sampling process, sampling theorem, convolution of discrete time signals, analysis of LTI systems using Z transforms. DFT and FFT,

Types of digital filters.

Module VIII - Measurements and Instrumentation [6 marks]

Principles of PMMC, moving iron, and electrodynamometer type instruments, error analysis, measurement of voltage, current, power energy and power factor, induction type watt-hour meter, DC bridges and AC bridges, magnetic measurements, Instrument transformers, digital voltmeters and multimeters, digital measurements of frequency, phase angle and time interval.

Electronic energy meter, high voltage measurements, oscilloscopes, data acquisition systems.

Transducers for temperature, force, flow and pressure.

Module IX - Analog and Digital Electronics [12 marks]

BJT and FET amplifiers – biasing circuits, types of amplifiers, low frequency and high frequency considerations. Oscillators and feedback amplifiers.

Operational amplifier parameters, circuits and applications – simple active filters. VCOs and timers.

Combinational and sequential logic circuits – comparators, parity generators and checkers, encoders, decoders, BCD to seven segment decoder, code converters, multiplexers, demultiplexers, adders, flip flops, counters, shift registers, TTL & CMOS logic families.

Schmitt trigger, multivibrators, sample and hold circuits, A to D and D to A converters

Module X - Power Electronics [12 marks]

Thyristors, triacs, GTOs MOSFETs & IGBTs – principles of operation, triggering circuits, phase-controlled rectifiers, bridge converters – fully controlled and half controlled.

Inverters – voltage source inverters– single phase half-bridge & full bridge inverter, pulse width modulation.

DC-DC converters – step-down and step-up choppers – single quadrant, two-quadrant & four quadrant chopper – pulse width modulation.

Switching regulators – buck, boost & buck-boost, Voltage Regulators, SMPS

Basic concepts of ac and dc drives.

Module XI - Microprocessor and Computer Systems [6 marks]

8 bit and 16-bit microprocessor basics, architecture, programming and interfacing. ROM, PROM, EPROM & RAM, memory organisation.

Computer arithmetic - signed and unsigned numbers - addition and subtraction - logical operations.
Basic Structure of computers – functional units, network protocols.

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NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.