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**Uttar Pradesh Public
Service Commission
(UPPCS Mains)**

Exam Syllabus

Optional Subjects
Electrical Engineering

:: PAPER - I ::

(i) IE.M. Theory: Analysis of Electrostatic and magnetostatic Fields, Laplace, Poisson & Maxwell's equation. Electromagnetic wave equations. Poynting's Theorem. Waves on transmission lines. Wave-guides. Microwave resonators.

(ii) Networks & Systems: Systems and signals, Network Theorems and their applications. Transient and steady-state analysis of systems. Transform techniques and circuit analysis, Coupled circuits. Resonant circuits, Balanced three-phase circuits. Network functions. Two-port network. Network parameters. Elements of network synthesis. Elementary active networks.

(iii) Electrical & Electronic Measurement & Instrumentation: Basic methods of Measurement. Error analysis, Electrical Standards. Measurement of voltage, current, power, energy, power-factor, resistance, inductance, capacitance, frequency and loss angles. Indicating instruments. DC and AC Bridges, Electronic measuring instruments. Multi-meter, digital voltmeter, frequency counter, Q-meter, oscilloscope, techniques, special purpose CRO's. Transducers and their classifications. Thermo-couple, thermistor, RTD, LVDT, strain-gauges. Piezo-electric transducers etc., Application of transducers in the measurement of non-electrical quantities like pressure, temperature, displacement, velocity acceleration, flow-rate etc.; Data-acquisition systems.

(iv) Analog & Digital Electronics: semiconductors, semiconductor diodes & zener diode, Bi-polar junction transistor and their parameters. Transistor biasing, analysis of all types of amplifiers including feedback and D.C. amplifiers; Operational amplifiers and their application; Feedback oscillators: Colpitts and Hartley types, waveform generators; Multivibrators; Boolean algebra. Logic gates Combinational and sequential digital circuits. Semiconductor memories. A/D & D/A converters; Microprocessor. Number system and codes, elements of microprocessors & their important applications.

(v) Electrical Machines: D.C. Machines: commutation and armature reaction, characteristics and performance of motors and generators; Applications, starting and speed control. Synchronous generators: Armature reaction, voltage regulation, parallel operation. Single- and Three-phase Induction motors: Principle of operation, performance characteristics, starting, speed control. Synchronous Motors: Principle of operation, performance analysis, Hunting, Synchronous condenser. Transformers: Construction, phasor diagram, equivalent circuit, voltage regulation, Performance, Auto-transformers, instrument transformers. Three-phase transformers.

(vi) Material Science: Theory of Semiconductors, Conductors and insulators. Superconductivity. Various insulators used for Electrical and Electronic applications. Different magnetic materials, properties and applications. Hall Effect.

:: PAPER - II ::

(SECTION-A)

1. Control Engineering: Mathematical Modeling of physical dynamic systems. Block diagram and signal flowgraph. Transfer function. Time-response and frequency-response of linear systems. Error evaluation, Bode Plot, Polar Plot and Nichol's chart, Gain Margin and Phase Margin, Stability of linear feedback control systems. Routh-Hurwitz and Nyquist criteria. Root locus technique. Design of compensators. State variable methods in system modeling, analysis and design. Controllability and Observability and their testing methods. Pole placement, design using state variables feedback. Control system components (Potentiometers, Tachometers, Synchros & Servomotors).

2. Industrial Electronics: Various power semiconductor devices. Thyristor & its protection and series-parallel operation. Single-phase and poly-phase uncontrolled rectifiers. Smoothing filters, D.C. regulated power supplies. Controlled converters and inverters, choppers. Cyclo-converters, A.C. voltage regulators. Application to variable speed drives. Induction and Dielectric heating.

SECTION-B: (HEAVY CURRENT)

(3) Electrical Machines: (Fundamentals of Electro-Mechanical energy conversion. Analysis of Electro-Magnetic torque and induced voltages. The general torque equation.

(ii). Three- Phase Induction motors: Concept of revolving field. Induction motor as transformer. Phasor diagram and equivalent circuit. Performance evaluation. Correlation of induction motor operation with basic torque relations. Torque-speed characteristics. Circle diagram, starting and speed-control methods.

(iii). Synchronous Machines: Generation of e.m.f.; Equivalent circuit, Experimental determination of leakage and synchronous reactances. Theory of salient-pole machines. Power equation. Parallel operation. Transient and sub-transient reactances and time constants. Synchronous motor. Phasor diagram and equivalent circuit. Performance, V-curves. Power factor control, hunting.

(iv). Special Machines: Two-phase A.C. servomotors.-Equivalent circuit and performance; Stepper motors. Methods of operation, Drive amplifiers. Half stepping. Reluctance type stepper motor, Principles and working of universal motor. Single-phase A.C. compensated series motor.

(4) Electric Drives: Fundamentals of electric drive, Rating estimation. Electric braking. Electro-mechanical transients during starting and braking, time and energy calculations. Load equalization. Solid-State control of D.C., Three-phase Induction and Synchronous motors. Applications of electric motors.

(5) Electric Traction: Various Systems of track electrification and their comparison. Mechanics of train movement. Estimation of tractive effort and energy requirement. Electrification and their comparison, Traction motors and their characteristics.

(6) Power System and Protection:

(a). Types of Power Station. Selection of site. General layout of Thermal, Hydro and Nuclear Stations. Economics of different types. Base load and peak load of stations. Pumped-storage Plants.

(b). Transmission and Distribution: A.C. and D.C. Transmission systems. Transmission line parameters and calculations. Performance of Short, Medium and Long transmission lines, A-, B-, C-, D-parameters.

Insulators. Mechanical design of overhead transmission lines and Sag calculation, Corona and its effects, Radio interference. EHVAC and HVDC transmission lines, underground cables. Per unit representation of power system. Symmetrical and unsymmetrical fault analysis. Symmetrical components and their application to fault analysis. Load flow analysis using Gauss-Seidel and Newton-Raphson methods. Fast de-coupled load flow. Steady-state and transient stability. Equal area criterion, Economic operation of power system, incremental fuel costs and fuel rate. Penalty factors. ALFC and AVR control for real-time operation of interconnected power system.

(c). Protection: Principle of arc extinction, Classification of circuit breakers. Restriking phenomenon. Calculation of restriking and recovery voltages. Interruption of small inductive and capacitive currents Testing of Circuit Breakers.

(d). Relaying Principles: Primary and back-Up relaying, over-current, differential, impedance, and direction relaying principles. Constructional details. Protection schemes for transmission line, transformer, generator, and bus protection. Current and potential transformer and their applications in relaying. Traveling waves. Protection against surges, Surge impedance.

(OR)

SECTION-C (Light Current)

(7) Communication System: Amplitude, Frequency and Phase modulation and their comparison, Generation and detection of amplitude, frequency, phase and pulse modulated signals. Modulators and demodulators, Noise problems, Channel efficiency. Sampling theorem. Sound and vision broadcast, transmitting and receiving systems. Antennas and feeders. Transmission lines at Audio, Radio and ultra-high frequencies. Fiber-optics and optical communication systems. Digital communications, pulse code modulation. Data communication, satellite communication. Computer communication system- LAN, ISDN etc. Electronic Exchanges. (a) Microwaves: Electromagnetic waves, unguided media, wave guides. Cavity resonators and Microwave tubes, Magnetrons, Klystrons and TVVT. Solid-State microwave devices. Microwave amplifiers. Microwave receivers. Microwave filters and measurements. Microwave antennas.

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Address: 635, Ground Floor, Main Road, Dr. Mukherjee Nagar, Delhi 110009
Phone No: 011-47354625/ 26 , 9205274741/42, 011-49274400