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Electrical Engineering Syllabus for Uttarakhand State  
Civil Services Main Exam-2011

## ELECTRICAL ENGINEERING

### PAPER-I

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

**(ii) Networks & System:** Systems and signals, Network Theorems and their applications. Transient and state analysis of systems. Transform techniques in circuit analysis laplace transform, fourier transform; Coupled circuits; Resonant circuits; Balanced three-Phase circuits; Network functions. Two port network, Network parameters. Elements of network synthesis Elementary active network. Graph theory.

**(iii) Electrical & Electronic Measurement & Instrumentation:** Basic methods of measurements. Error analysis. Electrical standards: Measurement of voltage, current, power, energy, power factor, resistance, inductance, capacitance, frequency. Loss Angles indicating instruments D.C. and A.C. Bridges. Electronic measuring instruments. Multimeter, digital voltmeter, frequency counter, Q-meter, oscilloscope techniques, special purpose CROs.

Transducers and their classification. Temp., Displacement, strain, pressure, velocity transducers, thermo-couple, thermistor, LVDT, strain gauges, piezo-electric crystal etc. transducers. 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 and Semiconductor diodes & zener-diodes. 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 applications. Analog computers. 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 Systems 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 and performance characteristics, starting and speed control. Synchronous motors: Principle of operation. Performance analysis, Hunting. Synchronous condensers. Transformers: Construction, Phasor diagram, equivalent circuit, voltage regulation, Performance, Auto-transformers, instrument Transformers. Three phase transformers.

**(vi) Material Science:** Band- Theory, Semiconductors. Conductors and insulators. Superconductivity. Various Insulators used for electrical and Electronic applications. Different magnetic materials, properties and application, Hall effect.

### PAPER-II

#### SECTION-A

**(1) Control Engineering :** Mathematical modeling of physical dynamic systems. Block diagram and signal flow graph. Transfer function. Time response and frequency response of linear system . Error evaluation. Bode-plot, polar plot and Nichol's chart, gain margin and phase margin. Stability of linear feedback control system; Routh-Hurwitz and Nyquist criteria. Root locus technique. Design of compensators. State-variable methods in system modeling, analysis and design. Controllability observability and their testing methods. Pole placement design using state variable 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 polyphase rectifiers. Smoothing filters. D.C. regulated power-supplies. Controlled converters and inverters, choppers. Cycle-converters. A.C. voltage regulators. Application to variable speed drives Induction and dielectric heating. Timers and welding circuits.

**SECTION-B (Heavy Currents)****(3) Electrical Machines :**

1. Fundamental of electromechanical energy conversion. Analysis of Electromagnetic torque and induced voltages. The general torque equation.
2. 3-Phase Induction Motors: Concept of revolving field. Induction motor as a 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.
3. Synchronous Machines: Generation of e.m.f. Linear and non-linear analysis. 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.
4. Special Machines: Two phase a.c. servomotors. Equivalent circuit and performance. Stepper motors. Methods of operation. Drive amplifiers. Half stepping. Reluctance type stepper motor. Principle and working of universal motor. Single phase a.c. compensated series motor. Principle and working of schrage motor.

**(4) Electric Drives:** Fundamentals of electric drives. Rating estimation. Electric braking. Electromechanical 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 system of track electrification and their comparison. Mechanics of train movement. Estimation of tractive effort and energy requirement. Traction motors and their characteristics.

**(6) Power Systems and Protection :**

1. Types of Power Station: Selection of site. General layout of thermal, hydro and nuclear stations. Economics of different types. Base load and peak load stations. Pumped storage plants.
2. 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. EHV AC 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-seidal and Newton-Raphson methods. Fast de-coupled load flow. Steady state and transient stability. Equal area criterion. Economic operation of power systems. Incremental fuel costs and fuel rates. Penalty factors. ALFC and AVR control for real time operation of interconnected power systems.
3. Protection: Principles of arc extinction. Classification of circuit breaker. Restriking phenomenon. Calculation of restriking and recovery voltages. Interruption of small inductive and capacitive currents. Testing of circuit breakers.
4. Relaying Principles: Primary and back-up relaying. Over current, differential, impedance and directional relaying principles constructional details. Protection scheme for transmission line, transformer, generator and bus protection, current and potential transformers and their applications in relaying. Travelling waves. Protection against surges. Surge impedance.

Or

**SECTION-C (Light Current)**

**(7) Communication Systems:** Amplitude, frequency and phase modulation and their comparison, generation and detection of amplitude, frequency, phase and pulse modulated signals using oscillators. 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 ultrahigh frequencies.

Fiber optics and optical communication systems. Digital communication, pulse code modulation, data communication, satellite communication, computer communication systems. LAN, ISDN etc. Electronic Exchanges.

**(8) Microwaves:** Electromagnetic waves in guided media, wave guides. Cavity resonators and Microwavetubes, Magnetrons, Klystyons and TWT. Solid state microwave devices. Microwave amplifiers Microwave receivers. Microwave filters and measurements. Microwave antennas.