IES Syllabus (EEE) Electrical Engineering Syllabus

(For both objective and conventional type papers)

PAPER – I

1. **EM Theory:** Electric and Magnetic fields. Gauss's Law and Amperes Law. Fields in dielectrics, conductors and magnetic materials. Maxwell's Equations. Time varying fields. Plane-Wave propagating in dielectric and conducting media. Transmission lines.

2. **Electrical Materials:** Band Theory, Conductors, Semi-conductors and Insulators. Super-conductivity. Insulators for electrical and electronic applications. Magnetic materials. Ferro and Ferri magnetism. Ceramics, Properties and applications. Hall Effect and its applications. Special semi conductors.

3. **Electrical Circuits**: Circuit elements. Kirchoff's Laws. Mesh and nodal analysis. Network theorems and applications. Natural response and forced response. Transient response and Steady state response for arbitrary inputs. Properties of Networks in terms of poles and zeros. Transfer function. Resonant circuits. Threephase circuits. Two-port networks. Elements of two-element network synthesis.

4. **Measurement & Instrumentation** : units and standards. Error analysis, measurement of current, voltage, power, power-factor and energy. Indicating instruments. Measurement of resistance, inductance, capacitance and frequency. Bridge measurements. Electronic measuring instruments. Digital voltmeter and frequency counter. Transducers and their applications to the measurement of non electrical quantities like temperature, pressure, flow-rate displacement, acceleration, noise level, etc. Data acquisition systems. A/D and D/A converters.

5. **Control Systems**: Mathematical modeling of physical systems. Block diagrams and signal flow graphs and their reduction. Time domain and frequency domain analysis of linear dynamical systems. Errors for different types of inputs and stability criteria for feedback systems. Stability analysis using Routh-Hurwitz array, Nyquist plot and Bode plot. Root locus and Nicols chart and the estimation of gain and phase margin. Basic concepts of compensator design. State

variable matrix design. Sampled data system and performance of such a system with the samples in the error channel. Stability of sampled data system. Elements of non-linear control analysis. Control system components, electromechanical, hydraulic, pneumatic components.

PAPER – II

1. **Electrical Machines and Power Transformers:** Magnetic Circuits - Analysis and design of power transformers. Construction and testing. Equivalent circuits. Losses and Efficiency. Regulation. Auto-transformer, 3-phase transformer. Parallel Operation.Basic concepts in rotating machines. EMF, torque, basic machine types. Construction and Operation, Leakage losses and efficiency.B.C. Machines. Construction , excitation methods. Circuit models. Armature reaction and commutation. Characteristics and performance analysis. Generators and motors. Starting and speed control. Testing, losses and efficiency.Synchronous machines. Construction. Circuit model. Operating characteristics and performance analysis. Synchronous reactants. Efficiency. Voltage regulation. Salient -pole machine, parallel operation. Hunting. Short circuit transients.Induction machines. Construction. Principle of Operation. Rotating fields. Characteristics and performance analysis. Determination of circuit model. Circle diagram. Starting and speed control.Fractional KW Motors. Single-phase synchronous and induction motors.

2. **Power Systems:** Types of power stations, Hydro, Thermal and nuclear stations. Pumped storage plants. Economics and operating factors.Power Transmission lines. Modeling and performance characteristics. Voltage control. Load flow studies. Optimal power system operation. Load frequency control. Symmetrical short circuit analysis. ZBus Formulation. Symmetrical Components. Per unit representation. Fault analysis. Transient and steady state stability of power systems. Equal area criterion.Power system transients. Power system protection circuit breakers. Relays. HVDC transmission.

3. **Analog and Digital Electronics and Circuits:** Semi conductor device physics, PN junctions and transistors, circuit models and parameters, FET, Zener, Tunnel, Schottky, photo diodes and their applications, rectifier circuits, voltage regulators and multipliers,

Switching behavior of diodes and transistors.Small signal amplifiers, Biasing circuits, frequency response and improvement, multistage amplifiers and feedback amplifiers, D.C. amplifiers, coupling methods, push pull amplifiers, operational amplifiers, wave shaping circuits. Multivibrators and flip-flops and their applications. Digital logic gauge families, universal gates-combinational circuits for arithmetic and logic operational, sequential logic circuits. Counters, registers, RAM and ROMs.

4. **Microprocessors:** Microprocessor architecture-instruction set and simple assembly language programming. Interfacing for memory and I/O. Application of microprocessors in power systems.

5. **Communication Systems:** Types of modulation; AM, FM, and PM. Demodulators. Noise and bandwidth consideration. Digital communication system. Pulse code modulation and demodulation. Elements of sound and vision broadcasting. Carrier communication. Frequency division and time division multiplexing, telemetry system in power engineering.

6. **Power Electronics:** Power Semiconductor devices. Thyristor. Power transistor, GTOs and MOSFETS. Characteristics and operation. AC to DC converters; 1-phase and 3-phase DC to DC converters; AC regulators. Thyristor controlled reactors; switched capacitor networks.Inverters; single phase and 3-phase. Pulse width modulation. Sinusoidal modulation with uniform sampling. Switched mode power supplies.