

## ANNEXURE-II

### Syllabus for written test for Ph.D Admission in Department of Electrical Engineering

#### **Basic Electrical Engineering:**

D.C. Circuit Analysis: Independent and Dependent sources, Nodal and Mesh circuit analysis, Source equivalence and conversion, Superposition, Thevenin, Norton, Maximum Power Transfer and Reciprocity theorems. AC fundamentals and Circuits: A.C. generation, waveforms, R-L, R-C and R-L-C circuits, Three-phase circuit analysis: Star and Delta connected Systems, voltages, current and power in 3-phase circuits.

#### **Power Systems:**

Transmission Lines: Line Parameters, Inductance-Inductance of solid cylindrical conductor, composite conductor, Concept of G.M.D., Inductance of single conductor with ground return, 2-conductor single phase line, inductance of three phase single circuit, Skin effect and proximity effect, Bundle conductors, Capacitance of isolated conductor, 2-conductor single phase line, Performance of Transmission Lines: Performance of short- length, Performance of medium-length lines: Nominal- T and Nominal- pi representation, Performance of long transmission lines, Interpretation of the long- line equations, SIL, Ferranti effect, Symmetrical and Unsymmetrical Faults: Symmetrical Fault calculations, Symmetrical components of unsymmetrical phasors, sequence impedance and sequence networks, Sequence networks of unloaded generators, Sequence impedances of circuit elements, Unsymmetrical faults in power systems, Single line to ground, line-to-line and double line to ground faults on unloaded generator.

#### **Electrical Machines:**

D.C. machines: Operating principle, construction, characteristics of DC generators and DC motors, starting and speed control. Single-Phase transformer: principle of operation, equivalent circuit, losses, testing, efficiency and voltage regulation. Single-phase induction motor: Operating principle and Starting. Three-phase induction motor: Production of rotating field, Operation, Types, Torque-speed characteristics, speed control.

#### **Control Systems:**

Fundamentals of Control system: Basic Definitions-Linear, Nonlinear, Time Invariant and Time Variant, Continuous and discrete control systems, Classification of control systems, open loop and close loop control systems, Effects of feedback. Mathematical Model of Physical Systems: Introduction, Differential equation representation of physical systems, Transfer function concepts, Block diagram algebra and Signal flow graphs. Time Response Analysis: Introduction, Standard test signals, Performance indices, Time response of first and second order systems, steady state error and their minimization, error coefficients, P, PI and PID type controllers.

#### **Power Electronics:**

Principle of operation, Static and dynamic characteristics of Power diodes, power MOSFET and IGBT. AC to DC converters: single phase and three phase controllers with R, RL load, Estimation of RMS load voltage, RMS load current and input power factor. DC to DC converters: DC choppers using devices other than thyristors, Principle of step up and step down operation. DC to AC converters: Inverters, Types, voltage source and current source inverters, single phase bridge inverters.

**Renewable Energy Sources:**

Renewable energy resources and their importance, Environmental aspects of energy utilization, Solar Energy: Availability of solar energy, nature of solar energy, solar cell energy conversion, efficiency, characteristics, effect of variation of solar insolation and temperature. Wind Energy: Wind resource assessment, power conversion technologies. Bio-Mass, Bio-Gas, Tide and Wave Energies: Basic concepts and principles of operation.