

**ELECTRICAL ENGINEERING :**

Paper – I :

**Electrical Circuits and Network :**

Circuit components, network graphs, KCL, KVL.  
Circuit analysis methods : nodal analysis/mesh analysis, basic network theorems and applications.  
Transient analysis : RL, RC and RLC circuits.  
Sinusoidal steady state analysis, resonant circuits and applications.  
Coupled circuits and applications.  
Balanced 3-phase circuits.  
Two-port networks.

**Signals & Systems :**

Representation of continuous-time and discrete-time signals & systems, Analysis of signals & systems by Laplace Transform and Z-Transform, Poles & Zeroes, Fourier Transform, Sampling and Reconstruction of Signals, analysis of discrete time signals by DFT and FFT.

**Field Theory :**

Electric Field : Gauss's Integral Law, Electric Dipole Fields, Electric Polarisation and its relation to the Permittivity of Di-electric media. Gauss's Law in differential form. Poisson's and Laplace Equations in different co-ordinates. Energy stored in Electric Field.

Magnetic Field : Ampere's Law and Biot-Savart's Law, Faraday's Law of Electromagnetic Induction, Self & Mutual Inductance, Energy in Magnetic Field, Force due to Magnetic Field.

Maxwell's equations, Wave propagation in bounded media. Boundary Conditions. Reflection and Refraction of Plane Waves, Distributed Parameter circuits.

**Analog & Digital Electronics :**

Characteristics and equivalent circuits (large and small-signal) of Diode, BJT, JFET and MOSFET.  
Diode circuits : Clipping, clamping and rectifiers.  
Biasing and bias stability of BJT.  
Amplifiers : Single and multi-stage, differential, operational, feed-back and power.  
OPAMP circuits, Active Filters.  
Sinusoidal oscillators : transistor and OPAMP configurations.  
Function generators and wave-shaping circuits.  
Boolean algebra; minimization of Boolean functions; logic gates.  
Digital IC families (TTL,MOS,CMOS).  
Combinational circuits : Arithmetic circuits, code converters, multi plexers and decoders.  
Sequential circuits : latches and flip-flops, counters and shift-registers.  
Comparators, timers, multivibrators.  
Sample and hold circuits, ADCs and DACs.  
Semiconductor memories.  
Logic implementation using MUX / DMUX and programmable devices (ROM, PLA, FPGA).

**Measurement and Instrumentation :**

Error analysis, measurement of current, voltage, power, energy, power-factor, resistance,

	<p>inductance, capacitance and frequency, bridge measurement, Use of CT and PT.</p> <p>Electronic measuring instruments : multimeter, CRO, digital voltmeter, frequency counter, Q-meter.</p> <p>Transducers : Thermocouple, thermistor, RTD, LVDT, strain-gauge, piezo-electric crystal, use of transducers in measurements of non-electrical quantities.</p> <p>Data acquisition systems.</p> <p><b>Control System :</b></p> <p>Elements of control systems, block-diagram representation, open-loop &amp; closed-loop systems, principles and applications of feed-back.</p> <p>LTI systems : time-domain and transform-domain analysis.</p> <p>Stability : Routh Hurwitz criterion, root loci, Nyquist's criterion, Bode plots.</p> <p>Design of lead-lag compensators.</p> <p>Proportional, PI, PID controllers.</p> <p>State-variable representation and analysis of control systems.</p> <p>Principles of discrete-control system.</p> <p><b>Microprocessors and Microcontrollers :</b></p> <p>Microprocessor architecture, Address/Data and Control lines, Timing Diagram, Internal Registers, Interrupt mechanism (hardware/software), Memory interfacing, I/O interfacing, Programmable Peripheral devices, Microcontrollers and Embedded Processors – its architecture.</p>
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Paper – II :

**Electrical Machines :**

Principles of electromechanical energy conversion : Torque and emf in rotating machines.

DC machines : characteristics and performance analysis, starting and speed control of motors.

Transformers : principles of operation, analysis, regulation, efficiency. 3-phase transformers.

3-phase induction machines and synchronous machines : characteristics, performance analysis, starting, speed control and braking.

Special machines : Stepper motors, brushless DC motors, permanent magnet motors, single-phase induction motors, AC series motors.

**Power Electronics & Electric Drives :**

Semi-conductor power devices : diode, transistor, thyristor, triac, GTO and Power MOSFET – static characteristic and principles of operation.

Diode rectifiers, phase control rectifiers, triggering circuits.

Bridge converters: fully-controlled and half-controlled.

Principles of choppers and inverters.

Basic concepts of speed control of dc and ac motor drives.

Linear power supplies and SMPS.

**Power Systems and Protection :**

Construction and parameters of overhead lines and underground cables,  $\pi$  and T models of lines, principles of active and reactive power transfer, per unit representation, load flow analysis, control of voltage, active and reactive power, frequency control, tie-line control, economic operation, analysis of symmetrical and unsymmetrical faults.

Concept of power system stability : rotor angle stability and voltage stability, swing equation, equal area criterion.

Line compensation, static VAR system, basic concepts of HVDC transmission and Flexible AC Transmission System (FACTS).

Power system protection : principles of overcurrent, differential and distance protection, protection of lines, transformers, busbars and generators.

Circuit breaker : principles of current interruption and arc quenching, restriking voltage, making capacity and breaking capacity, different types of circuit breakers.

Introduction to energy control centre : SCADA and RTUs.

Distribution system : radial and ringmain systems, calculation of voltage drop.

**Analog & Digital Communication :**

Signals and Spectra: properties of Signals and Noise.

Power Spectral Density and Autocorrelation, Random Signals, Random Process.

Analog modulation Techniques : AM, FM and PM.

Pulse Amplitude modulation and digital communication : PAM, Delta, ASK, FSK, PSK, MSK.

Performance of communication systems corrupted by Noise : signal-to-noise ratio, C/I ratio.

**Energy Sources :**

Present Electrical Power Scenario of West Bengal & India (Generation & Utilisation).

Main components of Thermal and Hydel Power Plant.

Basic theory of small Hydropower, Solar (thermal and photovoltaic), Wind & Bio-energy and other renewable sources.

Pollution from energy sources.

Energy Conservation & Storage.

Energy Management and Audit.

**Electrical Utilisation & Illumination Engineering :**

Electric heating. Resistance, Arc & Induction Furnaces - basic principles and application, Dielectric Heating - principles & application.

Radiometric and Photometric quantities, Laws of Illumination, Photometry.

Lamps : incandescent, discharge and solid-state types, their efficacies, features and applications.

Magnetic choke and glow starter operation in TL circuit. Difference between electronic and magnetic ballast.

Luminaire - its functions.

General indoor lighting design by Lumen method.