

- iii. Evolution of Land and Tenancy Reforms (1950-1980) and its economic consequence
- iv. Changing composition of SDP
- v. Social development indicators-health, education, environment
- vi. West Bengal: in relation to other major States of India.

**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>
Paper – II :	<p><b>Electrical Machines :</b></p> <p>Principles of electromechanical energy conversion : Torque and emf in rotating machines.</p> <p>DC machines : characteristics and performance analysis, starting and speed control of motors.</p> <p>Transformers : principles of operation, analysis, regulation, efficiency. 3-phase transformers.</p> <p>3-phase induction machines and synchronous machines : characteristics, performance analysis, starting, speed control and braking.</p> <p>Special machines : Stepper motors, brushless DC motors, permanent magnet motors, single-phase induction motors, AC series motors.</p> <p><b>Power Electronics &amp; Electric Drives :</b></p> <p>Semi-conductor power devices : diode, transistor, thyristor, triac, GTO and Power MOSFET – static characteristic and principles of operation.</p> <p>Diode rectifiers, phase control rectifiers, triggering circuits.</p> <p>Bridge converters: fully-controlled and half-controlled.</p> <p>Principles of choppers and inverters.</p> <p>Basic concepts of speed control of dc and ac motor drives.</p> <p>Linear power supplies and SMPS.</p> <p><b>Power Systems and Protection :</b></p> <p>Construction and parameters of overhead lines and underground cables, <math>\pi</math> 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.</p> <p>Concept of power system stability : rotor angle stability and voltage stability, swing equation, equal area criterion.</p> <p>Line compensation, static VAR system, basic concepts of HVDC transmission and Flexible AC Transmission System (FACTS).</p> <p>Power system protection : principles of overcurrent, differential and distance protection, protection of lines, transformers, busbars and generators.</p>

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.

**GEOGRAPHY :**

Paper - I :

**PRINCIPLES OF GEOGRAPHY (GROUP - A : PHYSICAL GEOGRAPHY)**

**Geomorphology**

Nature and composition of earth's crust; Structure of earth's interior; Origin, distribution and permanency of Continents and Ocean Basins; Theories of isostasy, continental drift, and plate tectonics; Earth movements - types and effects; Fundamental concepts in geomorphology; Gradational processes - weathering and masswasting; Landforms due to fluvial, glacial, aeolian, coastal and karst processes; Evolution of landscape - cyclic and non-cyclic models; Global hydrological cycle.

**Climatology**

Atmosphere - nature, composition and structure; Elements and factors of weather and climate; Insolation and Heat-budget; General circulation of winds, Jet Streams and Monsoons; Condensation and Precipitation; Airmass and fronts; Tropical and Extra-tropical cyclones; Thunderstorm and tornado; Climatic classification - principles and application(Koppen, Thorntwaite, Trewartha); Global climatic changes.

**Oceanography**

Origin of continents and ocean basins; Bottom topography of ocean basins: Indian, Pacific & Atlantic Oceans; Nature, origin and characteristics of continental shelves and slopes, submarine canyons and coral reefs and atolls; Ocean currents: Indian, Pacific and Atlantic oceans; Physical and Chemical properties of ocean water: temperature, salinity and density; TS Diagram and Watermass; Ocean Deposits; Marine Resources.