

Syllabus for the post of Colliery Engineer (Electrical)

General Knowledge / Current Affairs

History, geography, culture, sports, scientific research, knowledge of current events, general politics, Indian constitution, science – inventions & discoveries, economy, banking, finance, capitals, current affairs.

Electric circuits and Electromagnetic Fields

Ideal voltage and current sources, dependent sources; KCL, KVL, Node and Mesh analysis; Network graph; Thevenin's, Norton's, Superposition and Maximum Power Transfer theorems; Transient response of dc and ac networks; sinusoidal steady-state analysis, resonance; two port networks, balanced three phase circuits, star-delta transformation, complex power and power factor in ac circuits.

Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium, Capacitance of simple configurations, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Lorentz force, Inductance, Magneto motive force, Reluctance, Magnetic circuits, Self and Mutual inductance of simple configurations.

Signals and Systems

Representation of continuous and discrete time signals, shifting and scaling properties, Fourier series representation of continuous and discrete time periodic signals, sampling theorem, Applications of Fourier Transform, Laplace Transform and Z transform.

Electrical Machines

Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency.

Three-phase transformers: connections, vector groups, parallel operation; Auto-transformer, Electromechanical energy conversion principles.

DC machines: separately excited, series and shunt, motoring and generating mode of operation and their characteristics, speed control of dc motors.

Three-phase induction machines: principle of operation, types, performance, torque-speed characteristics, no-load and blocked-rotor tests, equivalent circuit, starting and speed control; Single-phase induction motors: Operating principle.

Synchronous machines & DC generators: cylindrical and salient pole machines, performance and characteristics, regulation and parallel operation of generators, starting of synchronous motors; Types of losses and efficiency calculations of electric machines.

Power Systems

Basic concepts of electrical power generation, Models and performance of transmission lines and cables, Electric field distribution and insulators, Distribution systems, Per-unit quantities, Bus impedance & admittance matrix, load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential, directional and distance protection, Circuit breakers, System stability concepts, Equal area criterion, Economic operation.

Control Systems

Mathematical modelling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs, Transient and Steady-state analysis of linear time invariant systems, Stability analysis using Routh and Nyquist criteria, Bode plots, State space model, Solution of state equations of LTI systems, R.M.S. value, average value calculation for any general periodic waveform.

Electrical and Electronic Measurements

Bridges and Potentiometers; Measurement of voltage, current, power, energy and power factor; Instrument transformers, Induction type instruments, Digital voltmeters and multimeters, PMMC, Phase, Time and Frequency measurement; Oscilloscopes, Error analysis.

Analog and Digital Electronics

Simple diode circuits: clipping, clamping, rectifiers.
Amplifiers: biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers.

operational amplifiers: characteristics and applications; single stage active filters, VCOs and timers, combinatorial and sequential logic circuits, multiplexers, demultiplexers, Schmitt triggers, sample and hold circuits, A/D and D/A converters.

Power Electronics

Construction and Characteristics of Power diodes, Static V-I characteristics and firing/gating circuits for Thyristor, MOSFET, IGBT; Phase Controlled (AC to DC) Converters, Bidirectional ac to dc voltage source converters.

DC-DC converter topologies: Principle, operation and analysis for Buck, Boost, Buck-Boost; Voltage and Current commutated Thyristor based converters.
