

**Syllabus for written test to the post of Assistant Engineer (Trainee-Electrical)  
Chhattisgarh State Power Company Limited**

**Section -A** -20 marks - (20 multiple choice type questions of each 1 mark)

General Knowledge

- Current events — National & International
- Constitution of India, Political system and Indian Administrative system
- Knowledge of Chhattisgarh, geographical location, natural resources, industries, education, administrative structure, history & culture of Chhattisgarh, ancient history, freedom struggle, major archaeological tourist centers of the state.

2. Reasoning and arithmetic

- Coding — Decoding
- Number series
- Non-verbal series
- Directions
- Decision making
- Alphabet series
- Clocks & calendars
- Number ranking
- Cube & dice
- Mirror images
- Blood relations
- Arithmetical reasoning
- Embedded figures
- Arithmetic - multiplication, division, addition, subtraction etc.

**Section –B-80 marks - (80 multiple choice type questions of each 1 mark)**

### **1. Electromagnet Field Theory**

Co-ordinate system, Scalar and Vector fields, stokes theorem  
Coulomb's law, Laplace's & Poisson's equations, solution of Laplace's  
equation, Biot-Savart's Law, Ampere's Circuital Law, Magnetic Boundary  
conditions, Scalar Magnetic Potential, Vector Magnetic Potential, Self and  
Mutual Inductances, Faraday's Law, Maxwell's equations, Wave Equations &  
Solution, Pointing Vector.

Network Analysis- Circuit elements, Voltage and current sources, DC  
Circuit analysis, AC circuit under sinusoidal steady state, KCL and KVL  
analysis, magnetically coupled circuits initial conditions, Network topology.

Network Theorem for AC & DC, circuit Frequency domain Analysis-  
Laplace transform, transform of waveform, Network Theorems in transform  
domain, Fourier series, Network Function, Two ports parameters,  
Interconnection of two ports networks.

### **2. Electronics**

Electronics Device and Circuit, Semiconductors diodes, circuit &  
frequency response, analysis of diode circuit, diode application.

Transistor Characteristics: Construction, Principle of operation, VI  
Characteristic, Applications, Limitations and Specification of different types.

Amplifiers: Fixing operating point, h-parameters, voltage gain, current  
gain, input impedance, output impedance, coupled amplifier- cascaded  
amplifiers, High frequency model of transistor, bandwidth of amplifiers.

Feedback Amplifiers and Oscillators: Negative & Positive feedback,  
Power Amplifiers and Tuned Amplifiers, stability consideration.

Number Systems and Codes, Alphanumeric codes: Boolean Algebra,  
Demorgan's Theorem, Boolean expression and logic diagram, Truth table and  
maps.

Combinational Circuits: Design procedure, comparator, Decoder, Demultiplexer, Encoders, Multiplexer.

Sequential Logic Circuit: Clocked sequential circuit, state equations, Registers and Counters, Random Access Memory, Timing Waveform, Programmable Logic Array (PLA), Analog to digital Conversion, Digital to Analog converters.

16-bit 8086 Microprocessor, instruction set, Addressing mode, machine language programming, interface 16-bit microprocessor.

Microcontroller- Architecture of 8051, Interfacing to ADC and DAC.

### **3. Power Electronics Circuit**

Applications and Characteristics of power electronics devices, Commutation techniques, firing of SCR.

Rating and protection of SCR, Series and Parallel operation of SCR, Operation and analysis of rectifier circuits.

Voltage source and current Source Invertor, Harmonics and their reduction techniques.

Principle of chopper operation, Various control strategies in chopper, commutation of chopper and, Cyclo convertor.

### **4. Electrical Instrumentation**

Measuring Instruments types, Accuracy and precision, Error & Error Analysis, Testing and Calibration, Operating, Damping and Controlling torque, Extension of range of instruments.

Instruments transformers, Measurements of power and energy, Energy meter, Tri-vector meter- Maximum demand meter, Amperehour meter, Power factor meter, Frequency Meter, Ohmmeter, Multimeter, Megger & Ratio meter, Earth resistance measurement, Magnetic Measurement.

Bridges & Measurement with bridge circuits, Sources of error in Bridges, Transducers, Classification, Characteristics & Choice of

Transducers, Digital data acquisition systems, Signal Generators, wave analyser, Digital instruments, resolution and sensitivity of Digital meters, Digital display System and indicators, Analog recorders, X-Y recorders.

## 5. Control Engineering

Modeling of dynamic systems: Electrical, Mechanical and hydraulic systems, transfer functions, Open & closed loop systems, Signal flow graph, Mason's Formula, Components of control systems: Error Detectors (Synchros and Potentiometer), Servomotors (AC & DC), techo generator, Power amplifier, stepper motors.

Time-domain analysis of closed loop systems: Time response of first and second order systems, Steady state error & error constants, Feedback control actions: stability analysis, Characteristics equation of closed loop system, root loci, stability of root loci, frequency- Domain analysis, Bode plots, Nyquist stability analysis, relative stability, Frequency- Domain compensation: Design of compensating networks, State-space Analysis, observability, optimal control.

## 6. Power System

Structure and components of power network, Power generation-conventional, non-conventional & generations, Effect of transmission voltage on power system economy, Problems associated with modern large interconnected power system, HVAC and HVDC Systems, Plant Economics.

Transmission Line Components and Under Ground Cabling, Transmission line parameters, Underground Cable- Grading of cables, ionization, Heating of cables, Phenomena of dielectric losses and sheath loss in cables, thermal resistance of cables.

Transmission systems & performance of transmission line Short, Medium and Long transmission line and their representation, Surge Impedance, loading, Interpretation of long line equation and its equivalent equation. Power flow through transmission line, Method of voltage control, Static and rotating VAR generator, transformer control.

Insulator and Mechanical Design, Vibration and Vibration dampers, Types of Insulators for overhead transmission, String efficiency Substation layout, Substation equipment.

Fault Analysis

Symmetrical components, Sequence networks, Current limiting reactors.

Protective Relays- Primary and backup protections, Electromagnetic relays, Static analog and digital relays.

Circuit breakers

Principle of arc quenching, recovery and re-striking voltage, Bulk oil, Minimum oil, Air break, Air blast, SF6, Vacuum circuit breakers and DC circuit breakers, HRC Fuses, testing of circuit breakers.

System protection:

Protection of generators-

Protection of transformers

Protection of transmission lines.

Switching surges, Phenomena of lightning, Insulation, coordination.

## **7. Problem Associated with modern interconnected power system**

Power flow studies- Formulation of Static power flow equation and solutions, Economic operation of power system, Regulating transformers line load ability, capability curves of alternator.

MW frequency control, MVAR voltage control Problem - Control of load bus voltage, Voltage stability, PV Curve for voltage stability, Power System Stability- Steady state, dynamic and transients stability, Swing equation, solution of swing equation, methods of improving transient stability.

SCADA, Concepts of Smart Grid, Energy Management

Energy audit, Energy auditing instruments.

Load curve analysis

  
**DY. General Manager (HR)-II**  
**C.S.P.T.C.L., RAIPUR**

Power factor improvement in power system, Energy Conservation in transportation system, Co-Generation, Energy conservation in Industry and in building heating and lightning.

## 8. Electrical Machine

Transformer

e.m.f. equation, construction, phasor diagrams, equivalent circuit, voltage regulation, losses & testing, Excitation phenomenon Autotransformer.

Rotating Electrical machine- DC Machine, Emf equation, Torque equation, Armature Reaction, Speed control.

Three phase Induction Motor: Principle, construction.

Power factor control, Cogging & Crawling, impact of unbalanced supply and harmonics on performance, speed control, breaking Induction Generator.

Single Phase Induction motor: Construction, Starting Methods Comparison with three phases Induction Motor.

Synchronous machines

Synchronous generators, emf equation, harmonics and their elimination, Armature reaction, determination of equivalent circuit parameters, phasor diagram, Effect of excitation variation.

Salient pole machine, Two reaction theory, phasor diagram, Determination of  $X_d$  and  $X_q$  Power angle equation, Synchronizing power, parallel operation.

Synchronous Motor: Starting Pull in torque, armature reaction, V curves, inverted V curves, Hunting & damper winding, efficiency and losses. Analysis under sudden short circuit, determination of transient parameters, Generalizing theory of Electrical machine, Kron's Primitive machine, Park's and Inverse park's transformation.

9. **Special Motors-** Permanent magnet motors, P.M. synchronous motors, shaded pole motors, Repulsion motor, Universal Motors, Hysteresis Motors,

Reluctance Motors, Stepper Motors, AC-series motors, Linear induction motors, DC & AC servo motors, Magnetic levitation vehicles, Brushless dc motors.

Control of D.C. motors by convertors

Speed and Torque expression, Speed-Torque Characteristics, Four quadrant operation, Closed loop operation of DC motor. Control of D.C. motors by Choppers.

Control of Induction motors: Speed torque characteristics, Variable frequency control of induction motor, PWM control, slip power recovery static Scherbius Drive, Static Kramer Drive.

Control of Synchronous Motors: Operation, Waveform, Speed torque Characteristics.

## **10. Domestic and Industrial Wiring**

Illumination Engineering

Nature of light, units, sensitivity of the eye, luminous efficiency, glare, Various types of lamps, lightning calculation.

Heating Welding and Electrolysis

Electrical heating methods and application, power supply and control.

Different methods of electrical welding and equipment for them. Furnace and welding transformers. Electrolytic principles, laws of electrolysis, electroplating, power supply for electrolytic process.

Traction

Special Features of Traction motors, selection of Traction Motor, Different system of electric traction and transmission requirement, Mechanics of train movement, transmission requirement.

Electric Drives

Individual and collective drives- electrical braking, plugging, rheostatic and regenerative braking, load equalization use of fly wheel, criteria for selection of motors for various industrial drives.