

**SYLLABUS FOR THE RECRUITMENT TEST TO THE POST OF
FIELD ENGINEERS (ELECTRICAL/MECHANICAL)**

Technical Paper - 100 Marks

Duration - 3 Hours

Personal Interview - 50 Marks (for short listed candidates only)

The questions will be of multiple choice.

Technical Paper (100 Marks)

Part A: Common for Electrical and Mechanical Engineers – 20 Marks

1. Magnetism – Nature of Magnetism, Laws of Magnetic force, Magnetic field, Field Intensity, Flux density, Magnetic Potential, Tangent law, Gauss's Theorem, Electromagnetism, Magnetometers.
2. Electrostatic-Nature of Electricity, Electric charge, Coulumb's law, Electric field and intensity, Electric Flux, Electric Potential, Gauss's Theorem Electrometers, Capacitance
3. Electromagnetic induction
4. Magnetic Effect of Current
5. Circuit Theory-Ohm's law, Kirchoff's laws, Network Theorems, etc.
6. Work, Power and Energy
7. Alternating Current (AC) –AC Fundamentals and AC circuits
8. Transformer- Fundamentals
9. Conversion from AC to DC – Single phase.
10. Cells - Primary Cells, Standard Cells, Secondary Cells, Batteries
11. Fundamentals of DC and AC generators
12. Elementary Electronics- Semiconductors, Diodes, Transistors and their applications
13. Thermo-electricity
14. Photo-electricity
15. Computer Fundamentals
16. Thermodynamics
17. Hydraulics, Hydraulic turbines and pumps
18. Fundamentals of Internal Combustion Engines
19. Common Electrical Appliances.
20. I.C. Engines.

PART B: Electrical 40 Marks

1. ELECTRO MAGNETIC THEORY.

Electric and magnetic fields. Gauss's Law and Amperes Law. Fields in dielectrics, conductors and magnetic materials. Maxwell's equations. Time varying fields. Plane Wave propagating in dielectric and conducting media. Transmission lines.

2. ELECTRICAL MATERIALS

Band Theory, Conductors, Semiconductors and Insulators. Superconductivity. Insulators for electrical and electronic applications. Magnetic materials. Ferro and ferri magnetism. Ceramics properties and applications. Hall effect and its applications. Special semiconductors.

3. NETWORK THEORY

Circuits elements. Kirchoff's Laws. Mesh and nodal analysis. Network Theorems and applications. Natural response and forced response. Transient response and steady state response for arbitrary inputs. Properties of networks in terms of poles and zeros. Transfer function. Resonant circuits. Three phase circuits. Two port networks. Elements of two element network synthesis.

4. ELECTRICAL MACHINES

Magnetic Circuits Analysis and Design of Power transformers. Construction and testing. Equivalent circuits. Losses and efficiency. Regulation. Autotransformer, 3 phase transformer. Parallel operation. Basic concepts in rotating machines. EMF, torque, basic machine types. Construction and operation, leakage losses and efficiency.

D.C. Machines. Construction, Excitation methods. Circuit models. Armature reaction and commutation. Characteristics and performance analysis. Generators and motors. Starting and speed control. Testing, Losses and efficiency.

Synchronous Machines. Construction. Circuit model. Operating characteristics and performance analysis. Synchronous reactance. Efficiency. Voltage regulation. Salient pole machine, Parallel operation. Hunting. Short circuit transients.

Induction Machines. Construction. Principle of operation. Rotating fields. Characteristics and performance analysis. Determination of circuit model. Circle diagram. Starting and speed control. Fractional KW motors. Single phase synchronous and induction motors.

5. MEASUREMENT AND INSTRUMENTATION

Units and Standards. Error analysis, measurement of current, Voltage, power, Power factor and energy. Indicating instruments. Measurement of resistance, inductance, Capacitance and frequency. Bridge measurements. Electronic measuring instruments. Digital Voltmeter and frequency counter. Transducers and their applications to the measurement of nonelectrical quantities like temperature, pressure, flowrate displacement, acceleration, noise level etc. Data acquisition systems. A/D and D/A converters.

6. ELECTRICAL POWER SYSTEM

Types of Power Stations, Hydro, Thermal and Nuclear Stations. Pumped storage plants. Economics and operating factors. Power transmission lines. Modeling and performance characteristics. Voltage control. Load flow studies. Optimal power system operation. Load frequency control. Symmetrical short circuit analysis. ZBus formulation. Symmetrical Components. Per Unit representation. Fault analysis. Transient and steady state stability of power systems. Equal area criterion. Power system Transients. Power system Protection Circuit breakers. Relays. HVDC transmission.

7. ANALOG AND DIGITAL ELECTRONICS AND CIRCUIT

Semiconductor device physics, PN junctions and transistors, circuit models and parameters, FET, Zener, tunnel, Schottky, photo diodes and their applications, rectifier circuits, voltage regulators and multipliers, switching behaviour of diodes and transistors. Small signal amplifiers, biasing circuits, frequency response and improvement, multistage amplifiers and feedback amplifiers, D.C. amplifiers and Oscillators. Large signal amplifiers, coupling methods, push pull amplifiers, operational amplifiers, wave shaping circuits. Multivibrators

and flipflops and their applications. Digital logic gate families, universal gates combination circuits for arithmetic and logic operational, sequential logic circuits. Counters, registers, RAM and ROMs.

8. POWER ELECTRONICS AND DRIVES

Semiconductor power diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs static characteristics and principles of operation; triggering circuits; phase control rectifiers; bridge converters fully controlled and half controlled; principles of choppers and inverters; basis concepts of adjustable speed dc and ac drives.

9. MICROPROCESSORS

Microprocessor architecture, Instruction set and simple assembly language programming. Interfacing for memory and I/O. Applications of Microprocessors in power system.

PART B : Mechanical 40 Marks

1. THEORY OF MACHINES.

Simple Mechanism; Friction; Belt, Rope and Chain Drive; Gears; Governors; Brakes and Dynamometers; Cams; Gyroscope.

2. MANUFACTURING SCIENCE.

Basic Machining Process; Types of Machine Tools; Extrusion; Welding; Drilling; Shaping; Boring; Reaming; Milling; Grinding; Finishing Processes; Patternmaking and Foundry.

3. INDUSTRIAL ENGINEERING.

Plant Layout; Material Handling; Work Study; Economic Analysis; Break Even Analysis; Present Value Criterion; Inventory Control; Network Analysis; PERT; CPM.

4. FLUID MECHANICS.

Hydrostatics; Buoyancy; Hydrokinematics; Hydrodynamics; Orifices, Mouthpieces and Nozzles; Flow over Notches and Weirs; Flow in Pipes, Open Channels; Viscous Flow; Flow around Immersed Bodies.

5. HYDRAULIC MACHINES.

Hydraulic Turbines; Pumps;

6. THERMO-DYNAMICS

Properties of Gases; Properties of Steam; Power Cycles; Steam Boilers; Steam Engines; Condenser; Fuels; Combustion of Fuels.

7. HEAT TRANSFER, REFRIGERATION.

Refrigeration Cycles; Refrigeration Equipment; Refrigerants; Psychometrics; Comfort, Cooling and Dehumidification.