



ODISHA STAFF SELECTION COMMISSION

Unit -II, Bhubaneswar - 751001

No. IIE-22/2024- 387 /OSSC;

Date. 22.01.2025

NOTICE

Sub- Publication of syllabus of Technical Paper of Main Written Examination for the post of Junior Engineer (Electrical)- pursuant to Clause-4(a) of Notification No.5161/OSSC dated 23.12.2024 and Advertisement No.1233/OSSC dated 14.03.2024.

As per N.B.-of Clause-4 (a) of Notification No. 5161/OSSC dated 23.12.2024, the syllabus of Technical Paper for Main Written Examination for the post of Junior Engineer (Electrical) under CTSRE-2024 pursuant to Advertisement No.1233/OSSC dated 14.03.2024 is herewith attached below.

By order of the Commission,

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22.01.2025.
Secretary



SYLLABUS OF TECHNICAL PAPER OF MAIN WRITTEN EXAMINATION FOR THE POST OF JUNIOR ENGINEER (ELECTRICAL)

1. Circuit and Network Theory

Magnetic Circuits: Magnetizing force, Intensity, MMF, flux and their relations, Permeability, reluctance and permeance, Analogy between electric and Magnetic Circuits, B-H Curve, Series & parallel magnetic circuit, Hysteresis loop, Coupled Circuits: Self-Inductance and Mutual Inductance, conductively coupled circuit and mutual impedance, Dot convention, Coefficient of coupling, Series and parallel connection of coupled inductors, Circuit Elements and Analysis: Active, Passive, Unilateral & bilateral, Linear & Non-linear elements, Mesh Analysis, Mesh Equations by inspection, Super mesh Analysis, Nodal Analysis, Nodal Equations by inspection, Super node Analysis, Source Transformation Technique, Network Theorems: Star to delta and delta to star transformation, Super position Theorem, Thevenin's Theorem, Norton's Theorem, Maximum power Transfer Theorem, Circuit and Resonance. through R-L, R-C & R-L-C Circuit, Power factor & power triangle, active, reactive, apparent power, resonant frequency of series resonance and parallel resonance circuit, Bandwidth, Selectivity & Q-factor in series circuit, Poly-phase Circuit: Concept of poly-phase system and phase sequence, Relation between phase and line quantities in star & delta connection, Power equation in 3-phase balanced circuit, Measurement of 3-phase power by two wattmeter method, Transients Two-Port Network: Steady state & transient state response, Response to R-L, R-C & RLC circuit under DC condition, Filters: Filter, Classification of pass Band, stop Band and cut-off frequency, Classification of filters, Constant – K low pass filter, Constant – K high pass filter, Constant – K Band pass filter, Constant – K Band elimination filter.

2. Energy Conversion

DC Generators, DC Motors, Single Phase Transformer, Auto Transformer, Instrument Transformers, Alternator (Synchronous Generator), Synchronous Motor, Three Phase Induction motor, Single Phase induction motor, Commutator motors: Repulsion start Motor, Repulsion start Induction run motor, Repulsion Induction motor, Special Electric Machine: Principle & Classification of Stepper motor, Principle of variable reluctance stepper motor, Permanent magnet stepper motor & hybrid stepper motor, Applications of Stepper motor, three phase transformers.

3. Electrical Measurement & Instrumentation

Measuring instruments, Analog ammeters and voltmeters: Moving iron type instruments, Permanent Magnet Moving coil type instruments, Dynamometer type instruments, Rectifier type instruments, Induction type instruments, Extension range of instruments, Wattmeter and measurement of power, Energy meters and measurement of energy, Measurement of speed, frequency and power factor, Measurement of Resistance, Inductance & Capacitance, Sensors and Transducer: Define & Classify transducer, various class of transducer, Resistive transducer, Inductive Transducer, Capacitive Transducer, Piezo electric Transducer and Hall Effect Transducer with their applications, Oscilloscope.

4. Generation Transmission & Distribution

Generation of electricity: Generation of electricity from Thermal, Hydel, Nuclear, Power station, Introduction to Solar Power Plant (Photovoltaic cells), generating stations, Transmission of electric power: Transmission and distribution scheme, Voltage Regulation & efficiency of transmission, Kelvin's law

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for economical size of conductor, Corona and corona loss on transmission lines, Overhead line: Types of supports, size and spacing of conductor, Types of conductor materials, types of insulator and cross arms, Sag in overhead line with support at same level and different level, Performance of short & medium lines: Calculation of regulation and efficiency, EHV Transmission: EHV AC transmission, Reasons for adoption of EHV AC transmission, HV DC transmission, Advantages and Limitations of HVDC transmission system, Distribution System: Distribution System, Connection Schemes of Distribution System: (Radial, Ring Main and Inter connected system), DC distributions, AC distribution system & Underground cable, Economic Aspects, Types of tariffs, Substation.

5. Electrical Installation and Estimating

Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023, Electrical installations: Electrical installations, domestics, industrial, Wiring System, Internal distribution of Electrical Energy. Methods of wiring, systems of wiring, wire and cable, conductor materials used in cables, insulating materials mechanical protection. Types of cables used in internal wiring, multi-stranded cables, voltage grading of cables, general specifications of cables, Accessories, Lighting Scheme, Internal wiring, overhead installation, overhead service lines, Estimating for distribution substations.

6. Switch Gear and Protective Devices

Introduction to switchgear, Fault calculation: Symmetrical faults on 3-phase system, Limitation of fault current, Percentage Reactance, Percentage Reactance and Base KVA, Short – circuit KVA, Reactor control of short circuit currents, Location of reactors, symmetrical Fault calculations, Fuses, Circuit breakers: Definition and principle of Circuit Breaker, Arc phenomenon and principle of Arc Extinction, Methods of Arc Extinction, Arc voltage, Re-striking voltage and Recovery voltage, Classification of circuit Breakers, Switchgear component, Resistance switching, Circuit Breaker Rating, Protective relays: Definition & fundamental requirement of protective relay, Basic Relay operation, Pick-up current, Current setting, Plug setting Multiplier, Time setting Multiplier, Classification of functional relays, Induction type over current relay (Non-directional), Induction type directional power relay, Induction type directional over current relay, Differential relay, Types of protection, Protection of electrical power equipment and lines: Protection of alternator, Differential protection of alternators, Balanced earth fault protection, Protection systems for transformer, Buchholz relay, Protection of Bus bar, Protection of Transmission line, Different pilot wire protection (Merz-price voltage Balance system), protection of feeder by over current and earth fault relay, Protection against over voltage and lighting, Static relay.

7. Utilization of Electrical Energy & Traction

Electrolytic Process, Electrical Heating: Advantages of electrical heating, Mode of heat transfer and Stephen's Law, Principle of Resistance heating, working principle of direct arc furnace and indirect arc furnace, Principle of Induction heating, Principle of dielectric heating and its application, Principle of Microwave heating and its application, Principles of Arc Welding: D. C. & A. C. Arc phenomena, D.C & A. C. arc welding plants of single and multi-operation type, Types of arc welding, principles of resistance welding and different resistance welding methods, Illumination, Industrial Drives, Electric Traction: Explain system of traction, System of Track electrification, Running Characteristics of DC and AC traction motor, control of motor, Regenerative Braking, Braking with 1-phase series motor, Magnetic Braking.

8. Electrical Engineering Material

Conducting materials: Introduction, Resistivity, factors affecting resistivity, Classification of conducting materials into low-resistivity and high resistivity materials, Low Resistivity Materials and their Applications, Stranded conductors, Bundled conductors, Low resistivity copper alloys, High Resistivity Materials and their Applications, Superconductivity, Superconducting materials, Application of superconductor materials, Semiconducting materials: Introduction, Semiconductors, Electron Energy and Energy Band Theory, Excitation of Atoms, Insulators, Semiconductors and Conductors, Semiconductor Materials, Covalent Bonds, Intrinsic Semiconductors, Extrinsic Semiconductors, N-Type Materials, P-Type Materials, Minority and Majority Carriers, Semi-Conductor Materials, Applications of Semiconductor materials, Insulating materials: Introduction, General properties of Insulating Materials, Insulating Materials – Classification, properties, applications, Insulating Gases, Dielectric materials: Introduction, Dielectric Constant of Permittivity, Polarization, Dielectric Loss, Electric Conductivity of Dielectrics and their Break, Properties of Dielectrics, Applications of Dielectrics, Magnetic materials: Introduction, Classification, Magnetization Curve, Hysteresis, Eddy Currents, Curie Point, Magneto-striction, Soft and Hard magnetic Materials, Material for special purposes: Introduction, Structural Materials, Protective Materials, Other Materials (Thermocouple materials, Bimetals, Soldering Materials, Fuse and Fuse materials, Dehydrating material).

9. Control System Engineering

Fundamental of control system, Mathematical model of a system, Control system components: Components of Control System, Gyroscope, Synchros, Tachometer, DC servomotors, AC Servomotors, Block diagram algebra & signal flow graphs, Time response analysis, Analysis of stability by root locus technique, Frequency response of system, Nyquist plot.

10. Testing and Maintenance of Electrical Machine

Installation, Commissioning and Testing of Machine: Inspection of arrival of machine and inspection procedure before its installation, Generalized procedure of installation of Electrical machines, Electric wiring for motors and switch gears, General requirement for Electric Installation according to Indian Electricity rules/Relevant Regulations, Necessity of starters and relays for both DC and AC machines, Testing before giving supply and testing report, Installation, Commissioning and Testing of Transformer: Basic idea on dispatch, inspection, storage and handling of transformer, Civil construction feature regarding connection like ventilation, noise level, space for free movement, Foundation and drainage of oil, Cabling and cable box for transformer, Provision for fire protection, Provision for bushing support location of switch gear, Steps for commissioning fitting of all accessories, Filling of oil, drying out, Charging the breather with fresh silica gel, Cleaning of bushing, fixing of conductor & cables, earthing of tank and cover, neutral earthing, Fixing of protection circuits and setting of relays, Installation, Commissioning & Testing of Sub-station: Design and planning of indoor substation, General requirement of layout of indoor substation and its key diagram, Consideration of safe operation of substation, Installation of outdoor substation, Testing and commissioning of substation, Bus-bar earthing connection, Earthing, Installation of outdoor circuit breaker, Pre-commissioning tests., Maintenance: Fundamental of maintenance, Preventive maintenance and planning, Advantages of Preventive maintenance, Breakdown maintenance: List of tools / instruments and materials used for maintenance, Making or Preparing Maintenance schedule of DC machines, Induction machines, Synchronous machines, Transformer, Transmission line, Distribution lines, Underground cables,

Circuit breakers, Switch gear and protective relays and substations, SF-6 circuit breakers, Batteries in substation.

11. Renewable Energy Systems

Introduction to Renewable energy: Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types & Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources, **Solar Energy:** Solar photovoltaic system-Operating principle, Photovoltaic cell concepts, Classification of energy Sources, Extra-terrestrial and terrestrial Radiation, Azimuth angle, Zenith angle, Hour angle, Irradiance, Solar constant, Solar collectors, Types and performance characteristics, Applications: Photovoltaic - battery charger, domestic lighting, street lighting, water pumping, solar cooker, Solar Pond, **Wind Energy:** Introduction to Wind energy, Wind energy conversion, Types of wind turbines, Aerodynamics of wind rotors, Wind turbine control systems; conversion to electrical power, Induction and synchronous generators, Grid connected and self-excited induction generator operation, Constant voltage and constant frequency generation with power electronic control, Single and double output systems, Characteristics of wind power plant, **Biomass Power:** Energy from Biomass, Biomass as Renewable Energy Source, Types of Biomass Fuels - Solid, Liquid and Gas, Combustion and fermentation, Anaerobic digestion, Types of biogas digester, Wood gasifier, Pyrolysis, Applications: Bio gas, Bio diesel, **Other Energy Sources:** Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems, Ocean Thermal Energy Conversion (OTEC), Geothermal Energy - Classification, Hybrid Energy Systems, Need for Hybrid Systems, Diesel-PV, Wind-PV, Microhydel-PV, Electric and hybrid electric vehicles.

12. Analog Electronics and OP-AMP

P-N Junction Diode: Working of Diode, V-I characteristic of PN junction Diode, DC load line, Important terms such as Ideal Diode, Knee voltage, Junctions break down, P-N Diode clipping Circuit, P-N Diode clamping Circuit, **Special Semiconductor Devices:** Thermistors, Sensors & varistors, Zener Diode, Tunnel Diode, PIN Diode, **Rectifier Circuits & Filters:** Classification of rectifiers, Analysis of half wave, full wave centre tapped and Bridge rectifiers and calculation of DC output current and voltage, RMS output current and voltage, Rectifier efficiency, Ripple factor, Regulation, Transformer utilization factor, Peak inverse voltage, **Filters:** Shunt capacitor filter, Choke input filter & π filter, **Transistors:** Principle of Bipolar junction transistor, Different modes of operation of transistor, Current components in a transistor, Transistor as an amplifier, Transistor circuit configuration & its characteristics, **Transistor Circuits:** Transistor biasing, Stabilization, Stability factor, Different method of Transistors Biasing, **Transistor Amplifiers & Oscillators,** Field Effect Transistor: Classification of FET, Advantages of FET over BJT, Principle of operation of BJT, FET parameters (no mathematical derivation), Biasing of FET, Operational Amplifiers.

13. Power Electronics and PLC

Understand The Construction and Working of Power Electronic Devices: power diode, SCR, DIAC, TRIAC, Power MOSFET, GTO & IGBT, Two transistor analogy of SCR, Gate characteristics of SCR, Switching characteristic of SCR during turn on and turn off, Turn on methods of SCR, Turn off methods of SCR, Voltage and Current ratings of SCR, Protection of SCR, Firing Circuits, Snubber Circuits, Understand the Working of Converters, AC Regulators and Choppers, Understand the Inverters and Cyclo-Converters: Classification

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and working of inverters, Cyclo-converters and its applications, Understand Applications of Power Electronic Circuits, PLC And Its Applications.

14. Digital Electronics & Microprocessor

Basics Of Digital Electronics, Combinational Logic Circuits: Half adder circuit, Full adder circuit, Full subtractor circuit, Operation of 4 X 1 Multiplexers and 1 X 4 demultiplexer ,Binary-Decimal Encoder & 3 X 8 Decoder, Two bit magnitude comparator, Sequential Logic Circuits: SR flip flop, JK flip flop using S-R flip-flop ,Concept of race around condition and master slave JK flip flop, D and T flip flops, Applications of flip flops, modulus of a counter ,4-bit asynchronous counter, Asynchronous decade counter,4-bit synchronous counter, Register and types of registers,8085 Microprocessor: Introduction to Microprocessors, Microcomputers, Architecture of Intel 8085A Microprocessor, Stack, Stack pointer & stack top ,Interrupts , Opcode & Operand, one byte, two byte & three byte instruction, Addressing mode, Fetch Cycle, Machine Cycle, Instruction Cycle, T-State , Timing Diagram for memory read, memory write, I/O read, I/O write ,Timing Diagram for 8085 instruction, Counter and time delay, Simple assembly language programming of 8085, Interfacing and Support Chips.

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