विद्युत पर्यवेक्षक परीक्षा

परीक्षा :– विद्युत पर्यवेक्षक परीक्षा वर्षातून दोनदा, सर्वसाधारणपणे मे व नोव्हेंबर महिन्यात घेण्यात येतील. परीक्षेचे वेळपत्रक मंडळामार्फत अधिसूचित करण्यात येईल.

विद्युत पर्यवेक्षक यांच्यासाठी असलेल्या परीक्षेकरिता उमेदवारांना प्रवेश :

१. परीक्षा प्रवेश:– ही परीक्षा महाराष्ट्र राज्यामध्ये अधिवास असणाऱ्या उमेदवारांसाठी उद्देशीत आहे. उमेदवार अर्जासोबत आवश्यक प्रमाणपत्रे सादर करील.

विद्युत पर्यवेक्षक परीक्षांच्याबाबतीत, नियम २० मध्ये, आणि तारतंत्री परीक्षेच्याबाबतीत नियम २१ मध्ये विनिर्दिष्ट केलेल्या पद्धतीनुसार आणि अनुक्रमे अनुसूची ″एस एस″ व ″ डब्लू एस ″ मध्ये देण्यात आलेल्या पाठ्यक्रमाप्रमाणे प्रत्येक परीक्षा घेण्यात येईल.

२. विद्युत पर्यवेक्षकासाठी परीक्षा:– विद्युत पर्यवेक्षकांची ही परीक्षा महाराष्ट्र राज्यात अधिवास असणा–या आणि वीजतंत्री किंवा पर्यवेक्षक किंवा कार्यदेशक किंवा प्रभार सहाय्यक म्हणून काम करणाऱ्या किंवा अन्य उमेदवारांसाठी उद्देशीत आहे, परंतु कोणत्याही तारतंत्रीला त्याची परीक्षेस बसण्याची इच्छा असेल तर त्याला या परीक्षेला बसता येईल.

३.विद्युत पर्यवेक्षक परीक्षेसाठी अहर्ता व अनुभव :– पर्यवेक्षक परीक्षेसाठीचा उमेदवार पुढीलप्रमाणे असेल :–

(एक) जी व्यक्ती महाराष्ट्र राज्याची अधिवासी आहे;

(दोन) (क) जिने तारतंत्री परीक्षा उत्तीर्ण केलेली आहे व किमान इयत्ता १० वी परीक्षा उत्तीर्ण केलेली आहे.

आणि

(ख) जिला सक्षमता प्रमाणपत्र धारकाच्या किंवा मंडळाचे समाधान होईल असा अहर्ताप्राप्त विद्युत अभियंत्याच्या थेट पर्यवेक्षणाखाली किमान एकूण तीन वर्षाचा प्रत्यक्ष कामाचा अनुभव आहे, त्यापैकी तारतंत्री परीक्षा उत्तीर्ण केल्यानंतर किमान दोन वर्षाच्या प्रत्यक्ष कामाचा अनुभव;

किंवा

(तीन) अखिल भारतीय तंत्र शिक्षण परिषदेने मान्यता दिलेल्या विद्यापीठाची किंवा मंडळाची किंवा संस्थेची विद्युत अभियांत्रिकी पाठ्यक्रमाखेरीज इतर क्षेत्रातील अभियांत्रिकी किंवा तंत्रज्ञान मधील पदवी किंवा पदवीका उत्तीर्ण केलेली आहे आणि सदर परीक्षा उत्तीर्ण झाल्यानंतर विद्युत अभियांत्रिकीच्या क्षेत्रामधील किमान एक वर्षाचा प्रत्यक्ष कामाचा अनुभव आहे असे उमेदवार.

परीक्षेचे विषय

४. विद्युत पर्यवेक्षक परीक्षेची संरचना :- ही परीक्षा लेखी व मौखिक असेल.

(१) लेखी परीक्षेसाठी पुढील प्रश्नपत्रिका असतील व प्रत्येक प्रश्नपत्रिकेसाठी दोन तासांचा अवधी असेल आणि त्या ५० गुणांच्या असतील. विद्युत पर्यवेक्षकाच्या परीक्षेस बसणा–या उमेदवारांसाठी प्रश्नपत्रिका एक व प्रश्नपत्रिका दोन अनिवार्य आहे तर खाणकामाशी संबंधित पयर्वेक्षक परीक्षेसाठी प्रश्नपत्रिका एक व प्रश्नपत्रिका तीन अनिवार्य आहे.

प्रश्नपत्रिका (एक)– विद्युत सिद्धांत (प्राथिमक ज्ञान)

व

प्रश्नपत्रिका (दोन)– घरगुती व औद्योगिक विद्युत संचमांडणी याकरीता पात्र होण्यास इच्छुक असणा–या उमेदवारांकरीता, विजेचे उपयोजन.

किंवा,

प्रश्नपत्रिका (तीन)– खाणीमध्ये विद्युत संचमांडणी याकरीता पात्र होण्यास इच्छुक असणाऱ्या उमेदवारांसाठी खाणी अंतगर्त विद्युत संचमांडणी.

लेखी प्रश्नपत्रिकासाठीच्या अभ्यासक्रमावर आधारित दोन मौखिक परीक्षा एकूण १०० गुणांसाठी घेण्यात येतील, उमेदवारांने परीक्षा उत्तीर्ण होण्यासाठी प्रत्येक लेखी प्रश्नपत्रिकेमध्ये २० गुण आणि मौखिक परीक्षेत एकुण ४० गुण मिळवणे आवश्यक असेल.

मौखिक परीक्षेसह प्रश्नपत्रिका (एक) व (दोन) किंवा प्रश्नपत्रिका (एक) व (तीन) मध्ये उमेदवार उत्तीर्ण झाल्याखेरीज त्याला कोणतेही प्रमाणपत्र देण्यात येणार नाही. प्रश्नपत्रिका (एक) व (दोन) यात उत्तीर्ण झालेल्या आणि खाणीअंतगर्त विद्युतसंचमांडणी यासाठी पात्र होण्यास इच्छुक असलेल्या उमेदवारास प्रश्नपत्रिका (एक) साठीच्या परीक्षेस पुन्हा बसण्यातून सूट मिळेल. पर्यवेक्षकाच्या परीक्षेचा अभ्यासक्रम ″एस एस″ अनुसूचीमध्ये विनिर्दिष्ट केल्याप्रमाणे असेल.

५. विद्युत पर्यवेक्षक परीक्षेसाठी प्रवेश शुल्क :- रुपये **५००/-** ग्रास प्रणालीद्वारे भरणा करावा.

६. विद्युत पर्यवेक्षक परीक्षेच्या अर्जाकरिता आवश्यक कागदपत्रे :-

अ) नमुना १२ "म"

आ) नमुना "सी"

इ) नमुना "डी' (पुनः प्रवेशासाठी)

ई) नमुना "ई"

उ) आवश्यक शैक्षणिक अहर्तेचे प्रमाणपत्र

ऊ) रहिवासी दाखला/ आधार कार्ड

ऋ) विद्युत पर्यवेक्षक परीक्षेसाठी प्रवेश शुल्क पावती.

७. विद्युत पर्यवेक्षक परीक्षेसाठी आवश्यक नमुने :- "Various forms" या टॅब मध्ये उपलब्ध आहे.

८. विद्युत पर्यवेक्षक परीक्षेचा अभ्यासक्रम :-

SCHEDULE "SS"

(See rule 20)

Electrical Supervisor Examination

Syllabus for Examination of Electrical Supervisory Certificate of Competency

Paper - I

Electrical- Theory

1. Principles of Electricity

Electric pressure, current and resistance – Ohm's Law, Kirchhoff's Law, specific resistance, laws of resistance and their application for calculating voltage drop-series and parallel circuit – simple problems. Practical units of voltage, current, resistance, power and energy. Relation between electrical power unit (kW) and mechanical power unit (HP). Inductance, capacitance, reactance and impedances. magnetic, chemical and heating effects of electric current simple problems on above.

2. Electromagnetism

Flux flux density – magnetic field strength, permeability – flux distribution due to straight conductor and circular loop – magnetic circuits – reluctance – calculation of MMF – effect of air gap – hysterisis loop of magnetic materials – force acting on a current carrying conductor – lifting power of a magnet.

Electro magnetic inductance – production of EMF – Flemings Hand Rules – Faraday's and Lenz's Law – statically and dynamically induced EMFs – self and mutual inductance – coupling coefficient. Magnetic properties of materials – electro magnets and their applications.

3. Materials

Conductors, non-conductors and insulators – insulating materials and their relative merits – transformer oil – effect of heat and moisture on insulation – lubricants and their uses – dielectrics – dielectric strength – permittivity.

Different types of wires, cables, switches and their safe current carrying capacity. Use of tables and data sheets generally given in electrical hand book.

4. Generation of electricity

Methods of generation of electric power – Block schematic layout of generating stations – hydroelectric, thermal, nuclear stations. Non conventional energy sources – solar, tidal and wind power. Economics of generation – load factor, diversity factor, plant factor.

5. AC Generators (Alternators)

Basic principle – details of construction and essential components – voltage Rule – methods of voltage Rule – synchronous reactance, Rule, methods of voltage control and frequency control – synchronizing of alternators – conditions and methods for synchronising – synchroscopes – bright lamp and dark lamp methods – simple associated switch board and its accessories.

6. DC Generators

Basic principle – essential components – details of construction – shunt, series and compound generators and their characteristics – causes of sparking interpoles, commutators and their maintenance – carbon brushes – their adjustment and care – voltage Rule – parallel operation of DC generators – shunt, series and compound. simple switch board and its accessories.

7. Batteries

Primary cells, dry cells, storage or secondary batteries – lead acid and nickel cadmium batteries– construction–characteristics– charging and discharging- precaution during charging- charging circuits and their calculation– series and parallel circuits – specification – maintenance – use of hydro meters-.maintenance free batteries, rechargeable batteries,

8. AC Motors

Rotating magnetic field – three phase induction motors – construction – principle of operation – speed – frequency – slip – types – star delta starting. single phase induction motor - construction – different methods of starting. squirrel cage induction motor – slip ring induction motor – construction. Methods of starting – slip torque – slip characteristics – no load and blocked rotor tests – efficiency – circle diagram and determination of characteristics – synchronous motors – general principle of operation – uses – installation – methods of starting and speed control and reversal of direction – commutator motors. Torque calculation and basic knowledge of variable voltage and variable frequency drives (vvvfd). starters-DOL, starter, star/delta starter, rotor resistant starter simple problems based on above.

9. DC Motors

Motor principle – series, shunt and compound wound type motors – their uses, installation – methods of starting – speed control – reversal of directions-3point.starter-4point starter

10. AC Circuits

Alternating current fundamentals – generation of alternating currents – waveform – frequency period – average value, rms value and form factor – different wave forms – phasor representation of alternating quantities – rectangular, polar and exponential forms.

Analysis of simple AC circuits with resistance, inductance and capacitance. Concept of impedence and admittance –Power and power factor in ac circuits – active and reactive components. Solution of RL, RC and RLC circuits – series, parallel and series parallel circuits.

Three phase systems – star and Delta connection – relationship between phase and line values of voltage and current – phasor representation – solution of balanced and unbalanced three phase

circuits – three wire and four wire systems – power in three phase systems – phase sequence – measurement of active and reactive power in single phase and three phase systems. simple problems based on above.

11. Switch gear and protection

Knowledge of various types of switches and protective fuses and circuit breakers like MCBs, MCCBs, RCCBs, ELCBs, ACBs, SF_6 breakers, etc, and protective devices for both AC and DC motors. Basic methods of transformer, generator, motor, and feeder protection. Thermal and magnetic releases – relays – IDMT, instantaneous type – over current, earth fault and earth leakage relays – time and current settings and their wiring with motors. Concepts, features and applications of static (electronic) relays, auto-reclosers, sectionalizes.

12. Transformers

Transformer – construction – use and maintenance – voltage and current relations – losses and efficiency – three phase transformer connections – star/star, delta/delta, star/delta, delta/star, V-V, TT-

Parallel operation of three phase transformers-Auto transformer – transformer tapings, temperature rise, automatic voltage boosters. Instrument transformers current transformers, potential transformers, ratio and phase angle errors, polarity checking, CT and PT specifications.

13. Conversion

Principle of operation of motor – generator set, rotary or synchronous convertors, UPS, inverters, thyristors and other static devices. Battery chargers – voltage equation. Filtering – half wave – full wave and bridge rectifiers.

14. Transmission and Distribution

Bulk transmission of electric power – typical power transmission scheme – need for high transmission voltage. Sub-stations substation equipments – primary and secondary transmission and distribution systems – overhead lines – effect of power factor – general principles and simple problems. Line constants – determination of voltage drop – Rule. construction of lines of voltage upto 250 V and exceeding 250 V but not exceeding 33 kV, types of conductor, length of spans, sags, strength of poles, spacing of conductors, cross-arms, effects of temperature, wind pressure, ice and snow, tension of wire, insulators, brackets, stays, struts, guard wires, vibration dampers and other protective devices. Earthing – lightning arrestors and lightning conductors and their testing. Testing and fault location. inspection of transmission and distribution lines. Concepts and advantages of 3-phase and 1-phase distribution systems of voltage exceeding 650 V but not exceeding 33 kV.

15. Underground cables

Simple calculations and general principles of laying Cables direct in the ground, in troughs and pipes, handling, bending, joining, plumbing, underground and above ground junction boxes. Distribution board and pillars. Joint box compound, melting of compounds and filling boxes with compounds. Testing and fault location – echo test, pressure test, current rating – short time rating and continuous rating – derating factors of cables – basic knowledge of different types of cables – PVC, APVC, AYFY, XLPE – calculation of voltage drop.

16. Illumination and Street lights

Characteristics of different types of lamps – incandescent lamps, fluorescent lamps, CFL lamp, sodium vapour lamps – energy efficient lamps – luminous tube sign installations of voltage exceeding 650 V but not exceeding 33 kV. Photo metric units and simple measurements. General requirements of efficient lighting – simple problems on illumination. Street lighting-time switches. Different types of poles – swaged poles and step up poles. Different types of brackets –

17. Electrical Safety Rules: Working knowledge of

i. Wiring Rules -according to BIS
ii. Protection and restoration of persons suffering from electric shock
iii. Working on over head lines / UG system
iv. Working in switch yard on voltage exceeding 650 V.
v. Preliminary knowledge of Codes of Practices and Specifications prescribed by Bureau of Indian Standards.
vi. Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulation, 2010.

Syllabus for Examination of Electrical Supervisory Certificate of Competency - Paper - II

Electrical Utilisation

1. Design of electrical installations

a. Domestic Installations

Various systems of LT wiring – PVS casing capping & rigid PVC conduit wiring, metal sheathed, conduit and armoured cable for lighting and power in residential premises – types of wires and cables, standards sizes – estimates of material and cost of different types of installations – wiring of temporary installations together with necessary switchgear and portable appliances. Electrical wiring installations for large multi-storied residential buildings.

b. Industrial Installations

Load survey – connected load –maximum demand – demand factor – diversity load centre, selection of sub-station site – transformer capacity – selection of distribution voltage – main switch board – sub-switch board and distribution fuse board – MCC – PMCC – PCC – distribution layout – location of switch boards – circuit diagrams.

2. Earthing

Resistivity of soil – measurement – computation of earth resistance – different materials used for earthing conductors - current densities – corrosion factors – determination of size of earth bus, number of earth electrodes – plate, pipe and strip electrodes – disposition of electrodes – joints in earth conductors – size of earth conductors for equipments of various capacities – earth continuity wire – earth continuity resistance – its rules.

3. Selection of equipments

Different. types of breakers – OCB – ACB – VCB – MCCB – MCB – contactors – breaking capacity – making capacity – selection of breakers –selection of switches – short time and continuous ratings – HRC fuses – uses – selection of HT and LT fuses – grading Switch boards – design of outlets –. Cables – short time and continuous ratings – derating factors – Hazardous areas. Motors–selection of starting methods of motors – DC motors –speed control– limitations on staring current and voltage drop–system disturbance. Motors of voltage exceeding 650 V but not exceeding 33 kV – protection – motor protection relays – capacitors – power factor improvement, Methods of P F improvement , Methods of connection of Special type transformers – furnace transformers– welding transformers – rectifier transformers scott connection – tertiary windings. captive generation – determination of capacity – load segregation – double bus system – changeover arrangements

4. Energy measurements and tariffs

Measurement of Power – Wattmeters, Energy meters, Power factor correction by capacitors – Trivector Meters – Installation and Computation of energy – T.O.D meters. Tariffs – different types for LT and HT consumers – Simple calculations relating to cost of energy.-Concepts and features of electronic/digital metering.

5. Installation, Testing and Maintenance

Insulation tester – earth tester – relay testing kit., Break down test of oil. Single phase and three phase energy meter testing, ammeter, voltmeter, wattmeter – different installation. Recommended values of insulation resistance – desired values. earth resistance measurements – desired values. Polarity tests – test for earth continuity paths – rectification of faults. detection and location of faults in domestic appliances and wiring installations. Relay testing – maintenance of various electrical installations – relevant standards andRules. Protective devices, basic knowledge of earthing of generators, motors, machines, installations and electrical appliances. Lightning protection – calculation of number of down conductors – test joint – lightning arrestors.

6. Cable Jointing

Aluminium and copper cable jointing – types – precautions – termination. Indian Standards.

7. Clearances

Statutory clearances of live parts from ground, buildings – sectional clearances – equipment clearances – clearance of switch boards – oil containing equipments – Indoor and outdoor equipment clearances.

8. Symbols.

List of symbols as per N.E.C/BIS – preparation of simple electrical wiring diagrams and electrical circuit diagrams – reading out simple electrical circuit diagrams.

9. Preparation of Schematic diagrams

Electrical connection for

1. DC and AC generators, switch board, transformers.
2. Main switch boards and sub-switch boards with circuit breakers, switch fuse units, with down stream load details in each circuit.
3. DC and AC motors, their starters, regulators.
4. Battery charging equipment.
5. Converting machinery.
6. Lifts with their safety devices.

10. Special Type of Equipments

Lift, cinema installations – relevant rules – circuitry – safety precautions – earthing – fire precaution measures.

11. Energy Audit and Conservation-concepts and applications

12. SCADA systems and remote data acquisition and control general concepts and applications.

13. Rules and standards: Working knowledge of

1. Central Electricity Authority (Measures relating to safety and Electric supply) Regulations, 2010
2. Code of practice for Cinema and Lift and Escalators Installations.

Syllabus for Examination of Electrical Supervisory Certificate of Competency

PAPER - III

Mines Installations

1. Wiring

Different types of wiring for power and lighting installations underground – different types of permissible types of cables to be used underground and in hazardous areas.

2. Preparation of schematic diagrams

1. DC and AC generators, switch boards, transformers etc.
2. Distribution boards with circuit breakers, switch fuse units with down stream load details in each circuit.
3. DC and AC motors with their starters and capacitors.

4. Battery charger and lamp cabin
3. Apparatus including flame proof apparatus for use in hazardous locations in coal and oil mines flame proof enclosures – general construction – rating plate and diagram of connections – rated voltage and frequency – rate outputs – rating of motors in flame proof enclosures – performance – temperature rise – tests for flame proofness.
4. Installation and maintenance of Electrical Equipments in Mines
1. General requirement of electrical equipment installed in mines – design – layout
2. Electrical protection of circuits and apparatus.
3. Protective measures against risk of electric shock.
4. Intrinsically safe apparatus and circuits.
5. Installation of electrical equipments.
6. Portable and transportable apparatus.
7. Cables.
8. Communication and signalling systems
9. Maintenance of electrical equipments in mines – Special precautions for maintenance of flame proof equipment – Special precautions for maintenance of intrinsically safe equipment
10. Installation and maintenance of:
a) Electrical winders, haulages and pump units, their control gears and starters.
b) Rectifiers, rotary converters and electric locomotives.
5. General principles and elementary knowledge of
1. Supply voltage for transmission, distribution and use underground
2. Control gear – transformers – insulated cables – cable terminal arrangement and sealing boxes – power distribution – motors and motor starters
3. Connected load – maximum demand – demand factor – diversity load centre
4. Power energy consumption in pumping, hauling and mining installations and other face machineries.
6. Power and energy measurement and tariffs
Measurement of power-watt meters – energy meters used in both DC and AC – power factor correction by capacitors – trivector meters – T.O.D. meters – their installation and computation of energy. Single
and three phase static meters and principles of measuring energy consumption.
Tariffs – Different tariffs for LT and HT consumers – simple calculation relating to cost of energy.
7. Testing and fault attendance-
Insulation tester – earth tester – relay testing kit – Schering Bridge, break down test of oil-single phase and three phase energy testing – voltmeter, ammeter and wattmeter testing – different installations – recommended values of insulation resistance – polarisation index – earth resistance measurements – desired values – Test for earth continuity paths – relay testing. detection and location of earth and faults in electrical apparatus and cables in voltage not exceeding 250 V and control circuits.
8. Flexing, trailing cables for portable and transportable apparatus. Knowledge of different types of cables including pliable armoured cables, their installation, maintenance, fault location, efficient repairs by vulcanized joints and testing.
9. Illumination, signalling and telecommunication system in Mines
10. Safety and protective devices
1. Electrical protection of circuits and apparatus – protection against over currents –protection against earth leakage.

2. Protective measures against risk of electrical shock – protection against contact with live parts – insulation resistance – protective earthing.

11. Safety Rules

1. Working knowledge of Central Electricity Authority (Measures relating to safety and Electric Supply) Regulations, 2010, with particular reference to chapter X.

EXAMINATION FOR ELECTRICAL SUPERVISOR

Examination: Electrical Supervisor Examination shall normally be held in May and November in a year. Examination Time table shall be notified by the Licensing Board.

Admission of candidates for examination for Electrical Supervisor:-

1. Admissions to Examination :- Examinations are intended for candidates domiciled in the State of Maharashtra. The candidate shall submit the necessary certificates along with the application form. Every examination shall be conducted in accordance with the method specified in rules 20, in the case of the Electrical Supervisors Examinations and rules 21, in case of Wiremen Examinations and as per syllabus given in Schedule "SS" and "WS" respectively.

2. Examination for Electrical Supervisor:- The examination for the Supervisors are intended for candidates domiciled in the State of Maharashtra and working as Electricians or Supervisors or Foreman or Charge-Hands and others, but, any Wireman may appear for the examination, if he desires to do so.

3.Qualification and experience for Electrical Supervisor Examination:- A candidate for the examination of Supervisors shall be a person

(I) who is domiciled of the State of Maharashtra ;

(II) **(a)** have passed the examination of Wireman and have passed at least 10^{th} Standard;

and

(b) have at least total three years practical experience, under direct supervision of Competency Certificate holder or qualified Electrical Engineer, as may be considered satisfactory by the Board, out of which minimum two years practical experience shall have been gained by the candidate after passing the Wiremen's Examination;

or

(III) have passed degree or diploma in Engineering or Technology other than Electrical Engineering course from the University or Board or Institute approved by the All India Council for Technical Education and practical experience for minimum one year in the field of Electrical Engineering must have been gained by the candidate after passing the Examination.

4. Structure for Electrical Supervisor Examination: - The Examination shall consist of written papers and Oral Examination.

(1) Written examination shall consists of the following Papers each of duration two hours, and each carrying 50 marks. It is compulsory for the candidates to appear for paper I and paper II for Electrical Supervisor and paper I and III for the supervisor dealing with mining operation.

Paper (I) -- Electricity-Theory and

Paper (II) -- Electricity utilization, for the candidates desiring to qualify for Domestic and Industrial Installations.

or

Paper (III) -- Mines Installation for the candidate desiring to qualify for electrical installation in mines

(2) Two Oral examinations based on syllabus for written papers shall be carried out for 100 marks in total. A candidate shall be required to secure 20 marks in each written paper and 40 marks in oral examination for passing the examination. No certificate shall be issued unless the candidate

passes in the papers (I) and (II) or papers (I) and (III) with oral examination. Candidate who passed paper (I) and (II) and desired to qualify for mines installations shall be exempted, from re-appearing in paper (I). Syllabus for the supervisor examination shall be as specified in schedule **"SS".**

5. Fee for Electrical Supervisor Examination: - Rs. 500/- to be paid through GRASS system.

6. Essential documents for application of Electrical Supervisor Examination:-

a) Form "12 M"
b) Form "C"
c) Form "D" (For readmission to examination)
d) For "E"
e) Certificates of educational qualification.
f) Domicile Certificate / Aadhar Card
g) Receipt of prescribed fees for electrical supervisor examination.

7. Formatsfor Electrical Supervisor Examination: Available under the Tab **"Various Forms"**.

8. Syllabus for Electrical Examination:-

SCHEDULE "SS"

(See rule 20)

Electrical Supervisor Examination

Syllabus for Examination of Electrical Supervisory Certificate of Competency

Paper - I

Electrical- Theory

1. Principles of Electricity

Electric pressure, current and resistance – Ohm's Law, Kirchhoff's Law, specific resistance, laws of resistance and their application for calculating voltage drop-series and parallel circuit – simple problems. Practical units of voltage, current, resistance, power and energy. Relation between electrical power unit (kW) and mechanical power unit (HP). Inductance, capacitance, reactance and impedances. magnetic, chemical and heating effects of electric current simple problems on above.

2. Electromagnetism

Flux flux density – magnetic field strength, permeability – flux distribution due to straight conductor and circular loop – magnetic circuits – reluctance – calculation of MMF – effect of air gap – hysterisis loop of magnetic materials – force acting on a current carrying conductor – lifting power of a magnet.

Electro magnetic inductance – production of EMF – Flemings Hand Rules – Faraday's and Lenz's Law – statically and dynamically induced EMFs – self and mutual inductance – coupling coefficient. Magnetic properties of materials – electro magnets and their applications.

3. Materials

Conductors, non-conductors and insulators – insulating materials and their relative merits – transformer oil – effect of heat and moisture on insulation – lubricants and their uses – dielectrics – dielectric strength – permittivity.

Different types of wires, cables, switches and their safe current carrying capacity. Use of tables and data sheets generally given in electrical hand book.

4. Generation of electricity

Methods of generation of electric power – Block schematic layout of generating stations –

hydroelectric, thermal, nuclear stations. Non conventional energy sources – solar, tidal and wind power. Economics of generation – load factor, diversity factor, plant factor.

5. AC Generators (Alternators)

Basic principle – details of construction and essential components – voltage Rule – methods of voltage Rule – synchronous reactance, Rule, methods of voltage control and frequency control – synchronizing of alternators – conditions and methods for synchronising – synchroscopes – bright lamp and dark lamp methods – simple associated switch board and its accessories.

6. DC Generators

Basic principle – essential components – details of construction – shunt, series and compound generators and their characteristics – causes of sparking interpoles, commutators and their maintenance – carbon brushes – their adjustment and care – voltage Rule – parallel operation of DC generators – shunt, series and compound. simple switch board and its accessories.

7. Batteries

Primary cells, dry cells, storage or secondary batteries – lead acid and nickel cadmium batteries– construction–characteristics– charging and discharging- precaution during charging- charging circuits and their calculation– series and parallel circuits – specification – maintenance – use of hydro meters-.maintenance free batteries, rechargeable batteries,

8. AC Motors

Rotating magnetic field – three phase induction motors – construction – principle of operation – speed – frequency – slip – types – star delta starting. single phase induction motor - construction – different methods of starting. squirrel cage induction motor – slip ring induction motor – construction. Methods of starting – slip torque – slip characteristics – no load and blocked rotor tests – efficiency – circle diagram and determination of characteristics – synchronous motors – general principle of operation – uses – installation – methods of starting and speed control and reversal of direction – commutator motors. Torque calculation and basic knowledge of variable voltage and variable frequency drives (vvvfd). starters-DOL, starter, star/delta starter, rotor resistant starter simple problems based on above.

9. DC Motors

Motor principle – series, shunt and compound wound type motors – their uses, installation – methods of starting – speed control – reversal of directions-3point.starter-4point starter

10. AC Circuits

Alternating current fundamentals – generation of alternating currents – waveform – frequency period – average value, rms value and form factor – different wave forms – phasor representation of alternating quantities – rectangular, polar and exponential forms.

Analysis of simple AC circuits with resistance, inductance and capacitance. Concept of impedence and admittance –Power and power factor in ac circuits – active and reactive components. Solution of RL, RC and RLC circuits – series, parallel and series parallel circuits.

Three phase systems – star and Delta connection – relationship between phase and line values of voltage and current – phasor representation – solution of balanced and unbalanced three phase circuits – three wire and four wire systems – power in three phase systems – phase sequence – measurement of active and reactive power in single phase and three phase systems. simple problems based on above.

11. Switch gear and protection

Knowledge of various types of switches and protective fuses and circuit breakers like MCBs, MCCBs, RCCBs, ELCBs, ACBs, SF_6 breakers, etc, and protective devices for both AC and DC motors. Basic methods of transformer, generator, motor, and feeder protection. Thermal and

magnetic releases – relays – IDMT, instantaneous type – over current, earth fault and earth leakage relays – time and current settings and their wiring with motors. Concepts, features and applications of static (electronic) relays, auto-reclosers, sectionalizes.

12. Transformers

Transformer – construction – use and maintenance – voltage and current relations – losses and efficiency – three phase transformer connections – star/star, delta/delta, star/delta, delta/star, V-V, TT-

Parallel operation of three phase transformers-Auto transformer – transformer tapings, temperature rise, automatic voltage boosters. Instrument transformers current transformers, potential transformers, ratio and phase angle errors, polarity checking, CT and PT specifications.

13. Conversion

Principle of operation of motor – generator set, rotary or synchronous convertors, UPS, inverters, thyristors and other static devices. Battery chargers – voltage equation. Filtering – half wave – full wave and bridge rectifiers.

14. Transmission and Distribution

Bulk transmission of electric power – typical power transmission scheme – need for high transmission voltage. Sub-stations substation equipments – primary and secondary transmission and distribution systems – overhead lines – effect of power factor – general principles and simple problems. Line constants – determination of voltage drop – Rule. construction of lines of voltage upto 250 V and exceeding 250 V but not exceeding 33 kV, types of conductor, length of spans, sags, strength of poles, spacing of conductors, cross-arms, effects of temperature, wind pressure, ice and snow, tension of wire, insulators, brackets, stays, struts, guard wires, vibration dampers and other protective devices. Earthing – lightning arrestors and lightning conductors and their testing. Testing and fault location. inspection of transmission and distribution lines. Concepts and advantages of 3-phase and 1-phase distribution systems of voltage exceeding 650 V but not exceeding 33 kV.

15. Underground cables

Simple calculations and general principles of laying Cables direct in the ground, in troughs and pipes, handling, bending, joining, plumbing, underground and above ground junction boxes. Distribution board and pillars. Joint box compound, melting of compounds and filling boxes with compounds. Testing and fault location – echo test, pressure test, current rating – short time rating and continuous rating – derating factors of cables – basic knowledge of different types of cables – PVC, APVC, AYFY, XLPE – calculation of voltage drop.

16. Illumination and Street lights

Characteristics of different types of lamps – incandescent lamps, fluorescent lamps, CFL lamp, sodium vapour lamps – energy efficient lamps – luminous tube sign installations of voltage exceeding 650 V but not exceeding 33 kV. Photo metric units and simple measurements. General requirements of efficient lighting – simple problems on illumination. Street lighting-time switches. Different types of poles – swaged poles and step up poles. Different types of brackets –

17. Electrical Safety Rules: Working knowledge of

i. Wiring Rules -according to BIS

ii. Protection and restoration of persons suffering from electric shock

iii. Working on over head lines / UG system

iv. Working in switch yard on voltage exceeding 650 V.

v. Preliminary knowledge of Codes of Practices and Specifications prescribed by Bureau of Indian Standards.

vi. Central Electricity Authority (Measures relating to Safety and Electric Supply)Regulation, 2010.

Syllabus for Examination of Electrical Supervisory Certificate of Competency -
Paper - II
Electrical Utilisation

1. Design of electrical installations

a. Domestic Installations

Various systems of LT wiring – PVS casing capping & rigid PVC conduit wiring, metal sheathed, conduit and armoured cable for lighting and power in residential premises – types of wires and cables, standards sizes – estimates of material and cost of different types of installations – wiring of temporary installations together with necessary switchgear and portable appliances. Electrical wiring installations for large multi-storied residential buildings.

b. Industrial Installations

Load survey – connected load –maximum demand – demand factor – diversity load centre, selection of sub-station site – transformer capacity – selection of distribution voltage – main switch board – sub-switch board and distribution fuse board – MCC – PMCC – PCC – distribution layout – location of switch boards – circuit diagrams.

2. Earthing

Resistivity of soil – measurement – computation of earth resistance – different materials used for earthing conductors - current densities – corrosion factors – determination of size of earth bus, number of earth electrodes – plate, pipe and strip electrodes – disposition of electrodes – joints in earth conductors – size of earth conductors for equipments of various capacities – earth continuity wire – earth continuity resistance – its rules.

3. Selection of equipments

Different. types of breakers – OCB – ACB – VCB – MCCB – MCB – contactors – breaking capacity – making capacity – selection of breakers –selection of switches – short time and continuous ratings – HRC fuses – uses – selection of HT and LT fuses – grading Switch boards – design of outlets –. Cables – short time and continuous ratings – derating factors – Hazardous areas. Motors–selection of starting methods of motors – DC motors –speed control– limitations on staring current and voltage drop–system disturbance. Motors of voltage exceeding 650 V but not exceeding 33 kV – protection – motor protection relays – capacitors – power factor improvement, Methods of P F improvement , Methods of connection of Special type transformers – furnace transformers– welding transformers – rectifier transformers scott connection – tertiary windings. captive generation – determination of capacity – load segregation – double bus system – changeover arrangements

4. Energy measurements and tariffs

Measurement of Power – Wattmeters, Energy meters, Power factor correction by capacitors – Trivector Meters – Installation and Computation of energy – T.O.D meters. Tariffs – different types for LT and HT consumers – Simple calculations relating to cost of energy.-Concepts and features of electronic/digital metering.

5. Installation, Testing and Maintenance

Insulation tester – earth tester – relay testing kit., Break down test of oil. Single phase and three phase energy meter testing, ammeter, voltmeter, wattmeter – different installation. Recommended values of insulation resistance – desired values. earth resistance measurements – desired values. Polarity tests – test for earth continuity paths – rectification of faults. detection and location of faults in domestic appliances and wiring installations. Relay testing – maintenance of various electrical installations – relevant standards andRules. Protective devices, basic knowledge of earthing of generators, motors, machines, installations and electrical appliances. Lightning protection –

calculation of number of down conductors – test joint – lightning arrestors.

6. Cable Jointing

Aluminium and copper cable jointing – types – precautions – termination. Indian Standards.

7. Clearances

Statutory clearances of live parts from ground, buildings – sectional clearances – equipment clearances – clearance of switch boards – oil containing equipments – Indoor and outdoor equipment clearances.

8. Symbols.

List of symbols as per N.E.C/BIS – preparation of simple electrical wiring diagrams and electrical circuit diagrams – reading out simple electrical circuit diagrams.

9. Preparation of Schematic diagrams

Electrical connection for

1. DC and AC generators, switch board, transformers.
2. Main switch boards and sub-switch boards with circuit breakers, switch fuse units, with down stream load details in each circuit.
3. DC and AC motors, their starters, regulators.
4. Battery charging equipment.
5. Converting machinery.
6. Lifts with their safety devices.

10. Special Type of Equipments

Lift, cinema installations – relevant rules – circuitry – safety precautions – earthing – fire precaution measures.

11. Energy Audit and Conservation-concepts and applications

12. SCADA systems and remote data acquisition and control general concepts and applications.

13. Rules and standards: Working knowledge of

1. Central Electricity Authority (Measures relating to safety and Electric supply) Regulations, 2010
2. Code of practice for Cinema and Lift and Escalators Installations.

Syllabus for Examination of Electrical Supervisory Certificate of Competency

PAPER - III

Mines Installations

1. Wiring

Different types of wiring for power and lighting installations underground – different types of permissible types of cables to be used underground and in hazardous areas.

2. Preparation of schematic diagrams

1. DC and AC generators, switch boards, transformers etc.
2. Distribution boards with circuit breakers, switch fuse units with down stream load details in each circuit.
3. DC and AC motors with their starters and capacitors.
4. Battery charger and lamp cabin

3. Apparatus including flame proof apparatus for use in hazardous locations in coal and oil mines flame proof enclosures – general construction – rating plate and diagram of connections – rated voltage and frequency – rate outputs – rating of motors in flame proof enclosures – performance – temperature rise – tests for flame proofness.

4. Installation and maintenance of Electrical Equipments in Mines

1. General requirement of electrical equipment installed in mines – design – layout
2. Electrical protection of circuits and apparatus.

3. Protective measures against risk of electric shock.
4. Intrinsically safe apparatus and circuits.
5. Installation of electrical equipments.
6. Portable and transportable apparatus.
7. Cables.
8. Communication and signalling systems
9. Maintenance of electrical equipments in mines – Special precautions for maintenance of flame proof equipment – Special precautions for maintenance of intrinsically safe equipment
10. Installation and maintenance of:
a) Electrical winders, haulages and pump units, their control gears and starters.
b) Rectifiers, rotary converters and electric locomotives.
5. General principles and elementary knowledge of
1. Supply voltage for transmission, distribution and use underground
2. Control gear – transformers – insulated cables – cable terminal arrangement and sealing boxes – power distribution – motors and motor starters
3. Connected load – maximum demand – demand factor – diversity load centre
4. Power energy consumption in pumping, hauling and mining installations and other face machineries.
6. Power and energy measurement and tariffs
Measurement of power-watt meters – energy meters used in both DC and AC – power factor correction by capacitors – trivector meters – T.O.D. meters – their installation and computation of energy. Single
and three phase static meters and principles of measuring energy consumption.
Tariffs – Different tariffs for LT and HT consumers – simple calculation relating to cost of energy.
7. Testing and fault attendance-
Insulation tester – earth tester – relay testing kit – Schering Bridge, break down test of oil-single phase and three phase energy testing – voltmeter, ammeter and wattmeter testing – different installations – recommended values of insulation resistance – polarisation index – earth resistance measurements – desired values – Test for earth continuity paths – relay testing. detection and location of earth and faults in electrical apparatus and cables in voltage not exceeding 250 V and control circuits.
8. Flexing, trailing cables for portable and transportable apparatus. Knowledge of different types of cables including pliable armoured cables, their installation, maintenance, fault location, efficient repairs by vulcanized joints and testing.
9. Illumination, signalling and telecommunication system in Mines
10. Safety and protective devices
1. Electrical protection of circuits and apparatus – protection against over currents –protection against earth leakage.
2. Protective measures against risk of electrical shock – protection against contact with live parts – insulation resistance – protective earthing.
11. Safety Rules
1. Working knowledge of Central Electricity Authority (Measures relating to safety and Electric Supply) Regulations, 2010, with particular reference to chapter X.