ANNEXURE – I

SYLLABUS FOR ELECTRICAL SUPERVISOR CERTIFICATE OF COMPETENCY (SCC – MV)

Electrical Engineering Paper (Written Test)

Paper – I & Paper – II for General Category of S.C.C. Examination

Paper – I & Paper – III for Mining Category of S.C.C. Examination

PAPER – I

(Common Syllabus for General & Mining category)

Electricity Theory (Elementary Knowledge)

Principles of Electricity – Electric voltage, Current and resistance, Ohm's law – specific resistance, Laws of resistance and their application for calculating voltage drop, series and parallel circuits, Practical units of voltage, current, resistance, power and energy. Relation between electrical power unit (KW) and Mechanical Power Units (HP).

Electro Magnetism – Concept of Electro Magnetic Force (EMF), production of E.M.F., Flemings Right and Left Hand Rules, Magnetic, Chemical and heating effects of electric current. Magnetic properties of material, Electromagnets and their various applications.

Materials – Conductors, Semiconductors and insulator materials and their relative merits. Transformer oil, Effect of heat and moisture on insulation. Lubricants and their uses.

Different types of wires, cables, switches, circuit breakers, cutouts, etc,

Generation of Electricity – Sources of natural energy. Renewable and Non-Renewable source methods of production of electricity both Alternating Current and Direct Current.

A.C. Generators (Alternators) – Essential components and constructional feature, Methods of voltage and frequency control conditions and methods for synchronizing, simple associated switch board and its accessories.

D.C. Generators – Essential components and constructional features, Shunt, series and compound dynamos and their characteristics, causes for sparking. Interpoles, Commutators and their maintenance. Carbon brushes, their adjustment and care. Methods of voltage regulation. Conditions for parallel operation, simple associated switch board and its accessories.

Batteries – Primary cells, Dry cells, storage or secondary batteries or accumulators and their installations. Lead acid cells, Nickel, Iron or Alkaline cells. Initial and subsequent charging of batteries. Charging circuits and their calculations. Series and parallel circuits. Maintenance of batteries. Use of Hydrometers.

A.C. Motors – Theory of induction (squirrel cage and slip-ring type) synchronous and commutator motors, their uses, installation, method of starting, speed control and reversal of direction.

D.C. Motors – Theory of series, shut and compound wound type motors, their uses, installation, method of starting, speed control and reversal of direction.

A.C. Circuits – Knowledge of vectors. Phase and phase difference. Resistance, inductance and capacitance in an A.C. Circuit. Periodicity or frequency. Power and power factor. Single phase and three phase systems. Star and delta connections. Phase sequence.

Controlling and Regulating Gear – Knowledge of various types of switches, circuit breakers, cutouts, starters, regulators and protective devices for both A.C. and D.C. motors and their wiring with the motors.

Transformation – Knowledge of single phase and three phase transformers, their construction, use and maintenance. Phasing out, parallel working, auto transformer, transformer tappings, temperature rise, instrument transformer.

Conversions – Principle of operation of motor generator sets, rotary convertors and mercury are rectifiers.

Transmission and Distribution –

Overhead Lines – Simple calculations and general principles of construction of low, medium and high voltage lines. Size of conductors, length of spans, sag, strength of poles, spacing of conductor, cross arms, effect of temperature, wind pressure, ice and snow, tension on wire. Insulators, brackets, stays, struts, guard wires and other protective devices. Earthing, lighting arrestors, lighting conductors and their testing and fault location.

Underground Cables – underground cables, simple calculations and general principles of laying cables direct in ground, introughs and pipes. Handling, bending, jointing, plumbing. Underground and above ground junction boxes. Distribution board and pillars. Joint box compound, melting of compound and filling boxes with compound. Testing and fault location.

Illumination – Metal filament lamps, fluorescent lamp circuits, high voltage luminous tube sign installations. Photometric units and simple measurements. General requirements of efficient lighting and elementary calculations. Street lighting. Time switches.

Generation: –

(a) DC and AC power supply for auxiliaries, arrangement of unit auxiliary and station service boards, station lighting and automatic changeover. Station batteries and charging methods. Standby and emergency power and lighting systems.

(b) Testing & Measurement – Working principle and basis of instrument and measurements. Details of measuring instruments for pressure, flow, temperature, level, vibration, alignment and current, voltage, power, reactive power, frequency, energy, winding temperature, auto controllers, recorder, insulation, tester, its use for primary detection of faults, data acquisition system, digital distributed control, UPS etc. Testing of electrical & mechanical testing equipments.

(c) Control & Protection – Sequential operation & interlocks, general machine start/stop, sequence of operation.

SAFETY RULES – Working Knowledge of –

(a) Safety regulation -2010 of CEA (Measures relating to safety and electric supply)

(b) Fire safety procedures, fire protection of generators, transformer and fire fighting and emulsifyer type protection, regarding Factory Act, Electricity Act-2003.

Protection and restoration of persons suffering from electric shock.

PAPER – II

Syllabus for General Category of SCC (MV)

Electricity Utilization for –

***Domestic installation* –**

- WIRING - Wiring layout of different types such as cleat, metal sheathed, wood casing and capping, cab type sheathed, conduit and armoured cable for lighting and power installations in residential premises together with the necessary switchgear, estimate of materials and cost of different types of installations. Wiring of temporary installations and portable appliances.

- CIRCUIT DIAGRAM **–** Electrical connections of various circuits for (i) House wiring including those for main and sub-distribution boards, switches and cutouts etc. together with the load statement for each circuit, (ii) Lifts with their safety devices.

- APPARATUS **–** Installations and maintenance of heaters, cookers, refrigerators and other domestic appliances. Electric bells and indicators. Small motors for pumps and electric lifts.

- ENERGY MEASUREMENT AND CHARGES **–** Energy meters both D.C. and A.C. for house service.

- SIMPLE CALCULATION – Simple calculations relating to cost of energy, elementary knowledge of methods of charging for energy.

- TESTING AND FAULT ATTENDANCE – Detection and location of faults in domestic appliances and wiring installations. Insulation and continuity test. Rectification of faults. Tests for insulation resistance to earth. Earth testing.

- PROTECTIVE DEVICES – Elementary knowledge of the use of fuses and cutouts, earthing of domestic appliances, motors etc. use of lighting arrestors.

Industrial installation –

- WIRING **–** Wiring layouts of different types such as cleat, wood casing and capping, metal sheathed, cab type sheathed, conduit and armoured cables for lighting and power installations in industrial premises together; with the necessary switchgear. Estimates of materials and cost of different type of installations. Wiring of temporary installations and portable appliances.

- CIRCUIT DIAGRAMS **–** Electrical connections for – D.C. & A.C. Motors, their starters regulators, Main and sub-distributing boards with circuit breakers, switches, fuse units with load statement for each circuit, D.C. & A.C. Motors, their starters regulators, Battery charging equipments, Converting machinery, Lifts with their safety devices.

- PUMP INSTALLATIONS **–** General principles and elementary calculations of head, power and energy requirements.

- APPARATUS **–** Installation and maintenance of generators, electric motors, electric lifts, electric furnaces, electric welding plants, haulage and winding machines, cooling and heating appliances.

- POWER AND ENERGY MEASUREMENT AND CHARGES **–** Measurement of power, Wattmeters, energy meters both D.C. & A.C., power factor correction by capacitors.

- SIMPLE CALCULATION – Simple calculations relating to cost of power and energy, elementary knowledge of methods of charging for demand and energy.

- TESTING AND FAULT ATTENDANCE **–** Detection and location of faults in D.C. & A.C. generators, motors, overhead distribution lines and underground cables, electric instruments and apparatus and wiring installations. Rectification of faults, Insulations and continuity tests. Tests for insulations resistance to each earth testing.

- PROTECTIVE DEVICES **–** Elementary knowledge of earthing of generators, motors, machines, installations and appliances. Use of lighting arrestors, fuses including high rupturing capacity fuses, cutouts, circuit breakers, over load and no volt protections, thermal trips, filed breaking switches and over speed protection.

PAPER - III

Syllabus for Mining Category of SCC(MV)

Mines installations –

- WIRINGS **–** Wiring layouts of different types such as cleats, lead covered, cab type sheathed for lighting purposes and armoured cables for power installations, different types of trailing cables and their use.

- CIRCUIT DIAGRAMS **–** Electrical connections for –: • D.C. & A.C. generators, switch boards, transformers etc. • Distribution boards with circuit breakers switches, fuse units and gate-end switches. • D.C. & A.C. motors, their starters and regulators.

- APPARATUS **–** Installation and maintenance of –: • Electrical Winders, haulages and pump units, their control gears and starters. • Rectifiers rotary convertors and electric locomotives. • Portable and transportable machineries, coal cutting machines, loaders, conveyors, gate-end switches. Drill panels with drill units and their control systems. • General principles and elementary calculations of load, power and energy consumption in pumping, hauling and winding installations and other working face machineries.

- POWER AND ENERGY MEASUREMENT AND CHARGES **–** Measurement of power, Wattmeters, energy meters both D.C. & A.C. power factor correction by capacitors. Simple calculations relating to cost of power and energy. Elementary knowledge of methods of charging for demand and energy.

- TESTING AND FAULT ATTENDANCE **–** Detection and location of earth or other faults in electrical apparatus and cables. Insulation and continuity test. Rectification of faults. Test for insulation resistance to earth. Testing of leakage, protective devices. Earth testing.

- PROTECTIVE DEVICES **–** Elementary knowledge of earthing of metal frames of machineries. Use of fuses. Over-load, no-volt and earth leakage protection of circuit breakers.

SAFETY RULES – Working knowledge of –: The CEA Safety Regulation -2010 i.e. (Measures relating safety and Electric supply) for mining installation.

ANNEXURE -II

SYLLABUS FOR ELECTRICAL SUPERVISOR CERTIFICATE OF COMPETENCY (SCC – HT)

PAPER – I

1. Subject covered under the syllabus for supervisor (MV) (General) Paper-I (Refer : Annexure-I) and the following:

2. *HT Overhead Lines – 11 KV & up to 33 KV:*

- Survey, Design, Construction standards, Foundation, Erection, Stringing and Construction equipments.
- Testing, Fault locations, commissioning, Maintenance and Protections, including safety devices and testing equipments.
- Selection of supports, cross arms brackets, stays, struts, insulators and associated hardware.
- Types and size of conductors. Length of spans, sag, spacing of conductors, effect of temperature, wind pressure, ice and snow on tension of conductors, lighting on conductors.
- Knowledge about construction standards of REC & CBIP for lines, sub-station and other equipments utilized in this HT system.
- General requirements of earthing, lighting arresters, guard wires, relays and other protective devices. Each type of earthing, size of earth conductor, pole earthing, lighting arrester earthing etc.

3. *HT Cables – 11 KV & 33 KV and Control Cables:*

1. Criteria for selection of power cables, types of cables, continuous current ratings of underground cables, short time loading of power cables, rating factors for intermittent loading, power factor of cables.
2. Guidelines for cable laying, recommendation and checklist for supervising cable laying work, termination, jointing, plumbing of cables, crimp connection.
3. Underground and surface junction boxes. Fault locating in underground cables, power cable sheath fault. Equipments used & methodology for locating fault in pilot cable etc.

34. *HT Sub-stations and Control Room:*

4. Layout, Design, Construction standards of HT Transformers and associated equipments (i.e. CBs, Insulators, LAs, Capacitors, CTs, PTs etc.). Gas insulated switchgear & sub-station. Sub-station earthing, Earth Mat, Tower groundup.
5. Power and distribution transformers, their erection, commissioning, fault locations and maintenance.
6. Protective relays and measuring equipments and their networking.
7. Testing, Commissioning, fault locations, maintenance and protection of HT cables and testing equipments.
8. Design and installation of capacitor banks and their maintenance.
9. Erection, Testing, Commissioning and Maintenance of Control Room equipments including station batteries and communication system.

5. *HT Motors and Generators (DC and AC):*

- Installation, Testing, Commissioning, protection and Control and Maintenance of HT Industrial Motors.
- Working of generating plants and power stations (Hydro Thermal, Nuclear etc.) including auxiliaries and their maintenance.
- Insulating materials, operating temperatures.

6. Working of Alternators, convertors and rectifiers and their applications.

7. Electrical Traction and selection of motors for Electrical locomotives.

8. Use and maintenance of High Voltage apparatus like x-ray machines, welding machines, neon signs etc.

9. Operational knowledge on measuring instruments i.e. oscilloscopes Ammeters, Voltmeters, Multimeters, VTVM, Tongue Testers, Meggers, HV testing Kits etc.

10. Generation, Transmission and Distribution of the State, Inter-State and the Central Net-Work.

11. Illumination, Fire fighting and Earthing systems including their maintenance.

12. Tariffs, including HT Tariffs, method of charging for demand and energy, power factor and billing.

13. Basics on operation and data analysis of computer, as relevant to the operation and maintenance in electrical net-works.

14. Preparation, representation, interpretation of electrical drawings and execution of electrical works.

15. Specifications, evaluation, analysis of electrical schemes, tendering, purchase orders, procurements, stores, inventory etc.

16. Conversant with electricity Act -2003, CEA safety regulation and the distribution code of OERC.

PAPER – II

1. Subject covered under the syllabus for supervisor (MV) (General) Paper-II (Refer : Annexure-I) and the following:

2. *HT Overhead Lines – 11 KV and up to 33 KV:*

- Survey, Design, Construction Standards, Foundation Erection, Stringing and Construction equipments.
- Testing, fault locations, commissioning, maintenance and protections including safety devices and testing equipments.
- Selection of supports, cross arms, brackets, stays struts insulators and associated hardwares.
- Types and size of conductors, length of spans, sag, spacing of conductors, effect of temperature, wind pressure, ice and snow on tension of conductors, lighting on conductor.
- Earthings, lighting arresters, guard wires, relays and other proactive devices.

3. *HT Cables – 11 KV and 33 KV and Control Cables*:

- Classification of cables, criteria for the selection of power cables, PVC & XLPE underground cables. Classification of tests for cables laying, safe handling of cable drums, cable joints, cable terminations, crimp connections, maintenance of electric cable, flexible cable, flexible cables for portable machines, faults in underground cables system, methods of fault location underground cable system.

4. *HT Sub-Stations and Control Room:*

- Layout, design, construction standards of HT transformers and associated equipments (i.e. CBs, Isolators, Las, Capacitors, CTs, PTs, etc)
- Power and distribution transformers – their erection, commissioning, fault locations, and maintenance.
- Protective relays and measuring equipments and their networking, Transformer protection, Generator, Diesel Generator protection.
- Testing commissioning, fault locations, maintenance and protection of HT cables and testing equipments.
- Design and installation of capacitor banks and their maintenance.
- Erection, testing, commissioning and maintenance of control room equipments including station batteries and communication system.

5. *HT Motors and Generators (DC and AC):*

- Installation, testing, commissioning, protection and control and maintenance of HT industrial motors.
- Working of Generating plants and power stations (Hydro, Thermal, Nuclear etc) including auxiliaries and their maintenance.

6. Working of Alternators, convertors and rectifiers and their applications.

7. Operational knowledge on measuring instruments i.e Oscilloscopes Ammeters, Voltmeters, Multimeters, VTVM, Tongue Testers, Meggers, HV testing kits etc.

8. Illumination, fire fighting and earthing systems including maintenance.

9. Preparation, representation, interpretation of electrical drawings and execution of electrical works.

10. Flame proof equipment / intensically safe for underground switch board, panels, breakers etc. for underground.

11. Basics on operation and date analysis of computer as relevant to the operation and maintenance in electrical net-works.

12. Conversant with electricity Act-2003, Safety Regulation-2010 of CEA.