



TRAINING STANDARDS

Bachelor of Technology Honours in Engineering (Electrical Engineering specialization)

Department of Electrical and Computer Engineering

Faculty of Engineering Technology

The Open University of Sri Lanka.

SPECIALIZATION: ELECTRICAL ENGINEERING

SECTION 1: GENERAL

1. Period of training: The student who follows BTechHons(Engineering)(Electrical) degree programme should undergo minimum of twenty six (26) weeks of industrial training.
2. Training Types: The student should undergo two types of training:
 - Electronics
 - Electrical Power
3. Student should spend minimum of ten weeks (10) for electronic training
4. Student should spend at least sixteen weeks (16) for electrical power training
5. Training placements: The student need to undergo training in an establishment, which is recognized by the NAITA as a place suitable for the undergraduate training for the electrical engineering specialization.
6. If the student has working experience in the relevant filed more than six months, such student may not be needed to undergo the training. In such situations the student is evaluated based on her/his working experience.
7. Apart from the specific areas that should be covered during the period of training, the trainee should get the exposure to the general topics as described in the table below

General areas of exposure	Details
Organization	Vision and mission of the organization Organization structure Main divisions, branches, units etc Main products and market share Facilities available
Human resource management	EPF, ETF, insurance, compensations Welfare activities Recruitment procedures Leave and grievance handling Training, professional development
Occupational health and safety	Guidelines and procedures
Resource management	Waste management Technologies involved On-site generation of energy/resources etc

SECTION 2: ELECTRONIC TRAINING

SECTION 2.1: GENERAL

1. Duration: Student should spend minimum of ten (10) weeks for electronic training
2. Major areas: Electronic training (for the electrical power undergraduates) is divided into following major areas:
 - a) Installation and commissioning of electronic systems
 - b) Electronic repairs and maintenance
 - c) Installation and maintenance of computer systems
 - d) Installation and management of computer and communication networks
 - e) Design and construction of electronic circuits, devices and systems
 - f) Installation/maintenance of storage batteries, rectifiers and convertors

SECTION 2.2: SPECIFIC TOPICS

- a) **Installation and commissioning of electronic systems**
 - i. Familiarize with the specification of individual components and the overall system specifications.
 - ii. Study the national and international standards for different electronic components.
 - iii. Familiarise with the standard installation and commissioning procedures.
 - iv. Familiarise with the safety precautions and measures to be followed during installations.
 - v. Familiarise with System Integration Testing (SIT).
 - vi. Perform the Performance Acceptance Test (PAT).
- b) **Electronic repairs and maintenance**
 - i. Familiarize with the methodical fault diagnosis procedures.
 - ii. Apply proper fault isolation techniques.
 - iii. Familiarize with safety measures and standards to follow during the electronic repairs.
 - iv. Perform appropriate after-repair testing.
 - v. Familiarize with the standard routine maintenance practices and procedures in electronic systems.
- c) **Installation and maintenance of computer systems**
 - i. Study the architecture and the configurations of the computer systems.
 - ii. Familiarizewith the latest technologies in computer hardware engineering.
 - iii. Perform standard assembling procedure.
 - iv. Perform standard hardware and software configurations.
 - v. Familiarize with the environmental, safety and ethical issues related to computer systems.
 - vi. Acquaint with computer fault diagnostics and troubleshooting.
 - vii. Perform routine preventive maintenance in computer systems.
- d) **Installation and management of computer and communication networks**

- i. Familiarize with the modern networking/communication hardware units.
- ii. Familiarize with the standards and regulations in networking/communication.
- iii. Design networking systems at LAN and WAN levels.
- iv. Configure different networking/communication devices such as routers, switches and gateways.
- v. Familiarize with network security issues and the standard security measures.
- vi. Familiarize with firewall setups and configurations.
- vii. Familiarize on IT system installation.

e) Design and construction of electronic circuits, devices and systems

- i. Familiarize with electronic circuit design principles and practices.
- ii. Familiarize with electronic design tools including software.
- iii. Familiarize with standard safety measures and regulations followed/adhered to during electronic circuit design.
- iv. Design electronic circuits for practical applications.
- v. Design printed circuit boards.
- vi. Perform standard testing to verify the designs.
- vii. Familiarize with constructing electronic circuits.
- viii. Perform standard testing procedures to verify the circuits.

f) Installation/maintenance of storage batteries, rectifiers and convertors

- i. Familiarize with charging operation and equalizing of batteries and perform associated measurements with regard to variation of specific gravity during charging and operation.
- ii. Familiarize with installation and commissioning of batteries.
- iii. Familiarize with circuitry and principles of operation of battery chargers.
- iv. Familiarise with regulators and their operation.
- v. Familiarize with methods of voltage regulation.
- vi. Familiarise with invertors and their operation.
- vii. Familiarize with electrical protective devices, their purpose and operation.

g) Operation and maintenance of electronic monitoring and control systems

- i. Familiarize with the need for electronic monitoring and control in Electrical/Computer industries.
- ii. Familiarize with the practical monitoring/control systems such as SCADA based PLC.
- iii. Perform routine maintenance in electronic control systems.

SECTION 3: ELECTRICAL POWER TRAINING

SECTION 3.1: GENERAL

3. Duration: Student should spend minimum of sixteen (16) weeks for electrical power training
4. Major areas: Electrical power training is divided into three major areas:
 - g) Electrical power generation
 - h) Electrical power transmission
 - i) Electrical power distribution

The duration of each of the above listed training depends on the opportunities available in the organizations which provide industrial training for the university students. However, the student needs to undergo at least one week of training in each of the above listed areas totalling sixteen weeks of the training.

5. Electrical power generation: The student should be placed in a power plant to obtain necessary training in electrical power generation. The power plant may be either a conventional [hydro or thermal (coal, diesel, gas turbine)]OR non- conventional (solar, wind, mini hydro) type.
6. Electrical power transmission: The student should be placed in an organization where construction and maintenance of high voltage (220 kV, 132 kV)overhead-lines/underground-cables and electrical substation maintenance training opportunities are available.

In a situation wheresuch opportunities are not available or limited, the student must be placed in an organization where power transformer manufacturing, testing, commissioning and maintenancetraining opportunities are available.

7. Electrical power distribution: The student should be placed in an organization where electrical power distribution line (33 kV, 11 kV, 0.4 kV)constructionand maintenance,distribution transformer installation and maintenance training opportunities are made available.

SECTION 3.2: GENERAL TOPICS

Following items are compulsory and the trainee shall be familiarized withallthe items:

- i. Familiarize with the Sri Lanka Electricity Act and amendments.
- ii. Acquaint with the safety precautions and first aid methods.
- iii. Acquaint with methods adopted in fire prevention and firefighting.

SECTION 3.3: SPECIFIC TOPICS

Depending upon the training placement the trainee may not get the opportunity to train in all the areas listed in this section. However, the trainee shall be given opportunity to get exposure in three major areas: generation, transmission and distribution as described in section 3.1

3.2.1 Electrical power generation

a) Hydro power plant

- i. Familiarize with the layout of hydropower system and Identify the feeding arrangement from the supply reservoir, diversion dam inclusive of surge chamber and valve house up to the turbine inlet valve.
- ii. Inspect and identify the type of turbine, governor, runner arrangement, their associated components, related safety devices and specific purpose.
- iii. Acquaint competence in the operation of pressure releasing valves and breaking devices.
- iv. Familiarize with the operation of the water discharge system.
- v. Familiarize with the bearing arrangement of the generator assembly, the supply and operation of the lubrication oil system.
- vi. Operate the cleaning and cooling equipment of lubricants.
- vii. Identify and locate the cooling water system/components and acquaint with pumping, filtering, storage and utilization of the same.
- viii. Acquaint with the generator arrangement(physical &electrical), excitation, cooling, earthing systems and safety precautions (including fire protection).
- ix. Familiarize with the AC and DC power supply systems while Identifying the auxiliary components and power supply arrangements to them.
- x. Acquire competence in the instrumentation and remote-control facilities and the various protective devices of the generator.
- xi. Familiarize with the switching arrangements and switch board components such as circuit breakers, bus bars, instruments, transformers etc.
- xii. Familiarize with the starting up, synchronizing, normal operation, loading, normal shut down and emergency shut down procedure of generators.
- xiii. Familiarize with the routine inspection/maintenance procedures and attend to maintenance/repair work during breakdowns.
- xiv. Familiarize with power generator protection methods (overload, winding fault, unbalanced current, earth faults etc.)

b). Steam power plant

- i. Familiarize with the organization chart.
- ii. Familiarize with the layout/flow diagram of the thermal power station.
- iii. Acquaint with different sections and the co-ordination between them.
- iv. Identify the types and the characteristics of the primary fuel used, its flow and control.
- v. Familiarize with storage, pumping, filtering and preheating of fuel.
- vi. Familiarize with the arrangements for combustion in the furnace.
- vii. Acquaint with boiler, economizer, boiler feed pump and their auxiliaries and illustrate them in a diagram.
- viii. Familiarize with make-up water supply and water treatment plant.

- ix. Identify feed water equipment and understand their operation.
- x. Familiarize with boiler firing and heating of feed water.
- xi. Identify flow arrangements of steam in boiler, turbine and condenser.
- xii. Familiarize with the auxiliary utilization of steam.
- xiii. Familiarize with the intake, pumping and straining of cooling water and the cooling water line.
- xiv. Study the use of cooling water for condensing of steam.
- xv. Identify and locate the lubrication oil system and components.
- xvi. Acquaint with purification and cooling of lubricants.
- xvii. Familiarize with bearing arrangements of the generator assembly and the supply of the lubrication oil.
- xviii. Identify and locate the draught system and flow control.
- xix. Familiarize with super-heating, economizing and preheating arrangements.
- xx. Acquaint with the AC & DC power supply systems.
- xxi. Identify the auxiliary components and power supply arrangements to them.
- xxii. Acquire working knowledge of the instrumentation and remote-control facilities of the generator.
- xxiii. Familiarize with the switching arrangements and switch board components such as circuit breakers, isolators, instrument transformers, etc.
- xxiv. Familiarize with the starting up, synchronizing, normal operation, loading, normal shut down and emergency shut down procedure of generators.
- xxv. Familiarize with the routine maintenance (electrical and mechanical) schedule and procedures.
- xxvi. Attend to break-down maintenance (electrical and mechanical) work.

c). Diesel power plant

- i. Familiarize with storage, pumping and filtering of fuel oil type.
- ii. Familiarize with the injectors and injection pumps.
- iii. Acquaint with cylinder arrangement and firing order.
- iv. Familiarize with the air intake system.
- v. Identify exhaust and charging arrangements.
- vi. Acquaint with super-chargers and auxiliary systems.
- vii. Identify and locate the cooling water systems.
- viii. Familiarize with the supply and storage of cooling water.
- ix. Familiarize with the operation of the cooling water system.
- x. Identify and locate the lubrication oil system and components.
- xi. Acquaint with purification and cooling of lubricants.
- xii. Familiarize with the bearing arrangements of the generator assembly and the supply of the lubricating oil.
- xiii. Acquaint with the generator arrangements (physical and electrical) excitation, cooling, earthing and safety precautions including fire protection.
- xiv. Familiarize with AC and DC power systems.
- xv. Identify the auxiliary components and power supply arrangements to them.
- xvi. Acquire a working knowledge in the instrumentation and remote-control facilities of the generator.
- xvii. Familiarize with the switch board components and instrument transformers etc.
- xviii. Familiarize with the starting up, synchronizing, normal operation, loading, normal shut down and emergency shut down procedure of generators.
- xix. Familiarize with the routine maintenance (electrical and mechanical) schedules and procedures.

- xx. Attend to break-down maintenance (electrical and mechanical) work.

j) Wind power plant

- i. Observe the strength and limitations of wind power (i.e. power and energy variation with intermittency).
- ii. Inspect and identify the components of wind power plant and its specific purposes:
 - Wind power plant specifications
 - Wind turbine class
 - Rotor, nacelle, tower
 - Hydraulic system
 - Gear box
 - Electric generator
 - Cooling system
 - Electronic controller
 - Sensors in wind power plant (WPP)
 - Tower bottom electronic controller
 - Electric substation
- iii. Familiarize with wind energy conversion
- iv. Studying the rotation principles (drag and lift)
- v. Familiarize about the factors affecting performance of rotor (aerodynamic efficiency, tip speed, tip speed ratio (TSR), blade count,)
- vi. Acquaint the operation of wind turbine aerodynamics
 - a. Stall – controlled WPP
 - b. Pitch- controlled WPP
 - c. Active- stall controlled WPP
 - d. Halting a WPP (breaking system)
- vii. Familiarize about power electronic converters (PEC) such as:
 - a. Constant speed and variable speed WPPs
 - b. Back – to - back PEC in WPP
- viii. Acquaint with normal and emergency operation.
- ix. Acquaint with the generator arrangements (physical and electrical), excitation, cooling, earthing systems and safety precautions (including fire protection).
 - x. Familiarize with the AC and DC power supply systems.
 - xi. Identify the auxiliary components and power supply arrangements to them.
 - xii. Acquire competence in the various protective schemes and devices of the power plant.
 - xiii. Familiarize with the switching arrangements and switch board components such as circuit breakers, bus bars, instruments, generator-transformers etc.
 - xiv. Operate and familiarize with the lubrication system cooling system of the wind power plant.
 - xv. Familiarize with the routine inspection and maintenance procedures.
 - xvi. Assist in break-down maintenance and repair work.
 - xvii. Familiarize with the starting up, synchronizing, normal operation, loading, normal shut down and emergency shut down procedure of generators.

e). Solar PV

- i. Familiarize with the types of instrument and switchgear panels.
- ii. Studying about the inverters used.

- iii. Familiarize about the Pin configuration of inverters.
- iv. Acquaint with panel install configuration.
- v. Familiarize the cabling system.
- vi. Study the Inverter string configuration.
- vii. Observation of the Irradiation levels availability on solar PV park/roof
- viii. Studying the related power quality issues
- ix. Studying about the associated protection scheme
- x. Familiarize with the routine inspection and maintenance procedures and attend to maintenance work.

f). Mini Hydro power plants

- i. Familiarize with the layout of mini hydro power plant.
- ii. Identify the feeding arrangement of mini hydro power plant with weir, intake trash rack, head race channel, sluice gate, desilting tank, spillway, forebay, penstock, surge pipe and expansion joints installed in penstock etc.
- iii. Identify the purpose, type and the arrangement of main inlet valve (MIV).
- iv. Identify the purpose of bypass valve, its arrangement & operation
- v. Inspect and identify the turbine type with respective head, its components and specific purpose.
- vi. Familiarize with the turbine governor components and its arrangement, mechanism, and control principle.
- vii. Acquaint competence in the operation of pressure releasing valves and breaking devices.
- viii. Familiarize with the operation of the water discharge system.
- ix. Familiarize with the type of bearings and its arrangement in the generation assembly/turbine assembly and its lubrication system.
- x. Acquaint with cleaning and cooling of lubricants.
- xi. Operate the cleaning and cooling equipment of lubricants.
- xii. Identify and locate the cooling water system and components.
- xiii. Acquaint with pumping, filtering, storage and utilization of cooling water.
- xiv. Operate and familiarize with the component parts of the cooling water system.
- xv. Acquaint with the generator arrangements (physical and electrical), excitation system, generator protections, cooling arrangement, earthing systems and safety precautions (including fire protection).
- xvi. Familiarize with the AC and DC power supply systems.
- xvii. Identify the auxiliary components and power supply arrangements to them.
- xviii. Acquire competence in the instrumentation and remote control facilities and the various protective devices of the generator.
- xix. Familiarize with the switching arrangements and switch board components such as circuit breakers, bus bars, instruments, transformers etc.
- xx. Familiarize with the starting up, synchronizing, normal operation, loading, normal shut down and emergency shut down procedure of generators.
- xxi. Familiarize with the routine inspection and maintenance procedures and attend to maintenance work.
- xxii. Assist in break-down maintenance and repair work.

3.2.2 Electrical power transmission

a). Overhead lines

- i. Familiarize with preliminary work on transmission lines such as choice of right-of-way, route surveys, profile survey, drawing of profiles, location of towers, making of sag templates, use of sag charts.
- ii. Acquaint with line clearances, mechanical loading of conductors and line supports, earthing of lines etc.
- iii. Acquaint with specification for the line supports such as wood poles, concrete poles, steel poles and steel towers at the intermediate, angle and tension points.
- iv. Acquaint with specification for cross-arms, insulators, conductors, earth wire and earthing.
- v. Acquaint with insulation levels and insulation co-ordination with respect to nearby sub-stations.
- vi. Familiarize with issuing of notices to landowners under the electricity act, objections and settlements of same.
- vii. Study preliminary survey, profile surveys and pegging out of transmission lines.
- viii. Familiarize with reasons for deviations of routes.
- ix. Familiarize with ordering, transporting, storing out of materials and methods and techniques adopted in handling the same.
- x. Acquaint with management of labor.
- xi. Familiarize with progress charts and reports and methods of reporting progress to higher authorities.
- xii. Familiarize with assembly and setting out of templates.
- xiii. Acquaint with excavating, sub setting, concreting, back filling and identify types of foundations used.
- xiv. Familiarize with fixing of cross-arms, insulators and accessories.
- xv. Assist in drawing of earth wire and conductors and tensioning the same, familiarize with techniques and equipment used.
- xvi. Acquaint with safety precaution for men and materials.
- xvii. Familiarize with the methods used in earthing of towers.
- xviii. Assist in measurement of clearance and tower foot resistance.
- xix. Familiarize with different types and sizes of towers, insulators conductors and earth wire.
- xx. Identify and inspect joints, clamps, vibration dampers and other line accessories.
- xxi. Acquaint with installation of other line equipment such as isolators, gantries, air-break switches etc.
- xxii. Familiarize with procedures & techniques and acquaint with equipment's used in testing and commissioning of transmission lines.
- xxiii. Familiarize with protection of transmission lines (lightning protection, earth fault, line fault etc.) and acquaint with methods adopted for protection against transmission line breakage by falling of trees etc.

b) Underground cables

- i. Acquaint with different types of underground cables used in distribution systems (both HT and LT) such as Paper Insulated Lead Covered (PILC), Cross-Linked Polyethylene (XLPE), and Low-Pressure Oil Filled (LPOF) etc.
- ii. Familiarize with the selection of cables (current carrying capacity, single core/three core, sheath type, pulling tension).
- iii. Identify the underground cable assembly and function of each layer (Conductor, conductor screen insulation, metallic sheath, beading, armor)
- iv. Familiarize with cable bonding methods
- v. Familiarize with cable laying methods and techniques adopted and equipment used at different stages such as in trenching laying and closing.
- vi. Familiarize with cable jointing methods and accessories such as straight through, transition joint and end terminations in the switch gears and transformers and substation.
- vii. Identify types of faults occurring in cables and the method of protection employed.
- viii. Familiarize with techniques adopted and equipment used for:
 - (a) Testing of cables prior to commissioning. (IR, Sheath test, phase verification, soak)
 - (b) Fault identification, location and repairing
 - (c) Cable jointing tools and kits

c) Power transformers

TRANSFORMERS MANUFACTURE

- i. Familiarize with the various processes in the construction and assembly of a transformer. Study the layout of the factory in relation to the production process.
- ii. Familiarize with techniques involved in the construction of tank and conservator. Study the material requirements, cutting and bending of sheet metal, drilling and cutting of holes, welding, preparation of the surface, painting etc.
- iii. Familiarize with the cutting of laminations. Participate in assembly of laminations to form core of the transformer. Mounting of the assembled laminations.
- iv. Study the drawings for the construction of the transformer. Familiarize with the processes involved in the production of each section of the transformer and its final assembly.
- v. Participate in the manufacture of winding, both high voltage and low voltage, machine winding and hand winding. Use of insulators, spacers as per design.
- vi. Participate in the assembly of the tap-changer gear, and in the making of connections to the windings.
- vii. Familiarize with the procedure in the drying of the transformer, impregnation for dry types of transformers and the procedure of filling to the tank.
- viii. Familiarize with routine tests on transformers – polarity, insulation, turns-ratio no-load test, resistance of windings, load tests (temperature rise test), induced over-voltage test, etc.

- ix. Study reports and methods used in special test, and why such tests are necessary, such as impulse voltage, short circuit test etc.
- x. Familiarize with standards to which the manufacture of the transformer is done. Identify the important aspects to which manufactures to be adhered to. Familiarize with the quality control procedure used at the different stages in the manufacture.

TRANSFORMERS MAINTENANCE

- i. Familiarize with the construction and characteristics of different types of transformers such as power transformers, distribution transformers, welding transformers etc. and specification as regard to their construction, performance and efficiency and installation of transformers at transformer sub-stations.
- ii. carry out transformer test such as ratio test, magnetic balance, Insulation resistance, winding resistance, efficiency test etc.
- iii. Test samples of transformer oil (on relevant specifications) and familiarize with the operation of the filtering plant.
- iv. Identify common faults and their causes and familiarize with detection of faults and clearing of same.
- v. Assist in testing and commissioning transformers (new or repaired).
- vi. Acquaint with the protective devices of transformers, their location and functions.
- vii. Familiarize with the transformer protection schemes of mechanical (Winding and oil temperature, pressure relief, Bucholz relay, Oil level) and electrical (Over Current, Earth fault, Restricted Earth Fault, Deferential, Under/Over flux etc.)
- viii. Familiarize with the On-Load Tap Changer maintenance
- ix. Familiarize with transformer protection methods (overload, winding fault. Earth fault, line fault etc.)

d) Medium and High Voltage Switchgear MAINTENANCE

- i. Familiarize with the construction and characteristics of different types of switchgears and accessories such as Vacuum Circuit breaker, Air Insulated Switchgear and SF6 Switchgears and specification as regard to their construction, performance and efficiency and installation of switchgears and accessories at grid and primary sub-stations.
- ii. carry out switchgear test such as Insulation resistance, Contact resistance, Breaker open/close timing, SF6 Gas quality test etc.
- iii. Identify common faults and their causes and familiarize with detection of faults and clearing of same.
- iv. Assist in testing and commissioning switchgear (new or repaired).
- v. Acquaint with the protective devices of switchgear, their location and functions.
- vi. Familiarize with the switchgear protection schemes of mechanical (SF6 gas pressure, spring charge, etc.) and electrical (Over Current, Earth fault, Frame leakage, Deferential, etc.)
- vii. Familiarize with the operation and interlocking procedure of switchgears.

3.2.3 Electrical power Distribution

a). Overhead distribution system

- i. Acquaint with choice of line routes and substation sites.
- ii. Familiarize with issuing of notices to landowners under the electricity act, objections and settlement.
- iii. Acquaint with preliminary routes, profile surveys pegging out of line and substation layout.
- iv. Familiarize with spans, clearances, strength of support for conductors and earthing of lines.
- v. Acquaint with regulations framed under the electricity act.
- vi. Familiarize with the types of line supports and their specifications.
- vii. Acquaint with organization, methods and techniques used in erecting poles and struts.
- viii. Familiarize in burying and fixing of stays, fixing of cross arms and insulators, binding of conductors etc.
- ix. Acquaint with stringing, tensioning and fixing of earth wires and conductors.
- x. Familiarize in earthing of lines and all metal components and uses of earth electrodes.
- xi. Acquaint with different types of line materials accessories, tools and equipment used in erection.
- xii. Prepare bill of quantities of materials per unit length of line at different voltages using different types of line supports and conductors.
- xiii. Acquaint with various tests carried out prior to commissioning of lines and equipment and commissioning of same.
- xiv. Familiarize with allocation of work according to skill and temperament.
- xv. Estimate and cost materials requirement for a particular assignment.
- xvi. Acquaint with layout of different types of substation.
- xvii. Familiarize with installation of different types of oil circuit breakers, air circuit breakers, drop out switches, lighting arrestors (surge divertors) transformers, auto circuit reclosers, Load Break Switches, Fault indicators, remote terminal unit for the switchgears, bus bars, jumpers etc.
- xviii. Familiarize with installation of supply cables and overhead lines to consumer panels from distribution lines. Familiarize with installation of meters and metering equipment.
- xix. Familiarize with different methods of burying earth electrodes and improving of earth resistance.
- xx. Familiarize with accessories, tools and equipment used in construction.
- xxi. Familiarize with bill of quantities of materials and equipment used in different types of substations of different voltages and ratings.
- xxii. Acquaint with techniques and equipment used in testing prior to commissioning of MV distribution line, sub stations and commissioning of same.
- xxiii. Familiarize with the overhead distribution maintenance systems:
 - (a) Routine maintenance and
 - (b) break-down maintenance
- xxiv. Familiarize with the operation of the system as a whole, the control of voltage and power.
- xxv. Familiarize with protection schemes devices employed to protect equipment, remote control systems and indicating equipment.

- xxvi. Familiarize with relays, trip switches, cut-out circuits, lightning protections etc.
- xxvii. Acquaint with the schematic diagrams, line diagrams, circuit diagrams, relative to protection.

b). Underground distribution system

- ix. Acquaint with different types of modern underground distribution systems (both HT and LT) and sketch the line diagram of a typical underground distribution system.
- x. Familiarize with the choice of routes, substation sites and distribution points.
- xi. Familiarize with the procedure adopted in acquisition of sub-station sites, rules framed under the electricity act and laws framed by local authorities on matters pertaining to gas and water mains, opening up of road etc.
- xii. Identify different types of cables, both HT and LT according to their design specification and standards.
- xiii. Familiarize with cable laying methods and techniques adopted and equipment used at different stages such as in trenching laying and closing.
- xiv. Familiarize with cable jointing and accessories such as straight through, transition joint and end terminations in the switch gears, transformers and substation.
- xv. Identify types of faults occurring in cables and the method of protection employed.
- xvi. Familiarize with techniques adopted and equipment used for
 - (a) Testing of cables prior to commissioning.
 - (b) Fault identification, location and repairing
 - (c) Cable jointing tools and kits
- xvii. Familiarize with the choice of main equipment and auxiliaries such as transformers, Ring Main Units, switch gears, bus-bars, feeder pillars, etc. in relation their types and their ratings such as normal ratings, overload capacity and fault capacity.
- xviii. Familiarize with the interpretation and application of the standards to equipment used in an underground system.
- xix. Familiarize with protection schemes devices employed to protect equipment, remote control systems and indicating equipment.
- xx. Familiarize with the operation of the system as a whole; the control of voltage and power.
- xxi. Familiarize with the underground distribution maintenancesystems:
 - (a) Routine maintenance and
 - (b) break-down maintenance
- xxii. Acquaint with the operational safety rules and understand the nature of the hazards of mal-operation and steps taken in such instances.

c). Electrical Installation and wiring

- I. Identify the types and sizes of cables, connectors, conduits, trunking etc.
 - i. Familiarize with types of electrical testing and measuring instruments and their use.
 - ii. Familiarize with various types of electrical installations, electrical equipment and their layout and prepare layout plan of a typical electrical installation.

- iii. Familiarize with the interpretation of blue prints, layout plans, circuit diagrams and schematics.
- iv. Select the equipment required for the above.
- v. Acquaint with the use of appropriate type and size of wires or cables, connectors and conduits.
- vi. Cut, bend, form and thread rigid and flexible conduits.
- vii. Familiarize with installation and wiring of electrical equipment (switch gear, circuit breakers, meters etc.)
- viii. Familiarize with testing procedures (both commissioning and maintenance) for electrical installation.
- ix. Attend to service wiring for lighting and ventilation.
- x. Check the installations for conformity with the IET and Sri Lanka Electricity Act and Regulations.
- xi. Familiarize with earthing and protection systems against over current, earth fault, lightning and special measures and procedures taken in hazardous situations.
- xii. Familiarize with testing and commissioning of equipment, plant and machinery, localizing of fault, operations and maintenance.
- xiii. Familiarize with the earth leakage protection used for the installation
- xiv. Familiarize with protection methods used in machinery worked by electricity.