Electrical Installation and Maintenance Work - National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC)

Advanced Courses

Industrial Installation

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION & MAINTENANCE WORK		
MODULE: Industrial Installation	Course Code: CEI 21	Contact Hours: 360 Hours

GOAL: The module is intended to provide the trainee with further knowledge and skill to enable him carry out all types of domestic and industrial electrical installation and maintenance work.

GENERAL OBJECTIVES:

On completion of this module, the trainee should be able to:

1. Know the wiring of special installations.
2. Make and interpret electrical wiring drawing of equipment contained in the manufactures drawing.
3. Know the distribution and utilization of AC and DC power supply in industrial and outdoor installations up to 11 KV, Protect electrical installation from lighting and corrosion.
4. Understand the working principles of various types of lifts, escalators and elevators and be able to install and maintain them.
5. Know the installation of types of discharged lamps.
6. Know the disadvantages of low power factor and how power factor may be improved.
7. Know the testing and maintenance of overhead distribution and transmission systems.

PROGRAMME: ANTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: INDUSTRIAL INSTALLATION		Course Code: CEI 21	Contact Hours: 360 Hours
Course Specification: Theoretical Content			
	General Objective 1.0: Know the wiring of special Installation		
Week	Specific Learning Outcome	Teachers Activities	Resources
1-11	1.1 a. Explain the precautions necessary for special Installations b. Describe the materials used for Installing them. 1.2 Install the items listed in 1.1 above e.g. a. Farm and horticultural electrical Installation b. Standby plants and their automatic operation; c. Fire Alarm; d. Fire Detector; e. Neon Discharge Lamp; f. Central Air Conditioning System etc. 1.3 Install single-phase and 3-phase meters e.g., (KW/Hour) maximum demand meter etc. 1.4 Install protective devices against lightning strokes 1.5 Explain the causes of corrosion. State methods of protection against corrosion. 1.6 Explain various methods of earthing earth electrode, earthplate, protective multiple earthing. 1.7 Test all types of Installation for efficiency 1.8 Wire electrical items in explosive or hazardous situations such as a. extremes of temperature b. Corrosive atmosphere 1.9 Describe the application of Single-phase Instruments (Measuring)	• Explain special Installations. Use Tools and material used for the Installation. • Carry out Installation of fire alarm, fire detector, standby plants etc. • Show and demonstrate how to Install single and three-phase meters. • Demonstrate the Installation of arrestor. • Explain corrosion, its effects and remedies. • Explain Earthing, methods of protective-multiple, multiple earthing, earth electrode, show how to earth such circuits. • Carry out various tests on different Installations. • Carry out wiring examples. • Take students to petrol station or boiler house. • Describe application of Instrument used in single-phase Circuit.	• Chalkboard • Textbooks • Note. • Fire Alarm • Fire Detector • Neon Discharge Lamp • Air Condition system • Textbooks. • Single-phase • 3-phase meters • Lighting Arrestor • Earth Electrode

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Course: INDUSTRIAL INSTALLATION		**Course Code: CEI 21**	**Contact Hours: 360 Hours**
	General Objective 1.0: Know the wiring of special Installation		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
12 13	1.10 State the methods of Connections of Instrument transformer 1.11 Install Instrument transformers	• Show how to connect such Instrument including protective fuses. • Carry out the installation of Instrument transformers.	• Chalkboard • Chalkboard
	General Objective 2.0: Make, Interpret Electrical Wiring Drawing Of Equipment Contained In The Manufactures Drawing		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
	2.1 Identify all symbols in electrical wiring drawing 2.2 Make accurate sketches and drawings of electrical circuits 2.3 Interpret electrical diagram/drawings	• Use questions to discuss on electrical wiring symbols • Show sketches or drawing of electrical Wiring • Explain the interpretation of electrical diagrams	• Chalk Board • Chalk Board • Electrical Drawings
	General Objective 3.0: Know The Distribution And Utilization Of AC And DC Power Supply In Industrial And Outdoor Installations Up To 11KV.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
1-7	3.1 Distribute electrical loads in building site, factories including sub-stations. 3.2 Explain multi-substation systems with bulk High Tension supply and Control. 3.3 Calculate the protective short-circuit fault rating of a consumer Installation. 3.4 Install Switch-gear, protective devices, transformers using suitable cables. 3.5 Describe the types of cable for operating systems up to 11KV. Describe type of protective devices used. 3.6 Explain the effects of ambient temperature on grouping circuit protections e.g. close and coarse.	• Explain with circuit diagrams and calculations how to distribute electrical loads • Describe Multi-substation; its supply and control. • Calculate the rating of protective devices in an Installation • Using appropriate cables, show how to install control, protective devices in an installation. • Describe cables used on system up to 11KV and the type of protective devices. • Explain Ambient temperature its effect to include groupings and class of excess current protection.	• Chalk Board • Drawings • 11KV cables

PROGRAMME: ANTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: INDUSTRIAL INSTALLATION		**Course Code: CEI 21**	**Contact Hours: 360 Hours**
	General Objective 4.0: Protect Electrical Installation From Lighting And Corrosion		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
8-9	4.1 Explain the necessity for a method of protecting electrical installations against lighting strokes. 4.2 Explain the methods of earthing e.g. a. measurement of earth electrode resistance b. earth leakage protection c. protective multiple earthing.	• Give reasons for installing protective devices - lighting strokes. • Describe the methods and principles of earthing and how to care for resistance area.	• Lighting • Arrestor/Strokes • Chalkboard • Megger, • Earth electrode
10-11	4.3 Explain the principles of cathodic protection. State its application in protecting electrical installation from lighting. 4.4 Describe the causes and methods of protection against Corrosion of electrical Installation.	• Explain cathodic protection to include its Installation and application. • Explain the causes of and means of protecting against Corrosion.	• Chalkboard. • Chalkboard
	General Objective 5.0: Understand The Working Principles Of Various Types Of Lifts, Escalations And Elevators And Be Able To Install And Maintain Them.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
12-13	5.1 Select the various materials used for special lighting system e.g. discharge lamps and signs. 5.2 Install all kinds of discharge lamps and signs and their associated control gears.	• Show all materials used for Neon and other discharge lamps. • Demonstrate the installation of different discharge lamps, e.g. Neon, Mercury, Sodium etc.	• Discharge lamps, • Chalkboard
	General Objective 6.0: Know The Installations Of Types Of Discharged Lamps		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
1-8	6.1 Describe the Construction of Lifts, escalators, elevators. 6.2 Explain the principles of operation of escalator, elevator and lift. 6.3 Describe methods of scaffolding, lifting and handling equipment, ladders during installations.	• Explain the principles of design and construction of lifts, escalator, elevator and lift. • Explain how items above operates. • Explain Regulations on the use of Scaffolding	• Chalkboard • Scaffolding

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Course: INDUSTRIAL INSTALLATION		**Course Code: CEI 21**	**Contact Hours: 360 Hours**
	General Objective 6.0: Know The Installations Of Types Of Discharged Lamps		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
1-8	6.4 Apply basic regulations in the use of Scaffolds. 6.5 Lift equipments with care 6.6 Show how load on equipments is determined. 6.7 Install lift well and lift equipments in correct sequence. 6.8 Install the followings: a. machine room equipment; b. escalators. 6.9 Install different types of lift control system e.g. electronic control, pheumatic control etc. test 6.9 above. 6.10 Test installed lifts of all kinds. 6.11 Commission 6.10 above.	• Describe safe handling of equipment • Show how load on equipment is determine. • Demonstrate the installation of life well. • Explain the installation of equipment in machine room. Show how escalators are installed. • Demonstrate the installation of life. Demonstrate how to test lift controls • Demonstrate how to test life. Explain how to commission a lift.	• Chalkboard • Scaffolding • Ladder.
	General Objective 7.0: Know The Disadvantages Of Low Power Factor And Know How Power Factor May Be Improved		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
9-10	7.1 State the advantages and disadvantages of low power factor 7.2 Explain with the aid of diagrams how power factor can be improved. Using static capacitors/synchronous phase machines. 7.3 Describe individual load and overall system improvement of power facor. 7.4 Install static capacitors, synchronous motor, phase modifier in systems to improve the power factor.	• Explain p.f. and state the advantages and disadvantages of low p.f. Also its effects • Explain means for improving power factor e.g. the use of capacitors, synchronous motor, phase advancer. • Explain individual and central means of improving power factor. • Demonstrate the installation of capacitor and synchronous motors on the improvement of p. factor.	• Capacitors • Chalkboard • Static capacitors,

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Course: INDUSTRIAL INSTALLATION		Course Code: CEI 21	Contact Hours: 360 Hours
	General Objective 8.0: Know The Testing And Maintenance Of Overhead Distribution And Transmission Systems.		
Week	Specific Learning Outcome	Teachers Activities	Resources
11-13	8.1 Describe the tests to locate faults and conditions of Insulation of overhead lines. 8.2 Test for faults on overhead lines. 8.3 State the maintenance procedures for live-lines and dead-lines workings. 8.4 Explain how to maintain distribution/transmission systems.	• List the instruments and methods of testing overhead system. • Demonstrate how to test overhead lines. • Explain maintenance procedures of live and dead lines workings • Explain how to maintain transmission and distribution systems.	• Measuring Instruments. • Chalkboard. • Measuring Instruments

PRACTICALS

PRACTICAL CONTENT FOR INDUSTRIAL INSTALLATION CEI 21 MODULE

Week	Experiments	Student's Activities	Resources
1-2	1. Install Fire Alarm 2. Install Neon, Mercury, Sodium and Halogen discharge lamps.	• Carry out practical demonstration on fire alarm circuits. • Demonstrate how to install discharge lamps.	• Fire Alarm box, wiring board workshop. • Different discharge lamp's wiring boards. Workshops.
3-4	3. Install 3-phase energy meter.	• Connection of Wattmeters 3 - phase energy meters to a load.	• Workshop, meters i.e. single and 3-phase meters.
5-6	4. Site visit to a NEPA HV terminal/switchyard to identify key system elements e.g. lighting arrestors, switchgear, transformers, feeders, instrumentation, etc.	• Site visit.	• Safety Ware e.g. boats
7-9	5. Carry out simple circuit and do the earthing system including protective-multiple earthing with earth electrodes.	• Demonstrate the installation of earthing systems.	• Workshop, wiring board.
10-12	6. Site visit to a lift installation	• Site visit	• Selected industry

EVALUATION GUIDE

Students will be evaluated on:-

a. Multiple questions/answers,
b. Mid and final exams,
c. Quizzes, Drawing and Projects.

Advanced Winding

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK		
MODULE: WINDING	**Course Code: CEI 22**	**Contact Hours: 216 Hours**
GOAL: The module is designed to provide the trainee with further knowledge and skill to enable him wind or rewind heavy duty machines above 10 KVA. **GENERAL OBJECTIVES:** On completion of this module, the trainee should be able to: 1. Wind and rewind DC motors and DC generators. 2. wind and rewind AC motors and AC generators. 3. Wind and rewind single-phase and three-phase transformers.		

PROGRAMME: ANTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: WINDING		**Course Code: CEI 22**	**Contact Hours: 108 Hours**
Course Specification: Theoretical Content			
	General Objective 1.0: Wind and rewind DC motors and DC generators		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
1-13	1.1 Identify various types of motor and generators 1.2 State types of winding for a DC motor or generator e.g. Lap and wave winding. 1.3 Describe the layout of Simple lap winding using both progressive and retrogressive connections. 1.4 Describe various types of armature slots and their applications. 1.5 Develop winding diagram for lap and wave connected armature. 1.6 Determine Coil span from the number of poles and number of armature slots.	• List various motors and generators • Explain lap and wave winding of motors. • Illustrate simple layout of lap winding using progressive and tretrogressive connections. • Explain armature slots and their applications. • Design lap and wave winding for armature.. • Illustrate how to determine Coil span from number of poles and number of slots • Describe shield winding. • Explain Dummy coils in wave wound armature.	• Motor, Generator • Armature • Chalk Board • Winding former, • Copper wire, • Tools • Varnish

PROGRAMME: ANTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: WINDING		Course Code: CEI 22	Contact Hours: 108 Hours
	General Objective 1.0: Wind and rewind DC motors and DC generators		
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-13	1.7 Explain the use of shield winding. 1.8 Explain the use of dummy coils in wave wound armatures. 1.9 State the functions of equilizer in lap winding. 1.10 State the reasons for Varnishing 1.11 State the need for different classes of insulation. 1.12 Select insulation suitable for a given material 1.13 State the effect enclosures, ratings and types of insulation on frame size for a given output 1.14 State the characteristics and application of DC generator	• List the functions of equalizers in lap winding. • Explain varnishing and its application. • Describe various classes of insulation. • Explain factors for determining selection of materials • Explain enclosures, rating and different insulation • Explain the characteristics and application of DC generator.	
4-13	1.15 State classes of insulation and list insulation materials. 1.16 Describe in details, simple lap and wave winding. 1.17 Compare duplex and simplex winding 1.18 Describe the types of fields connections from a given circuit diagram. 1.19 Describe the methods of reversing rotation and the connections required. 1.20 Describe the effect of armature reaction.	• List and explain classes of insulating materials. • Ask questions on lap and wave winding. • Differentiate between duplex and simplex windings. • Describe types of fields from Circuit diagram. • Demonstrate how to effect the reverse of rotation of the Connection. • Explain armature reaction. • Illustrate reasons for interpoles	• Insulating Materials • Students • Chalk/Black Board • Motor • Motor/Brush • Motor and Generators • DC. Motors and Generators. • DC. Motor and generators

PROGRAMME: ANTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: WINDING		**Course Code: CEI 22**	**Contact Hours: 108 Hours**
	General Objective 1.0: Wind and rewind DC motors and DC generators		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
4-13	1.21 Explain the purpose of interpoles. 1.22 Describe the method of construction and materials used for interpoles. 1.23 State and sketch interpoles connections. 1.24 Describe how polarity is obtained. 1.25 Describe the effect of brush position on commutation. 1.26 Wind and rewind complex DC motors and generators. 1.27 Test wound and rewound DC Motors and generators for performance.	• Show how interpoles are connected. • Ask questions on interpoles • Explain how to obtain polarity. • Illustrate the effect of brush on commutator. • Demonstrate how to rewind dc motors and generators. • Test the performance of wound and rewound dc motors.	
	General Objective 2.0: Wind And Rewind AC Motors And AC Generators.		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
1-5	2.1 Describe the layout of AC winding of both concentric and distribution types. 2.2 Explain single layout and two layout arrangement of Stator Coil. 2.3 Explain coil pitch in Concentric and distribution windings. 2.4 Explain how the required magnetic poles are produced in a three-phase Stator winding.	• Illustrate concentric and distributed type of winding. • Explain single and two layout of stator coils. • Illustrate Coil pitch on Concentric and distribution winding. • Describe the production of required magnetic field and how it is obtained in 3-phase stator winding.	• Chalk Board • Chart • 3-phase motor

PROGRAMME: ANTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: WINDING		**Course Code: CEI 22**	**Contact Hours: 108 Hours**
	General Objective 2.0: Wind And Rewind AC Motors And AC Generators.		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
6-8	2.5 Describe with sketches, the winding connection of a two-speed AC motor of pole changing and dual wound types. 2.6 Describe the arrangement of Start and run winding in 3-phase motor. 2.7 State terminal markings as used in 3-phase motors. 2.8 Explain how to Wind or rewind AC motor and generator. Test for performance.	• Draw and explain winding connection for a two speed AC motor. • Illustrate Starting arrangement for a 3-phase motors. • Explain how to mark terminals of 3-phase motors. • Rewind AC motors and carry out test for good performance.	• Chalk Board • 3-Q Motors • Winding coils.
	General Objective 3.0: Wind And Rewind Single - Phase And Three-Phase Transformers		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
9-13	3.1 Describe types of transformers. 3.2 Identify terminal marking on transformer winding and its purpose. 3.3 Describe the disc and layer types of transformer winding used in 3-phase transformers. 3.4 Describe the methods of Securing turn as used in 3-phase transformers. 3.5 Explain the term rating of transformers' and give reasons for rating transformers in KVA.	• Define and explain the transformers. • Describe different types of transformer winding and, ask questions. • Describe and show the disc and layer types of transformer winding used in 3 phase transformer. • Explain how counter and other materials are used to secure turns in 3-phase transformers • Explain why • AC plants (transformers) are rated in KVA	• Transformer. • - do -

PROGRAMME: ANTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: WINDING		Course Code: CEI 22	Contact Hours: 108 Hours
	General Objective 3.0: Wind And Rewind Single - Phase And Three-Phase Transformers		
Week	Specific Learning Outcome:	Teachers Activities	Resources
9-13	3.6 Explain the use of tapping and to changers and edge packing. 3.7 Wind or rewind all types of transformers e.g. auto transformer, etc. 3.8 Test rewound transformers.	• Illustrate the use of tap and tapping • Wind or rewind a simple transformer. • Test a rewound transformer.	• 3-Phase Transformer • Chalkboard • Winding Coil • Megger, Ohmmeter.

EVALUATION GUIDE FOR MODULE CEI 22 - WINDING (ANTC)

Students will be graded on the following criteria:

a. quizzes, tests and assignments, projects and, terminal examinations.

NATIONAL TECHNICAL CERTIFICATE AND ADVANCED NATIONAL TECHNICAL CERTIFICATE