

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

National Board for Technical Education

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Electrical Trades



Electrical Trades - Install & maintenance

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General Information



Electrical Trades - Install & maintenance

AIM

To give training and impart the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant.

ENTRY QUALIFICATIONS

Craft Programme

Candidates must not be less than 14 years of age and should have successfully completed three years of Junior Secondary education or its equivalent. Special consideration may be given to sponsored candidates with lower academic qualifications who hold trade test certificates and are capable of benefiting from the programme.

Advanced Craft Programme

Candidates should possess the National Technical Certificate or its equivalent and should have had a minimum of two years post qualification cognate industrial experience.

The Curriculum

The Curriculum of each programme is broadly divided into three components:

- a. General Education, which accounts for 30% of the total hours required for the programme.
- b. Trade Theory, Trade Practice and Related Studies which account for 65% and
- c. Supervised Industrial Training/Work Experience, which accounts for about 5% of the total hours required for the programme. This component of the course which may be taken in industry or in college production unit is compulsory for the full-time students.

Included in the curriculum is the teacher's activity and learning resources required for the guidance of the teacher.

Unit Course/Modules

A Course/Module is defined as a body of knowledge and skills capable of being utilized on its own or as a foundation or pre-requisite knowledge for more advanced work in the same or other fields of study. Each trade when successfully completed can be used for employment purposes.

Behavioural Objectives

These are educational objectives, which identify precisely the type of behaviour a student should exhibit at the end of a course/module or programme. Two types of behavioural objectives have been used as the curriculum. They are:

- a. General Objectives
- b. Specific learning outcomes

General objectives are concise but general statements of the behaviour of the students on completion of a unit of work such as understanding the principles and application in:

- a. Orthographic projection in engineering/technical drawing;
- b. Loci in Mathematics
- c. Basic concepts of politics and government in Political Science
- d. Demand and supply in Economics

Specific learning outcomes are concise statements of the specific behaviour expressed in units of discrete practical tasks and related knowledge the students should demonstrate as a result of the educational process to ascertain that the general objectives of course/programme have been achieved. They are more discrete and quantitative expressions of the scope of the tasks contained in a teaching unit.

General Education In Technical Colleges

The General Education component of the curriculum aims at providing the trainee with complete secondary education in critical subjects like English Language, Economics, Physics, Chemistry, Biology, Entrepreneurial Studies and Mathematics to enhance the understanding of machines, tools and materials of their trades and their application and as a foundation for post-secondary technical education for the above average trainee. Hence, it is hoped that trainees who successfully complete their trade and general education may be able to compete with their secondary school counterparts for direct entry into the polytechnics or colleges of education (technical) for ND or NCE courses respectively.

For the purpose of certification, only the first three courses in mathematics will be required. The remaining modules are optional and are designed for the above average students.

National Certification

The NTC and ANTC programmes are run by Technical Colleges accredited by NBTE.

NABTEB conducts the final National examination and awards certificates.

Trainees who successfully complete all the courses/modules specified in the curriculum table and passed the national examinations in the trade will be awarded one of the following certificates:

S/NO	LEVEL	CERTIFICATE
	Technical Programme	
1.	Craft Level	National Technical Certificate
2.	Advanced Craft Level	Advanced National Technical Certificate

Guidance Notes For Teachers Teaching The Curriculum

The number of hours stated in the curriculum table may be increased or decreased to suit individual institutions' timetable provided the entire course content is properly covered and the goals and objectives of each module are achieved at the end of the term.

The maximum duration of any module in the new scheme is 300 hours. This means that for a term of 15 weeks, the course should be offered for 20 hours a week. This can be scheduled in sessions of 4 hours in a day leaving the remaining hours for general education. However, (properly organized and if there are adequate resources), most of these courses can be offered in two sessions a day, one in the morning and the other one in the afternoon. In so doing, some of these programmes may be completed in lesser number of years than at present.

The sessions of 4 hours include the trade theory and practice. It is left to the teacher to decide when the class should be held in the workshop or in a lecture room.

INTEGRATED APPROACH IN THE TEACHER OF TRADE

Theory, Trade Science And Trade Calculation

The traditional approach of teaching trade science and trade calculation as separate and distinct subjects in technical college programmes is not relevant to the new programme as it will amount to a duplication of the teaching of mathematics and physical science subjects in the course. The basic concepts and principles in mathematics and physical science are the same as in the trade calculation and trade science. In the new scheme therefore, qualified persons in these fields will teach mathematics and physical science and the

instructors will apply the principles and concepts in solving trade science and calculation problems in the trade theory classes. To this end, efforts have been made to ensure that mathematics and science modules required to be able to solve technical problems were taken as pre-requisite to the trade module.

Evaluation Of Programme/Module

For the programme to achieve its objectives, any course started at the beginning of a term must terminate at the end of the term.

Instructors should therefore device methods of accurately assessing the trainees to enable them give the student's final grades at the end of the term. A national examination will be taken by al students who have successfully completed their modules. The final award will be based on the aggregate of the scores attained in the course work and the national examination.

Curriculum Table (NTC)

ELECTRICAL INSTALLATION & MAINTENANCE PRACTICE FOR NTC

S/No	Subject Code	Module	YEAR 1						YEAR 2						YEAR 3						Total Hours for Each
			Term 1		Term 2		Term 3		Term 1		Term 2		Term 3		Term 1		Term 2		Term 3		
			T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	
1.	CAM 12 - 15	Mathematics	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	216
2	CEN 11 - 17	English	2	-	2	-	2	-	3	-	3	-	3	-	3	-	3	-	3	-	288
3	CPH 10 - 12	Physics	2	-	2	-	2	-	2	1	2	1	2	1	2	1	2	1	2	1	288
4	CCH 10 - 12	Chemistry	2	-	2	-	2	-	2	1	2	1	2	1	2	1	2	1	2	1	288
5	CEC 11 - 13	Economics	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	216
6	CBM 11	Entrepreneurship	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-	-	-	-	48
7	ICT 11 - 15	Computer Studies	-	-	-	-	-	-	1	2	1	2	1	2	1	2	1	2	-	-	180
8	CTD 11 - 13	Drawings	-	3	-	3	-	3	-	3	-	3	-	3	-	4	-	-	-	-	264
9	CTD 14	Electrical/Electronics Drawing	-	-	-	-	-	-	-	1	2	1	4	-	-	-	-	-	-	-	96
10	CME 11	General Metal Work I	1	3	1	3	1	3	-	-	-	-	-	-	-	-	-	-	-	-	144
11	CEI 11	Basic Electricity	2	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	72
12	CEI 12	Domestic Installation	-	-	-	-	-	-	3	2	1	2	1	4	-	-	1	4	1	4	276
13	CEI 13	Industrial Installation	-	-	-	-	-	-	3	2	1	2	1	4	2	3	1	4	1	4	336
14	CEI 14	Cable Jointing	-	-	-	-	-	-	1	1	-	-	2	2	3	1	4	-	4	-	216
15	CEI 15	Battery Charging	-	-	-	-	-	-	1	2	3	2	1	4	-	-	1	-	-	-	168
16	CEI 16	Winding of Electrical Machines	-	-	-	-	-	-	-	-	-	-	2	3	1	4	3	4	1	4	264
17	CEI 17	Solid State Devices & Circuits	3	2	-	-	-	-	-	-	-	-	-	-	3	2	3	2	3	2	180
		GRAND TOTAL																			3,540

Curriculum Table (ANTC)

ELECTRICAL INSTALLATION & MAINTENANCE PRACTICE FOR ANTC

S/NO	SUBJECT CODE	MODULE	YEAR 1						Total Hours for Each
			Term 1		Term 2		Term 3		
			T	P	T	P	T	P	
1.	CMA 21 - 22	Mathematics	3	-	3	-	2	-	96
2.	CEN 21 - 22	English	1	-	1	-	1	-	36
3.	CEC 21 - 23	Economics	2	-	2	-	2	-	72
4.	CBM 21	Entrepreneurship	2	-	2	-	2	-	72
5.	ICT 21 - 22	Auto CAD 1 & 2	1	2	1	2	-	-	72
6.	CEI 21	Advanced Industrial Installation	3	7	3	7	3	7	360
7.	CEI 22	Advanced Winding	1	5	1	5	1	5	216
		GRAND TOTAL							926 Hrs

General Metal Work I

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION & MAINTENANCE WORK

Course: General Metal Work I

Course Code: CME 11

Contact Hours: 144

Module Specification: PRACTICAL/KNOWLEDGE REQUIREMENTS

General Objective: On completion of this module the student will be able to:

1. Understand workshop safety rules and their application in machine shop.
2. Know the physical properties, manufacturing process and application of ferrous and non-ferrous metals in common use.
3. Select and use common measuring, marking out, cutting and striking tools.
4. Understand the basic working principles of drilling machine and be able to use it for various types of screws threads rivets and be able to rivet and cut screws by hand.
5. Understand the application of various types of screw threads and rivets, and be able to rivet and cut screws by hand.
6. Understand the ISO system of tolerances and fits their application in engineering production.
7. Produce simple engineering components on the bench.
8. Understand the essential features and working principles of the center, lathe and carry out basic operations such as turning, stepped turning facing, taper turning, knurling, chamfering and undercutting.

Practical competence: On completion of this module, the student will be able to:

1. Use all tools correctly ensuring the machinery guards and protective eye shields are used at all times.
2. Comply with the general rules for safe practice in the work environment at all this.
3. Use and select handtools for carrying out various bench fitting and assembly tasks.
4. Tools: hacksaws, taps, reamers, drills, dividers, surface gauge.
5. Produce threads using taps and dies.
6. Correctly grind drill point angles: Drills: Twist and flat drills.
7. Select and set drilling machine speeds to carry out a range of operations using the appropriate coolants. Drilling, reaming, counter sinking, counter boring.
8. Perform metal joining by a range of processes. Cut through the joints and investigate the depth of penetration of the metals at the interface. Processes: Soldering, brazing, and fusion welding.
9. Mark out on metals and other materials, datum lines, angles, radii/circles and hole positions using a range of tools.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION & MAINTENANCE WORK			
Course: General Metal Work I		Course Code: CME 11	Contact Hours: 144
Course Specification: Knowledge Requirement			
General Objective 1.0: Understand Workshop Safety Rules and application in Machine Shop			
Week	Specific Learning Outcome	Teachers Activities	Resource
1	<p>1.1 State sources of hazard in the workshop and how to prevent them. e.g</p> <ul style="list-style-type: none"> a. handling and using tools, portable power tools and machines; b. stepping on or striking obstructions left on floors or benches; c. lifting, moving and storing materials or jobs; d. using inflammable or corrosive liquids and gases; e. inhaling vapours of fumes; <p>1.2 Explain the application of factory safety regulations in the machine shop.</p> <p>1.3 Name safety equipment and wears essential in the machine shop, and state their application in working situations</p> <p>Note: Example of safety wears and equipment should include overall, eye goggles, gloves, safety boots, helmet, fire extinguishers, etc.</p>	<ul style="list-style-type: none"> • State sources of hazards in the workshop. • Through questions and answers, determine whether the students grasped the topic • Show a film on industrial safety. • Through question and answers determine comprehension • Demonstrate how to treat emergency case like artificial respiration, cold compress etc • List the safety equipment and wards that are essentially in the workshop. • give detail notes and explanation in each topic a - e. • Use questions and answers to determine comprehension. • Assess the students 	<ul style="list-style-type: none"> • Safety posters, common hand tools like files hacksaw • Television, Video machine. • Overall, goggles, gloves, hardshoes, head shield, fire extinguishers.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION & MAINTENANCE WORK

Course: General Metal Work I

Course Code: CME 11

Contact Hours: 144

General Objective 1.0: Understand Workshop Safety Rules and application in Machine Shop

Week	Specific Learning Outcome	Teachers Activities	Resource
	<p>1.4 Outline safety rules and regulations relating to:-</p> <ul style="list-style-type: none"> a. clothing and health hazards; b. Workshop hygiene c. movement and other behaviour of workers in the workshops; d. materials handling; e. tool handling, storage and usage f. machine operation; g. fire protection <p>1.5 Understand appropriate procedures in the events of a workshop accident</p> <p>1.6 Examples of procedures may includes:</p> <ul style="list-style-type: none"> a. application of first aid to the victim; b. removal rectification of the accident; c. reporting the accident to the appropriate authority d. keeping a record of accidents for management use 	<ul style="list-style-type: none"> • Give detail notes and explanation of appropriate. • Procedures to be taken in the event of workshop accident 	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION & MAINTENANCE WORK

Course: General Metal Work I

Course Code: CME 11

Contact Hours: 144

General Objective 2.0: Know The Physical Properties, Manufacturing Process And Application Of Ferrous And Non-Ferrous Metals In Common Use

Week	Specific Learning Outcome	Teachers Activities	Resource
2	<p>2.1 Explain the meaning of the following general physical properties of metals: ductility, malleability, strength, toughness, brittleness, elasticity, plasticity</p> <p>2.2 Describes the basic composition and properties of plain carbon steels, cast iron and alloy steel and state their application in the engineering industry. Note: Specific examples of tools and equipment made from the various steel and cast iron should be mentioned. Examples of steels and cast irons should include: plain carbon steels, dead mild steels, mild steel, medium carbon steel, high carbon steel. Cast Iron: gray cast iron malleable cast iron, alloy cast irons (spheroidal and acicular) Alloy Steel - high speed steels, high tensile steels, tungsten, Iron carbide stainless steels, satellite.</p> <p>2.3 Outline:</p> <ol style="list-style-type: none"> the cupola process of manufacture of cast iron; the blast furnace process of manufacture of cast iron the direct reduction process of manufacture of steel. <p>Note:</p>	<ul style="list-style-type: none"> • Give detail notes and explanations to explain the meaning of the following general physical properties of metals; ductility, malleability. strength, toughness, brittleness, elasticity, plasticity, Assess the students • Give detailed notes and explanations of the topics in 2.1 • Give notes and specific examples of tools and equipment made from the various steels and cast iron. • Examples of steels and cast irons should include plain carbon steels, dead mild steels, mild steel, medium carbon steel, high carbon steel, gray cast iron, malleable cast iron alloy cast iron high speed steels, high tensile steels, tungsten, iron-carbide, stainless steels. • Give notes and explanation on the cupola process, the blast furnace and the direct reduction process of manufacture of steel. 	<ul style="list-style-type: none"> • Video and television including cassettes on production processes.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION & MAINTENANCE WORK			
Course: General Metal Work I		Course Code: CME 11	Contact Hours: 144
General Objective 2.0: Know The Physical Properties, Manufacturing Process And Application Of Ferrous And Non-Ferrous Metals In Common Use			
Week	Specific Learning Outcome	Teachers Activities	Resource
	2.4 Describe the physical properties and applications of non-ferrous metals below: copper, tin, zinc, aluminium and aluminium alloys brass (muntz metal, cartridge brass gilding etc) metal, bronze (manganese bronze gunmetal, bell metal, aluminium bronze, phosphor bronze and lead.	<ul style="list-style-type: none"> • This can be preceded by film show and a visit to the manufacturing plant. • Give detail and explanations describing the physical properties and applications of the following non-ferrous metals: copper, tin, zinc, aluminium, aluminium alloys, brass, (muntzmetal, cartridges brass, gilding metal) etc. bronze, manganese bronze bell metal, aluminium bronze phosphor bronze and lead. Assess the students 	
General Objective 3.0: Select And Use Common Measuring, Making Out, Cutting And Striking Tools			
Week	Specific Learning Outcome	Teachers Activities	Resource
3	<p>3.1 Explain with examples the difference between:line” and “end” measurement</p> <p>3.2 Explain the use of datum points, datum lines and datum faces in marking out.</p> <p>3.3 Describe, the functions and application of the following instruments used in metal-work steel rule, dividers, caliper, (inside, outside and odd-legs), trammel, scribe angle plate, vee-block, centre square.</p> <p>3.4 Describe, the various types of files, stating their grades and applications. Note. Types of files should include: flat, square, round, half round, three square, warding pillar, mill and rasp</p>	<ul style="list-style-type: none"> • Prepare notes that will clearly differentiate between “line” and “end” measurement • Prepare notes and examples that will explain the use of datum points, datum lines m and datum faces in marking out. • Give detail demonstrate notes and explanations regarding the functions and application of: steel rule, dividers, calipers (inside, outside and oddleg) trammel, scribe angle plate, vee block, centre square 	<ul style="list-style-type: none"> • Steel rules dividers callipers trammel, scribe range plate, vee block, centre square. • Micrometer vernier calipers vernier height gauge combination set • Flat file, hard file, round file square, half round, triangular warding, mill file, rasp file. • Flat file, handfile engineers square • Surface plate try square (engineers square)

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Course: General Metal Work I

Course Code: CME 11

Contact Hours: 144

General Objective 3.0: Select And Use Common Measuring, Making Out, Cutting And Striking Tools

Week	Specific Learning Outcome	Teachers Activities	Resource
3	<p>3.5 Classify the common files use in metal work and state their composition of material used for their manufacture.</p> <p>3.6 Sketch the bench vice explain its clamping power and demonstrate the technique of holding work in the vice for filing tapping and designing operation.</p> <p>3.7 Describe the functions of the various parts of a bench vice, its holding power while performing various operations on its, such as filing, etc.</p>	<ul style="list-style-type: none"> • Prepare note that will describe the various types of files stating their grades and applications, By type it means: flat square, round, half round, there square warding, mil and rasp. • Prepare detail notes that will classify the common files used in the metal work as will as stating the composition of materials used for their manufacture. • Show a bench vice and demonstrate the work in the vice for filing, tapping and designing operations • prepare detail notes that will describe the functions of the various parts of a bench vice, its holding power while performing various operation 	<ul style="list-style-type: none"> • File card • Flat file • Bench vice • Bench vice • Ball pein hammers mallets
4	<p>3.8 Show an bench vice and demonstrate the technique of holding work in the vice for filing, tapping and designing operations.</p> <p>3.9 Prepare detail notes that will describe the functions of the various parts of a bench vice, its holding power while performing various operation</p>	<ul style="list-style-type: none"> • Assess the students • Prepare detailed notes and demonstration that will describe the uses of: cold chisel, centre punch, dot punch, scrapers and power hacksaw. • Prepare notes that will describe the various parts of a hacksaw and their functions. • Show samples of hacksaw blades as well as prepare notes that will describe the common types of hacksaw blades their range of pitches and their applications. 	<ul style="list-style-type: none"> • Cold chisel, centre ranchers dot punch scrapers power hacksaw blades • Hacksaw blade • Hacksaw frame • Adjustable hacksaw, junior hacksaw, piercing saw. • Bench drill • Pillar drill

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Course: General Metal Work I

Course Code: CME 11

Contact Hours: 144

General Objective 3.0: Select And Use Common Measuring, Making Out, Cutting And Striking Tools

Week	Specific Learning Outcome	Teachers Activities	Resource
4	<p>3.10 Describe and use the following tools:</p> <ul style="list-style-type: none"> a. cold chisel (flat, cross, cut half round, diamond-points) b. centre punch and dot punch c. scraper (flat, triangular, half round) d. power hacksaw <p>3.11 Describe the various parts of a hacksaw and their function.</p> <p>3.12 Describe the common types of hacksaw blades, their range of pitches and their application</p>	<ul style="list-style-type: none"> • Prepare notes that will show correct way of inserting blades. • Prepare detail notes and explanation, stating the safety precautions to be observed when using a hand hacksaw. • Prepare detail notes and explanation, stating the safety precautions to be observed when using a hand hacksaw. • Prepare notes that will describe the uses of various hacksaws. <p>Assess the students</p>	<ul style="list-style-type: none"> • List drills, flat drill counter sunk drill, counter bore drill combination centre drill

General Objective 4.0: Understand The Working Principles Of A Drilling Machine, Use It To Drill And Ram Holes On Metals And Other Engineering Materials.

Week	Specific Learning Outcome	Teachers Activities	Resource
5.6	<p>4.1 Identify the various types of drilling machines</p> <p>4.2 Identify the various types of drilling machines</p> <p>4.3 Describe with sketches and state where each of the following types of drills are best suited e.g twist drill (taper shank, parallel shank and jobbers drill, and their relative merits), flat frill, countersunk drill, counter bore drill, combination centre drill.</p>	<ul style="list-style-type: none"> • Show different types of drilling machines • Make notes and drawings that will identify the various types of drilling machines. • Prepare detailed notes and drawings that will describe the main features of a bench or pillar drilling machine. • Solve many problems for students to practice. 	<ul style="list-style-type: none"> • Ball pein hammers, mallet, cold chisels, dot/centre punches, hacksaw and hacksaw blades • Drilling machines and its accessories.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION & MAINTENANCE WORK

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General Objective 4.0: Understand The Working Principles Of A Drilling Machine, Use It To Drill And Ram Holes On Metals And Other Engineering Materials.

Week	Specific Learning Outcome	Teachers Activities	Resource
5.6	<p>4.4 Explain the effects of the following faults in a ground twist drill bit:</p> <ol style="list-style-type: none"> a. point angle too acute. b. point angle too obtuse: c. cutting edges at unequal angles d. insufficient lip clearance; e. excessive lip clearance <p>4.5 Calculate spindle revolution or cutting speed for specified size of drill using the formulae:-</p> <p>4.6 State the cause and remedy of drilling faults such as:-</p> <ol style="list-style-type: none"> a. drill breaking; b. drill coloured blue c. walls of drilled hole left rough d. chipped cutting lips <p>4.7 State the safety precautions to be observed when using a drilling machine reamers.</p> <p>4.8 Ream to given specification by hand and machine method.</p>	<ul style="list-style-type: none"> • Prepare notes and drawings that will describe where each of the following drills are best suited • Twist drill (tapper shank, parallel shank, jobber drill and their relative merits), flat drill, counterbore drill and combination center drill • Assess the students 	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION & MAINTENANCE WORK

Course: General Metal Work I

Course Code: CME 11

Contact Hours: 144

General Objective 5.0: Understand The Applications Of Various Types Of Screw Threads, Rivet And Cut Screws By Hand.

Week	Specific Learning Outcome	Teachers Activities	Resource
7	<p>5.1 Sketch the thread forms below and state their applications:-</p> <ul style="list-style-type: none"> a. the ISO metric thread b. the unified thread c. Whitworth and British fine threads d. British Association (BA) thread e. British Standard pipe f. Square thread g. Acme thread <p>5.2 Buttress thread.</p> <p>5.3 Sketch and state the functions of:-</p> <ul style="list-style-type: none"> a. taps (taper tap, second tap, plug) b. tap wrench c. die and die stock <p>5.3 Explain the meaning of tapping size or tapping drill and estimate its value in given situations using formulae such as:-</p> <p style="margin-left: 40px;">$T = D - P$</p> <p style="margin-left: 40px;">Where T = tapping diameter</p> <p style="margin-left: 40px;">D = thread top diameter</p> <p style="margin-left: 40px;">P = pitch</p> <p>5.4 State precautions to be taken when tapping on the bench.</p>	<ul style="list-style-type: none"> • Give detailed notes with diagrams that will show the various forms of thread and their uses. • State the functions of taps, tap wrench, die and die stock. • Demonstrate how to produce internal and external threads. • Give detailed notes that will explain the meaning of tapping size or tapping drill and estimate its values using the formula: $T = D - P$ Where T = tapping diameter D = thread top diameter and P = Pitch 	<ul style="list-style-type: none"> • Diagrams/charts of thread forms • Parallel reamers taper reamers twist drills.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION & MAINTENANCE WORK

Course: General Metal Work I		Course Code: CME 11	Contact Hours: 144
	<p>5.5 Describe and differentiate types of rivets e.g. snap and pan head, mushroom and counter-sunk head, flat head, dod rivet, etc.</p> <p>5.6 Sketch the rivet set and state its uses.</p> <p>5.7 Calculate the diameter of rivet and riveting allowance in given situations.</p>	<ul style="list-style-type: none"> • Give notes and diagrams that will describe and differentiate types of rivets, rivet sets, and its uses and guide to calculate the diameter of rivet and riveting allowance. • Assess the students. 	<ul style="list-style-type: none"> • Rivet sets
General Objective 6.0: Understand The ISO Tolerances And Fits And Its Application In Engineering Production.			
Week	Specific Learning Outcome	Teachers Activities	Resource
	<p>6.1 Differentiate between the following:-</p> <ol style="list-style-type: none"> nominal size limits (upper and lower) tolerance (unilateral and bilateral) fit (clearance, transition and interference). <p>6.2 Explain the importance of tolerance and fit in engineering production and describe briefly the ISO system of limits and fits.</p> <p>6.3 Determine by calculation the amount of tolerance and types of fit in given situations.</p>	<ul style="list-style-type: none"> • Give detailed notes that will differentiate between nominal size, limits, tolerance and fits. • Prepare detailed note and diagrams that will explain the importance of tolerance and fits in engineering production as well as describing the ISO systems of limits and fits. • Give notes and explanations that will guide in calculating the amount of tolerance and types of fits in given situations. • Assess the students. 	<ul style="list-style-type: none"> • Charts on tolerances, limits and fits.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION & MAINTENANCE WORK

Course: General Metal Work I

Course Code: CME 11

Contact Hours: 144

General Objective 7.0: Produce Simple Engineering Components On The Bench.

Week	Specific Learning Outcome	Teachers Activities	Resource
	<p>7.1 Explain layout procedures from working drawing of simple engineering components or tools such as:</p> <ul style="list-style-type: none"> a. open ended spanner b. engineer's try square c. tool maker's clamp d. plate bracket or gusset (involving rounds, angles, holes) e. centre square. <p>7.2 Explain how to produce any simple engineering component to given specifications including dimensions, tolerance and finish.</p> <p>7.3 Explain how to carry out simple precision fitting project, e.g hexagonal mild steel bar making push fit through a mild steel plate.</p>	<ul style="list-style-type: none"> • Teachers to prepare notes and explanations to guide the students in producing simple engineering components as in 7.1 • Assess the students. 	<ul style="list-style-type: none"> • Lesson notes. • Diagrams and charts.

General Objective 8.0: Understand The Essential Features And Working Principles Of The Centre Lathe And Use It To Carry Out Basic Operations Such As Plain Turning, Stepped Turning, Facing Taper Turning, Chamfering, And Under-Cutting.

Week	Specific Learning Outcome	Teachers Activities	Resource
	<p>8.1 Describe the essential features of a centre lathe and state their functions e.g lathe bed, headstock, tailstock, saddle or carriage, etc.</p> <p>8.2 Explain the working principles of the centre lathe.</p>	<ul style="list-style-type: none"> • Prepare detailed notes that will describe the essential features of center lathe and their functions. • Give notes and diagrams that will explain the working principles of center lathe and functions of its accessories. 	<ul style="list-style-type: none"> • Centre lathe and accessories like catch plates, face plates, center's fixed and travelling steadies. • Charts of center lathe and capstan lathe.

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Course: General Metal Work I

Course Code: CME 11

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General Objective 8.0: Understand The Essential Features And Working Principles Of The Centre Lathe And Use It To Carry Out Basic Operations Such As Plain Turning, Stepped Turning, Facing Taper Turning, Chamfering, And Under-Cutting.

Week	Specific Learning Outcome	Teachers Activities	Resource
	<p>8.2 Identify and state the functions of centre lathe accessories such as: catch or driving plate, face plate, lathe dog or carrier, lathe centres, fixed and travelling steadies.</p> <p>8.3 Explain the difference between the centre lathe, capstan lathe, in terms, of their main features and functions.</p> <p>8.4 Name types of cutting fluids used for lathe turning operations and state their composition and purposes.</p> <p>8.5 Outline safety precautions to be observed when working on the lathe.</p> <p>8.6 Sketch and describe common tools: e.g butt-brazed tool, tipped tool, bit and holder.</p> <p>Note: Tool description should include tool materials e.g plain carbon steel, high speed steel, satellite, cemented carbide, diamond.</p> <p>8.7 Explain with sketches the functions of tool angles (rake clearance), and state their values for different metals to be machined.</p>	<ul style="list-style-type: none"> • Give explanations that will show the difference between center lathe and capstan lathe in terms of their main features and functions. • Prepare notes that will list types of cutting fluid use for lathe turning operations and their composition and purposes. • Prepare detailed notes and explanation that will outlines safety precautions, common tools and materials used in marking them. • Give detailed notes and diagrams that will explain the functions of tool angles (rake, clearance) stating their values for different metals to be machined. • Assess the students. 	<ul style="list-style-type: none"> • Round nose turning tool, finishing tool, site finishing, knife tool, form tool, parting off tool, and boring tool.

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General Objective 8.0: Understand The Essential Features And Working Principles Of The Centre Lathe And Use It To Carry Out Basic Operations Such As Plain Turning, Stepped Turning, Facing Taper Turning, Chamfering, And Under-Cutting.

Week	Specific Learning Outcome	Teachers Activities	Resource
	<p>8.0 Differentiate between various tool shapes and state their uses e.g. Rouse nose rougher, fine finishing, side finishing, knife tool, form tool, parting off tool, boring tool, etc.</p> <p>8.10 Explain with sketches the effects of wrong setting of cutting tool: e.g vibration and chatter, tool rubbing against or digging into the job.</p> <p>8.11 Define cutting speed and feed with respect to lathe operation.</p> <p>8.12 Calculate the cutting speed and feed for given turning operation.</p> <p>8.13 Estimate the rate of metal removal and time required for carrying out specified turning operations.</p> <p>8.14 Estimate the rate of metal removal and time required for carrying out specified turning operations.</p> <p>8.15 State precautions to be observed when turning between centres. Set up the lathe for and carry out basic turning operations between centres.</p> <p>8.16 Compute required taper dimensions from given data using taper ratio angle formulae i.e</p> $\text{Taper Ratio} = \frac{d_2 - d_1}{L} \text{ OR}$ $\frac{\tan \frac{\alpha}{2}}{2} = \frac{d_2 - d_1}{2L}$ <p>where Tan = taper angle d_1 = small end diameter d_2 = large end diameter L = length of taper</p>	<ul style="list-style-type: none"> • Give notes and diagrams of various tool shapes and their uses. • Prepare detailed notes and explanations to cover 8.10 to 8.15 • Solve many problems for the students practise. • Assess the students. 	<ul style="list-style-type: none"> • Charts on tool height. • Charts and diagrams of different machining operations.

PRACTICAL TASKS

PROGRAMME NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION & MAINTENANCE WORK			
General Objective 1.0: On completion of the following practical task, the trainee will demonstrate the following abilities:			
Week	Specific Learning Outcome	Teachers Activities	Resource
1-3	1.1 Using and handling hand tools, portable power tools and machine 1.2 Lifting, moving and storing materials or job 1.3 Demonstrate first aid application in cases of minor cuts, electric shock, burns	<ul style="list-style-type: none"> • Demonstrate safe ways of handling basic and tools • Show a film in industrial safety • Demonstrate how to treat energy cases like artificial respiration cold compress, etc • Assess the student 	<ul style="list-style-type: none"> • Hand tools, files, hacksaw • Television, Video machines • Posters on artificial respiration
General Objective 2.0: Measuring, Marking, Cutting and striking			
Week	Specific Learning Outcome	Teachers Activities	Resource
	2.1 Describe the essential features and use of the following <ul style="list-style-type: none"> a. micrometer b. Vernier calliper c. Venier height gauge d. combination set 2.2 Maintain and care for the instruments listed above 2.3 Perform making out exercise on plane surface including profiles 2.4 File a piece of metal to given specifications using any of the following: Cross filing, draw filing, filing square and flat surfaces 2.5 Test surface for flattens using surface plate and try square and state precautions to be taken to avoid pinning 2.6 Maintain files in good working conditions	<ul style="list-style-type: none"> • Demonstrate how to use micrometer, venire calliper, venire height gauge, combination set • Demonstrate the maintenance and care of the instruments listed above • Perform marking out for the students to learn and practice till they become competent • Demonstrate how plat surface can be tested using surface plate and try square • Demonstrate how files are cleaned and state the precautions to be taken against pinning. Students to practice till competent 	<ul style="list-style-type: none"> • Micrometer vernier caliper, vernier height gauge, combinations sets • Steel rules, dividers, punches, trammel, scribe angle plate, vee - block, center square • Flat file, hand file, square • file card, flat file

PROGRAMME NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION & MAINTENANCE WORK

General Objective 2.0: Measuring, Marking, Cutting and striking			
Week	Specific Learning Outcome	Teachers Activities	Resource
	<p>2.7 Apply various hammers and mallets e.g ball pein, rubber mallets, etc for engineering purposes</p> <p>2.8 Select and insert hacksaw blade correctly</p> <p>2.9 Cut metal and other engineering materials to given specification using the adjustable hacksaws, junior hacksaws, piercing saw, etc drills and Drilling.</p>	<ul style="list-style-type: none"> • Demonstrate the application of hammers and mallets for engineering purposes • Demonstrate how a hacksaw blade can be inserted correctly • Demonstrate how to use adjustable hacksaw, junior hacksaw piercing • Students should be allowed to practice till competent • Guide student to produce simple Engineering component like opened ended spanner, engineers square tool makers clamp, centre square, etc • Assess the student 	<ul style="list-style-type: none"> • Ball pein hammers, mallet • Hacksaw blade, Hacksaw frame
General Objective 3.0: Machine Tools			
Week	Specific Learning Outcome	Teachers Activities	Resource
7-9	<p>3.1 Setting up and operate a drilling machine in given situations</p> <p>Note Setting up drilling machine should include</p> <ol style="list-style-type: none"> a. change of spindle speed b. adjustment of drilling table to require height and angle, holding of work on drilling bale to required height and angle using appropriate clamping device. c. Install up the drill bit in chuck 	<ul style="list-style-type: none"> • Demonstrate how to set up and operate a drilling machine in given situation • Students to practice till competent • Demonstrate how a twist drill can be sharpened correctly • Demonstrate with the appropriate facility how to perform all the drilling operations 	<ul style="list-style-type: none"> • Bench drill, pillar drill, drill, bits • Bench drill, pillar drill, twist drill, flat drill, counter sunk drill, counterbore drill, center drill. • Drills taps, tap wrench, die and die stock

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General Objective 3.0: Machine Tools

Week	Specific Learning Outcome	Teachers Activities	Resource
7-9	<p>3.2 Sharpen a twist drill correctly to manufacturers specification</p> <p>3.3 Perform with facility the following operations:</p> <p style="padding-left: 40px;">a. drilling blind</p> <p style="padding-left: 40px;">b. drilling round stock</p> <p style="padding-left: 40px;">c. counterboring and counter-sinking</p> <p style="padding-left: 40px;">d. drilling large diameter holes</p> <p>3.4 List the operation sequence and cut internal (through and blind) and external thread by hand method and state precautions to be taken when tapping on the bench.</p> <p>3.5 Rivet metals together in any given situations</p> <p>3.6 Mark out only given bench work using datum points, datum lines, datum faces, chalk or marking solution center or dot, punch, blocks or measurement transfer.</p>	<ul style="list-style-type: none"> • Students to practice till they become competent • Give notes as well as demonstrate the operation sequence in cutting internal (through and blind) and external threads by hand method • Demonstrate how riveting can be done and let the students practice same till they become competent • Demonstrate the marking out procedures on bench working using datum lines datum faces, etc • Students to practice till they become competent • Assess the Student 	<ul style="list-style-type: none"> • Rivets and sets of drill bits • Surface table, surface plate marking solution, center/dot punches, scribing block

General Objective 4.0: Lathe and Lathe work

Week	Specific Learning Outcome	Teachers Activities	Resource
10-12	<p>4.1 Sharpen cutting tool for plain turning shouldering, parting off and facing operations.</p> <p>4.2 Set up rough and turned stock N 3-jaw-chuck</p> <p>4.3 Select appropriate cutting tool and set them up to centre height for turning or facing operations</p>	<ul style="list-style-type: none"> • Guide the students to sharpen cutting tools for plain turning, shouldering, parting off and facing operations and allow students to practice till competent • Demonstrate how to set-up rough and turned stock practice till competent 	<ul style="list-style-type: none"> • Point tools, grinding machine, lathe machine • 3-jaw chuck and lathe machine • Point tools lathe machine • Lathe machine and accessories • Centre lathe and accessories like catch plate, face plate, dog, lathe, lathe centers fixed steady and travelling steading

PROGRAMME NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION & MAINTENANCE WORK

General Objective 4.0: Lathe and Lathe work

Week	Specific Learning Outcome	Teachers Activities	Resource
10-12	<p>4.4 Carry out chuck work involving facing, step turning, undercutting, reducing, chamfering, parting off and knuring</p> <p>Note: Component should be produced to specified tolerance and finish</p> <p>4.5 Produce simple components involving taper turning using the compound slid</p>	<ul style="list-style-type: none"> • Guide the students to select appropriate cutting tools and set them up to center height for lathe work • Make a simple recession fitting project like hexagonal mild steel bar making push fit through a mild steel plate • Students should be allowed to practice till they become competent • Prepare simple exercise that will guide students to produce components involving taper turning using the compound slide, Asses the students 	<ul style="list-style-type: none"> • Round nose turning tool, fine finishing tool, form tool, parting off tool, boring tool, bar of goods length and 4mm diameter, Live/deed centres catch plates • Standard exercise prepared

Assessment profile: Practical to take 60% of the overall assessment

Basic Electricity

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK

MODULE: BASIC ELECTRICITY

Course Code: CEI 11

Contact Hours: 264 Hours

GENERAL OBJECTIVES:

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

1. Understand the structure of matter and its relevance to electricity/electronics.
2. Understand the chemical sources of electromotive force.
3. Understand the construction of resistors, inductors and capacitors and explain their functions in a simple circuit
4. Know the values of resistor(s).
5. State Ohm's Law and apply it to calculate resistance, voltage and current.
6. Distinguish between AC and DC quantities.
7. Understand the principles of transformer, its construction and operation.
8. Analyse, connect and carry out simple calculation on simple electrical circuit.
9. Interpret basic electronic signs and symbols.
10. Understand the operation, uses and limitations of indicating instruments and operate them.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 11 - BASIC ELECTRICITY		Course Code: CEI 11	Contact Hours: 264 Hours
Course specification: At the conclusion of this module, the student should be able to understand and demonstrate the basic electrical theory Theoretical Content			
General Objective 1.0: Understand The Structure Of Matter And Its Relevance To Electricity/Electronics.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-3	<p>On completion of this module the trainees should be able to:</p> <p>1.1 Define:</p> <ul style="list-style-type: none"> a. Molecule b. Electron c. Atom d. Electric charge e. Electric Current f. Coulomb <p>1.2 Explain the difference between positive and negative charges.</p> <p>1.3 Explain the flow of electricity</p> <p>1.4 Distinguish between insulators and conductors</p>	<ul style="list-style-type: none"> • With diagram define atom, electron, proton, molecule, electric charge, electric current, Coulomb. • Give full explanation on the difference between positive & negative charge. • Describe how electricity flows. • Explain insulator and conductors with sample 	<ul style="list-style-type: none"> • Chalkboard • Textbooks
General Objective 2.0: Understand The Chemical Source Of Electromotive Force.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
4-6	<p>2.1 Define:</p> <ul style="list-style-type: none"> a. Electric power b. Energy <p>2.2 Distinguish between emf and potential difference (p.d)</p> <p>2.3 Identify the following:</p> <ul style="list-style-type: none"> a. Primary Cells b. Secondary Cells <p>2.4 Test for the condition of a cell or battery</p>	<ul style="list-style-type: none"> • Explain electric power and energy stating their unit, symbol and formula. Work problems based on Power and Energy • Distinguish the differences between emf and pd. • Show primary and secondary cells and describe their construction. • Use instruments and visual observation to show how to test cell condition. 	<ul style="list-style-type: none"> • Chalkboard • Textbook • Calculator • Primary cell • Battery

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 11 - BASIC ELECTRICITY		Course Code: CEI 11	Contact Hours: 264 Hours
General Objective 2.0: Understand The Chemical Source Of Electromotive Force.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
8	2.5 Connect cells in: a. Series b. Parallel c. Series - Parallel	• Show how cells can be connected in series, and series -parallel Advantages of cells in series or parallel connections. e.g voltage in series and on parallel	• Primary Cell
	2.6 Explain the effects of internal resistance on battery voltage output.	• Explain with calculations how resistance affect battery voltage.	• Chalkboard
General Objective 3.0: Understand The Construction Of Resistors, Inductors And Capacitors And Explain Their Functions.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
9-11	3.1 Identify the various types and sizes of the following: a. Resistors b. Capacitors c. Inductors. 3.2 Identify the following resistors: a. Composition type resistor b. Wire wound type resistor c. Variable resistors d. Fixed resistors 3.3 State the function of the following: a. Resistor b. Capacitor c. Inductor in a Circuit 3.4 Describe the constructional detail of the following: Resistors Capacitors Inductors 3.5 Explain the meaning of power rating of a resistor 3.6 Identify the power rating of different resistance types. 3.7 Explain the practical application of various types of resistors 3.8 Identify the working Voltage of a capacitor	• Define and show resistors, capacitors and inductors. State their unit and symbols • Show students various types of resistors • Explain and show how each can be connected and their function. • Describe on chalkboard the constructional detail of the three. • Explain power rating of resistor. • Show how to identify the power rating of each resistor. • Explain the application of resistor in a circuit. • Explain the maximum working voltage of a capacitor.	• Capacitors • Inductors • Resistors & Chalk board

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 11 - BASIC ELECTRICITY		Course Code: CEI 11	Contact Hours: 264 Hours
General Objective 4.0: Know The Values Of Resistor(s).			
Week	Specific Learning Outcome:	Teachers Activities	Resources
12-13	4.1 Explain the colour coding system of a. resistors b. capacitors 4.2 Calculate the following: a. Resistance of a resistor using colour codes b. capacitance of a capacitor using colour codes 4.3 Identify the tolerance of resistors and capacitors. 4.4 Calculate the value of the tolerance of any a. Resistor using colour codes b. Capacitors using colour codes	<ul style="list-style-type: none"> • Show and explain how to identify colour coding of resistor. • From colour code, show how to calculate the values of resistor and capacitor • Show and calculate the tolerance of resistors and capacitors • Show and calculate the tolerance of resistors and capacitors. 	<ul style="list-style-type: none"> • Chalkboard • Textbooks • Calculator • Chalk Board • Color Coded Resistors
General Objective 5.0: State Ohm's Law And Apply It To Calculate Resistance, Voltage And Current			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-7	5.1 Define Ohm's law 5.2 Calculate resistance, Voltage or Current using Ohm's law e.g. - $R = \frac{V}{I}$ 5.3 Connect: a. resistors in series b. resistors in parallel c. series and parallel connection 5.4 Connect: a. batteries in series b. batteries in parallel c. batteries in series parallel connection 5.5 Connect capacitors in series and parallel and capacitors in series parallel connection as above.	<ul style="list-style-type: none"> • Define Ohm's Law • Work some calculations on Ohm's law • Show how resistor can be connected in series, parallel and series-parallel and perform calculations. • Refer students to batteries connected in the three modes by asking questions. • Show capacitor in series parallel and in series-parallel. • Explain the implication of modes 5.3 - 5.5 • Work samples of Capacitors and inductor in series & parallel. 	<ul style="list-style-type: none"> • Chalk Board • Batteries • Resistors • Multimeter

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 11 - BASIC ELECTRICITY		Course Code: CEI 11	Contact Hours: 264 Hours
General Objective 5.0: State Ohm's Law And Apply It To Calculate Resistance, Voltage And Current			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-7	5.6 State the implication of the connections mode in 5.3 - 5.5 5.7 Calculate the inductance, capacitance connected in series and parallel. 5.8 Define Kirchoff's laws:- a. Current law b. Voltage law	• Define the law. Use vector diagram to explain the current law. E.g. $I_1 + I_2 + I_5 = I_3 + I_4$	• Textbooks • Chalk and Black board
8-13	5.9 Solve simple numerical problems involving 5.8a & 5.8b above. 5.10 Define Superposition theorem 5.11 Solve simple numerical problems to illustrate Superposition theorem	• Define the voltage laws. Draw a simple circuit to illustrate the law, • State the law. Draw a simple circuit to illustrate the law • Super position theorem. Use simple circuit to illustrate the theorem.	- do - - do - - do -
General Objective 6.0: Distinguish Between AC And DC Current And Voltage			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-7	6.1 Explain the difference between AC and DC. 6.2 Explain the Characteristic of alternating current. 6.3 Define peak value, mean value, RMS value, Frequency of Wave. 6.4 Calculate peak value from RMS values of Current, and voltage, and vice versa 6.5 Describe the simple treatment of R,L,C in AC circuit. 6.6 Explain the concept of resistance in AC circuit. 6.7 Calculate inductive and capacitive reactance. $X_L = 2 \pi f L$ (Inductive reactance) $X_C = 1/2\pi f C$ (Capacitive reactance)	• With the aid of a diagram explain the difference between AC to DC. • Explain fully AC. • Draw diagrams to explain AC variables like RMS, mean value, etc. • Work some samples on how to calculate the variables above • Explain the effect of AC on R,L,C in parallel i.e. voltage and current relationships • Explain resistor in AC circuit. • Explain inductive and capacitive reactance and work some calculation on $X_L X_C$, (like X_C above)	• Lesson note • Chalkboard • Chalk Board • Signal Generator • oscilloscope

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Course: CEI 11 - BASIC ELECTRICITY		Course Code: CEI 11	Contact Hours: 264 Hours
General Objective 7.0: Understand The Principles Of Transformer, Its Construction And Operations.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
8	7.1 Explain the concept of Magnetism <ol style="list-style-type: none"> temporary and permanent magnets magnetic field magnetic poles law of attraction and repulsion 	<ul style="list-style-type: none"> Define magnet and explain temporary, permanent and natural magnet. Define laws of magnet, show diagram where necessary. 	<ul style="list-style-type: none"> Magnet Soft Iron DC Power Coil Compass Copper Coil
9-13	7.2 Explain the effect of fields as applied to electro-magnetism 7.3 State the colour code used for the winding of transformer. 7.4 Describe with the aid of sketches the principles of operation of a single phase, double wound transformer. 7.5 State the reasons for laminating the core of a transformer. 7.6 Explain the types of losses in transformers and state ways to reduce them. 7.7 Calculate transformer efficiency 7.8 Construct a simple single phase double wound transformer 7.9 Identify the following types of transformers: <ol style="list-style-type: none"> Auto-transformer; C-Core transformer; Toroidal transformer. Rudolf transformer Audio transformer 3-phase transformer Current transformer; State the uses of each type of transformer	<ul style="list-style-type: none"> Show and explain magnetic fields. Explain fully mode of winding of transformer. $\frac{VP}{VS} = \frac{NP}{NS}$ Explain <ul style="list-style-type: none"> Show lamination and explain reasons for lamination. List and explain iron and copper loss and how to reduce them Explain efficiency and work some sample on efficiency Demonstrate how to construct double would. Explain fully different type of transformers e.g. power, isolation auto etc. Make available for inspection a number of examples. 	<ul style="list-style-type: none"> Transformer Components. A transformer Chart Calculator Textbook Lesson plan Chalkboard Different types of transformers

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Course: CEI 11 - BASIC ELECTRICITY		Course Code: CEI 11	Contact Hours: 264 Hours
General Objective 8.0: Analyse, Connect And Carry Out Simple Calculations On Simple Electrical Circuit.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-3	8.1 Explain the difference between series and parallel circuit 8.2 Calculate the total resistance in a series DC circuit 8.3 Calculate the voltage drop across each resistor of a series circuit 8.4 Calculate the total resistance of a parallel circuit 8.5 Investigate by experiment, the effect of resistors in series and in Parallel. 8.6 Calculate the current in each arm of a parallel circuit.	<ul style="list-style-type: none"> • Define an electric circuit and state the difference between series and parallel. • Give students calculation • Work samples on Vd on each resistor in a circuit and ask students to do same. • Request students to work some calculation • Carry out experiment to show the effect of resistor in series and in parallel. • Show how to calculate the current in each arm. 	<ul style="list-style-type: none"> • Chalkboard • Textbooks/Notes • Calculator • Notes • Resistors • DC power supply multimeter
4-13	8.7 Investigate the effect of capacitor in an electric circuit.	• Ask question on connection of capacitor.	• Chalk Board
	8.8 Calculate the total voltage and current in series and parallel connected cells.	• Calculate voltage and current in series and parallel cells.	• Chalk Board
	8.9 Calculate the voltage and current in a series and parallel circuit.	• Calculate voltage & current in series and parallel circuit.	• Chalk Board

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 11 - BASIC ELECTRICITY		Course Code: CEI 11	Contact Hours: 264 Hours
	8.10 Investigate the current and voltage relationship in: a. an inductive circuit e.g. current leads the applied voltage. b. Capacitive circuit, e.g. current lags the applied voltage c. The combination of capacitance and inductance (i) in series (ii) in parallel.	• Define Pf and show this effect on phasor diagrams with calculations.	• Chalk Board
	8.11 Calculate impedance in an AC Circuit	• Define impedance, give the symbols, unit and formula • Calculate impedance	• Textbooks • Note • Calculator • Chalk Board
	8.12 Explain the meaning of resonance in: a. a series circuit b. a parallel circuit	• Draw and explain resonance in series and parallel and simple calculations.	• Chalk Board
	8.13 Explain the simple meaning of a. Q factor b. Bandwidth	• Define Qf, B.W. and Fr. State the relationship among the three.	• Chalk Board
	8.14 Calculate resonant frequency.	• Do some calculations on the three.	• Chalk Board
General Objective 9.0: Interpret Basic Electronic Signs And Symbols.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1	9.1 State the common abbreviations used in electrical and electronic circuits. I = Current A = Amp C = Capacity V = Voltage	• List and show various abbreviations used in electrical and electronics circuits.	• Textbooks • Note
2	Draw the graphical symbols for components, units and systems used in electronics/electrical system e.g. transistor, amplifiers, switch, socket outlet, etc.	• Ask questions on symbols used on electrical and electronics.	• Chalkboard

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 11 - BASIC ELECTRICITY		Course Code: CEI 11	Contact Hours: 264 Hours
General Objective 10.0: Understand The Operation, Uses And Limitations Of Indicating Instruments And Operate Them,			
Week	Specific Learning Outcome:	Teachers Activities	Resources
3-13	10.1 Describe the functional part of the multi-meter 10.2 Set and the meter for: a. AC and DC voltage measurement b. Resistance measurement c. Ac and DC current measurement 10.3 Use the Ohm-meter to test semi-conductor devices. 10.4 Recognize a fault condition of meter	<ul style="list-style-type: none"> • Describe the parts, operation and uses of multimeter. • Demonstrate how to use the instrument in measuring current voltage and resistance both on AC and DC • Show how to use the multimeter to test diode, transistors etc. • Explain how to identify fault and how to rectify such. 	<ul style="list-style-type: none"> • Multimeter - digital and analogue • Ohmeter • Chalkboard • Note. • Chalk Board

PRACTICAL CONTENT FOR BASIC ELECTRICAL CEI 11 FOR MODULE

ALL EXPERIMENTS MUST BE PERFORMED BY STUDENTS

Week	Experiments	Teacher Activities	Resources
1-12	Demonstrate by experiment Resistors in Series and in Parallel Demonstrate by experiments the effect of connecting capacitors in series and in parallel Demonstrate by experiment Ohms law $R = V/I$ Demonstrate by experiment - Kirchoff's laws Demonstrate by experiment the Superposition theorem. Demonstrate by experiment self-induction. Natural induction of a coil R & L in series AC circuit, R & C in series AC circuit R & L in parallel AC circuit and R&C in parallel AC circuit Demonstrate by experiment series Resonance in AC and Parallel resonance in AC. Plot graphs for both series and parallel resonance. Determine the Q-factors in:	<ul style="list-style-type: none"> • Circuit Resistors in Series and then in parallels with meters and power supply. • Current capacitors in <ul style="list-style-type: none"> • in series • in parallel. • Measure current and voltage • Current resistor R in series with ammeter. Measure current I in R and measure voltage V across Resistor R. • Wire sot and take readings • Move permanent in an out of the coil as note. Deflection on the metre. • Cunnect the circuit and demonstrate variations of frequency at constant voltage • Plot the graph. 	<ul style="list-style-type: none"> • DC Ammeters, DC Voltmeters, Resistors power supply unit. • Capacitors, DC Ammeters DC Voltmeters, Power supply. • Tools and Equipment • Kirchoff's laws unit. • - do - • Components, Signal generator • Components, Signal generator • AC micrometer, AC Voltmeter (oscilloscope) capacitor, sine wave, signal generator. • Chalkboard.

EVALUATION GUIDE FOR MODULE CEI 11 - BASIC ELECTRICITY

The student will be assessed on the basis of demonstrating an understanding of basic electrical theory

Students will be graded on the following Criteria:

- a. Tools,
- b. Assignments and
- c. Terminal Examinations.

The laboratory reports should also be assessed and graded.

Domestic Installation

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK

MODULE: DOMESTIC INSTALLATION

Course Code: CEI 12

Contact Hours: 276 Hours

GOAL: This module is intended to provide the trainee with the knowledge and skill to enable him carry out complete electrical installations in a building and its associated equipment.

GENERAL OBJECTIVES:

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

1. Understand electrical working diagrams.
2. Know different types of domestic surface wiring.
3. Know different types of domestic conduit wiring.
4. Understand the principles of protecting electrical devices and install them.
5. Understand sequence for inspecting and testing domestic installations.
6. Understand the terms used in illumination.
7. Know various types of lamps for illumination.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI I2 - DOMESTIC INSTALLATION		Course Code: CEI 12	Contact Hours: 276 Hours
Course Specification At the conclusion of this module, the student will be able to wire a domestic electrical installation Theoretical Content			
General Objective 1.0: Understand Electrical Working Diagrams			
Week	Special Learning Outcome:	Teachers/Students Activities	Resources
1 2 3-5 6-8 9-13	1.1 Identify symbols used in electrical engineering drawing of an electrical installation. 1.2 Interpret the scale used in working drawing 1.3 Locate the position of the various accessories on a drawing 1.4 List all the electrical accessories required for a job from the working drawing 1.5 Interpret the distribution system from a drawing	<ul style="list-style-type: none"> • Draw each standard symbol on the chalk Board. • Explain the meaning of each symbol. • Demonstrate the scale-Rule application on sample working drawing • Show on the working drawing the position of symbols. • Demonstrate by placing symbol on working drawing plan. • Explain each item of accessories on the list. • Demonstrate on the working drawing, the appropriate positions of distribution units for single and polyphase phases & neutral. 	<ul style="list-style-type: none"> • Drawing Rule Scale • Working drawing • Chalk Board • Chalk board, Flip chart.
General Objective 2.0: Understand Different Types Of Domestic Surface Wiring Techniques			
Week	Special Learning Outcome:	Teachers/Students Activities	Resources
	2.1 Fixing cable to a surface	<ul style="list-style-type: none"> • Show clips, gim pins, rawl drill & plug. Explain how to use the materials. 	<ul style="list-style-type: none"> • Surface wiring materials & basic tools
1-2	2.2 Identify cable types and sizes used for lighting, heating, cooker and socket outlets.	<ul style="list-style-type: none"> • Show assorted type of cables e.g. PVC, MICC, Armoured, etc. List standard sizes of cables. 	<ul style="list-style-type: none"> • Cable display board.
3-13	2.3 Explain cable rating, maximum load demand and ambient temperature 2.4 Use plumb line, chalk line and spirit level.	<ul style="list-style-type: none"> • Explain using IEE charts the cable rating, maximum load demand and ambient temperature. • Demonstrate the application of plumb line, chalk line and spirit level. 	<ul style="list-style-type: none"> • IEE Regulation • Chalkboard. • Plumb line, spirit level and vertical/Horizontal surfaces.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI I2 - DOMESTIC INSTALLATION		Course Code: CEI 12	Contact Hours: 276 Hours
General Objective 2.0: Understand Different Types Of Domestic Surface Wiring Techniques			
Week	Special Learning Outcome:	Teachers/Students Activities	Resources
3-13	<p>2.5 Carry out simple, surface wiring of building (residential) using appropriate tools.</p> <p>2.6 State relevant statutory regulations regarding surface wiring</p> <p>2.7 Apply the regulations of Electrical Board of Nigeria and National Electric Power Authority (NEPA) on surface wiring.</p>	<ul style="list-style-type: none"> • Use questions/answers to discuss simple surface wiring. • Explain regulations in respect of surface wiring. Students should carryout the wiring. • Use questions/answers method to discuss regulations on surface wiring. 	<ul style="list-style-type: none"> • Chalkboard. • Flip chart • IEE Regulations, • Chalkboard • IEE & NEPA Regulations
General Objective 3.0: Know Different Types Of Domestic Conduit Wiring			
Week	Special Learning Outcome:	Teachers/Students Activities	Resources
1-10	<p>3.1 Explain the meaning of conduit</p> <p>3.2 State the advantages and disadvantages of conduit installation.</p> <p>3.3 Identify types of conduits; steel conduit, flexible conduit and pvc conduit.</p> <p>3.4 State the applications of sticks, taps and dies, hacksaw</p> <p>3.5 State relevant conduit statutory regulations</p> <p>3.6 Explain appropriate procedures for preparing conduit for Installation</p> <p>3.7 Use of running coupler, conduit boxes, bend, elbows, tees and accessories for conduit work.</p> <p>3.8 Determine set and bend permissible radial length</p>	<ul style="list-style-type: none"> • Use sketch to explain conduit • Discuss advantages and disadvantages of conduit wiring • Show assorted conduit pipes. • Show tools, use preparing conduit pipes • Explain regulations guiding conduit Installation • Show conduit square cutting. • Show conduit thread • Explain regulations regarding set and bend • Explain regulations regarding set and bend 	<ul style="list-style-type: none"> • Flip chart • Chalk board. • Steel conduit, • PVC conduit & • Flexible conduit. • Hacksaw, stacks, Taps & dies. • IEE Regulation. • Pieces of conduit with threads and without. • Running coupler set, conduit boxes, bends, etc. • Set 90 Degrees, 45 degrees and bend.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI I2 - DOMESTIC INSTALLATION		Course Code: CEI 12	Contact Hours: 276 Hours
General Objective 3.0: Know Different Types Of Domestic Conduit Wiring			
Week	Special Learning Outcome:	Teachers/Students Activities	Resources
11-12 13 13	3.9 Draw in cables using fish wire	• Demonstrate cable draw in conduit using fish wire.	• Conduit length, fish wire.
	3.10 Test the installation as stipulated by the statutory regulations		
	3.11 Maintain tools and equipment used on conduit installation.	• Describes how to maintain tools and equipment for conduit installation.	• Hand tools, megger
General Objective 4.0: Understand The Principles Of Protecting Electrical Devices And Install Them.			
Week	Special Learning Outcome:	Teachers/Students Activities	Resources
1-10	4.1 Identify common types of protective devices 4.2 Explain the principles and application of circuit breakers and fuses in electrical installation 4.3 Determine current rating of fuses 4.4 Earthing of electrical installations and devices 4.5 State the regulations relating to various types of protective devices. 4.6 Use current and voltage operated earth leakage circuit breaker observing relevant regulations.	• Select protective circuit breakers, and fuses for single/polyphase. • Describe the functions of circuit breaker and fuses in electric circuit • Show circuit breakers and fuses • Explain fuses current rating in respect of fusing factor and current • Explain the purpose of earthing installations and devices • Discuss the regulations concerning circuit breakers and fuses • Select earth leakage circuit breaker for single and 3 - phase dwelling	• Single phase breaker, 3 - phase breaker, ELCB and fuse link. • Sketches and chalkboard • Circuit breakers and fuses • IEE Tables for current rating. • Sketches and chalkboard • Chalk board • ELCB and flip chart.
General Objective 5.0: Understand Sequence For Inspection And Testing Of Domestic Installations.			
Week	Special Learning Outcome:	Teachers/Students Activities	Resources
11	5.1 Apply statutory safety regulations for life, properties and environment	• Relate statutory regulations in electrical installation environment.	• IEE Regulations
12	5.2 Visually detect electrical and mechanical loose connections.	• Inspect electrical and mechanical connections to avoid partial contact	• Chalk board and wiring board.
13	5.3 Explain 3 types of electrical Installation Tests	• Demonstrate polarity test using bell and battery, test lamp, multimeter	• Multimeter, bell, battery, test lamp.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI I2 - DOMESTIC INSTALLATION		Course Code: CEI 12	Contact Hours: 276 Hours
General Objective 6.0: Understand The Terms Used In Illumination.			
Week	Special Learning Outcome:	Teachers/Students Activities	Resources
1-3 4-5 6-7 8-9 10 11	<p>6.1 Define the following terms in respect of illumination:</p> <p>a. Luminous intensity (Symbol I)</p> <p>b. Luminous flux (Symbol I)</p> <p>c. Illumination (Symbol E)</p> <p>6.2 Explain the words Cosine law, Brightness glare and photometry</p> <p>6.3 Explain methods of denoting luminous intensity e.g. plan, horizontal luminous intensity, mean spherical luminous intensity.</p> <p>6.4 Solve mathematical problems in the calculation of illumination using lumen method.</p> <p>6.5 Define the following terms:</p> <p>a. Coefficient of utilization</p> <p>b. Maintenance factor</p> <p>6.6 Explain spacing/Mounting height ratio</p>	<ul style="list-style-type: none"> • Discuss illumination, luminous intensity and flux in respect lamps types • Describe Cosine law, brightness and glare • Show using diagrams the horizontal luminous and mean spherical luminous intensity. • Apply simple lumen method formula: $N = (E \times A) / (Q \times CU \times MF)$ in solving given figures. • Explain coefficient of utilisation. • Discuss maintenance factor • Solve simple ratio figures of spacing - mounting height 	<ul style="list-style-type: none"> • Incandescent lamp, • Flourescent lamp and • Illumination charts. • Flip charts and • Chalkboard. • Chalkboard and Charts.
General Objective 7.0: Know Various Types Of Lamps For Illumination.			
Week	Special Learning Outcome:	Teachers/Students Activities	Resources
12	7.1 Identify different types of lamps	<ul style="list-style-type: none"> • Describe using sketches the incandescent lamp, Tungsten filament lamp, gas filled tungsten filament lamp, neon tube, hot and cold cathode. 	<ul style="list-style-type: none"> • Flip chart, chalk board, and the various lamps.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI I2 - DOMESTIC INSTALLATION		Course Code: CEI 12	Contact Hours: 276 Hours
General Objective 7.0: Know Various Types Of Lamps For Illumination.			
Week	Special Learning Outcome:	Teachers/Students Activities	Resources
13	7.2 Name different types of fluorescent lamps	<ul style="list-style-type: none"> List different types of fluorescent lamps 	<ul style="list-style-type: none"> Chalk board or flip chart.
13	7.3 Explain the following terms: <ul style="list-style-type: none"> a. Emergency lighting b. Shades, and c. Reflectors 	<ul style="list-style-type: none"> Show the emergency light, shades and reflectors. 	<ul style="list-style-type: none"> Rechargeable emergency lamp, shades & reflects.

PRACTICAL CONTENT FOR DOMESTIC INSTALLATION CET 12 FOR MODULE

Week	Practical Work	Student Activities	Resources
2 Terms	Draw electrical installation layout from a given living house plan.	<ul style="list-style-type: none"> Illustrate a simple Electrical Installation layout for one bedroom house. Assignment to draw electrical installation layout of a 3 bedroom living house. 	<ul style="list-style-type: none"> Chalkboard and Flip - chart.
1 Term	Surface wire an installation of two lighting points controlled by independent switches using PVC cable.	<ul style="list-style-type: none"> Mark out cable runs on wiring Board. Cut PVC Twin core cable to specifications. Assemble cables and accessories on the wiring board. Conduct polarity, continuity & insulation tests 	<ul style="list-style-type: none"> Transparency sheet and Drawing Instrument. Accessories, PVC Twin core 110mml, Brass nails, wooden Board, chalk, Meggar, hand tools & Ruler tape
1 Term	Using steel conduit wire a lighting point, controlled by two - 2 way switches.	<ul style="list-style-type: none"> Cut conduit pipes with hacksaw to given specifications/dimensions. Clean Burs at the end of each conduit pipe length using reamer. Assemble prepared conduit pipes & cables with all accessories on wiring board. Conduct polarity, continuity and insulation tests 	<ul style="list-style-type: none"> Hacksaw, reamer, pipe vice, Ruler Tape, Saddles, Screws & conduit accessories.

Week	Practical Work	Student Activities	Resources
2 Terms	Wire up a complete electrical installation consisting of: <ul style="list-style-type: none"> a. Incoming mains b. Electrical energy meter c. Isolating fuse d. Switch board with main switch and two circuit breakers e. A single power outlet circuit using PVC cable f. A single incandescent lighting point controlled by a single switch using PVC cable g. An electric stove using PVC cable 	<ul style="list-style-type: none"> • Conduct polarity, continuity and insulation tests • Connect to supply and test. 	<ul style="list-style-type: none"> • Insulation tests • Equipment

EVALUATION GUIDE

To pass this module the student must be able to successfully wire a domestic electrical installation.

Marks shall be allocated as follows:

Theory 50%

Practice 50%

Industrial Installation and Electric Motors

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK		
MODULE: INDUSTRIAL INSTALLATION AND ELECTRIC MOTORS	Course Code: CEI 13	Contact Hours: 336 Hours
GOAL: The module is intended to provide the trainee with the knowledge and skill to enable him carry out all types of industrial/factory electrical installations and maintenance		
GENERAL OBJECTIVES:		
On completion of this module, the trainee should be able to:		
<ol style="list-style-type: none"> 1. Know different types of industrial installations. 2. Understand the installation of different types of ducts and trunkings applying all relevant regulations and safety precautions. 3. Understand the principles of operation of AC and DC machines and their applications. 4. Know the installation of all types of electrical machines and equipment. 5. Understand various methods of controlling electrical machines. 6. Know methods of maintaining electrical machines and equipment. 7. Diagnose faults in machines, equipment and installations. 8. Know the installation of MICC cable. 		

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: INDUSTRIAL INSTALLATION AND ELECTRIC MOTORS	Course Code: CEI 13	Contact Hours: 336 Hours	
Course Specification: Theoretical Content			
General Objective 1.0: Know the different type of Industrial Installations.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-2	1.1 Interpret electrical working drawing of a factory	<ul style="list-style-type: none"> • Using electrical layout drawings of a small and a large factory, illustrate the key features e.g. feeder cables, HV/LV transformers, metering, main and sub-switch boards, main cable/busduct runs, etc. • Visit factories and identify key elements of the electrical installation. 	<ul style="list-style-type: none"> • Chalkboard • Layout diagrams • Textbooks

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: INDUSTRIAL INSTALLATION AND ELECTRIC MOTORS		Course Code: CEI 13	Contact Hours: 336 Hours
General Objective 2.0: Understand The Installation Of Different Types Of Ducts And Trunkings Applying All Relevant Regulations And Safety Precautions.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
3-6	2.1 Carry out: a. Simple surface wiring for industrial installation b. Conduit wiring for industrial installation	• Demonstrate on wiring Board conduits wiring	• Conduit and its accessories • Wiring Board
	2.2 Show how to install MICC Cable	• Demonstrate the installation of MICC Cable	• MICC Cables, tools, wiring boards
7	2.3 Apply the safety measures as provided for by the prevailing statutory regulations when carrying out items 2.1 and 2.2 above.	• Explain regulations guiding MICC cable. State the advantages and disadvantages of MICC cables and list tools used for its installation.	Short lengths of ducts and
8-9	2.4 Describe ducts and trunking systems.	• Explain duct and trunking	• Trunking.
9	2.5 State the advantages and disadvantages of ducts and trunking in industrial electrical installation.	• List and explain the advantages and disadvantages of ducting and trunking.	• Chalkboard
10	2.6 Identify the different types of ducts and trunking e.g. metallic and non - metallic.	• Show the different types of ducts and trunking.	
11	2.7 Identify, select and maintain tools and equipment used for ducts and trunking systems.	• List tools and equipment used on duct and trunking	• Chalkboard.
11	2.8 Identify types of bus-bar trunking and recognise the necessity for accurate marking-out when cutting holes.	• List types of bus-bar trunking and explain methods of marking out when employing trunking system of wiring.	• Chart.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: INDUSTRIAL INSTALLATION AND ELECTRIC MOTORS		Course Code: CEI 13	Contact Hours: 336 Hours
General Objective 2.0: Understand The Installation Of Different Types Of Ducts And Trunkings Applying All Relevant Regulations And Safety Precautions.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
12	2.9 Explain how to bend, Set, Shape, File and fabricate accessories used in connection with ducts and trunkings using the appropriate tools and equipment.	<ul style="list-style-type: none"> List and explain accessories used on duct and trunking. List and explain the use of tools and accessories used in ducting and trunking. 	<ul style="list-style-type: none"> Tools and equipment.
13	2.10 Explain how to join lengths of ducts and trunkings using rivets, screws or adhesives.	<ul style="list-style-type: none"> Demonstrate how to join ducts and trunking. 	<ul style="list-style-type: none"> Rivet machine.
13	2.11 State the importance of earth continuity and ensure its provision on all types of ducts and trunking.	<ul style="list-style-type: none"> Explain the importance of earth continuity on ducting and trunking 	
13	2.12 Apply the necessary safety measures as provided for by the prevailing statutory regulations	<ul style="list-style-type: none"> Discuss relevant regulations guiding the installation of ducting and trunking. 	<ul style="list-style-type: none"> IEE Regulations
General Objective 3.0: Understand The Principles Of Operation Of AC And DC Machines And Their Applications.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-3	3.1 Describe the principle of operation of each of the following machines: <ul style="list-style-type: none"> a. DC motor b. DC generator c. AC motor (Single phase) d. AC generator (Single phase). 	<ul style="list-style-type: none"> Explain the principles of operation of generators and motors. Explain the difference between motor and generator. 	<ul style="list-style-type: none"> Chalkboard Examples of motors
4-5	3.2 Describe the constructional features of <ul style="list-style-type: none"> a. DC machines b. AC machines (Single phase) 	<ul style="list-style-type: none"> With the aid of a diagram or chart, explain the functions of AC and DC machines. 	<ul style="list-style-type: none"> Charts.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: INDUSTRIAL INSTALLATION AND ELECTRIC MOTORS		Course Code: CEI 13	Contact Hours: 336 Hours
General Objective 3.0: Understand The Principles Of Operation Of AC And DC Machines And Their Applications.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
6	3.3 Differentiate between: a. DC and AC motors b. DC and AC generators	<ul style="list-style-type: none"> • Explain the difference between AC and DC motors and generators. 	<ul style="list-style-type: none"> • AC and DC motors and generators.
8-13	3.4 Identify types of DC motors and generators; e.g. motor (Series, shunt, and compound), generator - separately and self excited (Series, Shunt, or compound). 3.5 State the applications of the machines stated in 3.4 above. 3.6 Identify types of AC motors: (Single and 3 - phase) e.g. Squirrel cage motor, wound rotor motor, inductor motor, AC commutator synchronous motors, etc. 3.7 State the applications of each of the motors listed in 3.4 above. 3.8 Describe the principle of operation of polyphase machines.	<ul style="list-style-type: none"> • List DC motors (Series, Shunt, compound). • Explain the operation of each motor stated in 3.4. • List and explain AC Motor - Single phase and 3 - phase. • Explain the application of AC motors listed in 3.4. • Describe the principle of operation of polyphase machine. 	<ul style="list-style-type: none"> • DC Motors - series, shunt & compound • DC Motors - series, shunt & compound • AC Motors: Single phase and 3 - phase. • Chalkboard. • Chalk Board
General Objective 4.0: Know The Installation Of All Types Of Electrical Machines And Equipment.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-10	4.1 Identify types of enclosures and their application e.g. totally enclosed, water proof and semi-enclosed, etc. 4.2 Describe the construction of a good foundation for mounting machines and equipment.	<ul style="list-style-type: none"> • List and explain different ways by which machines can be enclosed. • Explain and demonstrate how to construct foundation for mounting a machine. • Explain how to lift handle and mount machine. 	<ul style="list-style-type: none"> • Chalkboard • Chart • Gravel, Sand, Cement, Water, Spade, etc. • Chalkboard

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: INDUSTRIAL INSTALLATION AND ELECTRIC MOTORS		Course Code: CEI 13	Contact Hours: 336 Hours
General Objective 4.0: Know The Installation Of All Types Of Electrical Machines And Equipment.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-10	4.3 Lift, handle, mount, and align AC and DC machines and equipment. 4.4 Identify types of connections e.g. Star - Delta, Delta - Star, etc. 4.5 Select the correct size of cable for the appropriate machine installations. 4.6 Select flexible conduit correctly for machine terminations. 4.7 Select suitable starter for different motors e.g. direct-on-line, Star-Delta, Auto transformer.	<ul style="list-style-type: none"> Describe types of connections: Star - Delta, Delta - Star. Explain how to calculate current rating of cable. Demonstrate the use of flexible conduit in connecting a motor. List and explain the operation and uses of starters for motors. 	<ul style="list-style-type: none"> Short length of flexible Conduit. Direct - on - line starter, Star - Delta, Auto transformer starters.
11	4.8 State the principle of operation of a Starter.	<ul style="list-style-type: none"> Describe the principle of operation of each Starter 	<ul style="list-style-type: none"> Direct - on - line starter, Star - Delta, Auto transformer starters.
12	4.9 Test for correct rotation, short circuit and earth fault.	<ul style="list-style-type: none"> Explain and demonstrate how to test machines. 	<ul style="list-style-type: none"> Tachometer Growler
13	4.10 Apply all relevant safety measures as provided for by the prevailing statutory regulations.	<ul style="list-style-type: none"> Explain regulations guiding choice, installation and maintenance of machines. 	<ul style="list-style-type: none"> Bar to Bar tester.
General Objective 5.0: Understand Various Methods Of Controlling Electrical Machines.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
	5.1 Explain the different levels of controlling the speed of a machine e.g. direct - on - line, auto transformer, star - delta, capacitor start, rotor resistance starter,	<ul style="list-style-type: none"> Various starters should be used to demonstrate the speed control of a motor Prepare teaching notes and diagrams Set up a demonstration. 	<ul style="list-style-type: none"> Various starters Chalk Board Materials for demonstration.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: INDUSTRIAL INSTALLATION AND ELECTRIC MOTORS		Course Code: CEI 13	Contact Hours: 336 Hours
General Objective 5.0: Understand Various Methods Of Controlling Electrical Machines.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-13	<p>5.2 Investigate and describe an electrical control circuit consisting of a stop/start station, overloads, two-3phase motors (which have isolating switches). One of the motors is attached to a pump, and the other is driving a pressure tank that has a high pressure switch.</p> <p>5.3 Investigate and describe the operation and structure of programmable Logic Control Systems including programming for basic logic factors (AND, OR, YES, NOT); Programming for timer, counter functions, Network (ladder diagram presentation), Set up a program for a motor control system.</p>	<ul style="list-style-type: none"> • Prepare teaching notes using a machine manual • Work through the topics • Set up a demonstration. 	
General Objective 6.0: Know Methods Of Maintaining Electrical Machines And Equipment.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-4	<p>6.1 Describe the types of maintenance, e.g. routine maintenance, corrective, etc.</p> <p>6.2 Provide Maintenance procedure for each item and type of equipment and machine.</p> <p>6.3 Identify types and grades of lubricants e.g. grease, oil, coolant. etc.</p> <p>6.4 State the application of each type of lubricant and apply them in the appropriate item.</p>	<ul style="list-style-type: none"> • Explain maintenance, types, and why it is necessary. • Explain procedure for maintaining machines and equipment. • List lubricants used on machines. • State the uses of lubricants and demonstrate how to apply each type. 	<ul style="list-style-type: none"> • Chalkboard. • Chart. • Lubricants - grease, oil, coolant.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: INDUSTRIAL INSTALLATION AND ELECTRIC MOTORS		Course Code: CEI 13	Contact Hours: 336 Hours
General Objective 6.0: Know Methods Of Maintaining Electrical Machines And Equipment.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
4	6.5 Identify and operate various types of tools and equipment used for maintenance: grease gun, oil can, screw driver, pulley extractors, wrenches, blower, filler gauge.	<ul style="list-style-type: none"> List tools and equipment used for maintenance of machines. Demonstrate the use of each item. 	<ul style="list-style-type: none"> Tools and equipment.
5-6	6.6 Describe the constructional features of electrical equipment e.g. cooker, heater, iron, etc. and state the functions of their parts.	<ul style="list-style-type: none"> With the aid of diagram, explain the working principles of Cooker, heater, iron. 	<ul style="list-style-type: none"> Cooker, iron, heater
7-8 9	<p>6.7 Maintain equipment or machine following maintenance procedure specified by manufacturers ensuring that:</p> <ol style="list-style-type: none"> Ventilating holes are cleared of dirt; Dead or worn out bearings are replaced; Belt tension is adjusted where necessary; Alignment are checked and worn out machine parts e.g. brushes, holders and spring and machine guide are replaced. <p>6.8 Test to ensure that the maintained parts of the machine or installation is in working condition.</p> <p>6.9 Keep record of maintenance.</p>	<ul style="list-style-type: none"> Explain how to make use of data and manufacturer's specifications in maintenance of machines. Show how to carry out tests on machine Describe how records are kept 	<ul style="list-style-type: none"> An old motor Used Motor Chalkboard Notebook.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: INDUSTRIAL INSTALLATION AND ELECTRIC MOTORS		Course Code: CEI 13	Contact Hours: 336 Hours
General Objective 7.0: Diagnose Faults In Machines, Equipment And Installations.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-10	<p>7.1 Identify causes of breakdown, eg. Short circuit, open circuit, worn-out part, insulation breakdown, incorrect use, overload, ageing, etc.</p> <p>7.2 Identify and explain the causes of faults e.g. fuse melting, Circuit breaker tripping, etc.</p> <p>7.3 Determine fault by noise Symptoms.</p> <p>7.4 Interpret Circuit diagram</p> <p>7.5 Apply trouble Shooting techniques to diagnose faulty item eg.</p> <p style="padding-left: 20px;">a. Visual inspection</p> <p style="padding-left: 20px;">b. Voltage test using meters</p> <p style="padding-left: 20px;">c. Current test using meters</p> <p style="padding-left: 20px;">d. Continuity test using meters.</p> <p>7.6 Apply the appropriate tools and equipment to effect the repair of faulty part.</p> <p>7.7 Test for correct performance of the machine/equipment or installation after repairs.</p>	<ul style="list-style-type: none"> • Demonstrate how to detect faults and causes of break-down on machines and how to rectify such faults. • Ask questions on fault finding, causes and remedies. • Explain how to detect fault by noise. • Show and explain Circuit diagrams. • Demonstrate how to diagnose faults by usual inspection, and using Voltmeter and ammeter. • Show with normal tools how to repair and replace faulty parts. • Demonstrate how to carry out final test on machine before it is connected. 	<ul style="list-style-type: none"> • Megger • 3-phase motor • Voltmeter • Ammeter • Typical Installation • Ball bearing. • Electric iron.
General Objective 8.0: Know The Installation Of MICC Cable			
Week	Specific Learning Outcome:	Teachers Activities	Resources
11-13	<p>8.1 State MICC cable application</p> <p>8.2 Select tools and materials for MICC Installation</p> <p>8.3 State regulation relevant to MICC Installation work</p>	<ul style="list-style-type: none"> • Identify MICC cable • Explain MICC use • List basic tools and materials for MICC Installation work • Discuss regulation in respect of MICC Installation. 	<ul style="list-style-type: none"> • MICC Sample • Hand tools and MICC materials • IEE Regulation

PRACTICAL CONTENT FOR INDUSTRIAL INSTALLATION CEI 13 FOR MODULE

Week	Experiments	Student's Activities	Resources
1 Term.	Install MICC cable system including a switch controlling a single light.	<ul style="list-style-type: none"> • Carryout simple installation of MICC cable and test. • Conduct polarity, continuity and insulation tests on completed job. • Connect to supply and test. 	<ul style="list-style-type: none"> • MICC Cable, wiring Board, hammer, hacksaw, switch light fitting, megger.
1 Term	Join lengths of ducts	<ul style="list-style-type: none"> • Demonstrate how to join ducts 	<ul style="list-style-type: none"> • Rivet machine, rivets.
1 Term	Mounting electric machines	<ul style="list-style-type: none"> • Construct a foundation, allow to set, mount the machine. 	<ul style="list-style-type: none"> • Gravel, Sand, Cement, water, spade.
1 Term	Carryout test and inspection on an AC Machine, AC induction motor, AC round rotor motor.	<ul style="list-style-type: none"> • Inspect machines: the test machines.. 	<ul style="list-style-type: none"> • Megger
3 Terms	Set up a 3-phase AC motor control system, which will include a 3-phase motor, contractor, overloads, stop/start station, pressure switch and limit switch. The motor will have a 3-phase isolating switch.		<ul style="list-style-type: none"> • Items as listed.

EVALUATION GUIDE FOR MODULE: CEI 13 - INDUSTRIAL INSTALLATION

To pass this module, students must be able to connect a 3-phase motor control system.

Pass assignments, tests and Examination.

Cable Jointing

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK		
MODULE: CABLE JOINTING	Course Code: CEI 14	Contact Hours: 216 Hours
<p>GOAL: The module is designed to provide the trainee with the knowledge and skill to enable him undertake with proficiency various methods of cable jointing and terminations.</p> <p>General Objectives:</p> <p>On completion of this module, the trainee should be able to:</p> <ol style="list-style-type: none"> 1. Know how to make simple joints and terminations. 2. Know various types of armoured cables, their applications, jointing and terminations. 3. Know the installation of underground cables. 4. Understand the installation of overhead wires and cable for distribution/transmission system. 5. Know the various types of data and communication cabling methods. 		

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 14 CABLE JOINTING		Course Code: CEI 14	Contact Hours: 216 Hours
Course Specification: Theoretical Content			
General Objective 1.0: Know How To Make Simple Joints And Terminations			
Week	Special Learning Outcome:	Teachers Activities	Resources
1-13	1.1 Identify the tools and materials related to cable jointing 1.2 Identify the use of tools and materials related to cable jointing terminations e.g. soldering bit, blow lamp, strippers, soldering lugs, electric soldering iron, pot and ladle, pliers etc. 1.3 Recognise different types of insulating materials e.g. PVC cables, etc. 1.4 Identify different types of Conductors e.g. Copper, aluminium, etc.	<ul style="list-style-type: none"> • Explain and show tools and equipment used in joints and soldering. • Describe the procedure for cable joint. Highlight the sizes and uses. • Show insulating materials • Display and explain different insulating materials. Show conductors e.g. Copper and Aluminium etc. 	<ul style="list-style-type: none"> • Tools • Equipment • Materials • Different sizes of cables. • PVC cables • Chalkboard

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 14 CABLE JOINTING		Course Code: CEI 14	Contact Hours: 216 Hours
General Objective 1.0: Know How To Make Simple Joints And Terminations			
Week	Special Learning Outcome:	Teachers Activities	Resources
1-13	1.5 State the advantages and disadvantages of different conducting materials. 1.6 Cut cable ends, strip insulation and tape joint on completion 1.7 Shape conductors to avoid strains 1.8 Fix appliances and accessories into their terminal correctly 1.9 Select the right size of cable lugs and glands.	<ul style="list-style-type: none"> • Explain the advantage and disadvantages of conductors displayed. • Demonstrate how to prepare cable for joint. • Demonstrate shaping of Conductor • Show how to fix accessories to terminals • Explain the selection of lugs and glands used for termination. 	<ul style="list-style-type: none"> • Conductors • Insulators • Cables • Lugs • Glands
General Objective 2.0: Know Various Types Of Armoured Cables, Their Applications, Jointing And Terminations.			
Week	Special Learning Outcome:	Teachers Activities	Resources
1-3	2.1 Recognise the types of Armouring materials 2.2 Explain why armouring is necessary 2.3 Explain the application of armouring cable	<ul style="list-style-type: none"> • Show different armoured cable. • Explain the usefulness of armouring • Give the application of armoured cable. 	<ul style="list-style-type: none"> • Armoured Cable • Chalk Board
4-13	2.4 Describe with diagram the Constructional features of armoured Cable 2.5 Join armoured Cables at Intermediate positions. 2.6 Terminate armoured cable.	<ul style="list-style-type: none"> • Draw to show the Constructional parts of armoured Cable. • Join two length of armoured cable. • Demonstrate how to terminate armoured cable. 	<ul style="list-style-type: none"> • Chalk Board • Air on armoured cable

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 14 CABLE JOINTING		Course Code: CEI 14	Contact Hours: 216 Hours
General Objective 3.0: Know The Installation Of Underground Cables			
Week	Special Learning Outcome:	Teachers Activities	Resources
1-11	<p>1.3 Select appropriate types of cable for underground electrical installation works e.g. Heeled cable, Screened or H-type Cable, HSL - type Cable, (screened lead), single and three cord 132KV oil filled cable, external gas pressure and impregnated cable, PVC armoured.</p> <p>3.2 Convey underground cable to site.</p> <p>3.3 Prepare trench to appropriate depth for cable laying</p> <p>3.4 Lay cables in trench using appropriate methods e.g. Jacks and rollers, Winches etc.</p> <p>3.5 Identify various materials and tools used for joints and termination in underground cables e.g. glands boxes, pot and ladles, plumbers, metals, gas blow lamps.</p> <p>3.6 Make cables joints/termination e.g. tee, straight, finals terminations.</p>	<ul style="list-style-type: none"> • Explain factors affecting underground cables and the type of cable need for underground system. • Ask question on above. • Explain how to convey underground cable to the site. • Demonstrate how to prepare trench depth for cable laying. • Show how to lay cable in trench using jacks, rollers etc. • Show tools and equipment used in terminating underground cable. • Explain all safety precaution and regulations. 	<ul style="list-style-type: none"> • Chalkboard • Materials for preparing Trench • Planks • Jacks and Pollars • Gland Boxes • Gas
12	3.7 Solder underground cable joints	<ul style="list-style-type: none"> • Solder a joint. Show different types of tapes used in underground cable. Explain fully all IEE regulation guiding underground. Use Megger to test conformity of cable and Insulation assistance. 	<ul style="list-style-type: none"> • I.E.E. Regulation • Instruments • Chalkboard
13	3.8 Identify types of tapes used in underground cable	<ul style="list-style-type: none"> • Explain the principle of operation of instruments used in testing underground work of bridge Meggar, Slidewire etc. 	<ul style="list-style-type: none"> • Chalk Board
	<p>3.9 Apply I.E.E. regulation relevant to underground cable works.</p> <p>3.10 Test for conformity of wire and insulation</p> <p>3.11 Students to visit an underground cable installation activity.</p>		

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 14 CABLE JOINTING		Course Code: CEI 14	Contact Hours: 216 Hours
General Objective 4.0: Understand The Installation Of Overhead Wires And Cable For Distribution and Transmission System.			
Week	Special Learning Outcome:	Teachers Activities	Resources
1-13	4.1 Identify cable/wire, tools and equipment used in overhead distribution/transmission e.g. draw vices, safety belt, ladder, insulators. 4.2 Convey poles to site. Erect them correctly e.g. erect at appropriate poles pan and firmly in the ground. 4.3 State the uses of different types of stay wires. 4.4 Prepare different types of stay wires 4.5 Draw lines with appropriate tension. 4.6 State the uses of different types of cross-arms used in high tension transmission. 4.7 Make proper joint and terminations ensuring electrical continuity.	<ul style="list-style-type: none"> • Explain transmission and distribution stating tools and equipment used in the two system. • Explain how to convey poles to site and how to erect such. • Describe stay wire and its function • Demonstrate how to screw pole with stay wire. • Draw at least a phase on pole. • Show and demonstrate cross-arms used in Transmission line. • Demonstrate how to make a joint noting all precautions. 	<ul style="list-style-type: none"> • Draw vice • Safety belt • Ladder • Stay wire • Pole stay wire • Pole • Pole, Cross arm
General Objective 5.0: Know The Various Types Of Data And Communication Cabling Methods.			
Week	Special Learning Outcome:	Teachers Activities	Resources
1-8	5.1 Identify different type of Data Communication cables 5.2 Explain the uses of the cable RG.6	<ul style="list-style-type: none"> • Show different type of data cable, communication cables e.g. Computer cables, fibre optic, co-axial cable. • Mention areas where they were used. 	<ul style="list-style-type: none"> •Cable • Communication Equipment. • Samples RG.6 cable
9-13	5.2 Cable terminator - Connect a Small PABX	<ul style="list-style-type: none"> • Supervise connection 	<ul style="list-style-type: none"> • Cable (5 pairs) • Tools • PABX

PRACTICAL

PRACTICAL CONTENT FOR CABLE JOINTING CEI 14 FOR MODULE

Week	Experiments	Teacher's Activities	Resources
1-3	Prepare PVC taped and braided cables for termination.	• Demonstrate how to prepare PVC taped and braided cables for termination.	• Cable • Tools
4-6	Joint two length of Cables and use related materials for joints e.g. Soldering bit, lamp etc.	• Show how to join two length of cable and the related materials for joints i.e. soldering bit, lamp etc.	• Tools • Materials
7-9	Make different type of joint using prepared Cable end.	• Prepare different type of joints using appropriate cable end	• Cable
10-12	Prepare cable joints for insulation using rubber tape and PVC.	• Prepare cable joints for insulation using rubber tape and PVC.	• Tape
1-3	Prepare two different type of cable conductors for jointing using tinning.	• Demonstrate two different type of cable using tinning system.	• 2 different types of cables
4-6	Prepare the right size of Cable for soldering lug and glands.	• Show how to prepare the right size of cable for soldering lug and glands.	• Different types of cables.
7-9	Prepare service cable ready for soldering and brazing using different type of soldering methods.	• Show service cable ready for soldering and brazing using different type of soldering methods.	• Cable • Tape
10-12	Melt the solder and skin any impurity from the surface and warm the ladle	• Demonstrate how to melt the solder and skin any impurity from the surface and warm the laddle.	• Materials • Tools
1-3	Fill the socket with molten solder and tip it out quickly.	• Show how to fill the socket with molten solder and cable.	• Materials
4-6	Test for electrical continuity, short circuit and insulation remittance.	• Demonstrate how to test for electrical continuity, short circuit and insulation remittance by using necessary instruments.	• Instrument • Tools
7-9	Select and prepare different type of armoured cable ends.	• Prepare different type of armoured cable ends ready for termination.	• Armoured Cable
10-12	Joint and terminate armoured cables at intermediate positions.	• Demonstrate how to join and terminate armoured cables at intermediate positions.	• Cable • Material
1-3	Dig and prepare ground for laying of underground cable.	• Show how to dig and prepare ground for laying underground cable.	• Site
4-6	Show how to use pot and laddle in soldering/joining underground armoured cable.	• Demonstrate how to use pot and laddle in soldering/jointing underground armoured cable.	• Cable • Materials

Week	Experiments	Teacher's Activities	Resources
7-9	Demonstrate how to repair damaged underground armoured cable.	• Show how to repair/damaged underground armoured cable.	• Damaged Underground Armoured Cable.
10-12	Use Megger/Ohmmeter to test for continuity insulation resistance etc.	• Demonstrate how to use Megger/Ohmmeter to test for continuity, insulation resistance. Etc.	• Tools • Instrument
1-3	Lay cable in prepared trench using appropriate methods. Jack and Rollar and Winches etc.	• Show how to lay cable in prepared trench using appropriate method.	• Materials
4-6	Select cables/wire and tools used in overhead transmission and distribution system.	• Select cables/wire and tools used in overhead transmission and distribution system.	• Materials
7	Convey poles and transmission wire to the site.	• Show how to pack and load poles and transmission wire to the site.	• Poles • Cable
8-9	Dig and erect poles with stay	• Show how to dig and erect poles with stay.	• Sample of poles.
10-11	Draw lines with appropriate tools.	• Demonstrate how to draw lines with appropriate tools e.g. vice. Etc.	• Tools, Cables, Vice
12	Make proper Joints and terminations where applicable.	• Show how to make proper joint and termination where applicable.	

EVALUATION GUIDE

CABLE JOINTING

Set multichoice questions on cable jointing

Assign periodical Examinations, Tests, Worksheets, Tutorials and Assessment

Students will be graded on the following criteria:

1. Quizzes (Class test)	- 40
2. Mid & Final Exam	- 200
3. Work sheets (Tutorial)	- 60
4. Drawing	- 200
5. Final Project	- 50
6.. Workshop Manual	- 50
	- -
	600 points

Battery Charging and Repairs

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK		
MODULE: BATTERY CHARGING AND REPAIRS	Course Code: CEI 15	Contact Hours: 168 Hours
GOAL: The module is designed to provide the trainee with the knowledge and skill to maintain, repair and charge batteries efficiently.		
GENERAL OBJECTIVES:		
On completion of this module, the trainee should be able to:		
<ol style="list-style-type: none"> 1. Understand the working principles of a cell and the constructional feature of a battery. 2. Maintain, repair and charge batteries. 		

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 15 - BATTERY CHARGING AND REPAIRS	Course Code: CEI 15	Contact Hours: 168 Hours	
Course Specification: Theoretical Content			
General Objective 1.0: Understand the working principles of a Cell and the Constructional feature of a battery.			
Week	Special Learning Outcome:	Teachers Activities	Resources
1-2 3-5 5-7 8-13	1.1 Identify types of cells - Primary and Secondary cells. 1.2 Explain the working principle of Primary and Secondary cells 1.3 Identify the various parts of the cells 1.4 Construct a simple cell of battery	<ul style="list-style-type: none"> • Ask questions on Cells and Battery. • Explain primary and secondary cells. • Explain working Principle of 1.1 above. • Draw a labelled diagram of a cell. • Construct a small single cell in the Workshop 	<ul style="list-style-type: none"> • Cells • Battery • Charts • Chalkboard • Chemicals
General Objective 2.0: Maintain, Repair And Charge Batteries.			
Week	Special Learning Outcome:	Teachers Activities	Resources
1-8	2.1 Identify the materials, equipment and tools used for battery charging.	<ul style="list-style-type: none"> • Show tools, materials and equipment used with battery in a charging room. • List the precaution in a charge room. • Explain the precaution in a room. 	<ul style="list-style-type: none"> • Charging Equipment. • Acid • Potassium

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 15 - BATTERY CHARGING AND REPAIRS		Course Code: CEI 15	Contact Hours: 168 Hours
General Objective 2.0: Maintain, Repair And Charge Batteries.			
Week	Special Learning Outcome:	Teachers Activities	Resources
1-8	<p>2.2 Describe the condition suitable for battery charging e.g.</p> <ol style="list-style-type: none"> Observe polarity and terminal the room will be well ventilated remove the vent covers use non-corrosive base. <p>2.3 Prepare electrolyte observing necessary precaution</p> <p>2.4 Describe the various methods of charging battery e.g. Constant voltage, constant current, float charging, trickle charge.</p>	<ul style="list-style-type: none"> Demonstrate how to prepare electrolyte. Observe all precautions. State and describe various methods of charging battery. Explain methods of battery charging. 	<ul style="list-style-type: none"> Sulphuric Acid Chalkboard.
9-10	<p>2.5 Describe the various types of charge. E.g.:</p> <ol style="list-style-type: none"> Stickle charge Floated charge Equalizing charge Ordinary charge Initial charge. 	<ul style="list-style-type: none"> Describe all types of charges as stated. 	<ul style="list-style-type: none"> Battery Charger
11-13	<p>2.6 Determine the specific gravity of electrolyte using the hydrometers</p> <p>2.7 Determine the charge condition. Determine the discharge condition.</p> <p>2.8 Protect terminates from corrosion. Safeguard the battery, cells in a charge condition.</p> <p>2.9 Describe the constructional features of a charger.</p> <p>2.10 Operate the machine to charge a battery.</p>	<ul style="list-style-type: none"> Use hydrometer to demonstrate how to test the specific gravity. Explain charging and discharge state. Show how to determine them. Explain how to maintain terminals from corrosion. Draw a well labelled diagram of a charger. Show parts of a charger. Explain regulations guiding battery installation, charging and maintenance. Observe the regulation guiding battery charging. 	<ul style="list-style-type: none"> Hydrometer Chalkboard Grease Charger Chart Faulty Battery Battery Cells Battery Battery with open top

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 15 - BATTERY CHARGING AND REPAIRS		Course Code: CEI 15	Contact Hours: 168 Hours
General Objective 2.0: Maintain, Repair And Charge Batteries.			
Week	Special Learning Outcome:	Teachers Activities	Resources
11-13	2.11 Apply the necessary statutory regulation while charging 2.12 Detect faulty cells in a battery using voltage tester 2.13 Repair and replace fault cells in a battery 2.14 Seal battery top with the appropriate sealing compound.	<ul style="list-style-type: none"> • Show how to detect the condition of cells in a battery • Show how to repair and replace faulty cells. • Demonstrate how to seal battery tops with sealing compound. 	

BATTERY MAINTENANCE AND CHARGING PRACTICALS

PRACTICAL CONTENT FOR BATTERY CHARGING AND REPAIRS CEI 15 FOR MODULE

Week	Experiments	Student Activities	Resources
1-3	Demonstrate connection of Cells - Primary and Secondary	• Demonstrate how to connect cells. E.g. Primary and Secondary.	• Cells
4-6	Construct a simple cell/battery	• Show how to construct simple cell/battery	• Battery
7-9	Install/connect batteries for charging system e.g. Series, parallel connections.	• Connect batteries in both series and parallel connections.	• Batteries
10-12	Preparation of electrolyte for battery use.	• Demonstrate on how to prepare mixed electrolyte for battery	• Electrolyte • Acid • Water
1-3	Connect battery for trickle, float, equalizing charges. Etc.	• Demonstrate how to connect battery for trickle, float, equalizing charges.	• Charger • Battery
4-6	Show how to measure the specific gravity of electrolyte	• Show how to measure the specific gravity of electrolyte	• Electrolyte
7-9	Use hydrometer to determine the specific gravity of electrolyte.	• Demonstrate how to use hydrometer to measure specific gravity of electrolyte	• Hydrometer
10-12	Connect battery to observe the charging conditions	• Demonstrate how to observe charging conditions of battery	• Battery • Battery Charger
1-4	Operate charging machine to charge battery	• Demonstrate how to operate battery charging machine	• Charging Machine

Week	Experiments	Student Activities	Resources
6-12	Prepare and replace damaged battery cells.	• Demonstrate how to prepare and replace damaged battery cells.	• Battery • Cell

EVALUATION GUIDE

BATTERY MAINTENANCE AND CHARGING

Assign periodical examination, Tests Worksheets, Tutorials and Assessment.

- a. Students will be graded on the following criteria:
- b. Quizzes, Mid and Final Exam.
- c. Worksheet (Tutorial)
- d. Drawing
- e. Final projects and workshop Manual
- f. Performance of battery practical experiments.

Winding of Electrical Machines

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK		
MODULE: WINDING OF ELECTRICAL MACHINES	Course Code: CEI 16	Contact Hours: 264 Hours
<p>GOAL: The module is aimed at providing the trainee with the knowledge and skill to enable him wind or rewind AC and DC rotating/static machines up to 10 KVA</p> <p>GENERAL OBJECTIVES:</p> <p>On completion of this module, the trainee should be able to:</p> <ol style="list-style-type: none"> 1. Understand and apply all statutory regulations during electrical winding work. 2. Identify and select appropriate tools and equipment used for winding jobs. 3. Acquire skills for preparation and interpretation of winding drawing. 4. Acquire skills for dismantling machines for rewinding them. 5. Understand the rewinding of burnt static/rotating machines. 6. Know the skimming/undercutting of armature, commutators and slip rings. 7. Inspect rewound electrical machines and equipment and test for continuity, insulation, correct rotating voltage. 		

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 16 - WINDING OF ELECTRICAL MACHINES	Course Code: CEI 16	Contact Hours: 264 Hours	
Course Specification: Theoretical Content			
General Objective 1.0: Understand and apply all statutory regulations during electrical winding work			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-2	1.1 Apply the prevailing statutory regulation as it concerns: <ol style="list-style-type: none"> a. the use of Conductors b. Soldering of terminations c. Setting of winding machines d. Handling of Cable drums e. Use of Liquid Varnish and oven 1.2 Apply general safety precautions in an electrical workshop	<ul style="list-style-type: none"> • Explain relevant regulations on the use of Conductors, Soldering, winding machine, winding drums, Varnish and Oven. • Explain the relevant safety precautions in an electrical workshop. 	<ul style="list-style-type: none"> • Relevant Statutory Regulations; • Chalkboard; • Chalks.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 16 - WINDING OF ELECTRICAL MACHINES		Course Code: CEI 16	Contact Hours: 264 Hours
General Objective 2.0: Identify And Select Appropriate Tools And Equipment Used For Winding Jobs.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
	2.1 Identify and use the following tools: Hammers, Screwdrivers, Spanners, Crimping tools, Hacksaws, Knives, Mallets, growlers, Work benches, Winding machines.	<ul style="list-style-type: none"> List tools used in Winding work and enumerate their applications 	<ul style="list-style-type: none"> Mechanical Tool Box Electrical Tool Box Chalk and Board.
General Objective 3.0: Acquire Skills For Preparation And Interpretation Of Winding Drawing			
Week	Specific Learning Outcome:	Teachers Activities	Resources
3-13	3.1 Prepare and interpret simple wave winding, drawings. 3.2 Prepare and interpret lap winding drawings. 3.3 State the applications of each type of winding drawing 3.4 Determine Coil span per pitch, per phase, per pole. 3.5 Draw the position of Coil ends on Commutator/slip rings for fixed brush in a developed winding diagram.	<ul style="list-style-type: none"> Draw and explain the procedure for making Wave winding. Demonstrate how to carry out Lap Winding Explain the applications of Lap and Wave Windings. Define and Explain Span and Pitch as used in Winding. Show on the chalkboard/chart Coil ends position on Commutator and Slip-rings. 	<ul style="list-style-type: none"> Charts, Drawing, Chalk and Board. Starter Coil Chalk Board Exploded View of a motor
General Objective 4.0: Acquire Skills For Dismantling Machines For Rewinding			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1	4.1 Take and Record the necessary data from Nameplate.	<ul style="list-style-type: none"> Explain and show how to properly record information on machine Nameplate before dismantling. 	<ul style="list-style-type: none"> As Electric Motor, Nameplate,
2-3	4.2 Identify front and back shields.	<ul style="list-style-type: none"> Show how to identify shields. 	<ul style="list-style-type: none"> Shields.
4-13	4.3 Dismantle machines systematically: Note thus includes the use of extractors. 4.4 Determine types of Winding/Connections; Gauge of winding Conductor, pole pitch, Number of slots, front and back winding factor. 4.5 For the position of brushes.	<ul style="list-style-type: none"> Practical demonstration of dismantling electric machines using core Demonstrate how to notice winding connection, pitch, cross sectional area of winding Conductor. Show how to fix and replaced the brush 	<ul style="list-style-type: none"> Rotor circuit Stator core. Carbon Brushes Chalk and Board.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 16 - WINDING OF ELECTRICAL MACHINES		Course Code: CEI 16	Contact Hours: 264 Hours
General Objective 5.0: Understand The Rewinding Of Burnt Static/Rotating Machines			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-13	5.1 Identify types of Conductors used in winding 5.2 Describe winding insulation materials 5.3 Explain classes of insulation materials 5.4 Prepare or construct winding formers. 5.5 Prepare Winding Coil 5.6 Fix the winding Coils in their slots ensuring that the slots are properly insulated. 5.7 Connect the winding using the prepared data 5.8 Test for continuity and earthing 5.9 Apply varnish and dry in Oven 5.10 Test the Completed work	<ul style="list-style-type: none"> • Display different conductors used in winding work. • Show different insulation materials • Explain the classification/applications of insulation Materials. • Demonstrate how to construct a winding former. • Show how Winding Coils are properly fixed in slots • Prepare simple winding Coil • Show how to connect the winding: Series/Parallel (shunt) for Wave/Lap winding. • With a Megger Test Set, show how to Test for Continuity and Insulation Resistance. • Demonstrate the application of Varnish. • Carry out Final Tests on the job before recommissioning. 	<ul style="list-style-type: none"> • Various Conductors • Various Insulators • Laminated Iron Core • Iron Formers • Megger Test set • Avometer (Multi) • Varnish • Thinner • Chalk and Board. • Gauge Wire • Motor
General Objective 6.0: Know The Skimming/Undercutting Of Armature, Commutators And Slip Rings			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1	6.1 Determine the effectiveness of a Commutator	<ul style="list-style-type: none"> • Using Bar to Bar Test to test for good Commutation 	<ul style="list-style-type: none"> • Commutator: Rotor
2-4	6.2 Skin armature Commutator	<ul style="list-style-type: none"> • Identify various parts of a motor. 	<ul style="list-style-type: none"> • Carbon Bushes
	6.3 Skin Slip ring 6.4 Under cut the Commutator		<ul style="list-style-type: none"> • Glass Paper • Chalk and Board.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 16 - WINDING OF ELECTRICAL MACHINES		Course Code: CEI 16	Contact Hours: 264 Hours
General Objective 7.0: Inspect Rewound Electrical Machines And Equipment And Test For Continuity, Insulation, Correct Rotating Voltage.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
5-13	7.1 Inspect for good ball bearing and other parts of Machine 7.2 Assemble systematically; Ensure End Shields are in Position; Apply Grease to appropriate parts. 7.3 Test for Continuity and insulation resistance using Megger or Bridge Megger. 7.4 Test run the Machine ensuring correct rotation 7.5 Test for Voltage and Current with Avometer (Multimeter) 7.6 Test for Speed with Tachometer, ensuring conformity to Manufacturer's specification	<ul style="list-style-type: none"> • Show how to conduct visual inspection of Ball bearing. • Demonstrate how to Assemble Machine and apply grease. • Demonstrate how to Test for Continuity and Insulation Resistance using a Megger Test Set. • Show how to Test Run Machine and what to observe on Record. • Carry out all necessary Pre-Commissioning Tests, to conform to Manufacturers Specifications. • Demonstrate how to measure the speed of a motor using tachometer 	<ul style="list-style-type: none"> • Arbor Press • Bearing Pullers • Hydraulic Press • Grease • Greaser • Motors • Tachometer

PRACTICAL CONTENT

PRACTICAL CONTENT FOR WINDING OF ELECTRICAL MACHINES CEI 16 FOR MODULE

Week	Experiments	Teacher's Activities	Resources
1-3	2.1 Display some Basic tools and equipment used in winding work.	<ul style="list-style-type: none"> • Procure Requisition and display basic tools. • Itemize label and state Application of tools. 	<ul style="list-style-type: none"> • Electrical Tool • Mechanical Tool Box
4-6	3.1 Draw out on the Board some segments of half wave windings	<ul style="list-style-type: none"> • Draw and label diagrams 	<ul style="list-style-type: none"> • Chalk and Board
7-9	3.5 Draw on the board coil ends position on Commutator and Slip-rings	<ul style="list-style-type: none"> • Draw and label diagrams 	<ul style="list-style-type: none"> • Chalk and Board
10	4.1 Display a typical machine Name-plate to the class	<ul style="list-style-type: none"> • Procure, Itemize and Explain Name Plate Data. 	<ul style="list-style-type: none"> • Name plate, Shields, chalk Board.

Week	Experiments	Teacher's Activities	Resources
11-12	4.2 Display shields to the class	• Show shields to the class.	• Shields & chalkboard
1-4	4.3 Workshop Session: Dismantle a machine, using extractors.	• Demonstrate Procedure.	• An electrical Machine
5-8	4.4 Demonstrate the procedure for determining winding connections pitch, cross sectional area of conductor, number of turns of old winding (burnt or bad) before commencing rewinding.		
9-12	4.5 Workshop Session: Remove and replace worn-out brushes.	• Demonstrate the Procedure.	• Carbon Brushes
1	5.1 Display to the class different conductors used in winding work	• Itemize, label and state applications.	• Various Conductors.
2	5.1 Display to the class different insulation materials used in winding work.	• Itemize, label and State Applications.	• Various Gauge wires
3-6	5.4 Demonstrate the procedures for constructing a winding Former	• Demonstrate the Procedure	• Various Gauge wires
7-9	5.5 Prepare a winding Coil as a demonstration session	• Demonstrate the Procedure	• Various Former Cores
10-12	5.6 Demonstrate the connections/terminations for series and shunt (Parallel) arrangements.	• Demonstrate how various instructions are made on a motor	• Motor
1-3	5.7 Demonstrate by experiment the use of a Megger Test Set to determine Insulation Resistance, etc		• Megger Test Set
4-7	6.1 Demonstrate by experiment the Test for good commutation.	• Demonstrate procedure	• Equipment for equipment.
8-12	7.1 Demonstrate by experiment the assembling and greasing of machine parts.	• - do -	• Grease, Greasers and machine parts.

REWINDING EXERCISE

Each student is required to dismantle a small electric motor, rewind it, bake the machine, reassemble and test.

EVALUATION GUIDE

- a Set multichoice questions on winding/rewinding of machines
 - b Assign periodical Examinations, Tests worksheets, Tutorials and Blue print drawings for further assessment.
 - c Students will be graded on the following Criteria:
 - i. Quizzes (Class Tests) 50
 - ii. Mid and Final Examinations 200
 - iii. Drawings 200
 - iv. Final Project (Rewinding exercise) 500
 - v. Laboratory/Workshop Manual 50
- 1000 points

Solid State Devices and Circuits

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK		
MODULE: SOLID STATE DEVICES AND CIRCUITS	Course Code: CEI 17	Contact Hours: 180 Hours
<p>GOAL: The module is aimed at making the trainee to understand the basic electronic concepts and apply this information to simple circuits.</p> <p>General Objectives:</p> <p>On completion of this module, the student should be able to:</p> <ol style="list-style-type: none"> 1. Understand the basic principles, characteristic and application of common electronic devices. 2. Understand the principles of construction and operation of power supply and be able to construct simple power supply unit. 3. Know the basic principles of design of electronic circuits. 		

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 17: SOLID STATE DEVICES AND CIRCUITS	Course Code: CEI 17	Contact Hours: 180 hOURS	
Course Specification: Theoretical Content			
General Objective 1.0: Understand the basic principles, characteristic and application of common electronic devices.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-13	1.1 Explain intrinsic materials, Extrinsic, Semi conductors. 1.2 Explain the suitable concept of semi conductor diode. 1.3 Explain characteristics, operation of a diode. 1.4 Explain characteristic graphic of the diode. 1.5 Explain how diode action changes (rectifies)AC to DC. 1.6 Explain ½ wave/full wave rectification 1.7 Show the effect of filter on output DC ripples.	<ul style="list-style-type: none"> • With the aid of diagrams, explain conductor, insulators, intrinsic and extrinsic. • Explain semi conductors P-N function • Using diagram, explain the operation of a diode. • With the aid of graphs, explain behaviour of diodes. • With the aid of diagrams explain rectification action. 	<ul style="list-style-type: none"> • Oscilloscope • Components • Transformer

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 17: SOLID STATE DEVICES AND CIRCUITS		Course Code: CEI 17	Contact Hours: 180 hOURS
General Objective 1.0: Understand the basic principles, characteristic and application of common electronic devices.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-13	1.8 Explain the principles of operation of a transistor e.g. PNP, NPN. 1.9 Draw the characteristics graphs of a transistor. 1.10 Draw Load line on out-put characteristic graphs. 1.11 Determine gain, power from load line. 1.11 Identify transistor parameters 1.12 Select transistor equivalent replacement by using transistor manuals	<ul style="list-style-type: none"> • With the aid of diagrams and an oscilloscope, demonstrate and explain the use of (1) diode for ½ wave and (2) diodes, bridge rectifier for full wave. • With the aid of diagrams and an oscilloscope, demonstrate the smoothing action. • Draw transistor models and their symbols.. • Explain characteristic graphs at various base currents. • Explain the use of load line to estimate input signal gain. • Explain the use of load line to determine power, gain. 	<ul style="list-style-type: none"> • Chalk/Board • Transistor data sheets
13	1.13 Investigate the principles of operation of photo-electric devices. <ul style="list-style-type: none"> a. Photo resistors, b. Photodiodes, c. Photo transistors 1.8 Describe the construction and operation of the following devices: <ul style="list-style-type: none"> a. Zener diodes b. Tunnel diodes c. Thyristors d. Field effect transistors e. Triac Diac f. Unijunction Transistors 1.9 State the application of devices in 1.14 above e.g. use of thyristors in the spiral central of AC motors, lighting dimmers.	<ul style="list-style-type: none"> • Teacher to demonstrate the effect of vary light on photo-electric devices. • Discuss and demonstrate effect of operation of all these devices. • Explain how they work. • Explain various ways the devices are used. • Explain the block diagram of an IC. • Draw the IC symbol, explain various pin position. • Show how to identify each pin • Demonstrate how to Test transistor IC and diodes 	<ul style="list-style-type: none"> • Photo electric devices • Test equipment • Chalkboard • Zener diodes • Thyistors, etc • IC • IC data • Documentation • IC socket • Sample of ICs • Transistor, IC, diode

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 17: SOLID STATE DEVICES AND CIRCUITS		Course Code: CEI 17	Contact Hours: 180 hOURS
General Objective 1.0: Understand the basic principles, characteristic and application of common electronic devices.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
13	1.16 Explain that an intergrated circuit (IC) is a means of packaging electronic circuits. 1.17 Identify IC Symbol 1.18 Identify IC pins, IC sockets 1.19 Set up an audio amplifer IC to demonstrate operation as an example of IC usage. 1.20 Test various types of semi-conductors devices 1.21 Describe the functional parts of the Oscilloscope 1.22 Determine various wave forms using Oscilloscope.	<ul style="list-style-type: none"> • Show how to measure voltage frequency by the use of oscilloscope • With the aid of a simple diagram explain the operation of an oscilloscope. 	<ul style="list-style-type: none"> • Tester • Storage • Oscilloscope
General Objective 2.0: Understand The Principles Of Construction And Operation Of Power Supply And Be Able To Construct Simple Power Supply Unit.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-4	2.1 Describe the principles of operation of a power supply unit. 2.2 Identify power supply in a schematic diagram.	<ul style="list-style-type: none"> • Draw on the Board the circuit of a power supply and explain the function of each part. • With the aid of a schematic diagram explain how to identify various parts of a circuit. 	<ul style="list-style-type: none"> • Chalk/Board
5-13	2.3 Construct a stabilized low-voltage dc power supply unit. 2.4 Explain the effect of a capacity/inductor in a power supply unit. 2.5 Explain the difference between regulators and stabilizers 2.6 Distinguish between power supply with transformer and transformerless (switched mode) power supply.	<ul style="list-style-type: none"> • Demonstrate operation of unit, measuring voltages and waveforms around circuit. • With the aid of circuit diagrams explain the smoothing action of capacitors and inductors. between the two of them. 	<ul style="list-style-type: none"> • Chalk/Board • Power supply • Test equipment • Chalk/Board • Circuit diagrams • Stabilizer • Switched mode

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 17: SOLID STATE DEVICES AND CIRCUITS		Course Code: CEI 17	Contact Hours: 180 hOURS
General Objective 2.0: Understand The Principles Of Construction And Operation Of Power Supply And Be Able To Construct Simple Power Supply Unit.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
5-13		<ul style="list-style-type: none"> • With the aid of diagrams explain the function of regulations and stabilizers. Bring out the differences • With the aid of well labeled circuit diagrams explain the differences between power supply with transformer and transformerless power supply. 	
General Objective 3.0: Know The Basic Principles Of Design Of Electronic Circuits.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-11	3.1 Explain the concept and purpose of an oscillator 3.2 Explain the operation of the following Oscillators: a. LC Oscillators, b. Hartley Oscillator c. Colpit Oscillators, d. Tuned Oscillators. 3.3 Explain monostable multivibrator, Astable multivibrators, Bistable Multivibrator. 3.4 Explain the use of binary numbers in Electronic Circuits.	<ul style="list-style-type: none"> • Using relevant circuit diagrams explain how oscillation can be initiated in a circuit. • With the aid of well labeled diagrams, and functional oscillators explain how the following operations function: <ul style="list-style-type: none"> • - Hartley, Colpit, RC oscillator etc. • With the aid of well labeled diagrams and functional multivibrators explain the operation of monostable, Bistable and astable multivibrators. • Explain the conversion of numbers to base 2. Work examples converting numbers from other bases to base 2. 	<ul style="list-style-type: none"> • Chalk/Board • Oscillators • Test equipment • Chalk/Board • Multivibrators • Test equipment

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: CEI 17: SOLID STATE DEVICES AND CIRCUITS		Course Code: CEI 17	Contact Hours: 180 hOURS
General Objective 3.0: Know The Basic Principles Of Design Of Electronic Circuits.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
12-13	3.5 Recognise simple logic circuits of AND Gate, OR Gate NOT Gate, NAND Gate, NOR Gate. Draw symbols for gates in 3.5. Draw truth table for 3.5 above.	<ul style="list-style-type: none"> • Draw simple circuits to illustrate different logic circuits and explain their function. • Explain how an AND gate can be converted to NAND Gate OR Gate to NURC gate using their symbol. • Explain how to draw the truth table of a gate. Show how to determine the output from the truth table. • Demonstrate all the above functions to students. 	<ul style="list-style-type: none"> • Chalk Board • Gates • Test equipment

Demonstrate all the above functions to students.

PRACTICAL WORK

PRACTICAL CONTENT FOR SOLID STATE DEVICES AND CIRCUITS CEI 17 FOR MODULE

	Experiments	Student's Activities	Resources
Term 1	Determine by experiment the characteristic of a Semi Conductor diode.	• Connect circuit and performed experiements.	• Components • Test equipment
Terms 2	Determine by experiments the characteristics of a npn, pnp transistors, zenerdcodes, tannel/diodes, thyristors, field effect transistors, triacs/diacs, UJTS.	• Perform test.	• Sample of Components
Term 3	Demonstrate by experiment the principles of operation of half wave and full wave rectification.	• Connect up the experiment and take readings.	• Components and Test Equipment
Term 4	Construct a simple common emitter audio amplifier on a circuit board	<ul style="list-style-type: none"> • Perform tests including: • DC voltage levels • Frequency reporse • Deduce gar/power 	• Components & Circuit Board
Term 4	Integrated circuit experiment using LM386 audio amplifier	• Perform tests	• LM 386 Audio Amplifier

	Experiments	Student's Activities	Resources
Term 5	LIGHTING DIMMER Construct a lighting dimmer based on a triac as the control device.	• Construct and test using circuit diagram provided.	• Circuit Board & Chalkboard
Term 6	MOTOR CONTROLLER Construct a simple thyristor AC motor controller or a circuit board.	• Construct and test using circuit diagram provided.	

Refer to curriculum for associated theory section.

EVALUATION

To pass this module students must satisfactorily complete the practical assignments.

Theory examination: 100%

Practical assessment: 100%

Electrical/Electronics Drawing

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK		
MODULE: ELECTRICAL/ELECTRONICS DRAWING	Course Code: CTD 14	Contact Hours: 96 Hours
<p>GOAL: The module is designed to provide the trainee to understand the block and basic diagrams in circuit development.</p> <p>General Objectives:</p> <p>On completion of this module, the trainee should be able to:-</p> <ol style="list-style-type: none"> 1. Understand the block and basic diagrams in circuit development. 2. Understand the electronic component symbols 		

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: ELECTRICAL/ELECTRONICS DRAWING		Course Code: CTD 14	Contact Hours: 96
Course Specification: Theoretical Content			
General Objective 1.0: Understand the Block and Basic Diagrams in Circuit Development.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-7	1.1 Explain the purposes of block flow and logic diagrams. 1.2 Explain symbols used in preparation of block and logic diagrams. 1.3 Explain how to plan an arrangement of block symbols to produce Intelligible block and flow diagrams. 1.4 Describe drafting procedure for preparation of easily understood block diagrams. 1.5 Explain the elements of logic symbols diagrams 1.6 Draw block diagrams for electronic systems e.g radio, television, etc. 1.7 Draw flow diagrams for typical industrial production.	<ul style="list-style-type: none"> • Explain to students how blocks flow and basic diagrams can be used to describe flow of information. • Draw different types of symbols used and sequence of arrangements when drawing block, flow logic. • Explain the difference between flow diagrams and block diagrams use examples to illustrate the difference. • Explain methods to be used to prepare good diagrams • Draw logic symbols and their functions using truth table 	<ul style="list-style-type: none"> • Chalkboard.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: ELECTRICAL/ELECTRONICS DRAWING		Course Code: CTD 14	Contact Hours: 96
General Objective 1.0: Understand the Block and Basic Diagrams in Circuit Development.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-7		<ul style="list-style-type: none"> • Draw block diagrams for common electronic systems e.g Radio, TV • Draw flow diagram for producing typical items in an industry. 	
General Objective 2.0: Understand the Electronic Component Symbols			
Week	Specific Learning Outcome:	Teachers Activities	Resources
8-10	2.1 Explain the need for electronic symbols and schematic diagrams. 2.2 Explain the basic functions of commonly used electronic component 2.3 Relate component symbol shape to component functions.	<ul style="list-style-type: none"> • Explain why standard symbols are used in circuits. • Show as many components as possible and explain their functions. • Explain the functions of each component 	• Chalkboard
11 12.	2.4 Develop proficiency in drawing electronic symbols in acceptable standard form. 2.4 Learn to produce sketches of physical structures of common components e.g Resistors, Capacitors, Transformers, Diodes, Transistors variable resistors, Potentiometers switches, Batteries, Microphone, Recording, Pick up lead cerial, play back pick up lead etc.	<ul style="list-style-type: none"> • Familiarise with common component symbols. • Sketch the exact physical resembles/anal of common components. 	• Chalkboard
General Objective 3.0: Basic Circuits			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-6	3.1 Explain electronic symbols through circuit application e.g in simple amplifier.	• Explain how components are connected together to make a circuit using symbols.	• Chalkboard.
	3.2 Explain the purpose of schematic diagram.	• Draw schematic diagram and explain how it functions.	• Chalkboard

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: ELECTRICAL/ELECTRONICS DRAWING		Course Code: CTD 14	Contact Hours: 96
General Objective 3.0: Basic Circuits			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-6	3.3 Identify the basic elements needed in all electronic circuit.	• Explain the elements needed in most basic circuit.	• Chalkboard • Drawing sheet
	3.4 Identify the basic circuits which make up a complete electronic device.	• Identify stages needed in a typical electronic system.	• Chalkboard • Schematic diagram.
	3.5 Explain how to train a diagram of popular circuits e.g single stage, common emitter amplifier, 2-stage common emitter amplifier, power supply circuit receiver circuit, etc.	• Explain how a signal can be traced in a schematic diagram using left-right rule. Draw same of the circuits.	• Chalkboard • Schematic diagram.
General Objective 4.0: Schematic Diagrams			
Week	Specific Learning Outcome:	Teachers Activities	Resources
7-9	4.1 Explain the need for conformity in drawing schematic drawings.	• Explain the need for conformity when drawing schematic diagrams. • Show a schematic diagram indicating references symbol positions. • Students to copy examples. • Explain the need for symmetry and balance when drawing schematic diagrams. Show examples. • Students must draw.	• Chalkboard • Schematic diagram
	4.2 Identify properly drawn schematic diagrams		
	4.3 Explain symmetry and balance in drawing schematic diagram.		
4.4 Show symbol placement and space arrangement for maximum legibility.			
10-12	4.5 Draw the stages of a schematic diagram in proper sequential manner.	• Draw schematic diagram in sequential manner and explain how signal flow through. Show how to make parts list. • Explain how to convert simple wiring diagram to schematic diagrams and vice versa. • Explain the need to place component nos by the particular side of a component.	• Chalkboard. • Prepared drawings. • Schematic diagram.
	4.6 Explain how to convert a bread-boarder circuit into a proper schematic diagram.		
	4.7 Develop consistency in components code or reference location on the schematic diagram.		

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: ELECTRICAL/ELECTRONICS DRAWING		Course Code: CTD 14	Contact Hours: 96
General Objective 5.0: Industrial control Wiring Diagrams.			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-6	<p>5.1 Explain the differences among industrial power and residential wiring diagrams compared to electronic wiring diagrams.</p> <p>5.2 Explain how to read industrial control wiring diagrams.</p> <p>5.3 Identify electrical symbols used in power distribution diagrams.</p> <p>5.4 Explain the basic differences between AC and DC motors</p> <p>5.5 Explain the need for special starting circuits for industrial motors.</p> <p>5.6 Explain the basic principles of operations of electrical protective devices using their circuits.</p>	<ul style="list-style-type: none"> • Using examples explain the differences among industrial power and residential wiring diagrams compared to electrance wiring diagrams. • Show industrial control wiring diagrams. • Students should be made to draw simple industrial control wiring. • List sketch and draw all common components and symbols used in power distributions diagrams. • Explain the differences between AC and DC motors. • Draw diagrams for various starting methods and explain how they operate. • Students should draw the circuit. • List and sketch protective devices, draw their symbols. • Students must know how to do same. 	<ul style="list-style-type: none"> • Chalkboard • Drawing. • Chalkboard
General Objective 6.0: Electrical Building Construction Wiring Diagrams			
Week	Specific Learning Outcome:	Teachers Activities	Resources
7-9	<p>6.0 Explain the difference between schematic line diagrams.</p> <p>6.2 Explain how to read single line diagrams.</p> <p>6.3 Identify electrical symbols used in architectural plans.</p>	<ul style="list-style-type: none"> • Draw schematic and single line diagrams and explain the difference between them. • Brochure single line diagram and show students how to read it. • List and draw an electrical symbols used in architectural plans. 	<ul style="list-style-type: none"> • Chalkboard • Chalkboard • Single line diagram. • Chalkboard • List of electrical symbols drawing.

PROGRAMME: NTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
Course: ELECTRICAL/ELECTRONICS DRAWING		Course Code: CTD 14	Contact Hours: 96
General Objective 6.0: Electrical Building Construction Wiring Diagrams			
Week	Specific Learning Outcome:	Teachers Activities	Resources
10-12	6.4 Explain how basic lighting circuits are wired. 6.5 Explain how to determine the wire size needed under different load conditions. 6.6 Develop proficiency in the design of and wiring of residential circuits.	<ul style="list-style-type: none"> • Show how lighting circuits and power circuits are wired. Identify the difference between ring mains and radial wiring. • Explain advantages of ring over radial. • Show how to determine wire sizes under different load conditions. • Explain how to design and wire residential circuits or houses. 	<ul style="list-style-type: none"> • Chalkboard • Plan of a house. • Chalkboard • Chalkboard • Plan of a house.

EVALUATION GUIDE

Students' Assessment should be based on assignments, tests, his ability to carry out projects on electrical design on building plans, reading of schematic diagrams and recognition of electronic and electrical component symbols.

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	<p>1.1</p> <p>a. Explain the precautions necessary for special Installations</p> <p>b. Describe the materials used for Installing them.</p> <p>1.2 Install the items listed in 1.1 above e.g.</p> <p>a. Farm and horticultural electrical Installation</p> <p>b. Standby plants and their automatic operation;</p> <p>c. Fire Alarm;</p> <p>d. Fire Detector;</p> <p>e. Neon Discharge Lamp;</p> <p>f. Central Air Conditioning System etc.</p> <p>1.3 Install single-phase and 3-phase meters e.g., (KW/Hour) maximum demand meter etc.</p> <p>1.4 Install protective devices against lightning strokes</p> <p>1.5 Explain the causes of corrosion. State methods of protection against corrosion.</p> <p>1.6 Explain various methods of earthing earth electrode, earthplate, protective multiple earthing.</p> <p>1.7 Test all types of Installation for efficiency</p> <p>1.8 Wire electrical items in explosive or hazardous situations such as</p> <p>a. extremes of temperature</p> <p>b. Corrosive atmosphere</p> <p>1.9 Describe the application of Single-phase Instruments (Measuring)</p>	<ul style="list-style-type: none"> • Explain special Installations. <p>Use Tools and material used for the Installation.</p> <ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • Chalkboard • Textbooks • Note. • Fire Alarm • Fire Detector • Neon Discharge Lamp • Air Condition system • Textbooks. • Single-phase • 3-phase meters • Lighting Arrestor • Earth Electrode

PROGRAMME: ANTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
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	<ul style="list-style-type: none"> Show how to connect such Instrument including protective fuses. Carry out the installation of Instrument transformers. 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Use questions to discuss on electrical wiring symbols Show sketches or drawing of electrical Wiring Explain the interpretation of electrical diagrams 	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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	<p>4.1 Explain the necessity for a method of protecting electrical installations against lighting strokes.</p> <p>4.2 Explain the methods of earthing e.g.</p> <p>a. measurement of earth electrode resistance</p> <p>b. earth leakage protection</p> <p>c. protective multiple earthing.</p>	<ul style="list-style-type: none"> • Give reasons for installing protective devices - lighting strokes. • Describe the methods and principles of earthing and how to care for resistance area. 	<ul style="list-style-type: none"> • Lighting • Arrestor/Strokes • Chalkboard • Megger, • Earth electrode
10-11	<p>4.3 Explain the principles of cathodic protection. State its application in protecting electrical installation from lighting.</p> <p>4.4 Describe the causes and methods of protection against Corrosion of electrical Installation.</p>	<ul style="list-style-type: none"> • Explain cathodic protection to include its Installation and application. • Explain the causes of and means of protecting against Corrosion. 	<ul style="list-style-type: none"> • 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	<p>5.1 Select the various materials used for special lighting system e.g. discharge lamps and signs.</p> <p>5.2 Install all kinds of discharge lamps and signs and their associated control gears.</p>	<ul style="list-style-type: none"> • Show all materials used for Neon and other discharge lamps. • Demonstrate the installation of different discharge lamps, e.g. Neon, Mercury, Sodium etc. 	<ul style="list-style-type: none"> • Discharge lamps, • Chalkboard
General Objective 6.0: Know The Installations Of Types Of Discharged Lamps			
Week	Specific Learning Outcome	Teachers Activities	Resources
1-8	<p>6.1 Describe the Construction of Lifts, escalators, elevators.</p> <p>6.2 Explain the principles of operation of escalator, elevator and lift.</p> <p>6.3 Describe methods of scaffolding, lifting and handling equipment, ladders during installations.</p>	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • Chalkboard • Scaffolding

PROGRAMME: ANTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
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	<p>6.4 Apply basic regulations in the use of Scaffolds.</p> <p>6.5 Lift equipments with care</p> <p>6.6 Show how load on equipments is determined.</p> <p>6.7 Install lift well and lift equipments in correct sequence.</p> <p>6.8 Install the followings:</p> <p style="padding-left: 40px;">a. machine room equipment;</p> <p style="padding-left: 40px;">b. escalators.</p> <p>6.9 Install different types of lift control system e.g. electronic control, pneumatic control etc. test 6.9 above.</p> <p>6.10 Test installed lifts of all kinds.</p> <p>6.11 Commission 6.10 above.</p>	<ul style="list-style-type: none"> • 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. <p>Show how escalators are installed.</p> <ul style="list-style-type: none"> • Demonstrate the installation of life. Demonstrate how to test lift controls • Demonstrate how to test life. <p>Explain how to commission a lift.</p>	<ul style="list-style-type: none"> • 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	<p>7.1 State the advantages and disadvantages of low power factor</p> <p>7.2 Explain with the aid of diagrams how power factor can be improved. Using static capacitors/synchronous phase machines.</p> <p>7.3 Describe individual load and overall system improvement of power facor.</p> <p>7.4 Install static capacitors, synchronous motor, phase modifier in systems to improve the power factor.</p>	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • Capacitors • Chalkboard • Static capacitors,

PROGRAMME: ANTC IN ELECTRICAL INSTALLATION AND MAINTENANCE WORK			
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.	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • Carry out practical demonstration on fire alarm circuits. • Demonstrate how to install discharge lamps. 	<ul style="list-style-type: none"> • Fire Alarm box, wiring board workshop. • Different discharge lamp's wiring boards. Workshops.
3-4	3. Install 3-phase energy meter.	<ul style="list-style-type: none"> • Connection of Wattmeters 3 - phase energy meters to a load. 	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • Site visit. 	<ul style="list-style-type: none"> • Safety Ware e.g. boots
7-9	5. Carry out simple circuit and do the earthing system including protective-multiple earthing with earth electrodes.	<ul style="list-style-type: none"> • Demonstrate the installation of earthing systems. 	<ul style="list-style-type: none"> • Workshop, wiring board.
10-12	6. Site visit to a lift installation	<ul style="list-style-type: none"> • Site visit 	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • List various motors and generators • Explain lap and wave winding of motors. • Illustrate simple layout of lap winding using progressive and retrogressive 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. 	<ul style="list-style-type: none"> • 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 equalizer 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	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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	<p>2.5 Describe with sketches, the winding connection of a two-speed AC motor of pole changing and dual wound types.</p> <p>2.6 Describe the arrangement of Start and run winding in 3-phase motor.</p> <p>2.7 State terminal markings as used in 3-phase motors.</p> <p>2.8 Explain how to Wind or rewind AC motor and generator. Test for performance.</p>	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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	<p>3.1 Describe types of transformers.</p> <p>3.2 Identify terminal marking on transformer winding and its purpose.</p> <p>3.3 Describe the disc and layer types of transformer winding used in 3-phase transformers.</p> <p>3.4 Describe the methods of Securing turn as used in 3-phase transformers.</p> <p>3.5 Explain the term rating of transformers' and give reasons for rating transformers in KVA.</p>	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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 rewind transformers.	<ul style="list-style-type: none"> • Illustrate the use of tap and tapping • Wind or rewind a simple transformer. • Test a rewind transformer. 	<ul style="list-style-type: none"> • 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

Guidelines for Textbook Writers

The following guidelines are suggestions from the Engineering Committees to the writers of the textbooks for the new curricula. They are intended to supplement the detailed syllabuses which have been produced, and which define the content and level of the courses.

Authors should bear in mind that the curriculum has been designed to give the students a broad understanding of applications in industry and commerce, and this is reflected in the curriculum objectives.

1. One book should be produced for each syllabus
2. Page size should be A4
3. The front size should be 12 points for normal text and 14 point where emphasis is needed.
4. Line spacing should be set to 1.5 lines
5. Headings and subheadings should be emboldened
6. Photographs, diagrams and charts should used extensively throughout the book, and these items must be up-to-date
7. In all cases the material must be related to industry and commerce, using real life examples wherever possible so that the book is not just a theory book. It must help the students to see the subject in the context of the 'real world'
8. The philosophy of the courses is one of an integrated approach to theory and practice, and as such the books should reflect this by not making an artificial divide between theory and practice.
9. Examples should drawn from Nigeria wherever possible, so that the information is set in a country text.
10. Each chapter should end with student self-assessment questions (SAG) so that students can check their own master of the subject.
11. Accurate instructions should be given for any practical work having first conducted the practical to check that the instructions do indeed work.
12. The books must have a proper index or table of contents, a list of references and an introduction based on the overall course philosophy an aims of the syllabus.
13. Symbols and units must be listed and a unified approach used throughout the book.
14. In case of queries regarding the contents o the books and the depth of information, the author must contact the relevant curriculum committee via the National Board for Technical Education.
15. The final draft version of the books should be submitted to Nigerian members of the curriculum working groups for their comments regarding the content in relation to the desired syllabus.

List of Books and References

1. Electric Power Transmission System Engineering: Analysis and Design by Turan Gonen.
2. Electrical Engineers Reference Book 14th Edition by Laughton Say.
3. A Textbook of Electrical Technology 22nd Edition by B.L. Theraja A.K. Theraja.
4. Electrical Installation by A.O. Akintante and J.M. Hyde.
5. Electrical Safety Engineerign 2nd Edition by Fordham Cooper.
6. A Handbook of the 16th Edition of the IEE Regulation for Electrical Instalaltion.
7. Electrical Technology 6th Edition by Hughes
8. Electrical Installation Technology Volume 2 and 3 by Thompson.

List of Laboratories/Workshops and Equipment

LIST OF LABORATORIES

1. Chemistry Lab.
2. Physics Lab.

LIST OF WORKSHOP

1. Metal Workshop
2. Electrical Installation Workshop

LIST OF EQUIPMENT, INSTRUMENTS AND TOOLS FOR ELECTRICAL INSTALLATION AND MAINTENANCE

EQUIPMENTS

1. Work bench.
2. Crowbar
3. Conduit Bending Machine
4. Stock and Dies
5. Conduit Vice
6. Clamp
7. Winding Machine
8. Battery Charger
9. Grease Gun
10. Wiring Board's
11. Oil Can
12. Ladder
13. Scaffolding
14. Blow Lamp
15. Pot and Ladle
16. Goggle
17. Soldering Iron
18. Soldering Bit
19. Welding and Brazing Equipment
20. Handgloves
21. First Aid Box
22. Fractional Distillation Set
23. Heater (Oven)

24. Boots
25. Helmet
26. Safety Belt
27. Overall Uniform

INSTRUMENTS

1. AC and DC Ammeter
2. AC and DC Voltmeter
3. AC and DC Avometer
4. Wattmeter
5. Megger
6. Tachometer
7. Energy Meter (Single Phase, 3-phase)
8. Neon tester, voltage tester
9. Steel rule
10. Oscilloscope
11. Hydrometer
12. Ohmmeter
13. Spirit Level
14. Micrometer
15. Growler
16. Bridge Meggar
17. Measuring tape
18. Signal Generator

TOOLS

1. Screw drivers
2. Allen Keys
3. Strippers
4. Hammers
5. Pliers
6. Cutters
7. Hacksaws.
8. Mallets
9. Spanners (flat, ring, socket)
10. Files
11. Chisels
12. Taps, dies
13. Drills (manual, electric)

14. Reamers
15. Extractor
16. Knives
17. Rawl plug
18. Pipe wrenches
19. Gim let
20. Centre punch
21. Bell and battery set
22. Compressing tool
23. Ringing tools
24. Crimping tools
25. Resistors
26. Rheostat
27. Inductors
28. Capacitors
29. Transformers (various types)
30. DC motor (various types)
31. DC generators (various types and sizes)
32. AC motors (single and 3-phase)
33. AC generators (single and 3-phase)
34. Starters (various types)
35. Thermostats
36. Relays

CONSUMABLES

1. Ceiling roses
2. Plugs - assorted
3. Adaptors - assorted
4. Socket outlets - assorted
5. Switches - assorted
6. Lampholders - assorted
7. Fuses - assorted
8. Circuit breakers
9. Clips
10. Fluorescent fittings
11. Wiring nails
12. Conduit pipes (PV and accessories)
13. Conduit pipes (galvanized steel)
14. Soldering lead
15. Armature

16. Batteries
17. Crocodile clips
18. Distilled water
19. Sulphuric acid
20. Cables (various sizes and cores)
21. Insulation varnish
22. Earth rod
23. Sealing wax
24. Ceramic insulator
25. Fire extinguisher
26. Sand bucket
27. Safety posters

List of Participants

UNESCO-NIGERIA PROJECT IN SUPPORT OF REVITALISATION OF TECHNICAL AND VOCATIONAL EDUCATION IN NIGERIA

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