[9[098NATIONAL BOARD FOR TECHNICAL EDUCATION

NATIONAL TECHNICAL CERTIFICATE

AND

ADVANCED NATIONAL TECHNICAL CERTIFICATE

PROGRAMMES

IN

INSTRUMENT MECHANICS WORKS

CURRICULUM AND COURSE SPECIFICATIONS

AUGUST, 2001

NATIONAL TECHNICAL CERTIFICATE AND ADVANCED NATIONAL TECHNICAL CERTIFICATE PROGRAMMES

GENERAL INFORMATION

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 week 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 e 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.

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INSTRUMENTS MECHANICS

S/N	SUBJECT CODE	MODULE	
1.	CTD 14	Electrical/Electronics Drawing	
2.	CEI 11	Basic Electricity	
3	CIM 10	Mechanical and Pneumatic Instruments I	
4	CIM 11	Mechanical & Pneumatic Instruments II	
5	CIM 12	Electrical/Electronics Instrument I	
6	CIM 13	Electrical/Electronics Instrument II	
7	CIM 14	Auto Control	
8	CIM 15	Lab. Processing.	

S/N	SUBJECT CODE	MODULES	YEAR 1			YEAR 2			YEAR 3			TOTAL CONTACT HOURS/ SUBJECT
			Term 1	Term 2	Term 3	Term 1	Term 2	Term 3	Term 1	Term 2	Term 3	
			Thy/Prac	Thy/Prac	Thy/Prac	Thy/Prac	Thy/Prac	Thy/Prac	Thy/Prac	Thy/Prac	Thy/Prac	
1.	CMA 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 11-12	Chemistry	2 -	2 -	2 -	2 1	2 1	2 1	2 1	2 1	2 1	288
5.	CEC11-13	Economics	2 -	2 -	2 -	2 -	2 -	2 -	2 -	2 -	2 -	216
6.	CBM 11	Entrepreneurship	- -	- -	- -	- -	- -	2 -	2 -	- -	- -	48
7.	ICT11-15	Computer Studies	- -	- -	- -	1 2	1 2	1 2	1 2	1 2	- -	180
8.	CTD11-13	Drawing	- 3	- 3	- 3	- 3	- 3	- 3	- 4	- -	- -	264
9.	CTD 14	Elect/Electr Drawing	- -	- -	- -				1 2	1 4	- -	96
10.	CEI 11	Basic Electricity	2 1	1 2	- -	-	-	-	-	- -	- -	72
11.	CME 11	Metal Works (1)	2 5	2 5		- -	- -		- -	- -	- -	168
12.	CIM 10	Mech./Pneu. Instr.	- -	- -	- -	3 2	3 2	1 4	- -	- -	- -	180
13.	CIM 11	M/P Instrument	2 3	2 3	1 4	1 4	1 4	- -	- -	- -	- -	300
14.	CIM 12	Elect/Electr. Instr.	- -	- -	- -	3 2	2 3	1 4	- -	- -	- -	180
15.	CIM 13	Elect/Electr. Instr.	- -	- -	- -	- -	- -	2 3	1 3	2 4	1 4	240
16.	CIM 14	Auto Control	- -	- -	- -	- -	- -	2 3	4 6	4 6	3 7	420
17.	CIM 15	Lab. Processing	- -	- -	- -	- -	- -	- -	1 3	1 3	1 3	144

PROGRAMME: National Technical Certificate in Instrument Mechanics Works

MODULE: CTD 14 Electrical/Electronics Drawing

DURATION: 96 Hours

GOAL: The Module is designed to provide the trainee to understand the Block and Basic diagrams in circuit development

GENERAL OBJECTIVES:

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

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 Hour: 8 Hrs/Wk**
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand the Block and Basic Diagrams ion Circuit Development**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
Yr3t1 1	1.1 Explain the purposes of block flow and logic diagrams	▪ Explain to Students how blocks flow and basic diagrams can be used to describe flow of information	▪ Chalkboard
	1.2 Explain symbols used in preparation of block and logic diagrams	▪ Draw different types of symbols used and sequence of arrangements when drawing block flow logic.	▪ Chalk Board
	1.3 Explain how to plan an arrangement of block symbols to produce intelligible block and flow diagrams	▪ Explain the difference between flow diagrams and block diagrams use examples to illustrate the difference	▪ Chalk Board
2	I.4 Describe drafting procedure for reparation of easily understood block diagrams	▪ Explain methods to be used to prepare good diagrams	▪ Chalk Board
	1.5 Explain the elements of logic symbols diagrams	▪ Draw logic symbols and their functions using truth table	▪ Chalk Board
3	1.6 Draw block diagrams for electronic systems e.g radio, Television, etc.	▪ Draw block diagrams for common electronic systems e.g Radio, TV.	▪ Chalk Board
	1.7 Draw flow diagrams for typical Industrial productions	▪ Draw flow diagram for producing typical items an industry	▪ Chalk Board
	General Objective 2.0: Understand The Electronic Component Symbols		

	2.1 Explain the need for electronic symbols and schematic diagrams	▪ Explain why standard symbols are used in circuits.	▪ Chalkboard
	2.2 Explain the basic functions of commonly used electronic component	▪ Show as many components as possible and explain their functions	▪ Chalk Board
4	2.3 Relate component symbol shape to component functions	▪ Explain the functions of each component	▪ Chalk Board
	2.4 Develop proficiency in drawing electronic symbols in acceptable standard form	▪ Familiarize with common component symbols	▪ Chalk Board
	2.5 Learn to produce sketches of physical structures of common components e.g. Resistors, Capacitors, Transformers Diodes, Transistors variable resistors, Potenticemeters switches Batteries, Microphone, Recording, Pick up Lead cyerial, Play back pick up lead etc.	▪ Sketch the exact physical resembles/anal of common components	▪ Chalk Board
	General Objective 3.0: Basic Circuits.		
5	3.1 Explain Electronic Symbols through Circuit application e.g in simpler amplifier	▪ Explain how components are connected together to make a circuit using symbols	▪ Chalk Board
	3.2 Explain the purpose of schematic diagram	▪ Draw schematic diagram and explain how it functions	▪ Chalk Board
	3.3 Identify the basic elements needed in all electronic circuit	▪ Explain the elements needed in most basic circuit	▪ Chalk Board ▪ Drawing Sheet
	3.4 Identify the basic circuits which make up a complete electronic device	▪ Identify stages needed in a typical electronic system	▪ Chalk Board ▪ Schematic diagram
6	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 chit receiver circuit, etc.	▪ Explain how a signal can be traced in a schematic diagram using left-right rule, Draw same of the circuits	▪ Chalk Board ▪ Schematic diagram

	General Objective 4.0: Schematic Diagrams		
7	4.1 Explain the need for conformity in drawing schematic drawings	▪ Explain the need for conformity when drawing schematic diagrams	▪ Chalk Board
8	4.2 Identify properly drawn schematic diagrams	▪ show a schematic diagram indicating references symbol positions ▪ Students to copy examples	▪ Schematic diagram
9	4.3 Explain symmetry and balance in drawing schematic diagrams	▪ Explain the need for symmetry and balance when drawing schematic diagrams. Show examples. Students must draw	▪ Chalk Board
10	4.4 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 lid.	▪ Chalk Board
11	4.5 Explain how to convert a bread-boarded circuit into a proper schematic diagram	▪ Explain how to convert simple wiring diagram to schematic diagrams and vice versa	▪ Chalk Board ▪ Prepared drawings
12	4.6 Develop consistency in components coche or reference location on the schematic diagram	▪ Explain the need to place coche nos by the particular side of a component	▪ Chalk Board ▪ Schematic diagram
	General Objective 5.0: Industrial Control Wiring Diagrams		
Yr3t2	5.1 Explain the differences among industrial power and residential wiring diagrams compared to electronic wiring diagrams	▪ Using examples explain the difference among industrial power and residential wiring diagrams compared to electrance wiring diagrams	▪ Chalk Board ▪ Drawings
2	5.2 Explain how to read industrial control wiring diagrams	▪ Show industrial control wiring diagrams	▪ Chalk Board

		▪ Students should be made to draw simple industrial control wiring	
3	5.3 Identify electrical symbols used in power distribution diagrams	▪ List sketch and draw all common components and symbols used in power distributions diagrams	▪ Chalk Board
4	5.4 Explain the basic differences between Ac and Dc motors	▪ Explain the differences between AC and DC Motors	▪ Chalk Board
	General Objective 6.0: Electrical Building Construction wiring Diagrams		
5	6.1 Explain the need for special starting circuits for industrial motors	▪ Draw diagrams for various starting methods and explain how they operate ▪ Students should draw the circuit	▪ Chalk Board
6	6.2 Explain the basic principles of operations of electrical protective devices using their circuits	▪ List and sketch protective devices draw their symbols. ▪ Students must know how to do same	▪ Chalk Board
7	6.3 Explain the difference between schematic and singles line diagrams	▪ Draw schematic and single line diagrams and explain the difference between them	▪ Chalk
8	6.4 Explain how to read single line diagrams	▪ Prochure single line diagram and show students how to read it	▪ Chalk Board ▪ Single line diagram
9	6.5 Identify electrical symbols used in architectural plans	▪ List and draw electrical symbols used in architectural plans	▪ Chalk Board ▪ List of electrical symbols drawing
10	6.6 Explain how basic lighting circuit are wired	▪ Show how lighting circuits and power circuits are wired. Identify the difference between ring mains and radial wiring, Explain advantages of ring over radial	▪ Chalk Board ▪ Plan of a house
11	6.7 Explain how to determine the wire size needed under	▪ Show how to determine wire sizes	▪ Chalk Board

	different load conditions	under different load conditions	
12	6.8 Develop proficiency in the design of and wiring of residential circuits	▪ Explain how to design and wire residential circuits or houses	▪ Chalk Board ▪ Plan of a house

EVALUATION GUIDE

Student's 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.

PROGRAMME: NARTIONAL TECHNICAL CERTIFICATE IN INSTRUMENT MEHCANICMS WORK		
Course: General Metal Work I	**Course Code: CME 11**	**Duration: 144 Hours**
Module Specification: PRACTICAL/KNOWLEDGE REQURIEMENTS		

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-ferrours 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 treads 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 hand tools for carrying out various bench fitting and assembly tasks.
4. Tools: hacksaws, taps, reamers, drills, dividers, surface guage.
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, counterboring.
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 MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: General Metal Work I		**Course Code: CME 11**	**Contact Hours 14 Hrs/Wk**
Course Specification: Knowledge Requirement			
WEEK	**General Objective 1.0: Understand Workshop Safety Rules and application in Machine Shop**		
	Specific Learning Outcome	**Teachers Activities**	**Resource**
1	1.0 Workshop safety rules and practice. On completion of this module, the trainee should be able to: 1.1 State sources of hazard in the workshop and how to prevent them. e.g 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; 1.2 Explain the application of factory safety regulations in the machine shop. 1.3 Name safety equipment and wears essential in the machine shop, and state their application in working situations Note: Example of safety wears and equipment should include overall, eye goggles, gloves, safety boots, helmet, fire extinguishers, etc.	▪ 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-g. ▪ Use questions and answers to determine comprehension. ▪ Assess the students	▪ Safety posters, common hand tools like files hacksaw ▪ Television, Video machine. ▪ Overall, goggles, gloves, hardshoes, head shield, fire extinguishers.
	1.4 Outline safety rules and regulations relating to:- a. clothing and health hazards; b. Workshop hygiene	▪ Give detail notes and explanation of appropriate. ▪ Procedures to be taken in the event of	

	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 1.5 Understand appropriate procedures in the events of a workshop accident 1.6 Examples of procedures may includes: a. application of fist 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	workshop accident	
	General Objective 2.0: Know The Physical Properties, Manufacturing Process And Application Of Ferrous And Non-Ferrous Metals In Common Use		
	2.1 Explain the meaning of the following general physical properties of metals: ductility, malleability, strength, toughness, brittleness, elasticity, plasticity 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.	▪ 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 form 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	▪ Video and television including cassettes on production processes.

	2.3 Outline: a. the cupola process of manufacture of cast iron; b. the blast furnace process of manufacture of cast iron c. the direct reduction process of manufacture of steel. Note:	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.	
	2.4 Describe the physical properties and applications of non-ferrous metals below: copper, tin, zinc, aluminum and aluminum alloys brass (muntz metal, cartridge brass gilding etc) metal, bronze (manganese bronze tunmetal, bell metal, aluminum bronze, phosphor bronze and lead.	▪ This can be preceded by film show and a visit to be manufacturing plant. ▪ Give detail notes and explanations describing the physical properties and applications of the following non-ferrous metals: copper, tin, zinc, aluminum, aluminum alloys, brass, (muntzmetal, cartridges brass, gilding metal) etc. bronze, manganese bronze bell metal, aluminum bronze phosphor bronze and lead. Assess the students	
	General Objective 3.0: Select And Use Common Measuring, Making Out, Cutting And Striking Tools		
3	3.1 Explain with examples the difference between :line" and "end" measurement 3.2 Explain the use of datum points, datum lines and datum faces in marking out. 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. 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	▪ 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 and datum faces in marking out. ▪ Give detail 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 ▪ Prepare note that will describe the various types of files stating their grades and applications, By type it means: flat square round, halfround, there square	▪ Steel rules dividers calipers 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) ▪ File card

	3.5 Classify the common files used in metal work and state their composition of material used for their manufacture. 3.6 Sketch the bench vice, explain its clamping power and demonstrate the technique of holding work in the vise for filing tapping and designing operation. 3.7 Describe the functions of the various parts of a bench vice, its holding power while performing various operations on it, such as filing, etc.	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	▪ Flat file ▪ Bench vice ▪ Bench vice ▪ Ball pein hammers mallets
4	3.8 Show an bench vice and demonstrate the technique of holding work in the vice for filing, tapping and designing operations. 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 3.10 Describe and use the following tools: a. cold chisel (flat,cross, cut half round, diamond-points) b. centre punch and dot punch c. scraper (flat, triangular, half round) d. power hack saw 3.11 Describe the various parts of a hack saw and their function. 3.12 Describe the common types of hacksaw blades, their range of pitches and their application	▪ 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. ▪ 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. Assess the students	▪ Cold chisel, centre ranchers dot punch scrapers power hacksaw blades ▪ Hacksaw blade ▪ Hacksaw frame ▪ Adjustable hacksaw junior hacksaw piercing saw. ▪ Bench drill ▪ Pillar drill ▪ List drills, flat drill counter sink 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.		
5.6	4.1 Identify the various types of drilling machines 4.2 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, countersink drill, counter bore drill, combination centre drill. 4.3 Explain the effects of the following faults in a ground twist drill bit: a. point angle too acute. b. point angle too abtuse: c. cutting edges at unequal angles d. insufficient lip clearance; e. excessive lip clearance 4.4 Calculate spindle revolution or cutting speed for specified size of drill using the formulae:- 4.5 State the cause and remedy of drilling faults such as:- a. drill breaking;	▪ Show different types of drilling machines ▪ Make notes and drawings that will identify the various types of drilling m/cs. ▪ 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. ▪ 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	▪ Ball pein hammers, mallet, cold chisels, dot/center punches, hacksaw and hacksaw blades ▪ Drilling machines and its accessories.
	b. drill coloured blue c. walls of drilled hole left rough d. chipped cutting lips 4.6 State the safety precautions to be observed went using a drilling machine reamers. 4.7 Ream to given specification by hand and machine method.`		
	General Objective 5.0: Understand The Applications Of Various Types Of Screw Threads, Rivet And Cut Screws By Hand.		
7	5.1 Sketch the thread forms below and state their applications:- a. the ISO metric thread b. the unified thread	▪ Give detailed notes with diagrams that will show the various forms of thread and their uses. ▪ State the functions of taps, tap wrench,	▪ Diagrams/charts of thread forms

	c. Whitworth and British fine threads d. British Association (BA) thread e. British Standard pipe f. Square thread g. Acme thread 5. Buttress thread. 5.2 Sketch and state the functions of:- a. taps (taper tap, second tap, plug) b. tap wrench c. die and die stock 5.3 Explain the meaning of taping size or tapping drill and estimate its value in given situations using formulae such as:- T = D – P Where T = tapping diameter D = thread top diameter P = pitch 5.4 State precautions to be taken when taping on the bench.	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	▪ Parallel reamers taper reamers twist drills.
	5.5 Describe and differentiate types of rivets e.g. snap and pan head, mushroom and counter-sunk head, flat head, dod rivet, etc. 5.6 Sketch the rivet set and state its uses. 5.7 Calculate the diameter of rivet and riveting allowance in given situations.	▪ 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.	▪ Rivet sets

	General Objective 6.0: Understand The ISO Tolerances And Fits And Its Application In Engineering Production.		
8	6.1 Differentiate between the following:- a nominal size b limits (upper and lower) c tolerance (unilateral and bilateral) d fit (clearance, transition and interference). 6.2 Explain the importance of tolerance and fit in engineering production and describe briefly the ISO system of limits and fits. 6.3 Determine by calculation the amount of tolerance and types of fit in given situations.	▪ 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.	▪ Charts on tolerances, limits and fits.
	General Objective 7.0: Produce Simple Engineering Components On The Bench.		
9	7.1 Explain layout procedures from working drawing of simple engineering components or tools such as: 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. 7.2 Explain how to produce any simple engineering component to given specifications including dimensions, tolerance and finish. 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.	▪ Teachers to prepare notes and explanations to guide the students in producing simple engineering components as in 7.1 ▪ Assess the students.	▪ 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.		
10-12	8.1 Describe the essential features of a centre lathe and state their functions e.g lathe bed, headstock, tailstock, saddle or carriage, etc. 8.2 Explain the working principles of the centre lathe. 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. 8.3 Explain the difference between the centre lathe, capstan lathe, in terms, of their main features and functions. 8.4 Name types of cutting fluids used for lathe turning operations and state their composition and purposes. 8.5 Outline safety precautions to be observed when working on the lathe. 8.6 Sketch and describe common tools: e.g butt-brazed tool, tipped tool, bit and holder. **Note:** Tool description should include tool materials e.g plain carbon steel, high speed steel, stellite, cemented carbide, diamond. 8.7 Explain with sketches the functions of tool angles (rake clearance), and state their values for different metals to be machined.	▪ 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. ▪ 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.	▪ Centre lathe and accessories like catch plates, face plates, center,s fixed and travelling steadies. ▪ Charts of center lathe and capstan lathe. ▪ Round nose turning tool, finishing tool, site finishing, knife tool, form tool, parting off tool, and boring tool.
	8.8 Differentiate between various tool shapes and state their uses e.g Rounse nose rougher, fine finishing, side finishing, knife tool, form tool, parting off tool, boring tool, etc.	▪ Give notes and diagrams of various tool shapes and their uses. ▪ Prepare detailed notes and explanations to cover 8.10 to 8.15	▪ Charts on tool height. ▪ Charts and diagrams of different machining operations.

	8.9 Explain with sketches the effects of wrong setting of cutting tool: e.g vibration and chatter, tool rubbing against or digging into the job. 8.10 Define cutting speed and feed with respect to lathe operation. 8.11 Calculate the cutting speed and feed for given turning operation. Estimate the rate of metal removal and time required for carrying out specified turning operations. 8.12 Estimate the rate of metal removal and time required for carrying out specified turning operations. 8.13 State precautions to be observed when turning between centres. Set up the lathe for and carry out basic turning operations between centres. 8.14 Compute required taper dimensions from given data using taper ratio angle formulae i.e Taper Ratio = $\frac{d_2 - d_1}{}$ OR $\frac{\text{Tan}}{2} = \frac{d_2 - d_1}{2}$ where = taper angle d_1 – small end diameter d_2 = large end diameter L = length of taper	▪ Solve many problems for the students practise. ▪ Assess the students.	

PRACTICAL TASKS

PROGRAMME NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
WEEK	**General Objective 1.0: On completion of the following practical task, the trainee will demonstrate the following abilities:**		
	Specific Learning Outcome	**Teachers Activities**	**Resource**
	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	▪ 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	▪ Hand tools files hacksaw ▪ Television, Video machines ▪ Posters on artificial respiration
	General Objective 2.0:Measuring, Marking, Cutting And Striking		
	2.1 Describe the essential features and use of the following 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 2.7 Apply various hammers and mallets e.g ball pein, rubber mallets, etc for engineering purposes	▪ Demonstrate how to use micrometer, vernier caliper 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 ▪ 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	▪ 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 ▪ Ball pein hammers, mallet ▪ Hacksaw bald, Hacksaw frame

	2.8 Select and insert hacksaw blade correctly 2.9 Cut metal and other engineering materials to given specification using the adjustable hacksaws, junior hacksaws, piercing saw, etc drills and Drilling.	competent ▪ Guide student to produce simple ▪ Engineering component like opened ended spanner, engineers square tool makers clamp, centre square, etc ▪ Assess the student	
	General Objective 3.0:Machine Tools		
7-9	3.1 Setting up and operate a drilling machine in given situations Note Setting up drilling machine should include a. change of spindle speed b. adjustment of drilling table torequire 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 3.2 Sharpen a twist drill correctly to manufacturers specification 3.3 Perform with facility the following operations: - drilling blind - drilling round stock - counterboring and counter-sinking - drilling large diameter holes 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 taping on the bench. 3.5 Rivet metals together in any given situations 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.	▪ 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 ▪ 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 sam 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	▪ Bench drill pillar drill, drill, bits ▪ Bench drill, pillar drill, twist drill, flat drill, counter sink drill, counterbore drill, center drill. ▪ Drills taps, tap wrench,m die and die stock ▪ Rivets and sets of drill bits ▪ Surface table, surface plate marking solution, center/dot punches, scribing block

10-12	**General Objective 4.0:Lathe And Lathework**		
	4.1 Sharpen cutting tool for plain turning shouldering, parting off and facing operations. 4.2 Set up rough and turned stock N 3-jaw-chuck 4.3 Select appropriate cutting tool and set them up to centre height for turning or facing operations 4.4 Carry out chuck work involving facing, step turning, undercutting reducing, chamfering, parting off and knurling **Note:** Component should be produced to specified tolerance and finish 4.5 Produce simple components involving taper turning using the compound slid	▪ 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 ▪ Guide the students to select appropriate cutting tools and set them up to center height for lathe work ▪ Make a simple recision 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	▪ 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 ▪ 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

PROGRAMME: National Technical Certificate in Instrument Mechanics Work		
Course: Basic Electricity	**Course Code: CEI II**	**Duration: 264hrs**

GOAL: This module is designed to provide the trainee with basic knowledge of electricity and the competency to wire simple circuits and use common electrical measuring instruments.

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 current and voltage.
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 INSTRUMENT MECHANICS WORK			
Course: CEI 11 ELECTRICITY		**Course Code: CEI 11**	**Contact Hours: 6 Hrs/Wk**
Course Specification : Theoretical Content			
WEEK	**General Objective 1.0: Understand the Structure of matter and its relevance to electricity/electronics.**		
	Specific Learning Outcome:	**Teachers Activities**	**Resources**
Yr1t1 1-2	On completion of this module the trainees should be able to: 1.1 Define: a. Molecule b. Electron c. Atom d. Electric charge e. Electric Current f. Coulomb 1.2 Explain the difference between positive and negative charges. 1.3 Explain the flow of electricity 1.4 Distinguish between insulators and conductors	▪ With diagram define atom, electron, proton¸ molecule, electric charge, electric current, Coulomb. ▪ Give full explanation on the difference between +ve -ve charge. ▪ Describe how electricity flows ▪ Explain insulator and conductors with sample	▪ Chalkboard ▪ Textbooks
	General Objective 2.0: Understand The Chemical Source Of Electromotive Force.		
3	2.1 Define: a. Electric power b. Energy	▪ Explain electric power and energy stating their unit, symbol and formula. Work problems based on Power and Energy	▪ Chalkboard ▪ Textbook ▪ Calculator
4	2.2 Distinguish between emf and potential difference (p.d)	▪ Distinguish the differences between emf and pd	▪ Chalkboard
5	2.3 Identify the following: a. Primary Cells b. secondary cells	▪ Show primary and secondary cells and describe their construction.	▪ Primary Cell
6	2.4 Test for the condition of a cell or battery	▪ Use instruments and visual observation to show how to test cell condition.	▪ Primary Cell
7-8	2.5 Connect cells in: a. Series b. Parallel c. Series – Parallel	▪ Show how cells can be connected in series, and parallel Advantages of cells in series or parallel connections. e.g voltage in series and on parallel	▪ Chalk Board

	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.		
	3.1 Identify the various types and sizes of the following: a. Resistors b. Capacitors c. inductors.	▪ Define and show resistors, capacitors and inductors. State their unit and symbols	▪ Capacitors ▪ Inductors ▪ Resistors
9	3.2 Identify the following resistors: a. Composition type resistor b. Wire wound type resistor c. Variable resistors **d.** Fixed resistors	▪ Show students various types of resistors	▪ Resistors
10	3.3 State the function of the following: a. Resistor b. Capacitor c. Inductor in a Circuit	▪ Explain and show how each can be connected and their function	▪ Resistors & ▪ Capacitors ▪ Indicator
10	3.4 Describe the constructional detail of the following: a. Resistors b. Capacitors c. Inductors	▪ Describe on chalkboard the constructional detail of the three.	▪ Chalk Board ▪ Components
11	3.5 Explain the meaning of power rating of a resistor	▪ Explain power rating of resistor.	▪ Chalk Board
11	3.6 Identify the power rating of different resistance types.	▪ Show how to identify the power rating of each resistor.	▪ Resistor
11	3.7 Explain the practical application of various types of resistors	▪ Explain the application of resistor in a circuit.	▪ Chalk Board
11	3.8 Identify the working Voltage of a capacitor	▪ Explain the maximum working voltage of a capacitor.	▪ Chalk Board
	General Objective 4.0: Know The Values Of Resistor(s)		
12	4.1 Explain the colour coding system of a. resistors b. capacitors	▪ Show and explain how to identify colour coding of resistor.	▪ Chalkboard ▪ Textbooks ▪ Calculator
13	4.2 Calculate the following: a. Resistance of a resistor using colour codes b. capacitance of a capacitor using colour codes	▪ From colour code, show how to calculate the values of resistor and capacitor	▪ Chalk Board ▪ Color coded resistors

13	4.3 Identify the tolerance of resistors and capacitors.	▪ Show and calculate the tolerance of resistors and capacitors	▪ Chalk Board
13	4.4 Calculate the value of the tolerance of any a. Resistor using colour codes b. Capacitors using colour codes	▪ Show and calculate the tolerance of resistors and capacitors.	▪ Chalk Board ▪ Color coded Resistors
	General Objective 5.0: State Ohm's Law And Apply It To Calculate Resistance, Voltage And Current		
Yr1t1 1	5.1 Define Ohm's law	▪ Define Ohm's Law	▪ Chalk Board ▪ Batteries ▪ Resistors ▪ Multimeter
1	5.2 Calculate resistance, Voltage or Current using Ohm's law e.g. R=V/I	▪ Work some calculations on Ohm's law	▪ Chalk Board
	5.3 Connect: a. resistors in series b. resistors in parallel c. series and parallel connection	▪ Show how resistor can be connected in series, parallel and series-parallel and perform calculations.	▪ Chalk Board
2-3	5.4 Connect: a. batteries in series b. batteries in parallel c. batteries in series parallel connection	▪ Refer students to batteries connected in the three modes by asking questions.	▪ Chalk Board
4-7	5.5 Connect capacitors in series and parallel and capacitors in series parallel connection as above.	▪ Show capacitor in series parallel and in series-parallel.	▪ Chalk Board
	5.6 State the implication of the connections mode in 5.3 – 5.6	▪ Explain the implication of modes 5.3 – 5.6	▪ Chalkboard
8-9	5.7 Calculate the inductance, capacitance connected in series and parallel.	▪ Work samples of Capacitors and inductor in series parallel.	▪ Textbooks
10	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. $I_1 + I_2 + I_5 = I_3 + I_4$	▪ Chalk and Black board
11	5.9 Solve simple numerical problems involving 13.a & 13.b above.	▪ Define the voltage laws. Draw a simple circuit to illustrate the law,	
12	5.10 Define Superposition theorem	▪ State the law. Draw a simple circuit to illustrate the law	"

13	5.11 Solve simple numerical problems to illustrate Superposition theorem	Super position theorem. Use simple circuit to illustrate the theorem.	"
Yr2t1	**General Objective 6.0: Distinguish Between AC And DC Current And Voltage.**		
1	6.1 Explain the difference between AC and DC.	▪ With the aid of a diagram explain the difference between Ac to DC.	▪ Lesson note
2	6.2 Explain the Characteristic of alternating current.	▪ Explain fully AC.	▪ Chalkboard
3	6.3 Define peak value, mean value, RMS value, Frequency of Wave.	▪ Draw diagrams to explain AC variables like RMS, mean valve, etc.	▪ Chalk Board ▪ Signal Generator ▪ osciloscope
4	6.4 Calculate peak value from RMS values of Current, and voltage, and vice versa	▪ Work some samples on how to calculate the variables above	▪ Chalk Board
5	6.5 Describe the simple treatment of R,L,C in AC circuit.	▪ Explain the effect of AC on R,L,C in parallel i.e. voltage and current relationships	▪ Chalk Board
6	6.6 Explain the concept of resistance in Ac circuit.	▪ Explain resistor in AC circuit.	▪ Chalk Board
7	6.7 Calculate inductive and capacitive reactance. XL = 2π fL (Inductive reactance) Xc = $\frac{1}{2\pi fC}$ (Capacitive reactance)	▪ Explain inductive and capacitive reactance and work some calculation on X_l, X_c, (like $X_{c\ above}$)	
8	**General Objective 7.0: Understand The Principles Of Transformer, Its Construction And Operations.**		
	7.1 Explain the concept of Magnetism a. temporary and permanent magnets b. magnetic field c. magnetic poles d. law of attraction and repulsion	▪ Define magnet and explain temporary, permanent and natural magnet. ▪ Define laws of magnet, show diagram where necessary.	▪ Magnet ▪ Soft Iron ▪ DC Power ▪ Coil ▪ Compass ▪ Copper Coil
9	7.2 Explain the effect of fields as applied to electro-magnetism	▪ Show and explain magnetic fields.	▪ Chalk Board
10	7.3 State the colour code used for the winding of transformer.	▪ Explain fully mode of winding of transformer.	▪ Chalkboard
10	7.4 Describe with the aid of sketches the principles of operation of a single phase, double wound transformer.	▪ Explain Vp/Vs=Np/Ns	▪ A transformer ▪ Chart ▪ Chalk Board

	7.5 State the reasons for laminating the core of a transformer.	▪ Show lamination and explain reasons for lamination.	▪ Calculator ▪ Chalkboard ▪ Textbook
12	7.6 Explain the types of losses in transformers a. State ways to reduce them.	▪ List and explain iron and copper loss and how to reduce them	▪ Chalkboard
	7.7 Calculate transformer efficiency	▪ Explain efficiency and work some sample on efficiency	▪ Lesson plan
13	7.8 Construct a simple single phase double wound transformer	▪ Demonstrate how to construct double would.	▪ Chalkboard
	7.9 Identify the following types of transformers: a. Auto-transformer; b. C-Core transformer; c. Toroidal transformer. d. Rudolf transformer e. Audio transformer f. 3-phase transformer g. Current transformer; state the uses of each type of transformer	▪ Explain fully different type of transformers e.g. power, isolation auto etc. ▪ Make available for inspection a number of examples.	▪ Different types of transformers
Yr2t2	**General Objective 8.0: Analyse, Connect And Carry Out Simple Calculations On Simple Electrical Circuit.**		
1	8.1 Explain the difference between series and parallel circuit	▪ Define an electric circuit and state the difference between series and parallel .	▪ Chalkboard ▪ Textbooks/Notes
1	8.2 Calculate the total resistance in a series d.c. circuit	▪ Give students calculation	▪
2	8.3 Calculate the voltage drop across each resistor of a series circuit	▪ Work samples on Vd on each resistor in a circuit and ask students to do same.	▪ Calculator
2	8.4 Calculate the total resistance of a parallel circuit	▪ Request students to work some calculation	▪ Notes
3	8.5 Investigate by experiment, the effect of resistors in series and in Parallel.	▪ Carry out experiment to show the effect of resistor in series and in parallel.	▪ Resistors ▪ DC power supply multimeter
3	8.6 Calculate the current in each arm of a parallel circuit.	▪ Show how to calculate the current in each arm.	▪ Chalk Board
4	8.7 Investigate the effect of capacitor in an electric circuit.	▪ Ask question on connection of capacitor.	▪ Chalk Board

4	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
5	8.9 Calculate the voltage and current in a series and parallel circuit.	▪ Calculate voltage & current in series and parallel circuit.	▪ Chalk Board
6	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
7	8.11 Calculate impedance in an AC Circuit	▪ Define impedance, give the symbols, unit and formula ▪ Calculate impedance and ask students to do same	▪ Textbooks ▪ Note ▪ Calculator ▪ Chalk Board
10	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
11	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
12-13	8.14 Calculate resonant frequency.	▪ Do some calculations on the three and ask students to do same.	▪ Chalk Board
	General Objective 9.0: Interpret Basic Electronic Signs And Symbols. Year 2, Term 3 Contact Hour: 1-4		
Yr2t3 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 and ask student	▪ Textbooks ▪ Note
2	9.2 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

3-5	**General Objective 10.0: Understand The Operation, Uses And Limitations Of Indicating Instruments And Operate Them,**		
	10.1 Describe the functional part of the multi-meter	▪ Describe the parts, operation and uses of multimeter.	▪ Multimeter – digital and analogue
6-9	10.2 Set and the meter for: a. AC and DC voltage measurement b. Resistance measurement c. AC and DC current measurement	▪ Demonstrate how to use the instrument in measuring current voltage and resistance both on AC and DC	
10-12	10.3 Use the Ohm-meter to test semi-conductor devices.	▪ Show how to use the multimeter to test diode, transistors etc.	▪ Ohmeter ▪ Chalkboard ▪ Note.
13	10.4 Recognize a fault condition of meter	▪ Explain how to identify fault and how to rectify such.	▪ Chalk Board

PRACTICAL CONTENT FOR BASIC ELECTRICAL CET 11 FOR MODULE

ALL EXPERIMENTS MUST BE PERFORMED BY STUDENTS

	Experiments	**Teacher/Students Activities**	**Resources**
1-4	Demonstrate by experiment Resistors in Series and in Parallel	▪ Circuit Resistors in Series and then in parallels with meters and power supply.	▪ DC Ammeters, Dc Voltmeters, Resistors power supply unit.
5-6	Demonstrate by experiments the effect of connecting capacitors in series and in parallel	▪ Current capacitors in ▪ in series ▪ in parallel. ▪ Measure current and voltage	▪ Capacitors, DC Ammeters DC Voltmeters, Power supply.
9-12	Demonstrate by experiment Ohms law R = V/I	▪ Current resistor R in series with ammeter. Measure current I in R and measure voltage V across resistor.	
1-6	Demonstrate by experiment – Kirchoff's laws	▪ Wire sot and take readings	▪ Kirchoff's laws unit.
7-12	Demonstrate by experiment the Superposition theorem.	"	
1-4	Demonstrate by experiment self induction. Natural induction of a coil	▪ Move permanent in an out of the coil as note. Deflection on the metre.	
5-12	R & L in series AC circuit, R&C in series AC circuit		▪ Components, Signal generator
1-6	R & L in parallel AC circuit and R&C in parallel AC circuit		▪ Components, Signal generator
7-12	Demonstrate by experiment series Resonance in AC and Parallel resonance in AC.	▪ Cunnect the circuit and demonstrate variations of frequency at constant voltage	▪ AC micrometer, AC Voltmeter (oscilloscope) capacitor, sine wave, signal generator.
1-12	Plot graphs for both series and parallel resonance. Determine the Q-factors in:		

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: .
d. The laboratory reports should also be assessed and graded.

PROGRAMME: National Technical Certificate in Instrument Mechanics work.

MODULE: CIM 10 – Mechanical and Pneumatic Instruments I

DURATION: 180 Hours

GOAL: This module is designed to equip the trainee with knowledge and technique to install and maintain common mechanical – pneumatic instruments found in industry.

GENERAL OBJECTIVE:

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

1. Appreciate the application of safety in industry
2. Understand the basic principles of pressure and be able to use and maintain pressure measuring instruments.
3. Understand the basic principles of flow and be able to use, install and maintain flow measuring instruments.

Programme: NTC INSTRUMENT MECHANICS WORKS			
Module: MECHANICAL AND PNEUMATIC INSTRUMENTS 1		**Module Code: CIM 10**	**Contact Hours: 15 Hrs/Wk**
Module Specification:			
WEEK	**General Objective 1.0: Appreciate The Application Of Safety In Industry And Explain Accident Prevention.**		
	Specific Learning Outcome:	**Teacher Activities:**	**Learning Resources:**
1-3	1.1 Explain 'Safety' 1.2 Explain safety using workshop examples (e.g oil spilling on the floor). 1.3 Explain 'Accident'.	▪ Demonstrate the use of safety materials e.g safety book, glove etc) ▪ Show various safety devices.	▪ Films Show Projector or Video
4	1.4 Differentiate between safety and accident. 1.5 State common causes of accidents (e.g use of defective tools smoking/naked flames etc). 1.6 State possible ways of preventing accidents	▪ Ask questions on safety and accident. ▪ Watch learners apply correct safety wears to different workshop situations e.g overall, safety book etc.	▪ ▪ Overall, safety book, gloves.
5-6	1.7 Identify major hazards in industry e.g. a. Electrical hazard b. Toxic fumes c. Fire 1.8 State examples of each of the hazards mentioned in 1.6 above. 1.9 Use fire fighting equipment and other safety wears.	▪ Organise workshop practical using fire fighting equipment and appropriate safety wears	▪ Fire extinguishers ▪ Water type, Co_2 type and dry powder.
	General Objective 2.0: Understand The Basic Principles Of Pressure And Be Able To Use Install And Maintain Pressure Measuring Instruments		
7-8	2.1 Explain 'Pressure' as: a. force per unit area b. height and density Give the SI unit - N/M^2 or NM^{-2} and Pascal (P_a). 2.2 Explain the following terms used in pressure measurement. a. Atmosheric pressure b. Gauge pressure c. Absolute pressure d. Differential pressure measuring instruments.	▪ Ask question on pressure let learners list three terms needed in pressure measurement.	▪ Lesson plan chalkboard.
	2.3 Identify pressure measuring instruments.	▪ Display various types of pressure measuring instruments.	▪ Various pressure measuring instruments.

9-10 11	2.4 Explain the following types of pressure measuring instruments. a. Barometers b. Bourdon tube gauge (c-type helical and spiral) c. Diaphragm gauge (rubber and shift metallic) d. Bellows gauge e. Manometers	▪ Discuss each instrument stating the application of each.	▪ Foot pump with gauge
	2.5 Explain with the aid of diagram the principle of operation and the application of each item in 2.3 above.	▪ Make neat sketches on cardboard and display on chalkboard.	
	2.6 Draw graphical symbols of pressure elements and pressure measuring instrument.	▪ Students to connect all measuring instruments to measure pressure.	
12	2.7 Define 'Calibration' 2.8 Explain the working principle of a dead weight pressure tester.	▪ Demonstrate the calibration of a pressure gauge using a standard gauge e.g Dead weight tester	▪ Dead weight tester
	2.9 Use U-tube standard calibrator to calibrate a pressure gauge.	▪ Demonstrate the calibration of a pressure gauge with a u-tube pressure calibrator	
	2.10 Explain the following calibration errors: a. Zero error b. Angularity error c. Multiplication error	▪ Show these errors using gauges.	
	2.11 Explain the protection of pressure measuring instruments by use of: a. Pig tails b. Pressure sinbbers c. Pressure straightner	▪ Display pia tails ▪ Pressure snubers ▪ Pressure straight nuts	▪ Pressure snubers ▪ Pig norib ▪ Pressure straight nut
	2.12 Draw up the installation of pressure measuring instruments to show the use of: a. Pig tail connection b. Static head correction c. Use of sealing liquid.	▪ Demonstrate the method of installing pressure instruments	▪ Pressure measuring instructments

12	2.13 Identify the protective devices used for pressure gauge	▪ Discuss pressure surge and display the following: ▪ Pressure snubers ▪ Pressure straightner ▪ Pig tails.	▪ Protive pressure protective Drawing
	2.14 Dismantle and correct the calibration errors noticed. Re -assemble and re-calibrate. 2.15 Detect surge in a pressure line and make correction.	▪ Create a surge in the pressure line. ▪ Ask question on how surge could be protected in pressure measurement.	▪ Manometers ▪ Pressure Gauges
	2.16 Explain the following methods of pressure transmission in industry: a. Pneumatic b. Hydraulic c. Pneumatic cylinders d. Pressure recorder	▪ Ask learners to list three methods of transmitting pressure in industry	
	2.17 Dismantle a pressure recorder, service the pen and linkages.	▪ Show the lay-out of a pneumatic system. ▪ Watch learners assemble a dismantled recorder given relevant manuals and catalogues. ▪ Students also should undertake the task.	▪ Pressure recorder. Hydraulic jack.
	General Objective 3.0: Understand The Basic Principles Of Flow And Be Able To Use, Install And Maintain Flow Measuring Instruments.		
	3.1 Define 'Flow' 3.2 Distinguish between 'Quantity' (Q) and flow rate (q). 3.3 Explain flow patterns e.g streamlined and turbulent flow.	▪ Discuss flow in details. ▪ Sketch the two flow patterns	
	3.4 State bernonllis principles 3.5 Define Reynolds number. 3.6 Explain the following terms: a. Potential energy b. Kinetic energy c. Pressure energy d. Heat energy	▪ Explain clearly with diagrams the Barnett's Principles	▪ Flow bench and its apparatus

	3.7 Explain the practical application of Bernon Ui's principle		
9	3.8 Explain differential pressure method of flow using the following element: a. Orifice plate b. Venturi tube c. Dall tube d. Pitot tube	▪ Demonstrate the use of the primary elements. ▪ State the advantages and disadvantages of their use. ▪ Install the various elements in their flow line.	▪ Orifice plate ▪ Venturi tube ▪ Dall tube ▪ Pilot tube
	3.9 Sketch the primary elements in their installed position.		
10	3.10 Distinguish between flow rate meters and positive displacement meters.	▪ Discuss the construction and operation of the flow meters listed in 7.2	
11	3.11 List instruments for measuring flow e.g. a. Rotating vane meters b. Reciprocating piston type meter c. Semi-rotary type d. Rotor type e. Helical type f. Oval gear type g. Volumetric meter h. Weighing meter.	▪ Display meters	▪ Examples of meters should be available to students
	3.12 Explain the construction and operation of various flow meters.		
12	3.13 Dismantle different flow meters and re-assemble.		▪ Flow meters in 7.2
	3.14 Service the flow meters making sure the component parts are replaced in their correct positions.		▪ Examples of meters should be available to students.
	3.15 Clean the parts and lubricate if necessary.	▪ Ask questions on the working principle of some of the instruments in (7.2) above.	▪ Examples of meters should be available to students.
13	3.16 Re-calibrate the flow measuring instruments.	▪ Watch learners dismantle, service and re-assemble some of the meters in 7.2 – 7.7	▪ Flow measuring instruments

	3.17 Explain the function of a 'Rotameter'. 3.18Explain its working principle. 3.19 Identify different types in use.	▪ Describe in detail the operation of a Rotameter. Include in the description, the material used for its construction.	▪ Rotameter.
	3.20 Identify and name the materials used for float element. 3.21 Install a float on flow line and recognise its correct position on the line	▪ Show a float and locate its position on flow line	▪ Float element
	3.22 Calibrate flow rate instruments using meter provers. 3.23 Explain the operation of a meter prover.	▪ Describe the function of a meter prover.	▪ Meter provers.
	7.8 Observe safety precaution when calibrating the flow meters.	▪ Emphasize the need for observance of safety precautions when calibrating	▪ Chalk Board
	3.24 Define integrator/totalizer. 3.25 State the functions of an integrator. 3.26 Name at least three types of integrators e,g. a. Pneumatic integrator b. Electrical integrator c. Mechanical integrator. 3.27 Explain the principle of a pneumatic integrator. 3.28 Strip and inspect a typical pneumatic integrator	▪ Describe the operation and use of a pneumatic integrator. ▪ Dismantle and re-assemble a typical pneumatic integrator	▪ Mechanical Electrical and Pneumatic integrators.
	3.29 Explain the operation of a mechanical integrator. 3.30 Identify the components of 11.1 above. 3.31 State the function of each component in 11.2 above.	▪ Discuss the underlying principle.	▪ Chalkboard.
	3.32 Dismantle a mechanical integrator.	▪ Demonstrate the procedure for dismantling and re-assembling stating safety precautions to be observed at each stage.	▪ Provision of precession tools
	3.33 Service the integrator, rectify any faults observed. 3.33 Re-assemble the integrator observing necessary safety precautions.	▪ To direct students to perform all the tasks.	▪ Intergrator
12-13	3.34 Identify standard graphical symbols of flow measuring devices and their elements.	▪ Prepare different graphical symbols on a cardboard.	▪ Flow measuring devices.

	3.35 Interpret flow installations e.g meter below orifice meter above orifice 3.36 Identify the components on the installation.	▪ Develop a flow installation using installation procedure and requirement. ▪ Place all necessary components in their appropriate position.	▪ Orifice meter
	3.37 Sketch a flow installation with the correct symbols in their appropriate positions.	▪ Display on the chalkboard two different sketch of flow installations.	▪ Chalkboard, cardboard

EXPERIMENT

NTC INSTRUMENTS MECHANICS WORK (CIM 10)

Week	Experiment (M/P Instruments Cim 10)	Teachers/Students Activities	Resources
1-9	Demonstrate how meters can be used to show calibration errors		
10-18	Perform experiments to demonstrate the use of pressure measuring instruments to show the following: a. Pig tent connection b. Static head correction c. Use of sealing liquid		
19-27	Dismantle and correct the calibration errors observed. Reassemble how to detect single in a pressure line and make corrections.		

EVALUATION

Students must be able to dismantle and assemble, calibrate and test all instruments mentioned.
Students also must be made to write simple technical report on practicals.
Assessment - test and final examination shall also constitute part of assessment.

PROGRAMME: National Technical Certificate in Instrument Mechanics Works.

MODUEL: CIM 11 – Mechanical and Pneumatic Instruments II

DURATION: 300 Hours

GOAL: This module is designed to equip the trainee with knowledge and technique to install and maintain common mechanical – pneumatic instruments found in industry.

GENERAL OBJECTIVES:

1. Understand the concept of level and measuring devices.
2. Understand temperature and are able to use and maintain temperature devices.
3. Know speed and measure speed with appropriate instrument.

Programme: NTC INSTRUMENT MECHANICS WORKS			
Module: MECHANICAL AND PNEUMATIC INSTRUMENTS II		**Module Code: CIM 11**	**Contact Hours: 25 Hrs/Wk**
Module Specification:			
WEEK	**General Objective 1.0: On Completion Of This Module, The Trainee Should Be Able To: Understand The Concept Of Level And Measuring Devices.**		
	Specific Learning Outcome:	**Teacher Activities:**	**Learning Resources:**
1-4	1.1 Explain what is meant by level with respect to reference point of datum line. 1.2 State the unit of level measurement (unit of length) i.e. meters centimeters, height of liquid 1.3 Select the instruments used for the measurement of levels: a. Dipstick b. Slight glass c. Float device d. Differential Pressure Cell.	▪ Discuss various level measuring devices and its limitations.	▪ Level measuring devices
5-7	1.4 Explain the working principles of the level measuring instruments named in (1.2) above with the aid of leveled sketches.	▪ Demonstrate the use of level measuring instruments	▪ Level measuring instruments
8-11 12-13	1.5 Read and record levels indicated on the instruments in the appropriate units. 1.6 State the limitations of each of the level measuring instruments e.g. a. Dipstick cannot be used in pressurized vessel and b. Slight glass fragile and measurable range is limited. c. Float device is limited by friction: and accumulation of foreign bodies on the float causes error in level reading. 1.7 Disassemble sight glass and float device examining and noting the relative position of component parts. 1.8 Service sight glass and float device by: a. Changing of damaged components b. Cleaning of parts c. Lubricating moving parts.	▪ Choose material for floats. ▪ Demonstrate the use of sight glass level measuring device. ▪ Ask k questions on dismantling and assembling of various level meters. ▪ Students should participate on 2.3 – 2.5. ▪ Demonstrate the servicing procedure	▪ Sight glass level measuring devices ▪ Sight glass ▪ Float device
104	1.9 Reassemble sight glass and float device on appropriate equipment/system.		
	1.10 Explain the principle of any gas purge system.	▪ Use question and answer	▪ Tank standing pipe

5-6	1.11 Mention two methods of gas purge: a. Open tank b. Close tank. 1.12 Explain the effect of bubble rate and density of liquid 1.13 Identify the components of a gas purge level device. 1.14 Using gas purge level instrument, investigate effect of change of bubble rate.	techniques for gas purge system.	▪ Pressure gauge ▪ Air supply or Gas.
7-9	1.15 Enumerate differential pressure method of measuring level in: i. Open tank system 1..16 Draw sketches to illustrate the operation of the instrument. 1.17 Identify condencing chambers, seal, catch pot etc. Calibrate install and commission a differential pressure cell on tank level.	▪ Show different methods of level measurement . ▪ Ask question on construction and operation of the instrument. ▪ Students must perform this task.	▪ Close tank, Open tank, Connected accessories.
10-11	1.18 Explain the operation of diaphragm type of pressure measuring level . 1.19 State what type of liquid contents used in the application of the level devise in 5.1. 1.20 State the operation of a bellow type level measuring device. 1.21 Study design of the two pressure instruments, and use instructional journal as a guide.	▪ Illustrate the operation and construction of the level meters.	▪ Diagram box and bellows ▪ Instructional journal
	General Objectives 2.0: Understand Temperature And Be Able To Use And Maintain Temperature Devices.		
12-13	2.1 Define temperature as the degree of hotness and coldness.		
1-3	2.2 State the unit temperature: a. Fahrenheit b. Centigrade c. Kelvin (Absolute) 2.3 Convert one system of temperature to another. i.e degrees Centigrade to degrees Fahrenheit or Kelvin 2.4 Mention the instruments used for the measurement of temperature. e.g a. -Mercury (Thermometer assorted) b. Mercury in glass c. Mercury in steel d. Gas thermometers e. Resistance thermometers f. Solid expansion	▪ Ask question on calibration and conversion of temperature.	▪ Various types of Thermometer. ▪ Optical and total radiation pyrometer. ▪ Glass thermometer mercury in steel thermometer source of heat.

	g. Vapour pressure thermometer h. Thermocouple i. Pyrometers. j. Optical pyrometer k. Total radiation pyrometer.		
	2.5 Explain with the aid of diagram the operating principle of a. Mercury in glass b. Mercury in steel 2.6 Mention the trouble shooting in the two thermometers.	▪ Demonstrate the use of the thermometers. ▪ Discuss, possible errors in the two thermometers.	▪ Thermometers
8-13	2.6 Explain the working principle of (1) Gas thermometer. (2) Vapour - Pressure thermometer. 2.7 Detect the faults in the thermometer. 2.8 Dismantle the thermometer gauges. 2.9 Service the mechanism 2.10 Check the capillary tubes. 2.11 Reassemble the gauges 2.12 Calibrate.	▪ Trouble shoot the two thermometers. Students should perform this task. ▪ Ask questions on the temperature measuring instrument	▪ Gas thermometer vapour pressure thermometer bath and steam.
	General Objective 3.0: Know Speed And Measure Speed With Appropriate Instrument		
1-6 7-11	3.1 Speed and Speed Measuring Instruments. 3.2 Define speed as distance or angle covered per units time. (a) V = S/t Where V = linear speed in meters or feet per second. S = distance in meters or feet t = time in seconds (b) W = ϴ/t Where w = angular speed in radians per second. ϴ = angle in radians t = time in seconds. 3.3 Define velocity as speed in a given direction. NOTE: Formulae for velocity is the same as for in (8.1) above thus V and ϴ become linear and angular velocities respectively. 3.4 Define frequency as number of revolutions or cycles per second. 3.5 State the unit of frequency as the Hertz or cycles per second. 3.6 Convert frequency to angular velocity using the formulae.	▪ Ask question on formulae of speed measurement. ▪ Work through worked examples provide student exercise and assist those needing extra help.	▪ Chalkboard, Chalk.

	W = 2 ~~n~~f Where f frequency in Hertz or cycles per second.		
12-13	3.7 Convert angular velocity to linear velocity using the formula v = wr Where r = distance from the center of rotation to a given point on the rotating body.		
1-4 5-6	3.8 Describe instruments used for speed measurement indicating the nature of speed measured. a. D.P. cell - linear velocity b. Pitot tube - linear velocity c. Anemeter - linear velocity d. Tachometer - angular speed. 3.9 Briefly discuss the application of the following speed reading instruments: a. Tachometer - speed or rotation of compressor rotors, pump shaft, turbine, etc. b. Pitot tube - velocity of aeroplane, flow of fluid in pipes etc. c. Anemometer - wind speed. d. D.P. cell - speed of flow of liquid in pipes.	▪ Display different types of instruments speed used for special measurement	▪ Various special measuring instruments
7-10	3.9 Explain the working principles and the constructional details of the speed measuring instruments named in 9.2. 3.10 Construct and calibrate the following instruments observing safety. a. Anemometer to measure gas and air b. Tachometer to measure the speed of an engine, wheel or shaft. 3.11 Dismantle and reassemble gas and air measuring devices noting the relative positions of component parts. 3.12 Read and record speed using the following instruments. a. Tachometer for angular speed b. Anemometers c. D.P. Cell d. Orifice plate. e. Venturi f. Deflecting vane	▪ Provide learner exercise on the topics	▪ Tachometer , Anamometer ▪ D.P. Cell.

	g. Rotating vane h. Float and tapered-tub meter.		
11	3.13 Finish the exercise on week 10		▪ Speed calibrator. ▪ Instrument tools
12-13	3.14 Install the speed measuring instrument. 3.15 Re-calibrate. 3.16 Mention some trouble shooting in their operation.	▪ The student should perform this task.	▪ Speedometer

EXPERIMENT

NTC INSTRUMENTS MECHANICS WORK (CIM 11)

Week	Experiment (M/P Instruments Cim 11)	Teachers/Students Activities	Resources
1-6	Dismantle different flow meters. Service them and reassemble.		
7-12	Re-calibrate the flow measuring instruments		
13-18	Strip and inspect a typical pneumatic integrator and service it		
19-24	Dismantle a mechanical integrator and service it		
25-30	Reassemble sight glass and float device and service it and reassemble.		
31-36	Construct and calibrate the following instruments: a. An ammeter to measure gas and air		
37-42	Read and record speed using the following instruments: a. Tachometer b. D.P. cell c. Orifice plate d. Venturin e. An ammeter f. Deflecting lane g. Rotating vane h. Float and tapped tub meter.		
43-48	Demonstrate how to install speed-measuring instrument.		

PROGRAMME: National Technical Certificate in Instrument Mechanics work

MODULE: CIM 12 – Electrical/Electronics Instrument I

DURATION: 180 Hours

GOAL: This module is designed to equip the trainee with the knowledge of common electrical devices and instruments found in industry with the intent to be able to install and maintain them.

GENERAL OBJECTIVES:

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

1. Know common electrical devices and measuring instruments for resistance, current and voltage.
2. Understand the composition of the resistance thermometers and apply them in experimental work.
3. Understand the working principles of the thermocouple and its applications.
4. Understand the concept of time and the working of time measuring devices.
5. Know electrical/electronic components and functional circuits.

Programme: NTC INSTRUMENT MECHANICS WORKS			
Module: ELECTRICAL/ELECTRONIC INSTRUMENT I		**Module Code: CIM 12**	**Contact Hours: 15 Hrs/Wk**
Module Specification:			
WEEK	**General Objective 1.0: Know Common Electrical/Electronic Devices And Measuring Instruments For Resistance, Current And Voltage.**		
	1.1 Describe the following electrical/electronic devices with the aid of sketches and state their uses:viz. a. Switches b. Mercury switches c. Push buttons d. Relays e. Contactors f. Fuses g. Circuit breakers. 1.2 Select and identify instruments used for measuring resistance e.g: a. Ohmmeter b. decade box c. wheatstone bridge d. megger etc.	▪ Display measuring instruments and show how they are used ▪ Ask question and answer technique to arouse the interest of the learner. ▪ Display the measuring instrument for identification.	▪ Measuring Instruments ▪ Switch, relay, fuse, circuit breaker ▪ Make available a range of electrical devices and Resistance measuring instruments.
	1.3 Explain the working principles of the resistance measuring instruments mentioned in (1.2) above with the aid of simple sketches. 1.4 Identify devices used for measuring current e.g. a. Galvanometer b. Ammeter c. (multimeter etc.) d. moving coil meter e. moving iron meters, f. digital multimeter 1.5 Explain the working principles of the current measuring devices in 1.4 above with the aid of sketches.	▪ Present a well labeled sketch of instrument in 1.3 demonstrate practically the use of the instrument listed in 1.4.	▪ Galvanometer ▪ Ammeter, Multimeter
	1.6 Identify instruments for measuring voltage e.g. a.Voltmeter b. Potentiometer	▪ Discuss various voltage measuring instruments.	▪ Voltmeter potentiometer, multimeter.

7	c.Multimeter 1.7 Explain the working principles of voltage measuring instruments named (1.6) above with the aid of simple sketches.		
8-9	1.8 Explain the following errors associated with measuring instruments: e.g. a. zero error b. parallax c. range d. hysteresis 1.9 Explain what is meant by the following terms as applied to manipulation of meter ranges: a. Shunts b. multipliers.	▪ Demonstrate using typical measuring instruments. ▪ Make available shunts and multipliers for inspection.	▪ Resistor ▪ Multimeter ▪ Voltmeter ▪ Ammeter ▪ Shunts Multipliers
11-13	1.10 State the degree of accuracy that can be measured by the resistance measuring instruments named in (1.2) 1.11 Set up given resistance measuring instruments and use them to measure resistances. NOTE: Never leave resistance measuring instruments switched when stored. Remove battery from instrument during long period of storage. 1.12 Set up given current measuring instruments and measure A-C and D-C currents. NOTE: Make sure meter is set up to the correct range before connection to circuit for measurement. 1.13 NOTE: Safety to instrument and user. i.e. care of polarity in the case of DC. NOTE: Methods of connection series or paralle.	▪ Demonstrate the use of measuring instruments in the circuits	▪ Ohmeter ▪ Ammeter ▪ Voltmeter, etc
1-2	1.13 Set up given voltage measuring instruments and measure A-C and D-C voltages. NOTE: Make sure meter is set at the correct range before Connection to circuit for measurement. 1.14 Disassemble given meter and note the relative positions of parts: NOTE: Galvanometer should never be subjected to rough handling.	▪ Set up the experiment to demonstrate the AC and DC meters	▪ DC Ammeter ▪ DC Voltage ▪ Digital Multimeter. ▪ Analogue Multimeter

	1.15 Assemble and repair simple meters taking into consideration the use of shunts and multipliers;		
	General Objectives 2.0: Understand The Composition Of The Resistance Thermometers And Apply Them In Experimental Work		
3-4	2.1 Identify the materials used for resistance thermometer e.g a. Platinum b. Nickel c. Copper etc. 2.2 Explain the relationship between temperature and resistance as applied to resistance thermometers. 2.3 State the fundamental interval and express temperature coefficient of resistance, over the interval using the formula. $\alpha = \frac{RT - Rt}{(T-t)Rt}$ α = Temperature coefficient RT = Resistance at T temperature Rt = Resistance at temperature NOTE: Simple calculation involving temperature co-efficient of resistance and fundamental interval should be treated	▪ Discuss resistance relationship with temperature and solve simple calculation.	▪ Chalk Board
5-6	2.4 Explain the working principles of the resistance thermometer. 2.5 Give the range of temperature that can be measured by a resistance thermometer. 2.6 Perform experiment to determine temperature coefficient of resistance for different metals.	▪ Laboratory experiment on the relationship of resistance to temperature.	▪ Resistance thermometer and tools.
	General Objectives 3.0: Understand The Working Principles Of The Thermocouple And Its Applications.		
	3.1 Name and identify the materials used for thermocouple e.g. a. Platinum b. Radium c. Constant d. Copper e. Nickel etc.	▪ Display thermocouple	▪ Thermocouple

8-9 10	3.2 Explain the principle of thermocouple. 3.3 Give simple explanation on the relationship between e.m.f. and temperature e.g. When two dissimilar metals are joined together and the junctions maintained at two different temperatures, e.m.f. is generated which is proportional to the difference in temperature and related to type of materials. 3.4 Give example of the combination of these materials for a thermocouple and indicate the temperature range. e.g iron - constantan radium - platinum. 3.5 Give the range of e.m.f which can be generated by a thermocouple. 3.6 Explain how the e.m.f. generated by a thermocouple can be boosted for industrial use stating the equipment used for the conversion e.g. potentiometers. 3.7 Explain the following terms as related to thermocouple. a. hot junction b. cold junction c. cold junction compensation	▪ Discuss in detail the principle, construction and application of the T/C set up apparatus for experiment.	▪ Bunsen burner multimeter
11	3.8 Perform an experiment to show the relationship between thermal e.m.f. and temperature 3.9 Explain how the variation (change) in resistance with temperature can be measured and used for indication or control purpose e.g. potentiometer.		
	General Objectives 4.0: Understand The Concept Of Time And The Working Of Time Measuring Devices.		
12-13	4.1 State the unit of time e.g. a. Micro second b. Second c. Minute d. Hour 4.2 Example the meaning of the following terms: a. On/off i.e something is on when it is engaged off when it is disengaged. b. Reset i.e reactivating of the timer from off position to on position.	▪ Use question and answer techniques and the real subject to demonstrate time varying devices.	▪ Tinner stop chalkboard ▪ Stop watches.

	c. Time delay i.e the period of disengagement between two successive periods of engagement. d. Repeat time i.e time of complete cycle of events. 4.3 Identify instruments used for the measurement of time - a. Clocks (mechanical and digital) b. Repeat timers etc. 4.4 Explain the working principles of RC timers and electronics timers. 4.5 Read and record time with given timers indicating the readings units shown on the timer. 4.6 Set timers to achieve defined objectives according to instrumentation. 4.7 Install given timers to appropriate systems. 4.8 Trouble shoot given timers to locate and rectify faults.		
	General Objective 5.0: Know Electrical/Electronic Components And Functional Circuits.		
1-3	5.1 Identify the following components and indicate their conventional symbols. a. gas filled diode b. p.n. junction c. zener diode d. silicon controlled rectifier (SCR) e. transistor f. thyristor g. uni junction transistor h. field effect transistor (FET) i. thermistor j. transformer k. inductor etc.	▪ Display various components and discuss the function of each.	▪ Transistor theodes ▪ Indicator
4-6	5.2 State the functions of each of the components in 5.1 5.3 Explain the principle of operation and state the basic application of each of the components listed in (5.1) above. 5.4 Explain the function of a rectifier circuit. 5.5 Draw labelled schematic diagrams of the following rectifier circuits: a. half wave b. full wave	▪ Arrange for practical application on construction and operation ▪ Student must participate in this task.	▪ Indicator ▪ Resistor, diodes.

	c. bridge rectifier. d. Pn junction diode 5.6 Outline the merits of the rectifier circuits listed in (5.5) Above		
7-8	5.7 Explain the purpose of filter circuit in power supply. 5.8 Draw labeled schematic diagrams of filter circuits and explain their principles of operation. 5.9 Explain the purpose of voltage stabilization in power supplies. 5.10Draw a labeled schematic diagram of simple stabilized power supply circuit incorporating a zener diode or gas filled diode.	▪ Draw power supply ▪ Circuit with filter and explain how it operates ▪ Demonstrate stablization principles	▪ Chalk Board
9-10	5.11 Construct a power supply unit incorporating the following: a. transformer b. bridge rectifier c. L.C. filter circuit d. Zener diode.	▪ Building the power supply unit for the learning arouse their interest. ▪ Note: Safety to learner. Capacitor component should be connected with care of polarity.	▪ Transformer, oscilloscope diodes, zener diode. ▪ Capacitor
11	5.12 Check the voltage wave forms with the aid of oscilloscope at the following stages: a. Primary tappings of the transformer b. Secondary tappings of the transformer. c. Input of the rectifier d. Output of the filter e. Across the zener diode. NOTE: Different values of L and C can be replaced in the filter circuit to observe the variation in smoothing effects.	▪ Set up and explain by using oscilloscope and power supply to show wave forms and various points in the circuit	▪ Power supply unit ▪ Oscilloscope
12-13	5.13 Trouble shoot and rectify faults in a given power supply. 5.14 Check the physical conditions of components listed in (5.1 with appropriate instruments. 5.15 List necessary precautions to be taken during construction and repair to avoid damage to the components listed in (5.1)	▪ Create different faults for learners to identify.	▪ Power supply unit ▪ Oscilloscope

EXPERIMENT

NTC INSTRUMENTS MECHANICS WORK (CIM 12)

Week	Experiment (Electrical/Electronics Instruments I Cim 12)	Teachers/Students Activities	Resources
1-2	(1) Set-up given voltage measuring instruments and measure AC and DC voltages.		
3-4	Perform an experiment to show the relationship between thermal emf and temperature.		
5-6	Read and record time with given timers indicating the recordings units shown on the timer		
7-10	Construct a power supply unit using the following components: a. Transformer b. Bridge rectifier c. Instructive filter d. Capacitive filter e. Zener diode.		
11-12	Trouble shoot the power supply in (d) above and rectify faults.		
	Demonstrate the use of oscilloscope for measuring frequency AC and DC voltages.		

PROGRAMME: National Technical Certificate in Instrument Mechanics Works.

MODULE: CIM 13 – Electrical/Electronic Instruments II

DURATION: 252 Hours

GOAL: This module is designed to equip the trainee with the knowledge and skill to install, service and maintain other electrical/electronic instruments such as power and energy, frequency, level and speed devices, including electronic amplifiers/trained users as well.

GENERAL OBJECTIVES:

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

1. Understand the working principles of power and energy measuring instruments.
2. Know frequency meaning/indicating instruments
3. Understand the concept of electrical/electronic level measuring devices.
4. Understand the concept of speed measuring devices.
5. Know the working principles of electronic amplifiers
6. Know the working principles of electrical/electronics transducers
7. Know the working principles of electromagnetic solenoid.

Programme: : NTC INSTRUMENT MECHANICS WORKS			
Module: ELECTRICAL/ELECTRONIC INSTRUMENTS II		**Module Code: CIM 13**	**Contact Hours: 20 Hrs/Wk**
Module Specification:			
WEEK	**General Objective 1.0: Understand the working principles of power and energy measuring instruments.**		
	Specific Learning Objective:	**Teacher Activities:**	**Learning Resources:**
1-7	1.1 Identify the instruments used for the measurement of power and energy e.g. a. Wattmeter b. Watt hour demand meter. 1.2 Explain the working principles of the A.C. and D.C. wattmeters in terms of the following: a. kilo watt hour b. demand meters. 1.3. Distinguish between the A.C and D.C. wattmeters in terms of the following a. working principles b. construction. 1.4 Read and record powers and energy from appropriate meters. NOTE: Power and energy meters should be protected from atmosphere effects.	▪ Discuss the difference in operation in AC and DC. ▪ Display the meters for the learners.	▪ Watt meter ▪ Kilo watt ▪ Energy meter
	General Objective 2.0: Know Frequency Measuring/Indicating Instruments.		
8-13	2.1 Explain the function of a signal generator. 2.2 Explain the working principles of a signal generator. 2.3 Use signal generator to produce wave-forms and display the wave-forms on the oscilloscope.	▪ Use question techniques to describe working principle of signal generator. ▪ Set up the oscilloscope with the signal generator for operation.	▪ Signal generator ▪ Oscilloscope
1-7	2.4 Define the following terms: a. Frequency b. wavelength c. pitch d. period e. amplitude f. resonance g. bandwidth		

	2.5 Perform simple calculations involving frequency, wavelength, amplitude, resonance, etc. 2.6 Identify instruments used for measurement of frequency e.g oscilloscope, frequency meter. 2.7 Explain the working principles of the cathode ray tube with the aid of sketches. 2.8 Explain the working principles of the oscilloscope with the aid of labeled sketches.		▪ Oscilloscope.
8-13	2.9 Use the oscilloscope for the display of wave-forms NOTE: Oscilloscope carries very high voltages and therefore should be handled with necessary precaution. 2.10 Apply the oscilloscope for the measurement of the following: a. frequency b. amplitude etc. 2.11 Calculate the following from the results obtained in the wave-form measurement in (2.10) above. a. rms voltage b. average value c. period. 2.12 Use frequency meter to measure frequency of waveform and compare with the result obtained from the oscilloscope.	▪ Stress the necessary safety precaution in handling oscilloscope. ▪ Illustrate 2.11 on the chalkboard.	▪ Oscilloscope frequency meter.
	General Objective 3.0: Understand The Concept Of Electrical/ Electronic Level Measuring Devices.		
1-8	3.1 Identify electrical/electronic instruments used for level measurement e.g a. capacitance probe b. resistive probe c. electronic D.P. cell d. load cells. 3.2 Describe the working principles of the level measuring instrument by: a. disassembling and cleaning the parts b. reassembling and calibrating the instruments.	▪ Discuss the working principle, dismantle and assemble level measuring devices.	▪ Capacitor probe level meter DP. Cel.
	General Objective 4.0: Understand The Concept Of Speed Measuring Devices.		
	4.1 Identify electrical/electronic instrument used for speed measurement i.e voltage responsive tachometer. 4.2 Explain the working princple of the voltage responsive	▪ Provide the real object for demonstration.	▪ Tachometer

9-10	tachometer. 4.3 Use voltage responsive tachometer to measure speed.		
	General Objective 5.0: Know The Working Principles Of Electronics Amplifiers.		
11-13	5.1 Draw labeled schematic diagrams of simple amplifier circuit using: a. Transistor Configuration , common base, common emitter, common collector. b. transistors (PNP, NPN). 5.2 Explain the functions of the component parts of the amplifiers in (5.1) above. 5.3 Explain the principle in (5.1) above. 5.4 Construct simple amplifiers given the circuit diagrams. 5.5 Feed in signal into an amplifier with a signal generator and monitor the output with an oscilloscope.	▪ Show well labeled diagram for amplifier circuit. Carry out practical demonstration. ▪ Transistor configuration CC, CB, CE. ▪ Arrange different components of the amplifier and guide the leaners.	▪ Electronic amplifier. ▪ Multimeter ▪ Amplifier circuit.
1-4	5.6 Compare the input signal in (5.5) with the output signal and determine the gain of the amplifier. NOTE: Gain = Output Voltage / Input Voltage. 5.7Measure voltages at various points of a given amplifier and record the readings. 5.7 Test the amplifier given in (5.7) above for proper operation by feeding a signal into it and observing the output voltage. 5.8 Enumerate and describe the characteristics of the following types of amplifiers and state their uses e.g. a. audio amplifiers. b. power amplifiers. c. Operational amplifiers.	▪ Set the signal to show different characteristics of the amplifier bring out the difference in amplifier listed in 5.9.	▪ Audio power and Operation amplifier.
	General Objective 6.0: Know The Working Principle Of Electrical/Electronics Transducers.		
5-8	6.1 Explain the function of electrical/electronic transducers. 6.2 Name and identify the following types of transducers and state their application: a. voltage to pressure (E/P) b. Pressure to current (P/I), Voltage to current (E/I)	▪ Carry out demonstration to name and identify the various transducers mentioned.	▪ Transducers.
	6.3 State the standard range of variables in the transducers named in (6.2) above. a. E/Pv – 10v/0.2kg/cm2-1kg/cm2	▪ Discuss the operating principle and units of measurement and students should be engaged in	▪ Transducers.

9	b. I/P 4mA-20mA/0.2kg/cm2-cm2-1kgcm2 c. E/I 0-10v-/4mA-20mA. 6.4 Explain the principle of operation of each of the transducers in 6.2	the practical examples.	
	General Objective 7.0: Know The Working Principles Of Electromagnetic Solenoid.		
10-12	7.1 Explain the principle of operation of electro-magnetic solenoid with the aid of sketches. 7.2 Give examples of the use of solenoid in instrumentation e.g. a. opening and closing of solenoid valves. b. Control valves. c. Control of power cylinders etc.	▪ Set up practical demonstration of electro-magnetic solenoid effect.	▪ Electro-magnetic solenoid
13	7.3 State the importance of electro-magnetic principle in Electrical/Electronic Instruments.	▪ Use questions and answers techniques to explain its importance.	

EXPERIMENT

NTC INSTRUMENTS MECHANICS WORK (CIM 13)

Week	Experiment (Electrical/Electronics Instruments Ii Cim 13)	Teachers/Students Activities	Resources
Term 1	Read and record powers and energy from appropriate meters		
Term 2	Demonstrate signal generators to produce wave forms and display the wave form on the oscilloscope.		
Term 3	Demonstrate how to use frequency meter to measure frequency of wave forms and compare with the result obtained from the oscilloscope.		
Term 4	Demonstrate how to use voltage responsive tachometer to measure speed.		
Term 5	Construct simple amplifiers given the circuit diagram. Feed signal into an amplifier with signal generator and monitor the impact on oscilloscope. Compare output/input signal and hence measure the gains.		

PROGRAMME: National Technical Certificate in Instrument Mechanics Works.

MODULE: CIM 14 – Automatic Controls

DURATION: 420 Hours

GOAL: This module is designed to equip the trainee with the knowledge and competence to man automatic control systems found in various industries.

GENERAL OBJECTIVES

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

1. 1.Know common terminologies used in automatic controls and demonstrate control modes by use of rings.
2. 2.Understand the application of control action.
3. 3.Understand the use of and carry out repairs on control elements and systems.
4. 4.Understand simple electronic control circuits by the use of binary number.

Programme: NTC INSTRUMENT MECHANICS			
Module: AUTOMATIC CONTROLS		**Module Code: CIM 14**	**Contact Hours: 35 Hrs/Wk**
Module Specification:			
WEEK	**General Objective 1.0: Know Common Terminologies Used In Automatic Controls And Demonstrate Control Modes By Use Of Rings.**		
1-13	1.1 Explain the meaning of the following terms used in automatic Controls with suitable sketches: a. control b. regulate c. signal d. feedback e. feed forward action f. primary element g. final control element h. on/off control i. loop (open and closed) j. input k. output l. process m. response n. deviation o. set point p. lag q. process lag r. distance velocity lag s. oscillation t. transfer lag u. proportional band v. motor element w. air to open – reverse action x. air to close – direct action	▪ Give thorough explanation on the purpose and use of the control terms.	▪ Control transmiters ▪ Controllers
1-3	1.2 Describe the following modes of control with suitable diagrams: a. open loop b. close loop	▪ Give thorough explanation and demonstrate the use of the loops	▪ Controller

	c. two step control. d. Multistep control e. Cascade control.		
4-6	1.3 Describe the following control action draw suitable diagrams and explain the mode of operation. a. Proportional action (P) b. Integral action (Reset) (I) c. Derivation action (Rate) (D) d. P + I e. P + I + D	▪ Show the sketchs explain the operation and identity each components of the instruments.	▪ Chalk Board
7-9	1.4 Use rigs to demonstrate each of the control modes described in (1.2) above taking note of the differences between the individual modes.	▪ Give practical demonstration of the use of the rigs.	▪ ▪ Rigs
10-13	1.5 Define deviation as (Po – Pi) i.e the change in output (Po) minus the change in input (Pi). 1.6 State the equation for proportional control action i.e Po = Kd where Po is the change in output d is the deviation K is a factor = Po/d 1.7 Draw graphs to show the relationship between output (Po) and deviation (d).	▪ Work through work examples on proportional control action.	▪ Graph book ▪ Chalkboad.
	General Objective 2.0: Understand the application of control action.		
1-5	2.1 Explain what is meant by integral action 2.2 Draw graphs to show the effect of integral action when used in conjunction with proportional control action. 2.3 Use rigs to demonstrate the control actions described in (1.3) above 2.4 Explain the conditions in a control system which will necessitate the use of each of the control actions described in (1.3) above.	▪ Demonstrate with the aid of graphs the various action	▪ Chalk Board
	General Objective 3.0: Understand The Use And Carry Out Repairs On Control Elements.		
6-8	3.1 Describe and identify the following control elements and explain the principle of operation. a. flapper and nozzle arrangement b. relay (Non bleed and continuous bleed)	▪ Discuss various control elements with diagrams.	▪ Simple transmitter.

	c. feed back bellows. d. Restrictor e. Amplifier f. Transducer g. Converter h. Control valves (pneumatic & electronic) i. Receivers (pneumatic & electronic) j. Recorders.	▪ Give example of their applications	▪ Transducer (P/I) ▪ Control Valve Recorder.
9-13	3.2 Sketch, label parts and explain the operation of the following control elements and state their functions in control system. elements listed in (3.1) above for the control of the following: a. flapper and nozzle transmitter. b. Pneumatic relay or amplifier	▪ Supply full explanation on the control elements their functions and mode of control	▪ Pneumatic Relay. ▪ Power cylinder ▪ Pneumatic transmitter.
1-2	a. Reset below b. Integral restriction c. Pneumatic control valve d. Valve positioner e. Power cylinders, f. Pneumatic transmitter		
3-6	4 Set up control loops involving the use of some of the control elements listed in (3.1) above for the control of the following. a. temperature b. flow c. level d. pressure e. speed NOTE: Control loops should include pneumatic and electronic elements.	▪ Give practical analysis of the variables in control system. Assist learner in the exercise.	▪ Workshop Practical experience.
7-8	4.1 Calibrate the following control elements; a. Transmitters (Pneumatic & electronic) b. Receivers c. Recorders d. Power cylinders e. Manual/Auto loading stations. NOTE: Necessary safety precautions should be observed	▪ Practical demonstration of the instruments in laboratory	▪ Calibration rigs

	4.2 Carry out repairs on the following taking into consideration the safety precautions involved.		
	General Objective 4.0: Understand Simple Electronic Control Circuit By The Use Of Binary Number.		
9-10	4.1 Explain the basic principles of design of simple electronic circuits e.g simple amplifier circuit Alarm system.	▪ Give basic principles of design of simple electronic circuits.	▪ Amplifier circuit
	4.2 Explain the application of various simple electronic circuits.	▪ Give explanation on operation and application in control system.	▪ Alarm circuit.
11	4.3 Explain the use of binary number in electronic circuits.	▪ Give explanation on the use of binary number.	▪ Integrated circuit (IC)
12-13	4.4 Identify simple logic circuit: a. AND b. OR c. NOR	▪ Explain the principle of logic circuit ▪ Recognise the use of logic circuit ▪ Using IC, logic gates, students are to set up a range of exercises to illustrate AND, OR, NOR, NAND functions.	▪ Integrated circuit.

EXPERIMENT

NTC INSTRUMENTS MECHANICS WORK (CIM 14)

Week	Experiment (Automatic Controls Cim 14)	Teachers/Students Activities	Resources
Term 1	Set up control lamps involving the use of the control elements (Reset below, integration restriction Pneumatic control valve, valve positioner, power cylinder Pneumatic transmitter) for the control of the following: a. temperature b. flow c. level d. pressure e. speed		
Term 2	Use rigs to demonstrate each of the control modes in: a. Open lamp b. Close lamp c. Two stop control d. Multi stap control e. Cascade control.		
Term 3	Set up control lamps involving the use of control lamps in (2) above for the control of the following: a. temperature b. flow c. level d. pressure e. speed		
Term 4	Calibrate the following control elements: a. transmitters (Pneumatic and electronic) b. Receivers c. renovators d. .power cylinder e. manual/auto loading stations		
Term 5	Perform experiments to measure turbidity with turbidity meter.		

PROGRAMME: National Technical Certificate in Instrument Mechanics work.

MODULE: CIM 15 – Laboratory/Process Analytical Instrument.

DURATION: 144 Hours

GOAL: This module is designed to equip the trainee with the competence in the use of given laboratory/processes analytical instruments with a view to be able to maintain the instruments effectively.

General Objective:

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

1. Understand and measure PH values with the PH meters.
2. Understand and measure humidity with the hygrometer
3. Understand and measure viscosity with the viscometer
4. Understand the nature of colour in liquids and be able to apply the tintometer to measure colour.
5. Know and apply the instruments used for gas detection.
6. Understand the working of instrument used for liquid separation.
7. Know and use instrument for measuring tibidity.

Programme: INSTRUMENT MECHANICS WORKS			
Module: LABORATORY/PROCESS ANALYTICAL INSTRUMENTS		**Module Code: CIM 15**	**Contact Hours: 12 Hrs/wk**
Module Specification:			
WEEK	**General Objective 1.0: Understand and measure PH values with the PH meters.**		
	Specific Learning Objective:	**Teacher Activities:**	**Learning Resources:**
1- 7	1.1 Give a qualitative definition of P^H. 1.2 State the P^H values of neutral liquid i.e (P^H 7) 1.3 State values for alkalinity and acidity with references to the neutral point. 1.4 Describe the instrument used for the measurement of P^H value with the aid of labeled sketches. E.g P^H meters. 1.5 Measure P^H values of different solutions with the aid of P^H meter. 1.6 Service a P^H meter by cleaning, changing of probes and replacing the fuse.	▪ Discuss the operation of the P^H meters. ▪ Use laboratory experiment to distinguish between alkalinity and acidity.	▪ P^H Meter acid alkaline beaker lab work sheet.
	General Objective 2.0: Understand And Measure Humidity With The Hygrometer.		
8-13	2.1 Define a. Relative humidity b. Humidity ratio or specific humidity. 2.2 Give the unit of humidity as: a. Percentage of humidity b. Kilogram moisture per kilogram air. 2.3 Describe instruments used for measuring humidity. e.g wet and dry bulb hygrometer hair hygrometer etc. 2.4 Measure the relative humidity of the process air in the laboratory with the aid of hygrometer and record the readings.	▪ Make hygrometer available to the learner. ▪ Discuss effect of humidity on measurement. ▪ Provide learners exercises on maintenance of the instrument.	▪ Hygrometer
	General Objective 3.0: Understand And Measure Viscosity With The Viscometer		
1-2	3.1 Define viscosity 3.2 Give the unit of measurement of viscosity i.e. Red Wood seconds. 3.3 Name, describe and identify the instruments used for the measurement of viscosity i.e viscometer.	▪ Explain viscosity and discuss the principle.	

3-6	3.4 Measure the viscosity of the following liquids and record the readings. a. water b. oil c. lubricating oil d. fuel oil etc.	▪ Demonstrate the action using viscometer involve learner in the activities.	▪ Viscometer liquid.
	General Objective 4.0: Understand The Nature Of Colour In Liquids And Be Able To Apply The Tintometer To Measure Colour.		
7-9	4.1 Explain colour in liquids. 4.2 Name, describe and identify the instrument used for measuring coloured liquid e.g. tintometer. 4.3 Measure colour in liquids with the aid of the tintometer and record the readings	▪ Show different colours of liquid, identify, and use tintometer to measure.	▪ Liquid ▪ tintometer
	General Objective 5.0: Know And Apply The Instruments Used For Gas Detection		
10-11	5.1 Name, describe and identify the following instruments used for detection of presence of gases: e.g a. carbon dioside analyzer b. oxygen analyzer c. chlorine analyzer, etc.	▪ Display different types of analysers and identify each	▪ Different Analyser
12-13	5.2 Use gas analysers to detect the presence of gases. 5.3 Describe the instruments for detecting radio active follouts: - Geiger counter.	▪ Demonstrate the use of gas analysers. Provide learners exercises	
1-3	5.4 Carry out proper care and maintenance of the analytical instruments named above.	▪ Demonstrate the practical analysis of the instrument. ▪ Present the real.	
	General Objective 6.0: Understand The Working Of Instrument Used For Liquid Separation Year 3, Term 3 Contact Hour: 1-3		
4-6	6.1 Explain the principles of liquid separation as applied to centrifuges. 6.2 Separate mixture of liquid in their separate components using a centrifuge. 6.3 Maintain and care for centrifuge.	▪ Instrument discussion and practical.	▪ Centrifuges liquid
	General Objective 7.0: Know And Use Instrument For Measuring Turbidity.		
7-9	7.1 Define turgidity. 7.2 Measure turbidity with turbidity meter. 7.4 Maintain and care for turbidity meter.	▪ Discuss the operation and practical applications	

10-13	7.5 Students should be made aware that many open and close loop process control functions can be managed by Programmable Logic Control PLC control systems.	▪ Refer to manufacturer's data manuals for range of options available. ▪ If possible arrange a visit to an industrial site to inspect a PLC Control System.	▪ Manufacturers data ▪ PLC System.

EXPERIMENT

NTC INSTRUMENTS MECHANICS WORK (CIM 15)

Week	Experiment (Laboratory/Processing Analytical Instruments Cim 15)	Teachers/Students Activities	Resources
Term 1	Service a P^h by cleaning, changing of probes and replaceing the fuse. Perform experiment to measure the relative humidity of the process air in the laboratory with the aid of hygrometer and recover the readings.		
Term 2	Perform experiment to measure the viscosity of the following liquids and recover their readings: a. water b. ii lubricating oil c. iii fuel oil		
Term 3	Perform experiments to measure colour in liquids with the aid of the trio meter and record the readings.		
Term 4	Perform experiments to show how to use gas analyzer to detect the process of gasses.		
Term 5	Perform experiments to separate mixture of liquids in their separate colours using a centrifugal..		

NATIONAL TECHNICAL CERTIFICATE AND ADVANCED NATIONAL TECHNICAL CERTIFICATE

GUIDELINES FOR TEXT BOOK 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 word'
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/REFERENCES

Instrument Technology 1-4
B.E. Noltingle (ed) (1989)
Butterworths, London.

LIST OF LABORATORIES

1. Physic Lab
2. Chemistry Lab
3. Instrument Mechanics Workshop
4. Metal Workshop

INSTRUMENT MECHANICS WORKS

INSTRUMENT MECHANICS WORKS

	Description of Items	**Minimum Quantity Required**
1.	Bourdon tube Pressure gauge C-tube Spiral Helical	 10 10 5
2.	Barometer	2
3.	Manometers	10
4.	Compound Gauge	5
5.	Bellows Gauge	5
6.	Diaphragm Gauge	5
7.	Dead Weight Tester	1
8.	Differential Pressure flow bench with accessories	1
9.	Venturi tube	5
10.	Orifice Plate	5
11.	Dall Plate	2
12.	Flow pipe 12-5mm, 025mm x 300mm	10
13.	Water Meter a. Reciprocating b. Rotating Piston c. Rotating Vane	 2 2 2
14.	Float Device	1 2
15.	Meter Prover	5
16	Rotameter	5
17.	Level Gauge	2
18.	Sight glass level indicator	5
19.	Dip Stick	1
20	500 gral. Water tank	1
21.	250 gal. Water tank	1

22.	Taps (Isolating valve)	30
23.	Capacitance Probe	20
24.	Resistive Probe	20
25.	Flow transmitter (Voltage/Current Variant)	1
26.	Level Transmitter	1
27.	Content Gauge	1
28.	Glass thermometer	20
29.	Chemical thermometer	10
30	Resistance thermometer	3
31.	Solid Expansion thermometer	1
32	Thermocouple meter	2
33.	Workshop table furnace	1
34.	Temperature Sensitive Grayon	10
35.	Thermocouple elements	10
36.	Gas burner	2
37.	Workshop Refrigerator	1
38.	Electrical switches (assorted)	20
39.	Mercury switch	20
40.	Push button	20
41.	Electrical relay	5
42.	Electrical fuse	10
43.	Circuit breaker, (current ratings) 2A 5A	5
44.	Ohmmeter	10
45.	Decade box	5
46.	Wheatstone bridge	5
47	Megger	2
48.	Galvanometer	5
49.	Ammeter	10
50.	Voltmeter	10
51.	Potentiometer	10
52	Multimeter	5
53.	Avometer	5
54.	Valve voltmeter	1
55.	Oscilloscope	2

56.	Timers	5
57.	Stop clock/watches	5
58.	Transformer (assorted)	10
59.	Tachometer	2
60	Power supply	2
61.	Wattmeter (AC/DC)	5
62.	Frequency meter	1
63.	Rectifier circuit	2
64.	Voltage stabilizer	2
65.	Pressure to current transducer	1
66.	Voltage to current transducer	1
67.	Pneumatic control valve	1
68	Electrical solenoid valve	5
69	Power cylinder	1
70	Pneumetic transmitter	1
71	2-term controller	1
72	3-term controller	1
73	P_H metter	5
74.	Air Hygrometer	2
75.	Wet and dry bulb hygrometer	2
76.	Viscometer	2
77.	Tintometer	2
78.	Gas analyzer	2
79.	Centrifuge	2
80.	Turbidity meter	2
81.	General Purpose Transistors, NPN, PNP Silicon type	12
82.	PN Junction diodes, Silicon type	12
83.	Resistors various values, $\frac{1}{2}$ Watt, 1 Watt	24

Materials & Tools		Minimum Quantity Required
	Tool box	20
	Electric soldering iron 60w, 100w	20
	Flexible wire	20 reels
	Electric cable (3029)	20 reels
	Hammer (20-25kg)	20
	Screwdriver Tester	20
	Clock screw driver	20
	Long nose plier	10
	Combination plier	10
	Small hacksaw frame/blade	10
	Big hacksaw frame/blade	
	Warding file (1 pack)	10
	Pipe wrench (assorted)	3
	Mallets (rubber, raw hide)	10
	Soldering lead	10 real

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

PROJECT TEAM MEMBERS

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2	Dr. M.S. Abubakar	Technical Coordinator
3	Engr. S.C. Odumah	Curriculum Development Coordinator
4	Mr. B.N. Niriyus	Staff Development Coordinator
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6	Isa Alhaji Sulaimanu	Project Accountant
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