FEDERAL MINISTRY OF EDUCATION

National Technical Certificate (NTC) Curriculum in

AUTOTRONIC GAS POWERED VEHICLE

February, 2025

Innovation Development and Effectiveness in the Acquisition of Skills (IDEAS) Project

Funded by IDEAS project

NATIONAL BOARD FOR TECHNICAL EDUCATION
Plot B, Bida Road, P.M.B. 2239, Kaduna, Nigeria

NATIONAL TECHNICAL CERTIFICATE

CURRICULUM AND MOUDULE SPECIFICATIONS IN

AUTOTRONIC GAS POWERED VEHICLE

2025

`

GENERAL INFORMATION

AIM

To give training and impact the necessary skills leading to the production of skilled personnel that can fit into the Autotronic sector as craftsmen and self-reliant entrepreneurs.

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 certificate 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 the College production unit is compulsory for the full-time students.

Included in the curriculum are 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 course/ module 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 in the curriculum. They are:

a. General Objectives
b. Specific Learning Outcomes

General objectives ensures that students acquire the necessary theoretical and practical skills to become skilled technicians or self-employed entrepreneurs in the field of Automotive Mechatronics and Gas-Powered Vehicles.

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 knowledge in critical subjects like English Language, Mathematics, Physics, Chemistry, Computer studies, Technical Drawing etc. to enhance the understanding of machines, tools and materials of their trades and their application 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 Universities, Polytechnics or Colleges of Education (Technical) for degree, 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 N.B.T.E.
NABTEB conducts the final nnational 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.	NTC	National Technical Certificate
2.	ANTC	Advanced National Technical Certificate

Guidance Notes for Teacher implementing 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 goals and objectives of each module are achieved at the end of the term.

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

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

`

INTEGRATED APPROACH IN THE TEACHING 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

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 all 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.

`

Table of Contents

CURRICULUM TABLE AND COURSE HOURS/WEEK PROGRAMME: NATIONAL TECHNICAL CERTIFICATE	8
MODULE: Introduction to Gas Powered Vehicles I	9
MODULE: Introduction to Gas Powered Vehicle II	13
MODULE: GAS POWERED VEHICLE (GPV) CONVERSION COMPONENTS	17
MODULE: GPV CONVERSION COMPONENTS	18
MODULE: GPV LAYOUT DESIGN	21
MODULE: GPV KITS & SAFE FUELING SYSTEM INSTALLATION	26
MODULE: CNG CALIBRATION	32
MODULE: CNG MAINTENANCE	38
MINIMUM TOOLS, EQUIPMENT, AND MATERIALS LIST	45
PRACTICAL MANUAL	47
LIST OF BOOKS	51
LIST OF JOURNALS	51
LIST OF PARTICIPANTS	52

`

PROGRAMME:

NATIONAL TECHNICAL CERTIFICATE IN AUTOTRONIC GAS-POWERED VEHICLE

GOAL: The Autotronic Gas-Powered Vehicle Programme is intended to produce a mechanic who should be able to Convert Petrol/Diesel Engine Vehicle into Gas Powered Vehicle, diagnose faults, carry out repairs and maintenance of GPV, the students should also have an in-depth theoretical and practical knowledge of its operations.

OBJECTIVES:

- Identify different types of motor vehicles.
- Classify different auto gases such as Compressed Natural Gas (CNG), Liquefied Petroleum Gas (LPG), and Liquefied Natural Gas (LNG).
- Identify key components of a CNG conversion kit.
- Identify different types of conversion kits (Venturi Kits, Sequential Injection Kits, Open-Loop System, Closed-Loop System).
- Support in assessment of vehicles for suitability for conversion to CNG.
- Assist in installation of conversion components, including gas injectors, reducers, and regulators.
- Identify safety procedures for handling, installing, and maintaining CNG systems.
- Support in leak detection and pressure tests to ensure safe operations.
- Follow regulatory and industry standards for CNG-powered vehicles.
- Interpret GPV system diagrams and schematics.
    - Support in planning a conversion layout, ensuring proper placement of key components.
    - Assist in connecting gas supply lines, fuel injectors, and ECU systems for efficient performance.
    - Use software and tools for ECU calibration.
    - Assist in diagnostics and troubleshooting using OBD-II scanners and calibration software.
    - Assist in routine maintenance on converted gas-powered vehicles.
    - Repair faults in fuel injectors, gas regulators, and safety valves.
    - Replace faulty components and ensure system efficiency.
    - Identify key electronic control units (ECU) used in CNG conversion.
    - Support in configure electrical wiring and sensor systems for gas-powered vehicles.
    - Perform electrical troubleshooting and repairs.

`

CURRICULUM TABLE AND COURSE HOURS/WEEK PROGRAMME: NATIONAL TECHNICAL CERTIFICATE

Module Code	MODULE	YEAR I						YEAR 2						YEAR 3						TOTAL HOURS
		Term 1		Term 2		Term 3		Term 1		Term 2		Term3		Term 1		Term 2		Term 3		
		T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	
CAM 12 - 15	Mathematics	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	216
CEN 11 - 17	English	2	-	2	-	2	-	3	-	3	-	3	-	3	-	3	-	3	-	360
CPH 10 - 12	Physics	2	-	2	-	2	-	2	1	2	1	2	1	2	1	2	1	2	1	288
CCH 10 - 12	Chemistry	2	-	2	-	2	-	2	1	2	1	2	1	2	1	2	1	2	1	288
CEC 11 - 13	Economics	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	216
CBM 11	Entrepreneurship	-	-	-	-	-	-	2	-	2	-	2	-	-	-	-	-	-	-	72
ICT 11 - 15	Computer Studies	-	-	-	-	-	-	1	2	1	2	1	2	1	2	1	2	-	-	180
CTD 11 - 13	Drawings	-	3	-	3	-	3	-	3	-	3	-	2	-	2	-	2	-	2	276
CME11	General Metal Work I	3	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	84
CME12	General Metal Work II	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-	60
CMV11	Petrol Engine Maint.	-	-	-	-	-	-	2	6	2	6	-	-	-	-	-	-	-	-	192
CMV16	Diesel Engine Maint.	-	-	-	-	-	-	-	-	-	-	-	-	2	6	2	6	-	-	192
CMV16	Auto Elect/Electronic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	6	96
CAP111	Introduction to GPV System I	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60
CAP122	Introduction to GPV System II	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60
CAP133	GPV Conversion Components	-	-	-	-	3	6	-	-	-	-	-	-	-	-	-	-	-	-	108
CAP 213	GPV Layout Design	-	-	-	-	-	-	3	6	-	-	-	-	-	-	-	-	-	-	108
CAP234	GPV Kits & Fuelling System Installation	-	-	-	-	-	-	-	-	3	6	-	-	-	-	-	-	-	-	108
CAP235	GVP CNG Calibration	-	-	-	-	-	-	-	-	-	-	3	6	-	-	-	-	-	-	108
CAP316	GPV Maintenance	-	-	-	-	-	-	-	-	-	-	-	-	3	6	-	-	-	-	108
	Total	15	10	12	6	13	9	21	22	19	19	17	12	17	18	14	12	13	10	**3108**

`

PROGRAMME: NATIONAL TECHN4ICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE			
MODULE: Introduction to Gas Powered Vehicles I		**COURSE CODE:** CAP111	**CONTACT HOURS: 60 HRS**
YEAR: 1	**TERM:** 1	**PRE: REQUISITE:**	**Theoretical:** 24 Hours **Practical:** 36 Hours
GOAL: This module is designed to give student the knowledge required to understand the working principles of a gas powered vehicles			

GENERAL OBJECTIVES: On completion of this module, the student should be able to:

1. Understand Motor Vehicle
2. Understand Auto gases
3. Understand compressed natural gas (CNG).
4. Understand CNG Conversion Kits

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

1. Identify Motor Vehicles
2. Identify Auto gases
3. Identify key components of CNG conversion kits

`

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE						
MODULE: Introduction to Gas Powered Vehicle I				**COURSE CODE: CAP111**		**CONTACT HOURS: 60HRS**
YEAR: 1	**TERM:** 1	**PRE: REQUISITE:**		**Theoretical:** 36 Hours **Practical:** 48 Hours		
GOAL: This module is designed to equip the student with the knowledge and skill required to understand the working principle of gas powered Vehicles						
Theoretical Content				**Practical Content**		
GENERAL OBJECTIVE 1.0: Understand Motor Vehicle						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
1-2	1.1 Define Motor vehicle	Describe Motor Vehicle	Board, Charts, Pictures	Identify Motor Vehicle	Guide students to identify Motor vehicle	Vehicles
	1.2 List types of Motor Vehicle	Discuss types of Motor Vehicle	Board, Charts, Pictures	Identify types Motor Vehicle	Guide students to identify types Motor vehicle	Vehicles
	1.3 Explain vehicles based on fuel powered • Petrol • Diesel • Compressed Natural Gas • Electric • Etc	Discuss vehicles based on fuel powered • Petrol • Diesel • Compressed Natural Gas • Electric Etc	Board, Charts, Pictures, Video	Identify vehicles based on fuel powered • Petrol • Diesel • Compressed natural gas • Electric Etc	Guide students Identify vehicles based on fuel powered • Petrol • Diesel • Compressed natural gas • Electric Etc	Vehicles
GENERAL OBJECTIVE 2.0: Understand Auto Gases						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
3-4	2.1 Define Auto Gases	Explain Auto Gases				

`

	2.2 List types of Auto Gases • Compressed Natural Gas (CNG) • Liquefied Petroleum Gas (LPG) • Liquefied Natural Gas (LNG)	Explain types of Auto Gases • Compressed Natural Gas (CNG) • Liquefied Petroleum Gas (LPG) • Liquefied Natural Gas (LNG)	Board, Diagrams, Charts, Text books and Images	Identify Auto Gases	Guide students to identify Auto gases	CNG LPG LNG
	2.3 Explain the characteristic of the following gases • Compressed Natural Gas (CNG) • Liquefied Petroleum Gas (LPG) • Liquefied Natural Gas (LNG)	Discuss the characteristic of the following gases • Compressed Natural Gas (CNG) • Liquefied Petroleum Gas (LPG) • Liquefied Natural Gas (LNG)	Board, Diagrams, Charts, Text books and Images			
GENERAL OBJECTIVE 3.0: Understand compressed natural gas (CNG).						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
5-6	3.1 Define compressed natural gas (CNG).	Discuss the compressed natural gas (CNG).	Board, Charts, Pictures			
	3.2 List different type of compressed natural gas (CNG).	Discuss type of compressed natural gas (CNG).	Board, Diagrams, Charts, Text books and Images			
	3.3 Explain the properties of CNG	Discuss the properties of CNG	Board, Diagrams, Charts, Text books and Images			

`

	3.4 Define Methane CH4 composition and storage	Explain Methane CH4 composition and storage	Board, Text books			
GENERAL OBJECTIVE 4.0: Understand CNG Conversion Kit						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
7-9	4.1 Define conversion kits	Discuss conversion kits	Board, Diagrams, Charts, Text books and Images			
	4.2 Explain different type conversion kits: • Venturi Kits • Sequential injection kits • Open-Loop system • Closed-loop system	different type conversion kits • Venturi Kits • Sequential injection kits • Open-Loop system • Closed-loop system	Board, Diagrams, Charts, Text books and Images	Identify type conversion kits: • Venturi Kits • Sequential injection kits • Open-Loop system • Closed-loop system	Guide students to Identify type conversion kits: • Venturi Kits • Sequential injection kits • Open-Loop system • Closed-loop system	• Venturi Kits • Sequential injection kits • Open-Loop system • Closed-loop system
	4.3 Explain the compatibility, design and operation of the following kits: - • Venturi Kits • Sequential injection kits • Open-Loop system • Closed-loop system	Describe the compatibility, design and operation of the following kits: - • Venturi Kits • Sequential injection kits	Board, Diagrams, Charts, Text books and Images			
	4.4 Explain importance of the kits.	Discuss importance of the kits	Board, Diagrams, Charts, Text books and Images			

`

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE			
MODULE: Introduction to Gas Powered Vehicle II		**COURSE CODE: CAP122**	**CONTACT HOURS: 60HRS**
YEAR: 1	**TERM:** 2	**PRE: REQUISITE: CAP111**	**Theoretical:** 24HRS **Practical:** 36HRS
GOAL : This module is designed to equip the student with the knowledge and skill required to understand the working principle of gas powered Vehicles			

GENERAL OBJECTIVES: On completion of this module, the student should be able to:

1. Understand Key Components of CNG Conversion Kits
2. Understand the conversion process.
3. Understand the safety and system performance.
4. Understand the cylinder materials.

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

1. Identify Components of a CNG Conversion Kits
2. Demonstrate conversion process.
3. Identify cylinder materials

`

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE						
MODULE: Introduction to Gas Powered Vehicle II				**COURSE CODE: CGP122**		**CONTACT HOURS: 60HRS**
YEAR: 1	**TERM:** 2	**PRE: REQUISITE: CAP111**		**Theoretical:** 24Hours **Practical:** 36Hours		
GOAL: This module is designed to assist the student with the knowledge required to understand the working principles of a gas powered vehicles						
GENERAL OBJECTIVE 1.0: Understand Key Components of CNG Conversion Kit						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
1-2	1.1 Define the components in the conversion kit	Discuss the components in the conversion kits	Posters, charts, pictures and text books and Board			
	1.2 List components of the conversion kit • Cylinder • ECU • Regulator • etc.	Discuss components of the conversion kit • Cylinder • ECU • Regulator	Posters, charts, pictures and text books and Board	Identify the components in the CNG conversion kit	Guide students to identify components in the CNG conversion kit	Cylinder ECU Regulator
	1.3 Define cylinder and Regular	Discuss cylinder and Regular	Board, Diagram, Text books	Identify cylinder and Regulator	Guide students to identify cylinders and Regulators	Cylinder Regulator
	1.4 Define ECU and electrical risk associated with ECU	Discuss ECU and electrical risk associated with ECU	Board, Diagram, Text books			
	1.5 Explain the relationship between the components in the CNG conversion kit	Discuss the relationship between the components in the CNG conversion kit	Board, Diagram, Text books	Demonstrate location of specific components and systems on a GPV diagram	Guide students to locate of specific components and	GPV Diagrams

`

					systems on a GPV diagram	
GENERAL OBJECTIVE 2.0: Understand the conversion process						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
3-5	2.1 Explain the process of vehicle assessment.	Discuss the process of vehicle assessment to evaluate engine capacity and performance	Board, Charts, diagram and pictures	Demonstrate process of vehicle assessment.	Guide students to assess vehicle	vehicle
	2.2 Define Sequential installation process	Discuss sequential installation process	Board,, Charts, diagram and pictures	Demonstrate sequential installation process	Guide students to demonstrate sequential installation process	Vehicle
	2.3 Define Calibration procedure	Discuss calibration as the process of fine tuning ECU parameters to optimize air fuel mixture and timing.	Board, Charts, diagram and pictures			
GENERAL OBJECTIVE 3.0: Understand the safety and system performance						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
6-7	3.1 Define vehicle safety checks.	Discuss how to Conduct thorough testing for gas leaks and safety compliance	Board, Text book, charts and Diagrams			
	3.2 Define ECU Optimization.	Discuss the process of ECU optimization for optimal air fuel ratio	Board, Text book, charts and Diagrams			
	3.3 Define performance Tuning	Discuss system fine-tune for best performance and efficiency	Board, Text book, charts and Diagrams			

`

GENERAL OBJECTIVE 4.0: Understand the materials of cylinder						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
8-9	4.1 Explain cylinder	Discuss cylinder	Board, Text book, charts and Diagrams			
	4.2 Explain cylinder properties	Discuss cylinder properties	Board, Text book, charts and Diagrams			
	4.3 List types of Cylinder	Explain types of cylinder	Board, Text book, charts and Diagrams	Identify type of cylinder	Assist students to Identify type of cylinder	Cylinder
	4.4 Explain safety of Cylinder	Discuss safety of cylinder	Board, Text book, charts and Diagrams			

`

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE			
MODULE: GAS POWERED VEHICLE (GPV) CONVERSION COMPONENTS		**COURSE CODE: CAP133**	**CONTACT HOURS: 108HRS**
YEAR: 2	**TERM:** 2	**PRE: REQUISITE: CAP122**	**Theoretical:** 36Hours **Practical:** 72Hours
GOAL: This module is designed to equip the student with the knowledge and skill required to identify the component parts required for conversion in the Gas powered Vehicles			

GENERAL OBJECTIVES: On completion of this module, the student should be able to:

1. Understand GPV Health and safety
2. Understand GPV KITS
3. Understand the process of Install Gas Tank and Mechanical Valves

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

1. Identify GPV personal protective Equipment
2. Identify GPV KITS
3. Demonstrate the process of Install Gas Tank and Mechanical Valves

`

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE						
MODULE: GPV CONVERSION COMPONENTS				**COURSE CODE: CAP133**		**CONTACT HOURS: 108HRS**
YEAR: 1	**TERM:** 3	**PRE: REQUISITE: CAP122**	**Theoretical:** 36 Hours **Practical:** 48 Hours			
GOAL This module is designed to equip the student with the knowledge and skill required to identify the component parts required for conversion in the Gas powered Vehicles						
Theoretical Content				**Practical Content**		
GENERAL OBJECTIVE 1.0: Understand GPV Health and safety						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
1-2	1.1 Define Health and Safety	Explain Health and Safety	Board, Charts, Pictures and textbooks			
	1.2 Explain hazard at work place	Discuss hazard at work place				
	1.3 list personal protective Equipment throughout the work process	Discuss the importance of putting personal protective equipment (PPE) during any activity in the workshop.	Board, Charts, Pictures and textbooks	Identify personal protective Equipment.	Guide the students on wear PPE during any work in the workshop	PPE, safety kits
	1.4 Explain the safety measures and regulations provided by statutory bodies	Discuss the safety measures and regulations provided by statutory bodies (ISO, SON, etc) regarding Auto-gas Conversion Kits installation	Board, Pictures, charts Textbooks and diagrams	Identify safety measures in work place	Guide students to Identify safety measures in work place	Safety equipment
	1.5 Explain accident in work place	Discuss accident in work place	Board, Charts, Pictures and textbooks			
	1.6 Explain accident prevention	Discuss accident prevention	Board, Charts, Pictures and textbooks	Demonstrate measures to prevent accident	Guide students how take measures to prevent accident	Safety kits

`

GENERAL OBJECTIVE 2.0: Understand GPV Kits						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
3-4						
	2.1 Define the following components: • Filters • Reducers • Multi-valves • Injector nozzles • Pipes • Regulator • SGI switch	Explain the following: - • Filters • Reducers • Multi-valves • Injector nozzles • Pipes • Regulator • SGI switch	Board, Pictures, charts, diagrams and text books	Identify the following: Filters • Reducers • Multi-valves • Injector nozzles • Pipes • Regulator • SGI switch	Guide students to Identify the following: Filters • Reducers • Multi-valves • Injector nozzles • Pipes • Regulator • SGI switch	• Reducers • Multi-valves • Injector nozzles • Pipes • Regulator • SGI switch
	2.2 Explain manufacturer's specifications on the following: • Tank • Multi-valves • filling point/valve • connecting gas hoses	Discuss the manufacturer's specification on the following: • Tank • Multi-valves • filling point/valve • connecting gas hoses	Board, Pictures, charts, diagrams and text books			
	2.3 Explain how to Locate and utilize existing holes (Where available) or drill new holes and provide bolts and nuts for mounting: - • Reducers • injector rail • ECU • Solenoid valves	Discuss on how to drill holes or use existing holes to secure:- • Reducers • injector rail • ECU	Board, Pictures, charts, drilling machine, hose cutter, spanner and screwdriver	Locate and utilize existing available holes .	Guide students to drill holes or use existing holes ones to secure:- Reducers injector rail ECU Solenoid valves Reducer/vaporizer Multi-valve	Pictures, charts, drilling machine, hose cutter, spanner and screwdriver

`

	• Reducer/vaporizer • Multi-valve Sensor • SGI switch (Change over switch), etc.	• Solenoid valves • Reducer /vaporizer • Multi-valve • Sensor SGI switch (Change over switch),			Sensor SGI switch (Change over switch),	
	2.4 Explain Reducer by connecting the inlet valves, gauges.	Describe the concept applied in preparing the reducer by connecting the inlet valves and gauges	Board, Reducer, hose cutter, clips and screwdriver	Prepare the Reducer by connecting the inlet valves, gauges.	Guide the student to preparing the reducer by connecting the inlet valves and gauges.	Reducer, hose cutter, clips and screwdriver

GENERAL OBJECTIVE 3.0: Understand the process of Install Gas Tank and Mechanical Valves						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
4-5	3.1 Define Mechanical Kits	Discuss Mechanical Kits	Boards, Posters, charts, pictures and text books			
	3.2 List types of Mechanical Kits	Discuss types of Mechanical Kits		Identify types of Mechanical Kits	Guide students to identify types of Mechanical Kits	Mechanical Kits
	3.3 Explain the differences between the Auto-gas (CNG/LNG/LPG) tanks	Discuss the differences between the Auto-gas (CNG/LNG/LPG) tanks	Boards, Posters, charts, pictures and text books			
	3.4 Explain process of right selection of tanks for the vehicle to be converted	describe the relationship between the components and symbols in GPV diagram	Boards, Posters, charts, pictures and text books			
	3.5 Describe the relationship between tilting cylindrical tank and the multivalve	Explain the relationship between tilting cylindrical tank and the multivalve diagram	Boards, Diagrams, charts, text books			

`

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE			
MODULE: GPV LAYOUT DESIGN		**COURSE CODE:** CAP214	**CONTACT HOURS: 180HRS**
YEAR: 2	**TERM:** 2	**PRE: REQUISITE: CAP133**	**Theoretical:** 72Hours **Practical:** 108Hours
GOAL: This module is designed to acquaint the student with the knowledge and skill required to interpret the layout design of gas powered vehicles			

GENERAL OBJECTIVES: On completion of this module, the student should be able to:

1. Understand Basic Vehicle Information
2. Understand how to read and interpret GPV diagram.
3. Understand the conversion layout of a vehicle
4. Understand installation of conversion components

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

1. To install the conversion components
2. Sketch Conversion Layout Plan
3. To Install gas tank and mechanical valves
4. To connect the gas supply line from the tank
5. To make proper electrical connections to the ECU

`

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE						
MODULE: GPV LAYOUT DESIGN				**COURSE CODE:**		**CONTACT HOURS:**
YEAR: 1	**TERM:** 1	**PRE: REQUISITE:**	**Theoretical:** 36 Hours **Practical:** 48 Hours			
GOAL: This module is designed to acquaint the student with the knowledge and skill required to interpret the layout design of gas powered vehicles						
Theoretical Content				**Practical Content**		
GENERAL OBJECTIVE 1.0: Understand Basic Vehicle Information						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
1-2	1.1 Define the following vehicle information	Discuss vehicle information:	Board, Charts, Pictures	•	•	
	1.2 Explain Basic Vehicle Information • Number of cylinder • Identification Number (VIN) • Year of manufacture • Name/brand of vehicle	Discuss the basic vehicle information, Locating Data Connector (DLC), vehicle identification number (VIN), and the vehicle specifications.	Board, Charts, Pictures	Locate the DLC of the vehicle, VIN and the Vehicle specifications.	Guide the students to locate the DLC, VIN and the vehicle specifications	DLC, VIN and OEM manual
	1.3 Explain Engine Capacity and Power rating	Discuss the importance of vehicle Engine capacity	Board, Charts, Pictures	Identify engine capacity and Power rating	Guide students to Identify engine capacity and Power rating	Engine blocks
	GENERAL OBJECTIVE 2.0: Understand how to read and interpret GPV diagram					
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
3-4	2.1 Explain gas-powered vehicle installation diagram	Discuss the components and symbols used in GPV diagrams	Board, Posters, charts, pictures and text	Interpret typical gas-powered vehicle installation diagram (refer to	Guide student to Interpret typical gas-powered vehicle installation diagram (refer to	OEM manual

`

			books and OEM manual	manufacturers specifications).	manufacturers specifications).	
	2.2 Explain Mapping out on the vehicle using installation (schematic) diagram	Discuss the relationship between the components and symbols in GPV diagram	Board, Posters, charts, pictures and text books and OEM manual	Perform Mapping out on the vehicle using installation (schematic) diagram	Guide student to Perform Mapping out on the vehicle using installation (schematic) diagram	OEM manual
	2.3 Explain the separate components or combined components using checklist	Discuss location of specific components and systems on a GPV diagram	Diagrams, charts, text books	Identify which components are separate or combined using Checklist	Guide the student to Identify which components are separate or combined using Checklist	OEM manual
	2.4 Explain brand and manufacturer's standards on cylinder and other documents (e.g. CNG/LNG/LPG enquiry form, batch inspection report, hydro test report)	Discuss manufacturer's standard on the cylinder	Diagram, Text books	Carryout batch inspection report, hydro test report on the cylinder	Guide student to batch inspection report, hydro test report on the cylinder	OEM manual
GENERAL OBJECTIVE 3.0: Understand the conversion layout of a vehicle						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
5-7	3.1 Explain types of Sketch for conversion layout plan	Discuss types of vehicle conversion layout plan	Board, Charts, diagrams and diagrams	Sketch conversion layout	Guide students to Sketch conversion layout	Drawing kits
	3.2 Explain the conversion layout of a vehicle to identify potential improvements or modifications	Discuss the conversion layout of a vehicle to identify potential improvements or modifications	Board, Charts, diagrams	Identify potential improvements or modifications of	Guide student to Identify potential improvements or	Layout of a vehicle

`

			and diagrams	conversion layout of a vehicle	modifications of conversion layout of a vehicle	
	3.3 Explain parts and required location for layout diagram	Discuss the parts and location required on the GPV layout diagram	Board, Charts, diagrams and diagrams	Identify parts and required location for layout diagram	Assist students to identify parts and required location for layout diagram	Layout diagram
	3.4 Explain how to mark out the appropriate location and suitable sizes	Discuss appropriate location and suitable sizes following manufacturer manual for proper guidance	Board, Charts, diagrams, and diagrams	Mark out the appropriate location and suitable sizes following manufacturer manual for proper guidance	Guide student to mark out the appropriate location and suitable sizes following manufacturer manual for proper guidance	Puncher, Marker and tape
GENERAL OBJECTIVE 4.0: Understand Installation of Conversion Components						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
8-9	4.1 Explain the safety measures and regulations provided by Statutory bodies	Discuss the safety measures and regulations provided by Statutory bodies (ISO, SON, etc.) regarding Auto-gas Conversion kits installation	Board, Text books, charts			
	4.2 Explain electrical drawings with respect to GPV	Discuss electrical drawings symbols in the GPV	Board, Charts, text books and drawings	Interpret electrical drawings	Show students how to interpret electrical drawings	Electrical drawing materials Symbols diagrams

`

	4.3 Define the following terms • wire connection • soldering • termination	Discuss soldering techniques and how to make proper wire connection, soldering and termination	Board, Charts, text books and drawings	Demonstrate good practice in wire connection, soldering and termination	Guide student to connect, soldering and termination of wires	Soldering iron, cable striper, wires
	4.4. List different electrical components used in the conversion process e.g. Solenoid valve	Discuss the procedure of Identifying different electrical components used in the conversion process	Board, Charts, text books and diagrams			
	4.5 Explain continuity testing using Multimeter	Discuss how to carryout continuity testing using a Multimeter	Board, Charts, Multimeter and diagrams	Carryout continuity testing with Multimeter	Guide student to carryout continuity testing with Multimeter	Multimeter, and meter probes
	4.6 Explain the use of electric soldering iron	Discuss the use of soldering in joining wire for making proper connection	Board, Charts and diagrams	Demonstrate the use of electric soldering iron	Guide the student to use of electric soldering iron	Soldering iron or soldering station and soldering lead
	4.7 Explain the use of wire stripper and different wire connection techniques	Discuss the procedure of using stripper and different wire connection techniques	Board, Charts and diagrams Wire stripper	Demonstrate the use of wire stripper and different wire connection techniques	Guide the student to use of wire stripper and different wire connection techniques	Wire stripper

`

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE			
MODULE: GPV KITS & SAFE FUELING SYSTEM INSTALLATION		**COURSE CODE:** CAP225	**CONTACT HOURS: 180HRS**
YEAR: 2	**TERM:** 1	**PRE: REQUISITE:** CAP214	**Theoretical:** 72 Hours **Practical:** 108 Hours
GOAL: This module is designed to equip the student with the knowledge and skills required to install GPV Kits and follow Safe fueling procedures			

GENERAL OBJECTIVES: On completion of this module, the student should be able to:

1. Understand Install Gas Tank and Mechanical Valves
2. Understand Installation and checking Fuel Transfer Lines and fuel line connectors
3. Understand Installation and Testing for Electrical Wiring and Components
4. Understand Electrical/Electronic Kits Installation
5. Understand Fuel tank installation.

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

1. Install gas tank and mechanical valves
2. Make proper electrical connections to the ECU
3. Connect the gas supply line from the tank

`

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE						
MODULE: GPV KITS & SAFE FUELING SYSTEM INSTALLATION				COURSE CODE:		CONTACT HOURS:
YEAR: 1	TERM: 1	PRE: REQUISITE:		Theoretical: 36 Hours Practical: 48 Hours		
GOAL: This module is designed to equip the student with the knowledge and skills required to install GPV Kits and follow Safe fueling procedures						
Theoretical Content				Practical Content		
GENERAL OBJECTIVE 1.0: Understand the Installation of Gas Tank and Mechanical Valves						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
1- 2	1.1 Outline the differences between the Auto-gas (CNG/LNG/LPG) tanks	Discuss the differences between the Auto-gas (CNG/LNG/LPG) tanks	Boards, Posters, charts, pictures and text books			
	1.2 State the relationship between the components and symbols in GPV diagram	Discuss the relationship between the components and symbols in GPV diagram	Boards, Posters, charts, pictures and text books	Identify the symbols in GPV diagram	Assist students to Identify the symbols in GPV diagram	Diagrams
	1.3 Describe the relationship between tilting cylindrical tank and the multivalve	Explain the relationship between tilting cylindrical tank and the multivalve diagram	Boards, Diagrams, charts, text books			
	1.4 Explain the following operations: • Location Selection for appropriate tank fixing • Tools/equipment required to drill holes • Tank Installation and tank bracket fixing	Discuss the following operations: Selection of the appropriate location to fix tank Tools/equipment to drill holes Install tank and fix the tank bracket	Boards, Diagrams, charts, text books	Select the appropriate location to fix tank Tools/equipment to drill holes Install tank and fix the tank bracket	Guide the student to Select the appropriate location to fix tank	Drilling machine, drilling bit and tools box
	1.5 Define piping and pipe size	Discuss piping and pipe size	Diagram, Text books	Install different types/sizes of pipes	Guide student to Install different types/sizes of pipes	Pipes

`

	1.6 Explain pipe cutting and pipes connection in conversion process	Discuss pipe cutting and pipes connection in conversion process	Board, Diagram, Text books	Carryout pipe cutting and connection of pipes during the conversion process	Guide student to Carryout pipe cutting and connection of pipes during the conversion process	Hose cutter, pipe cutter, hack saw
	1.7 Explain how to Firmly fasten and secure the tank belt	Discuss fasten and secure tank belt	Board, Diagram, Text books	Demonstrate procedure for fasten and secure the tank belt	Guide students to demonstrate procedure for fasten and secure the tank belt	Belt Tank
	1.8 Explain Gas and Heat-Shrink Tubing and routing	Discuss Gas and Heat-Shrink Tubing and routing	Board, Diagram, Text books	Demonstrate Gas and Heat-Shrink Tubing and routing	Assist students to identify Gas and Heat-Shrink Tubing and routing	Tube Pipe
GENERAL OBJECTIVE 2.0: Understand Installation and checking Fuel Transfer Lines and fuel line connectors						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
3-4	2.1 Define the Standards for selecting right hose/pipe for different application	Discuss Standards for selecting right hose/pipe for different application	Board, Text books, charts and diagrams	selecting right hose/pipe for different application	Guide student to selecting right hose/pipe for different application	Hoses Pipes
	2.2 Explain the functions of different Types of Hose/pipes	Describe the functions of different Types of Hose/pipes	Board, Text books, charts and diagrams	Identify functions of different Types of Hose/pipes	Guide students to identify functions of different Types of Hose/pipes	Hoses Pipe Diagrams
	2.3 Define fuel line mounting and Routing	Explain mounting and routing of fuel lines	Board, Text books, charts and diagrams	Carryout fuel line mounting and Routing	Guide student to Carryout fuel line mounting and Routing	Tools box Pliers, clips
	2.4 Describe the Standards for selecting right hose/pipe for different applications	Discuss the Standards for selecting right hose/pipe for different applications	Board, Text books, charts and diagrams			
	2.5 Define types of pressure relief devices (PRDs) channel configurations	Describe pressure relief device and its type	Text books, charts and pictures diagrams			

`

GENERAL OBJECTIVE 3.0: **Understand** Installation and Testing for Electrical Wiring and Components						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
5- 6	3.1 Define pressure and pressure rating	Describe pressure ratings on components	Board, Diagrams, charts and text book	Locate and read pressure ratings on components	Guide student to Locate and read pressure ratings on components	Pressure gauge
	3.2 Define ECU, and its characteristics	Explain Gas Electronic Control Units (ECU) based on vehicle type and characteristics	Board, Drawings, charts and text book	Install Gas Electronic Computer Units (ECU) based on vehicle type and characteristics	Guide student to Install Gas Electronic Computer Units (ECU) based on vehicle type and characteristics	ECU, Multimeter probes
	3.3 Define the term OEM	Explain the use of OEM electrical installation	Board, Diagrams, charts and text books	Demonstrate the use of OEM electrical installation diagrams and guide.	Guide student to use of OEM electrical installation diagrams and guide.	OEM Kits Diagrams
	3.4 Explain Fuel rail pressure and temperature sensors		Board, Diagrams, charts and text books			
	3.5 Define Manifold Absolute Pressure (MAP) in relation to pressure	Describe Manifold absolute pressure (MAP) sensor	Board, Diagrams, charts and text book			
	3.6 Define:-Petrol Injectors Ignition coil Crank Position sensor Cam position sensor	Describe how to connect emulation cables and other cables to vehicle's: Petrol Injectors Ignition coil Crank Position sensor Cam position sensor (In accordance to the OEM electrical Circuit diagrams	Diagrams, charts and text book	Connect emulation cables and other cables to vehicle's Petrol Injectors Ignition coil Crank Position sensor Cam position sensor (In accordance to the OEM electrical Circuit diagrams	Guide student to connect emulation cables and other cables to vehicle's Petrol Injectors Ignition coil Crank Position sensor Cam position sensor (In accordance to the OEM electrical Circuit diagrams	Cables, Striper, sensors, Soldering Iron or workstation

`

GENERAL OBJECTIVE 4.0: Understand Electrical/Electronic Kits Installation						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
6-7	4.1 Explain all electrical connections using manufacturers recommended electrical schematic diagram ECU Injector cables SGI Gas switch Reducer/vaporizer Regulator Multivalve Solenoid, etc.	Discuss the following: ECU Injector cable SGI gas switch Reducer/ Vaporizer Multivalve Solenoid Regulator	Board, Diagrams, charts and text book	Identify: ECU Injector cables SGI Gas switch Reducer/vaporizer Regulator Multivalve Solenoid, etc.	Guide the students to identify: ECU Injector cables SGI Gas switch Reducer/vaporizer Regulator Multivalve Solenoid, etc.	ECU Injector cables SGI Gas switch Reducer/vaporizer Regulator Multivalve Solenoid, etc.
	4.2 Explain continuity testing with Multimeter	Discuss continuity and how to do continuity test using Multimeter	Board, Diagrams, charts and text book	Carry out continuity testing with Multimeter	Assist student to carryout continuity test using with Multimeter	Multimeter, probes
	4.3 Describe the following: _ • Emulation for signals • Fuel injectors • Oxygen sensor • MAP sensor	Elaborate the following: _ • Emulation for signals • Fuel injectors • Oxygen sensor MAP sensor	Board, Diagrams, charts and text book	Carryout test to the following: • Emulation for signals • Fuel injectors • Oxygen Sensor • MAP sensor	Guide students to Carry out test on_ • Emulation for signals • Fuel injectors • Oxygen Sensor MAP sensor	Multimeter, probes
	4.4 Describe: • Negative cables to injector coils a • positive cables to switch (near the driver)	Elaborate test to distinguish between: • Negative cables to injector coils • Positive cables to switch (near the driver)	Board, Diagrams, charts and text book	Demonstrate test to distinguish between: • Negative cables to injector coils • Positive cables to switch (near the driver)	Guide students to demonstrate test to distinguish between: • Negative cables to injector coils Positive cables to switch (near the driver)	Negative cables Positive cables Switch Injector coil

`

GENERAL OBJECTIVE 5.0: Understand Fuel tank installation						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
8-9	5.1 Define pressure ratings	Discuss how to determine if pressure reading from label matches component pressure ratings	Board Diagrams, charts and text book			
	5.2 Define shut off valves	Discuss shutoff valves (In accordance with NFPA52 or manufacturer's specifications)	Board Diagrams, charts and text book, manufacturers manual, NFPA 52			
	5.3 List types of Valve	Explain types of valve: multi-valves and filling port/valves	Board Diagrams, charts and text book	Identify types of valve: multi-valves and filling port/valves	Guide students to Identify types of valve: multi-valves and filling port/valves	multi-valves and filling port/valves
	5.4 Describe how to ensure valves (multi-valves and filling port/valves) are in proper position	Explain how valves (multi-valves and filling port/valves) are in proper position	Board Diagrams, charts and text book	Identify valves (multi-valves and filling port/valves) are in proper position	Guide students to locate valves position (multi-valves and filling port/valves)	multi-valves and filling port/valves
	5.4 Explain the order of proper connections	Describe the connections (In accordance with NFPA52 or manufacturer's specifications) in the proper order (refer to manufacturers instruction, connect the Hose from the filling valve to the tank, and from the tank down to the front kits (gas line)	Board Diagrams, charts and text book, (refer to manufacturers instruction	Demonstrate connection procedure	Assist students to make proper connections: Hose from the filling valve to the tank, and from the tank down to the front kits (gas line	Hose Tank Valve Kits

`

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE			
MODULE: CNG CALIBRATION		**COURSE CODE:** CAP236	**CONTACT HOURS: 180HRS**
YEAR: 2	**TERM:** 3	**PRE: REQUISITE: CAP225**	**Theoretical: 72**Hours **Practical:** 108Hours
GOAL: This module is designed to equip the student with knowledge and skills required to competently calibrate the CNG powered vehicles			

GENERAL OBJECTIVES:

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

1. Understand Tools and Software for Calibration
2. Understand how to Perform Calibration Operations
3. Understand how to Manage Calibration Data and Information
4. Understand OBDII Scan Tool
5. Understand Performance and Supervise General Diagnosis

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

1. Identify and locate all the components installed for the conversion to ascertain proper calibration.
2. Observe and identify all the parameters on the software used for the calibration.

`

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE						
MODULE: Gas Powered Vehicle Calibration				**COURSE CODE:**		**CONTACT HOURS:**
YEAR: 1	**TERM:** 1	**PRE: REQUISITE:**		**Theoretical:** 36 Hours **Practical:** 48 Hours		
GOAL: This module is designed to equip the student with knowledge and skills required to competently calibrate the CNG powered vehicles						
Theoretical Content				**Practical Content**		
GENERAL OBJECTIVE 1.0: Understand Tools and Software for Calibration						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
1-2	1.1 Define Calibration	Discuss calibration	Board, Text books, Picture			
	1.2 Explain reasons for Calibration	Elaborate why calibration is importance	Board, Text books, Picture			
	1.3 Explain procedures for Calibration	Discuss parameters involves in Calibration	Board, Text books, Picture	Demonstrate Calibration procedure	Assist students in identifications of components involved in calibration	Computer, interface cable, ECU, Vehicle
	1.4 Explain Safety Precautions during calibration	Discuss safety protocols/procedure, including using PPE, avoiding live wire exposure, etc.	Board, Text books, Picture	Identify Safety Equipment	Guide student to identify safety equipment	PPE Kits etc.
	1.5 Define Tools Selection	Explain procedure in selecting and using tools such as OBD-II scanners, personal computers, and calibration-of specific software	Board, Text books, Laptop computer, Drawings and Pictures	Demonstrate Tool selection	Guide students on Identifying procedure to be used in selection of tools	OBD-II scanners, personal computer and calibration-specific software

`

GENERAL OBJECTIVE 2.0: Understand how to Perform Calibration Operations						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
3-4	2.1 Explain Vehicle Parameters	Discuss key parameters like RPM, fuel pressure, and injector timing, as per manufacturer standards.	Board, Text books, Picture			
	2.2 Explain Calibration Softwares	Discuss different software used for calibration based on the type of gas (CNG, LPG, etc.), unique features and applications.	Test books, board	Analyze Calibration Software	Guide the student to analyze Calibration Software	Software
	2.3 Explain Communication Wires	Describe communication wires, communication interfaces between the vehicle and calibration equipment	Board, Text books, Picture	Demonstrate Communication wires	Guide student to Identify different communication wire	Communication wires
	2.4 Define Parameters in calibration	Describe Parameters in calibration	Text books, software tools, laptop computer with software installed	Interpret real-time data for calibration tools	Guide student to interpret real-time data for calibration tools	Laptop computer with software installed
	2.5 Describe adjustment Parameters	Explain calibration involves for modifying settings such as fuel injection timing and air-fuel ratios to achieve optimal performance	Board, Laptop computer with software installed	Identify and locate calibration parameters	Guide student to identify and locate calibration parameters	Laptop computer with software installed
	2.6 Describe Gas Filling Procedures	Explain proper refueling techniques to maintain safety and avoid overpressure during calibration	Board, Diagrams, chats and Text books			

`

GENERAL OBJECTIVE 3.0: Understand how to Manage Calibration Data and Information						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
5	3.1 Define data Collection	Explain tools to be used in data collection and documentation in real- time during calibration for comprehensive records	Laptop computer, writing materials			
	3.2 Define calibration system components	Elaborate the components of a calibration system, including ECU, injectors, sensors, and software interfaces.	Board, Diagrams, chats and Text books	Demonstrate Components of Calibration system	Guide student to identify components of calibration system	ECU, injectors, sensors, and software interfaces.
	3.3 Define basic parameter settings in calibration	Explain the configuration systems to match engine type, gas type, and other variables based on manufacturer specifications	Board, Manufacturer's manual, text book			
	3.4 Define Injector Settings and Auto-Calibration	Explain fine-tune injector settings and execute auto-calibration processes.	Board, Text book, laptop computers and manufacturers manual			

GENERAL OBJECTIVE 4.0: Understand OBD-II Scan Tool						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
6-7	4.1 Explain Setup Base on Petrol Injection Pulses	Describe how to calibrate gas injection timing relative to petrol injector pulses	Board, Laptop computer with software installed	Demonstrate Setup Base on Petrol Injection Pulses	Guide student to Setup Petrol Injection Pulses	Laptop computer with software installed

`

	4.2 Define Setup STFT and LTFT Trims	Explain adjustment of fuel trims using OBD-II data for short- term and long-term performance optimization.	Board, Diagrams and chats	Setup STFT and LTFT Trims	Guide student to setup STFT and LTFT	OBD-II, Laptop computer
	4.3 Define and Set Maximum Load and Idle Speed Control	Explain by adjusting relevant parameters vehicle operates under varying loads and idle conditions.	Board, Diagrams and chats	Set Maximum Load and Idle Speed Control	Guide student to Observe the changes in maximum load and idle speed	OBDII, Laptop computer
	4.4 Define perform Calibration Documentation	Explain detailed calibration information, including before-and-after performance data, for future reference	Board, Writing materials			

GENERAL OBJECTIVE 5.0: Understand Performance and Supervise General Diagnosis						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
8-9	5.1 Define Diagnostic Procedures	Explain how to carryout diagnosis procedures	OBDII, Laptop computer, Board			
	5.2 Define Pre-Diagnosis Inspection	Explain visual and safety check for ventilation area, gas leak, gas cylinder, pipelines, CNG reducer, injectors, hoses, wiring connection, etc.	Board, Laptop computer	Demonstrate visual and safety check	Guide students to identify visual and safety check	Conversion kits
	5.3 Explain engine performance on both petrol and CNG mode	Describe procedure of checking engine performance on CNG & Petrol Mode	Manufacturer's manuals, Board, Laptop computer	Checking Engine Performance on CNG & Petrol Mode	Guide students to check engine performance on both petrol and CNG mode	Laptop computer, OEM Manual Converted vehicle

`

	5.4 Define Air-Fuel Ratio & Emission Diagnosis	Explain the function and working principles of Air-Fuel Mixture, Throttle Body & Air Intake System, Lambda Sensor	Laptop computer, Board, and Manufacturer's manual	Illustrate Air-Fuel Ratio & Emission Diagnosis	Guide students to illustrate Air-Fuel Ratio & Emission Diagnosis	Laptop computer and manufacturers manual
	5.5 Define ECU & Electrical System Diagnosis tool	Explain ECU & Electrical System Diagnosis tool	Board, Laptop computer, OBDII	Identify ECU & Electrical System Diagnosis	Guide students to identify ECU & Electrical System Diagnosis	Computer, ECU, Multimeter, scanner, OBDII
	5.6 Explain Supervision and Final Adjustments	Discuss Supervision and Final Adjustments by Test Drive the Vehicle, Recheck Gas Leaks, Verify Emissions Compliance and Provide Maintenance Recommendations	Board, text books and diagrams	Observe the reactions after conversion	Assist student to observe the reactions after conversion	Converted Vehicle

`

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE			
MODULE: CNG MAINTENANCE		**COURSE CODE:** CAP317	**CONTACT HOURS: 120HOURS**
YEAR: 3	**TERM:** 1	**PRE: REQUISITE: CAP236**	**Theoretical:** 48 Hours **Practical:** 72 Hours
GOAL: This module is designed to equip the student with knowledge and skills required to competently carryout maintenance services on CNG powered vehicles			

GENERAL OBJECTIVES:

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

1. Understand Maintenance of Auto Gas-Powered Vehicles
2. Understand Maintenance Checks on Gas-Powered Vehicles.
3. Analyse Functionality and Durability Tests.
4. Understand Auto-gas Vehicle Fuel Container Decommissioning.
5. Understand Service and Maintenance on Converted Vehicles.
6. Analyse Repairs on Converted Vehicles.

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

1. Perform Maintenance on Auto Gas-Powered Vehicles.
2. Perform maintenance checks on Gas-Powered Vehicles.
3. Understand Functionality and durability test.
4. Service and maintenance on converted vehicles.
5. Analyse repairs on converted vehicle.

`

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE						
MODULE: CNG MAINTENANCE				**COURSE CODE:**		**CONTACT HOURS:**
YEAR: 1	**TERM:** 1	**PRE: REQUISITE:**	**Theoretical:** 36 Hours **Practical:** 48 Hours			
GOAL: This module is designed to equip the student with knowledge and skills required to competently carryout maintenance services on CNG powered vehicles						
Theoretical Content				**Practical Content**		
GENERAL OBJECTIVE 1.0: Understand and Discuss the Term Maintenance						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
1-2	1.1 Define the Term CNG Maintenance	Explain maintenance in general	Text books, Board			
	1.2 List types of CNG Maintenance	Explain type of maintenance (Preventive and corrective Maintenance)	Text books, Board			
	1.3 Describe selection Tools and Equipment	Explain tools and equipment selection based on manufacturer's specifications	Board, Text books, Manufacturer's manual	Select Tools and Equipment	Guide students to select tools and equipment	Tools and Equipment
	1.4 Explain the Importance of Reducer Adjustments	Describe the Importance of Reducer Adjustments	Board, Text books, Manufacturer's manual			
	1.5 Define Health and Safety Procedures	Explain Health and Safety Procedures	Text books, Laptop computer, Drawings and Pictures	Demonstrate Health and Safety Procedures	Guide student on Health and Safety Procedures	PPE, Hand gloves, First aid box, fire extinguisher

`

GENERAL OBJECTIVE 2.0: Understand Performance Maintenance Checks on Gas-Powered Vehicles						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
3-4	2.1 Define Maintenance procedure on Components	Explain Maintenance procedure on critical Components such as gas tanks, filters, faro connectors, pipes, reducers, multi valves, nozzles, and pressure relief devices	Board, diagram, chats	Identify Maintenance on Components	Assist students to identify on components maintenance	Gas tanks, filters, faro connectors, pipes, reducers, multi valves, nozzles, and pressure relief devices
	2.2 Define Tools Selection	Explain method of Selecting Tools for Maintenance .	Textbooks, Board, Manufacturers manual	Select Tools for Maintenance	Elaborate method of tools for maintenance	Manufacturers manual, Board
	2.3 Define Perform Maintenance Activities	Describe Performance and Maintenance Activities including cleaning, lubrication, and replacement as necessary	Test books, pictures, chats and board	Perform Maintenance Activities	Guide student to carryout maintenance on communication wire	Communication wires lubricant
	2.4 Describe Adjustments on the Reducer	Explain Adjustments on the Reducer for proper calibration	Textbooks, Manufacturers manual, Board	Perform Adjustments on the Reducer for proper calibration	Guide student on Perform Adjustments on the Reducer for proper calibration	Reducer, Laptop computer and scanner
	2.5 Describe Interpret Customer Feedback and analyse Complaints	Explain how to Interpret Customer Feedback and analyse Complaints	Textbooks, Board			
	2.5 Discuss Safety Measures with	Explain Safety	Textbooks,			

`

	Customer	Measures with Customer	Manufacturers manual			

GENERAL OBJECTIVE 3.0: Analyse Functionality and Durability Tests						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
5-6	3.1 Define visual and functional tests.	Describe visual and functional tests to verify that repairs and adjustments meet manufacturer specifications.	Board, Manufacturers manual	Conduct visual and functional tests.	Guide student to carry Out Post-Checks on Maintained Unit	Vehicle
	3.2 Explain Drivability Checks	Describe Drivability Checks	Board	Conduct test drives.	Guide student to Conduct test drives to ensure vehicle performance under various conditions.	Vehicle
	3.3 Define Faults Diagnose	Explain Faults Diagnose	Manufacturers manual, Board	Elaborate Faults Diagnose	Identify Faults by the use of diagnostic tools `on fuel system	Diagnosis tools e.g. scanner, OBD-II, Laptop computer
	3.4 Define documentation of Results for Maintenance	Explain documentation of Results for Maintenance	Board			

`

GENERAL OBJECTIVE 4.0: Understand Auto-Gas Vehicle Fuel Container Decommissioning						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
7	4.1 Explain the Importance of Defueling and Decommissioning	Highlight the importance of safely removing gas from containers to prevent environmental hazards	Board			
	4.2 Describe Owner Responsibilities for Safe Removal of gas from the container	Explain owner's role in ensuring containers are safely decommissioned	Board, Gas container			
	4.3 Outline Safety Requirements for Defueling	Explain Safety Requirements for Defueling	Board and pictures			
	4.5 Explain the use of proper tools and adherence to safety protocols during defueling	Discuss use of proper tools and adherence to safety protocols during defueling	Board, Pictures,			
	4.6 Define Safely Purge Gas Containers	Describe methods to purge gas containers while minimizing risks	Board, Gas container			
	4.7 Describe handle Malfunctioning Valves	Explain safely decommission containers with faulty valves and render them unusable	Board, Gas container			

`

GENERAL OBJECTIVE 5.0: Understand Service and Maintenance on Converted Vehicles						
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
	5.1 Define General Vehicle Requirements	Discuss essential checks such as gas system integrity, pressure testing, and functionality of safety components	Board, Manufacturers manual			
	5.2 Define Maintenance Schedules	Describe Maintenance Schedules	Board, Manufacturers manual			
	5.3 Describe Installation of Maintenance Parts	Explain the proper installation of parts such as filters and injectors for maintenance	Manufacturers manuals, Board, Laptop computer	Perform proper installation of parts such as filters and injectors for maintenance	Guide the student to Perform proper installation of parts such as filters and injectors	Filters, Injectors, Reducers, ECU

GENERAL OBJECTIVE 6.0: Analyse Repairs on Converted Vehicles						
week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**
8-9	6.1 Define Cylinder properties	Discuss Cylinder properties	Board	Inspect cylinders for leaks, dents, and pressure integrity	Guide inspect cylinders for leaks, dents, and pressure integrity	Cylinders, safety kits
	6.2 Explain Cylinder Brackets and Isolator Inspection	Discuss Cylinder Brackets and Isolator Inspection	Board	Check brackets and isolators are secure and free from wear	Guide student to Check brackets and isolators are	Brackets, Isolators, Cylinder

`

					secure and free from wear	
	6.3 Describe techniques to repair or replace damaged fuel system components after collisions.	Explain techniques to repair or replace damaged fuel system components after collisions.	Board			

`

MINIMUM TOOLS, EQUIPMENT, AND MATERIALS LIST

Category	Item	Minimum Quantity	Available Quality	Additional Required
Hand Tools	Spanners (Combination set)	40		
	Screwdrivers (Flat & Philips)	40		
	Pliers (Long nose, cutting, adjustable)	40		
	Allen key set	40		
	Wire strippers	40		
	Torque wrench	40		
	Hose cutters	40		
	Hacksaws	40		
	Adjustable wrenches	20		
	Pipe wrenches	20		
Power Tools	Cordless drills with drill bit sets	10		
	Electric impact wrenches	5		
	Bench grinders	5		
	Electric soldering irons	5		
	Heat gun	5		
Workshop Equipment	Workbenches	4		
	Heavy-duty vices	4		
	Air compressors	2		
	Hydraulic lifting jacks	2		
	Engine hoist	1		
	Welding machine	1		
Diagnostic & Testing Equipment	OBD-II diagnostic scanners	5		
	Multimeter	5		
	Gas leak detectors	2		
	Fuel Pressure Testers	2		
	Exhaust Gas Analyser	1		

`

CNG Conversion & Calibration Equipment	ECU programming tools	5		
	CNG Injector Testing Tools	5		
	Gas Cylinder Filling Stations	2		
	Gas Flow Meter	1		
Conversion & Installation Materials	CNG conversion kits (Venturi & Sequential)	40		
	Pressure regulators	40		
	CNG fuel injectors	40		
	Gas pipes and hoses	40		
	Multi-valves	40		
	Filters (gas & air)	40		
	Gas filling valves	40		
	Electrical connectors	40		
Safety Gear	Safety gloves	40		
	Safety goggles	40		
	Coveralls	40		
	Fire-resistant aprons	40		
	Fire extinguishers	5		
	First aid kits	5		
Computers & Software for GPV Calibration	Laptops with GPV Calibration Software	5		
	ECU tuning software	5		
	OBD-II diagnostic software	5		
	Gas flow analysis software	2		

`

PRACTICAL MANUAL

Introduction to Gas Powered Vehicles I **CAP111**	Identify Motor Vehicle. Identify types of Motor Vehicle. Identify vehicles based on fuel powered: • Petrol • Diesel • Compressed natural gas. • Electric Etc. Identify Auto Gases: • Compressed Natural Gas (CNG) • Liquefied Petroleum Gas (LPG) • Liquefied Natural Gas (LNG) Identify type conversion kits: • Venturi Kits • Sequential injection kits • Open-Loop system • Closed-loop system
Introduction to Gas Powered Vehicle II **CAP122**	Identify the components in the CNG conversion kit. Demonstrate location of specific components and systems on a GPV diagram Demonstrate process of vehicle assessment. Demonstrate installation sequential process. Identify type of cylinders
GPV Conversion Components CAP133	Identify personal protective Equipment. Identify safety measures in workplace. Demonstrate measures to prevent accident. Identify the following: Filters: • Reducers • Multi-valves • Injector nozzles • Pipes • Regulator

`

	• SGI switch Drill holes or use existing holes ones to secure:- • Reducers • injector rail • ECU • Solenoid valves • Reducer/vaporizer • Multi-valve • Sensor SGI switch (Change over switch), Prepare the Reducer by connecting the inlet valves, gauges. Identify types of Mechanical Kits
GPV Layout Design CAP214	Locate the DLC of the vehicle, VIN and the Vehicle specifications. Identify engine capacity and Power rating. Interpret typical gas-powered vehicle installation diagram (refer to manufacturers specifications). Perform Mapping out on the vehicle using installation (schematic) diagram. Identify which components are separate or combined using Checklist. Carryout batch inspection report, hydro test report on the cylinder Sketch conversion layout Identify potential improvements or modifications of conversion layout of a vehicle. Identify parts and required location for layout diagram. Mark out the appropriate location and suitable sizes following manufacturer manual for proper guidance. Interpret electrical drawings. Demonstrate good practice in wire connection, soldering and termination. Carryout continuity testing with Multimeter Demonstrate the use of electric soldering iron. Demonstrate the use of wire stripper and different wire connection techniques.
GPV Kits & Safe Fuelling System Installation CAP225	Identify the symbols in GPV diagram. Select the appropriate location to fix tank. Install tank and fix the tank bracket. Install different types/sizes of pipes. Carryout pipe cutting and connection of pipes during the conversion process.

`

	Demonstrate procedure for fasten and secure the tank belt. Demonstrate Gas and Heat-Shrink Tubing and routing. Selecting right hose/pipe for different application Identify functions of different Types of Hose/pipes Carryout fuel line mounting and Routing Locate pressure ratings on components. Install Gas Electronic Computer Units (ECU) based on vehicle type and characteristics. Demonstrate the use of OEM electrical installation diagrams and guide. Identify: • ECU • Injector cables • SGI Gas switch • Reducer/vaporizer • Regulator • Multivalve • Solenoid, etc. Connect emulation cables and other cables to vehicle's: • Petrol Injectors • Ignition coil • Crank Position sensor • Cam position sensor (In accordance to the OEM electrical Circuit diagrams) Assist student to carryout continuity test using with Multimeter Carryout test to the following: • Emulation for signals • Fuel injectors • Oxygen sensor • MAP sensor Demonstrate test to distinguish between: • Negative cables to injector coils

`

	• Positive cables to switch (near the driver) Identify types of valves: multi-valves and filling port/valve Connect: Hose from the filling valve to the tank, and from the tank down to the front kits (gas line)
Calibration CAP236	Demonstrate Calibration procedure. Demonstrate Tool selection for calibration. Analyse Calibration Software Demonstrate Communication wires. Interpret real-time data for calibration tools Identify and locate calibration parameters Demonstrate Components of Calibration system Demonstrate Setup Based on Petrol Injection Pulses Setup STFT and LTFT Trims Set Maximum Load and Idle Speed Control Demonstrate visual and safety check Checking Engine Performance on CNG & Petrol Mode Illustrate Air-Fuel Ratio & Emission Diagnosis Identify ECU & Electrical System Diagnosis Observe the reactions after conversion
CPV Maintenance CAP317	Demonstrate Health and Safety Procedures for maintenance. Identify Maintenance on Components Select Tools for Maintenance Perform Maintenance Activities Perform Adjustments on the Reducer for proper calibration. Conduct visual and functional tests. Conduct test drives. Elaborate Diagnose Faults Perform proper installation of parts such as filters and injectors for maintenance. Inspect cylinders for leaks, dents, and pressure integrity. Check brackets and isolators are secure and free from wear.

`

LIST OF BOOKS

Title	Author(s)
Automotive Mechanics	William H. Crouse & Donald L. Anglin
Gas Powered Vehicles: Principles and Applications	A. K. Gupta
Automotive Technology: A Systems Approach	Jack Erjavec & Rob Thompson
CNG and LPG Vehicle Conversion Handbook	Richard Fritz
Alternative Fuels and Advanced Vehicle Technologies	Richard Folkson
Vehicle Maintenance and Repair	Nigerian Technical Education Board (NABTEB)
Automotive Electrical and Electronic Systems	Tom Denton
Fundamentals of Automotive Air Pollution Control	James D. Halderman
Engineering Drawing and Design	David A. Madsen & David P. Madsen
Workshop Safety and Maintenance Guide	NBTE (Nigeria)

LIST OF JOURNALS

Title	Publisher
Journal of Automotive Engineering & Technology	Society of Automotive Engineers (SAE) Nigeria
International Journal of Vehicle Mechanics and Mobility	Elsevier
African Journal of Science, Technology, and Innovation	African Union Scientific Council
Nigerian Journal of Engineering & Technical Studies	National Board for Technical Education (NBTE)
International Journal of Automotive Engineering	Springer
Journal of Alternative Fuels and Clean Energy Vehicles	University of Lagos
Journal of Transport and Automotive Technology	Nigerian Institute of Transport Technology (NITT)
Energy and Fuels Journal	American Chemical Society

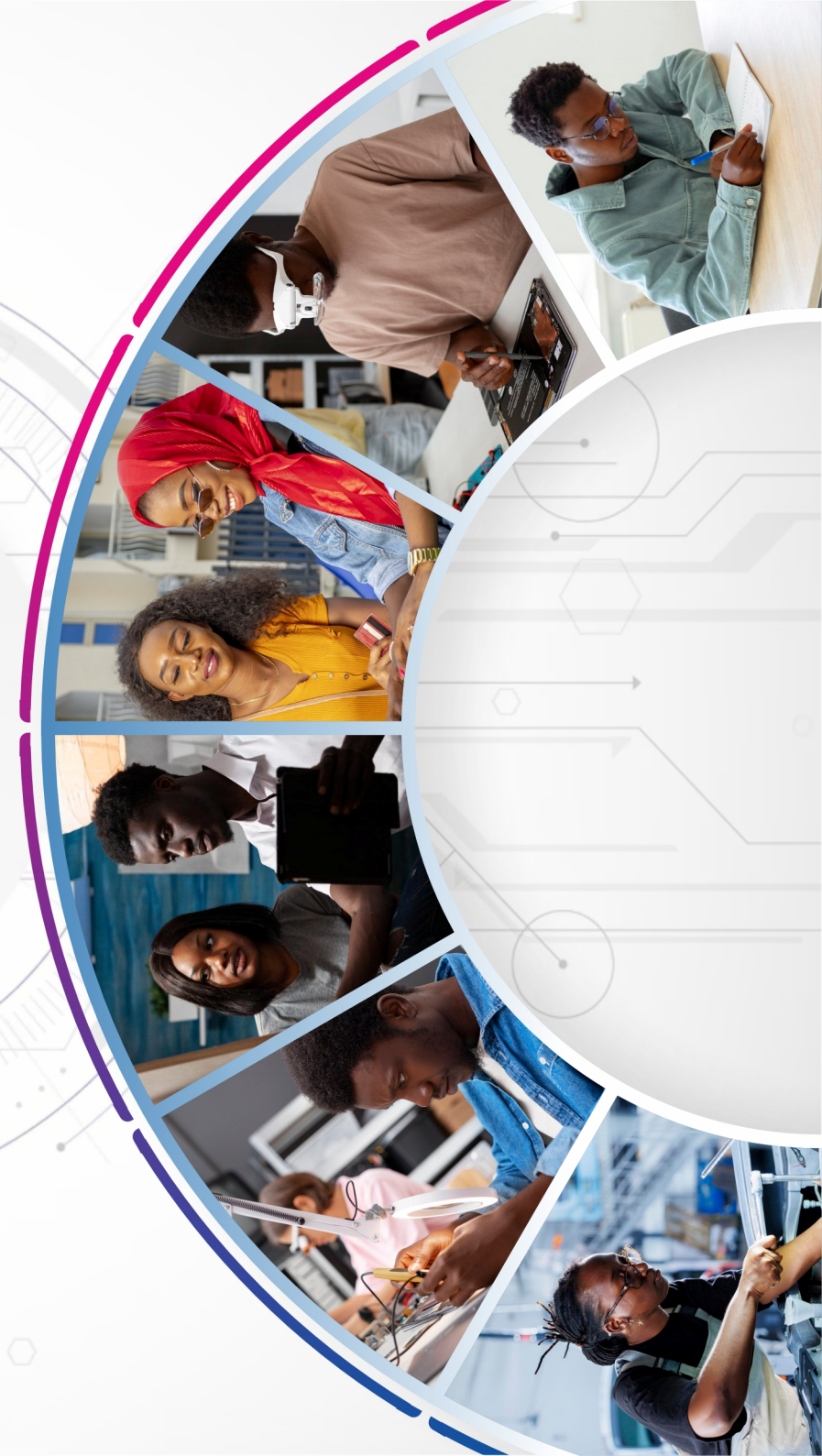
`

LIST OF PARTICIPANTS

NATIONAL TECHNICAL CERTIFICATE CURRICULUM DEVELOPMENT WORKSHOP FOR

AUTOMOTIVE MECHATRONIC (AUTOMATIVE GPV)

S/N	NAME	ADDRESS	EMAIL ADDRESS
1.	Col. Prof. AS Imam	NDA, Kaduna	abusurajo30@gmail.com
2.	Engr. Yakubu Rabiu	NDA, Kaduna	yakuburabiu05@gmail.com
3.	Aliyu Surajo	NDA, Kaduna	asurajo@gmail.com
NBTE STAFF			
4.	Prof. Idris M. Bugaje	Executive Secretary, NBTE Kaduna	es@nbte.gov.ng
5.	Engr. ADK Muhammad	PMU NBTE, Kaduna	
6.	Prof. Diya'uddeen B. Hassan	SA/ES, NBTE Kaduna	
7.	Engr. S M Yusuf	Director, VT&SD	
8.	Dr. Musa Hatim Koko	Director, CDD	Hatimlion@gmail.com
9.	Engr. Salisu Lawan	VT&SD, NBTE	salisulataura@gmail.com



World Bank – National Board
for Technical Education, Nigeria
Project on Innovation Development
and Effectiveness in the Acquisition
of Skills (IDEAS)

Plot B, Bida Road, PMB 2239,Kaduna
ideasworldbankproject@nbte.gov.ng
Tel: +234 (0) 802 4728 042