FEDERAL MINISTRY OF EDUCATION

National Technical Certificate (NTC) Curriculum in

AUTOMOBILE MECHANIC WORKS

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

AUTOMOBILE MECHANIC WORKS

2025

GENERAL INFORMATION

AIM

To give training and impart the necessary skills leading to the production of craftsmen 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 benefitting from the programme.

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 subject, which may be taken in Industry or 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 Subjects/Module

A Subject/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 subject/module when successfully completed can be used for employment purposes.

Behavioral Objectives

These are educational objectives, which identify precisely the type of behavior a student should exhibit at the end of a subject or programme. Two types of behavioral objectives have been used in the curriculum. They are:

a. General Objectives
b. Specific Learning Outcomes

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

a. Government in Political Science
b. Demand and supply in Economics
c. Orthographic Projection in Engineering/Technical Drawing;
d. Loci in Mathematics

Specific learning outcomes are concise statements of the specific behavior 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 subject/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, Physics, Chemistry, Economics, Biology, Entrepreneurial Studies and Mathematics to enhance the understanding of machines, tools and materials of their trades and their applications 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 programmes respectively.

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

National Certification

The NTC programme are run by Technical Colleges accredited by NBTE. The National Business and Technical Examinations Board (NABTEB) conducts the final National examination and awards certificates.

Trainee who successfully completes all the subjects/modules specified in the curriculum table and pass 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

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 subject 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 subject 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, (if properly organized and there are adequate resources), most of these subjects 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 Calculations

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 programm. The basic concepts and principles in mathematics and physical science are the same as in the trade calculations 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 are taken as pre-requisite to the trade module.

Evaluation of Programme/Module

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

Instructors should therefore devise methods of accurately assessing trainees to enable them give students 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 subject work and the National Examination.

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CURRICULUM TABLE – SUBJECT HOURS/WEEK – 12 WEEKS/TERM

SUBJECT: AUTOMOBILE MECHANIC WORKS

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE

SUBJECT CODE	MODULE	YEAR I						YEAR 2						YEAR 3						TOTAL HRS PER SUBJECT	HOURS PER WEEK
		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		
CMA 10	Mathematics	2	0	2	0	2	0	2	0	2	0	2	0	2	0	2	0	2	0	216	3.00
CPH 10	Physics	2		2		2	2	2	2	2	2	2	2	2	2	2	2	2	0	360	2.0
CCH 10	Chemistry	2	0	2	0	2	0	2	1	2	1	2	1	2	1	2	1	2	1	288	2.0
CEN 10	English Language and Communication	2	0	2	0	2	0	3	0	3	0	3	0	3	0	3	0	3	0	288	3.00
CEC 11-13	Economics	2	0	2	0	2	0	2	0	2	0	2	0	2	0	2	0	2	0	216	2.00
ICT 11	Introduction to Computers	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	36	3.00
ICT 12	Computer Application I	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	36	3.00
ICT 13	Computer Application II	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	36	3.00
ICT 13	AutoCAD I	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	36	3.00
ICT 14	AutoCAD II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	36	3.00
CTD 11	Technical Drawing	0	3	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	108	3.00
CTD 12	Plane Descriptive Geometry	0	0	0	0	0	0	0	3	0	3	0	3	0	0	0	0	0	0	108	3.00
CTD 13	Engineering Drawing	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	2	72	2.00
CME 11	General Metal Work I	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84	7.00
CME 12	General Metal Work II	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	60	5.00
CAM 111	Service Station	2	6																	96	8.00

	Mechanics I																				
CAM 122	Service Station Mechanics II			2	6															96	8.00
CAM 133	Tyre and Wheel Services I					2	6													96	8.00
CAM 2 11	Petrol Engine Maintenance I							2	6											96	8.00
CAM 2 2 2	Petrol Engine Maintenance II									2	6									96	8.00
CAM 223	Transmission System I									2	6									96	8.00
CAM 234	Tyre and Wheel Services II											2	6							96	8.00
CAM 235	Suspension Steering & Braking systems											2	6							96	8.00
CAM 311	Diesel Engine Maintenance I													2	6					96	8.00
CAM 322	Diesel Engine Maintenance II															2	6			96	8.00
CAM 323	Engine Reconditioning															2	6			96	8.00
CAM 334	Auto Elect/Electronics																	2	6	96	8.00
	GRAND TOTAL																			3348	116
CBM 10	Entrepreneurship										2		2	-	-	-	-	-		48	
	GRAND TOTAL																			3036	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE		
Subject: General Metal Work I	**Subject Code: MEC 11**	**Contact Hours 7hrs/wk**

Learning Outcome: On completion of this module the student will be able to:

1. Understand workshop safety rules and their application in machine shop.
2. Know ferrous and non-ferrous metals in common use
3. Understand the use of common measuring, marking out, cutting and striking tools.
4. Understand the working principles of drilling machine.
5. Understand the application of various types of screw threads and rivets.
6. Understand the ISO system of tolerances, fits and their application in engineering production.
7. Produce simple engineering components on the bench.
8. Know lathe machine operations and its uses.

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 time
3. Use and select hand tools for carrying out various bench fitting and assembly tasks
4. Use tools: such as hacksaws, taps, reamers, drills, dividers, surface gauge
5. Produce threads using taps and dies
6. Correctly grind drill point angles: twist and flat drills
7. Select and set drilling machine speeds to carry out a range of operations.
8. Perform metal joining by a range of processes.
9. Mark out on metals and other materials.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK						
Module: - General Metal Work I		**Module Code: MEC 11**		**Contact Hours: 7hrs/week**		
Subject Specification: Theoretical Content						
Week	**General Objective: 1.0Understand Workshop Safety Rules and Applications in Machine Shop**					
	Theoretical Content			**Practical Content**		
	Specific Objectives	**Teacher Activity**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1	1.1 State sources of hazards in the workshop and how to prevent them. e.g handling and using hand tools, portable power tools and machines; stepping on or striking obstructions left on floors or benches; lifting, moving and storing materials or jobs; using inflammable or corrosive liquids and gases; inhaling vapors or fumes; 1.2 Explain the application of factory safety regulations in the machine shop. 1.3 Explain Personal Protective	- Discuss sources of hazards in the workshop. - Discuss the application of factory safety regulations in the machine shop. - Discuss safety wears and equipment and their application in working situations. e.g Overall, eye goggle of safety wears gloves, safety boots, helmet, fire extinguishers, etc - Demonstrate how to treat	- Safety posters, - Common hand tools like files hacksaw. - Television - Overall, - Goggles, - Gloves, - Hard shoes, - Head shield, - Fire extinguishers. - Ferrous metals - Nonferrous metals - Overhead projector and Laptop.	Practice hazard preventive methods involving: handling and using hand tools, portable power tools and machines; stepping on or striking obstructions left on floors or benches; lifting, moving and storing materials or jobs; using inflammable or corrosive liquids and gases; inhaling vapors or fumes; - Select safety equipment and wears essential in a machine shop. - Select appropriate safety equipment and safety wears in the workshop.	- Guide the students on how to prevent hazard involving: handling and using hand tools, portable power tools and machines; stepping on or striking obstructions left on floors or benches; lifting, moving and storing materials or jobs; using inflammable or corrosive liquids and gases; inhaling vapors or fumes; -Guide student to select safety equipment and wears in the workshop. - guide students on use of safety equipment and wears essential in the	- Through questions and physical exercises to determine whether the students grasped the topic

	Equipment (PPE) essential in the workshop and their applications in working situations e.g. Overall, eye goggle, gloves, safety boots, helmet, fire extinguishers, etc.	emergency cases like artificial respiration, cold compress etc. - List the safety equipment and wears that are essential in the workshop.			machine shop	
General Objective 2.0: Know Ferrous and Non-Ferrous Metals in Common Use						
	2.1 Explain the following physical properties of metals: - ductility - malleability - strength - toughness - brittleness - elasticity - plasticity - 2.2 Describe the basic composition and properties of ferrous metals such as plain carbon steel, cast iron and alloy steel. 2.3 Explain with examples of tools and equipment made from steels and cast iron	- Discuss the physical properties of metals such as - - malleability - strength - toughness - brittleness - elasticity - plasticity Discuss the basic composition and properties of ferrous metals such as, plain carbon steel, cast iron and alloy steel - Describe with	Sample of mild steel, brass, low carbon steel, high carbon steel, aluminum, copper etc. Hand-held Photo Spectrometer, Multimedia Charts, Handheld spectrometer Cupola Furnace Blast furnace Hand held spectrometer Multimedia	1. Identify the physical properties of metals as listed in 2.1 2. Identify composition and physical properties of ferrous and nonferrous carbon steels or alloys 3. Identify the characteristics of tools or equipment made from steels and cast iron 4. Identify the application of plain carbon steel, cast iron and alloy steel 5. Identify	Show physical behavior of metal as listed in 2.1 Demonstrate using appropriate resources to determine composition and physical properties Demonstrate to the students the characteristics of tools or equipment made from steel or cast iron Demonstrate the application stated in 2.4 Demonstrate the different manufacturing process involved	Give students assignment on other methods of testing physical properties of metals Give students assignment on other methods of testing composition and physical properties of carbon or alloy Sketch and label tools equipment made from steel or cast iron Show the application of plain carbon steel cast iron and alloy steel by given example of their usage in the industry Sketch and label the

	2.4 Explain the application of plain carbon steel cast iron and alloy steel in the engineering industry. 2.5 Explain the following: a. the cupola process of manufacture of cast iron; b. the blast furnace process of manufacture of pig iron; c. the direct reduction process of manufacture of steel.	examples of tools and equipment made from steels and cast iron - Discuss the application of plain carbon steel cast iron and alloy steel in the engineering industry. - Discuss the following manufacturing process: a. the cupola process of manufacture of cast iron; b. the blast furnace process of manufacture of pig iron; c. the direct reduction process of manufacture of steel. Discuss the	Sample of Aluminum Zinc Cartridge brass Gilded metal Bronze Multimedia Charts	different manufacturing process involved in Cupola Furnace, Blast Furnace		features of the different types of furnace

	2.6 Explain 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 gunmetal, bell metal, aluminum bronze, phosphor bronze and lead.	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 gunmetal, bell metal, aluminum bronze, phosphor bronze and lead.				
General Objective 3.0: Understand the Use of Common Measuring, Marking-out, Cutting and Striking Tools.						
3-4	3.1 Explain units of measurement. 3.2 Explain with examples the difference between "line" and "end" measurement. 3.3 Explain the use of the measuring tools such as steel rule, measuring	- Discuss the units of measurement. - Differentiate between “line” and “end” measurement - Discuss the use of measuring tools listed in 3.3	Steel rule, dividers calipers, trammel, scribe, and angle plate vee block, Centre Square. Micrometer screw gauge, Vernier caliper, Vernier height gauge, combination set, Digital micrometer and digital	1. Identify and carry out the conversion in both Imperial and SI units for length, mass, area, volume and temperature. 2. Carry out line and end measurement on any material	Demonstrate the conversion of Imperial to SI unit Demonstrate line and end measurement to the students Guide student to use measuring tools as listed in 3.3: Guide students in	Give students exercise to perform unit conversion Give assignment to student to state the differences between line and end measurement

	tape, Vernier caliper and micrometer screw-gauge. 3.4 Explain the importance of accuracy in measurement. 3.5 Explain the use of datum points, datum lines and datum faces in marking out. 3.6 Describe the functions and application of the following instruments used in marking out; steel rule, dividers, trammel, scriber angle plate, vee- block, Centre punch, Tri- square. 3.7 Explain the use of template in marking-out operation 3.8 Explain the use of cutting tools such as straight snips, side cutting pliers,	- Discuss the term accuracy in measurement. - Discuss the use of datum point, datum lines and datum faces in marking out. - Discuss the functions and application of the following instruments used in marking out; steel rule, dividers, trammel, scriber angle plate, vee-block, Centre punch, Try-square. - Discuss the use of template in marking-out operation	Vernier caliper Steel rule, dividers, trammel, scriber angle plate, vee-block, Centre punch, Try square, straight snips, side cutting pliers, hacksaw, chisel and guillotine Flat file, hard file, round file square, half round, triangular file, warding file, rasp file Diagrams Charts Multimedia	3. Select the following measuring tools to measure diameter, length and thickness: - Steel rule -measuring -Tape - Vernier caliper - Micrometer Screw gauge - Digital Micrometer -Digital Vernier caliper Practice accuracy in the use of measuring instruments Practice marking out activities using datum points, datum lines Practice the use of all marking out instruments listed in 3.6 Practice the use of	making accurate measurement Guide students in marking out activities using datum points and datum lines Guide students in carrying out marking activities correctly Demonstrate the use of template in marking out operation. Demonstrate to students the use of various cutting tools listed in 3.8 Show students correct cutting techniques and posture Guide students in the use of appropriate files as listed in 3.10 Show diagram, charts or multimedia of a bench vice and its features	Perform test in the use of measuring instrument correctly Give students different work piece to measure and assess their accuracy of measurement Give students assignment to carry marking out activities Sketch with the aid of diagram use of template correctly in marking out operation Give students practical involving use of cutting tools listed in 3.8 and assess the students Give students practical exercise involving cutting technique and posture. Give students project having various shapes to students to file. Sketch a well label bench vice.

	hacksaw, chisel and guillotine. 3.9 Explain the importance of correct cutting technique and posture 3.10 Describe the various types of files, their grades and applications. 3.11 Describe the functions of the various parts of a bench vice and its holding power while performing various operations on it, such as filing, tapping, drilling etc. 3.12 Explain the use of the following striking tools such as chisel, hammer, mallet, wedges etc.	- Discuss the use of cutting tools such as straight snips, side cutting pliers, hacksaw, chisel and guillotine. Discuss the various types of files, their grades and applications. Discuss the various parts of a vice and its holding power while performing different operations in the workshop - Discuss correct cutting technique and posture. Discuss the use of the following striking tools such as chisel, hammer, mallet, wedges etc.		template in marking out operation Practice the use of cutting tools listed in 3.8 Practice correct cutting technique and posture Practice filing operation using different types of files as listed in 3.10 Sketch the bench vice and explain its clamping power Practice the technique of holding work in the vise for filing, drilling and tapping operations. Use the striking tools as correctly listed in 3.12	Demonstrate the technique of holding work in the vice for filing, drilling and tapping operations. Demonstrate the use of common striking tools in the workshop	Give students various work piece to hold, file, drill and tap for assessment. Give students project involving the use of striking tools.

General Objective 4.0: Understand the Working Principles of a Drilling Machine						
5-6	4.1 Explain the various types of drilling machines such as: Bench drill, Breast drill, Pillar drill, and drill bits. 4.2 Explain the main features of a bench or pillar drilling machine. 4.3 Explain 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 drill, countersink drill, counter bore drill, combination center drill. 4.4 Explain the effects of the following faults in a	Discuss the various types of drilling machines and bits Describe with sketches, the main features of a bench or pillar drilling machine. Discuss the use of the following types of drills: - twist drill - flat drill - countersink drill - counter bore drill - combination center drill Discuss the	Charts Multimedia Drilling machines and their accessories.	Sketch types of drilling machine and label them Identify the features of a bench or a pillar drilling machine. Carry out drilling operation that will require the use of twist drill Carry out drill operation that will require the use of jobber's drill Carry out drill operation that will require the use of flat drill Carry out the drill operation that will require countersink drill Carry out drill operation that will require the use of counter bore drill	- Show student types of drilling machines. Show the main features of a bench or pillar drilling machine Demonstrate the use of the following drills: - twist drill - flat drill - countersink drill - counter bore drill - combination Centre drill Guide students to identify faults in a ground twist drill bit Show student how to Calculate spindle revolution or cutting speed for specified size of drill using the formulae: - $N = 1000S/\pi d$ $S = \pi dN/1000$ Where S = cutting speed (m/min) N = revolution/minute	Give students assignment on the working principles of a drilling machine Give students exercises to calculate spindle revolution or cutting speed for specified size of drill using the formula. Perform safety precautions when using drilling machines. Sketch with the aid of

	ground twist drill bit: a. Point angle tool acute; b. Point angle tool obtuse; c. cutting edges at unusual angles; d. insufficient lip clearance; e. excessive lip clearance. 4.5 Describe the cause and remedy of drilling faults such as: a. drill breaking; b. drill colored blue; c. walls of drilled hole left rough; d. chipped cutting lips. 4.6 State the safety precautions to be observed when using a drilling machine. 4.7 Explain the purpose of reaming	effects of faults in a ground twist drill Discuss the cause and remedy of drilling faults such as: a. drill breaking; b. drill colored blue; c. walls of drilled hole left rough; d. chipped cutting lip Discuss the safety precautions to be observed when using a drilling machine.		Carry out drill operation that will require the use of combination center drill. Identify faults in a ground twist drill bit Calculate spindle revolution or cutting speed for specified size of drill using the formulae: - N = 1000S/πd S = πdN/1000 Where S = cutting speed (m/min) N = revolution/minute D = diameter of drill (mm) π = 3.142 Carry out remedy of drilling faults for: a. drill breaking; b. drill colored blue; c. walls of drilled hole left rough; d. chipped cutting lips. Carry out a project that involves the use	D = diameter of drill (mm) π = 3.142 Demonstrate how to remedy drill faults such as drill breaking, drill colored blue, walls of drilled hole left rough, chipped cutting lips etc. Give students to produce a project that involve the use of drilling machine Check for students' compliance to relevant safety precaution Show students how to ream to a given specification using hand and machine method	diagram types of hand and reaming machines.

	operation. 4.8 Describe different types of hand and machine reamers.	Describe reaming operation. Discuss different types of hand and machine reamers.		of drilling machine while observing safety precautions Ream to given specification by hand and machine method Sketch the different types of hand and machine reamers		
	General Objective 5.0: Understand the Application of Various Types of Screw Threads and Rivets					
7	5.1 Explain the various thread forms and their uses 5.2 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 tapping size and tapping drill. 5.4 State precautions to be taken when taping on the bench. 5.5 Describe the	- Discuss the various forms of threads and their uses Discuss the functions of taps, tap wrench, die and die stock Discuss the meaning of tapping size and tapping drill and estimate its value in given situations using formulae such as: - T = D - P Where T =	Diagrams/charts/real objects of thread forms. Parallel reamers taper reamers twist drills.	Sketch the thread forms below a. the ISO metric thread b. the unified thread c. Whitworth and British fine threads d. British Association (BA) thread e. British Standard pipe f. Square thread g. Acme thread h. Buttress Thread Sketch the following: - a. taps (taper tap, second tap, plug) b. tap wrench c. die and die stock.	Show the various thread forms Guide students to estimate tapping size and tapping drill Demonstrate the use of taps, tap wrench and die and die stock Observe student's compliance of safety precaution when taping on the bench Show to the students the various types of rivets Guide students to calculate diameter of rivet and riveting	Assess the Students

	types of rivets. e.g. Snap and pan head, mushroom and countersunk head, flat head, hollow head rivet, etc. 5.6 Explain rivet set and its use. 5.7 Explain how to calculate diameter of rivet and riveting allowance	tapping diameter D = thread top diameter P = pitch. Discuss precautions to be taken when taping on the bench. Explain the types of rivets. e.g. Snap and pan head, mushroom and countersunk head, flat head, hollow rivet, conical head rivet etc. Discuss rivet set and its use. Discuss how to calculate diameter of rivet and riveting allowance	Rivet set	Estimate the value of tapping size and tapping drill in given situations using formulae such as: - T = D - P Where T = tapping diameter D = thread top diameter P = pitch Practice the use of taps, tap wrench and die and die Carry out taping on the bench while observing relevant safety precautions Identify the types of rivets Sketch rivet set Calculate diameter of rivet and riveting allowance	allowance	

	General Objective 6.0: Understand the ISO Tolerances, 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 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.	Discuss nominal size, limits, tolerance and fit in engineering production Discuss the important of tolerance and fits in engineering production as well as describing the ISO systems of limits and fits. Explain how to calculate the amount of tolerance and select types of fits.	- Charts on tolerances, limits and fits.	Calculate the amount of tolerance and types of fit in given situations.	Guide students to calculate the amount of tolerance and select types of fit in a given situations.	Assess the Students

	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 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	Discuss 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. Describe how to produce a simple engineering component Discuss how to carry out simple precision fitting project. e.g. hexagonal mild steel bar, making push fit through a mild steel plate.	- Lesson notes - Diagrams and charts	Interpret layout procedure from working drawing.	Show students how to interpret layout procedures from working drawing Supervise students following the sequence to produce the engineering components like open ended spanner, engineer's try square, tool maker's clamp, plate bracket or gusset (involving rounds, angles, holes), Centre square etc. Show students how to carry out precision fitting.	

	General Objective: 8.0: Know Lathe Machine Operations and their Uses					
10	8.1 Explain the term lathe machine and its types 8.2 Explain the essential features and function of a center lathe machine such as lathe bed, headstock, tailstock, saddle or carriage, etc. 8.3 Explain the working principles of the center lathe. 8.4 Explain the function of the accessories of a center lathe machine such as chuck, drive plate, face plate, angle plate, carrier, lathe centers, mandrel etc 8.5 Explain the difference between center lathe and capstan lathe, in	Discuss the term lathe machine and its types Discuss the essential features and function of a center lathe machine such as lathe bed, headstock, tailstock, saddle or carriage, etc. Discuss the working principles of the center lathe. Discuss the function of the accessories of a center lathe machine such as chuck, drive plate, face plate, angle plate, carrier,	- Centre lathe and accessories like catch plates, face plates, centers, fixed and traveling 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. Charts on tool height - Charts and diagrams of different machining operations	Sketch three types of common lathe machine Operate the features of center lathe under supervision Practice the adjustment/use accessories of a center lathe machine chuck, drive plate, face plate, angle plate, carrier, lathe centers, mandrel etc Demonstrate the use of cutting fluids for different lathe operations Select common tools used in lathe machine Practice how to fix lathe tools practice varying tool angles for different metals	Show to the students various types of lathe machines. Show students how the features of a center lathe operate. Show students how to use the accessories of center lathe such as chuck, drive plate, face plate, angle plate, carrier, lathe centers, mandrel etc Show the different operational features of center lathe and capstan lathe. Show to the students different types cutting fluids used for lathe turning operations. Demonstrate how to fix common tools used in lathe. Show students how to	Assess the Students

	terms of their main features and functions. 8.6 Explain types and functions of cutting fluids used for lathe turning operations. 8.7 Describe common tools used in lathe machine: e.g butt-brazed tool, tipped tool bit etc. 8.8 Explain the functions of tool angles (rake, clearance), and the values for different metals to be machined. 8.9 Differentiate between various tool shapes and state their uses e.g Round nose rougher, fine finishing, side finishing, knife tool, form tool, parting off tool, boring tool, etc.	lathe centers, mandrel etc Differentiate between center lathe and capstan lathe, in terms of their main features and functions. List types of cutting fluids used for lathe turning operations. Discuss common tools used in lathe machine: e.g butt-brazed tool, tipped tool bit etc Discuss with sketches the functions of tool angles (rake, clearance), and the values for different metals to be machined. Discuss various		Select tools according to shape and use Identify the effects of wrong setting cutting tool Operate lathe machine while observing the relevant safety precautions 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 Compute required taper dimensions from given data using taper ratio angle formulae i.e. Taper Ratio = d2 – d1/L OR Tan 0/2 = d2 d1/2	vary tool angles for different metals Show students how to select tools in line job requirements Show students the use of wrong setting cutting tool Guide students to operate a center lathe machine while observing safety precautions in the workshop. Guide students to calculate the cutting speed and feed for given turning operation. Demonstrate how to Estimate the rate of metal removal and time required for carrying out specified turning operations Guide students to compute taper dimensions Show students how to	

	8.10 Explain the effects of wrong setting cutting tool: e.g vibration and chatter, tool rubbing against or digging into the job. Define cutting speed and feed with respect to lathe operation. 8.11 Explain safety precautions to be observed when working on the lathe. 8.12 Define cutting speed and feed with respect to lathe operation 8.13 Explain how to set up the lathe for carrying out turning between centres while observing safety precautions	tool shapes and state their uses such as Round nose rougher, fine finishing, side finishing, knife tool, form tool, parting off tool, boring tool, etc. Discuss with sketches the effects of wrong setting cutting tool: e.g vibration and chatter, tool rubbing against or digging into the job. Define cutting speed and feed with respect to lathe Operation. State the procedure to set up the lathe for use for turning operation while observing safety precautions Discuss cutting		where 0 = taper angle di - small and diameter d2 = large end diameter L = length of taper Set up the lathe for use in line with standard Carry out basic turning operations between centres with the assigned workpiece	set up the lathe for use Demonstrate turning operations between centres for a given metal	

		speedand feed with respect to lathe operations Discus how to set up the lathe for carrying out turning between center while observing safety				

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE		
MODULE: GENERAL METAL WORK II	**MODULE CODE : MEC 12**	**CONTACT HOURS: 5hrs/wk**

GOAL: The module is designed to introduce the trainees to basic processes in Mechanical Engineering such as forging, sheet-metal work and welding.

General Objectives:

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

1. Understand the basic principles and processes of heat treatment of metal in the workshop.
2. Produce simple engineering components by forging.
3. Understand the basic principles and techniques of gas and metal arc welding.

PRACTICAL COMPETENCE: On completion of this module students will be able to:

1. Carry out heat treatment of metal in the workshop
2. Produce simple engineering components by forging
3. Carryout gas/arc welding and apply them in fabricating simple engineering components

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE						
MODULE: GENERAL METAL WORK II	MODULE CODE: MEC 12			CONTACT HOURS: 5hrs/wk		
MODULE SPECIFICATION: KNOWLEDGE REQUIREMENTS						
GENERAL OBJECTIVES: General Objective 1.0: Understand the Basic Principles and Processes of Heat Treatment of Metal in the Workshop.						
THEORETICAL CONTENT				PRACTICAL CONTENT		
WEEK	**Specific Learning Outcome:**	**Teacher Activities**	**Resources**	**Specific learning outcome**	**Teacher activity**	**Evaluation**
1-4	1.1 List different types of metals used in workshop 1.2 Explain briefly the structural behavior of plain carbon steel as it is heated from room temperature to about 1000^0C for the purposes of: a. Hardening b. Tempering c. Annealing d. Normalizing e. Case-hardening. 1.4 Explain the meaning of hardening metal work. 1.5 State safety precautions relating to heat treatment processes and apply them in given situations. 1.6 State the importance of heat treatment of metal.	State the types of metals use in workshop Discuss the structural behavior of plain carbon steel as it is heated from room temperature to about 1000^0C for the purposes of: a. Hardening b. Tempering c. Annealing d. Normalizing e. Case-hardening Discuss hardening metal work. Discuss safety precautions relating to heat treatment processes and apply them in given situations. Discuss the importance of heat treatment of metal.	Electric furnace Blast furnace Tubular furnace Sample of metals	Select different types of metals in the workshop. Identify structural behavior of plain carbo steel when heated for the purpose: a. Hardening b. Tempering c. Annealing d. Normalizing e. Case- hardening Select safety equipment and wears in relation to its treatment.	Show to the Students different types of metals in the workshop Guide the students to identify structural behavior of plain carbon steel when heated for the purposes of metal heat treatment.	.

General Objective 2.0: Understand the Techniques of Producing Simple Engineering Components by Forging.						
5-6 **7-8**	2.1 Describe the main feature of the black smith's forge. 2.2 Explain the working principles of the black smith's forge. 2.3 State the functions of common forging tools such as anvil, swage block, leg vice, forging hammers, hot and cold sets, set hammer, punches and drifts, press, fullers, top and bottom swages flatter, tongs (open mouth, closed mouth, hollow bit, etc.). 2.4 Describe the following forging operations: a. upsetting b. drawing down c. setting down d. twisting e. forge welding (scarf and splice welds) f. bending g. forming closed ring h. forming an eye.	Discuss the main feature of the black smith's forge. Discuss the working principles of the black smith's forge. State the functions of common forging tools such as anvil, swage block, leg vice, forging hammers, hot and cold sets, set hammer, punches and drifts, press, fullers, top and bottom swages flatter, tongs (open mouth, closed mouth, hollow bit, etc.). Discuss the following forging operations: a. upsetting b. drawing down c. setting down d. twisting e. forge welding (scarf and splice welds) f. bending g. forming closed ring h. forming an eye.	- Charts - Poster	Sketch the main features and working principles of the black smith's forge. Sketch common forging tools select forging tools available in the workshop Carry out following forging operations: a. upsetting b. drawing down c. setting down d. twisting e. forge welding (scarf and splice welds) f. bending g. forming closed ring h. forming an eye.	Show students the main features of the black smith's forge Show students forging tools in the workshop Demonstrate forging operations such as upsetting, drawing down, setting down, twisting, forge, welding (scarf and splice welds), bending, forming closed ring, forming an eye etc	

General Objective 3.0: Understand the Basic Principles and Techniques of Gas and Metal Arc Welding						
	3.1 Define welding 3.2 Explain the principles and application of gas welding. 3.3 Explain the equipment used for gas welding. 3.4 State the safety precautions to be observed in carrying out gas welding 3.5 Explain the principle and application with metal arc welding. 3.6 Describe the equipment used for metal arc welding.	Discuss welding Discuss the principles and application of gas welding. Discuss the equipment used for gas welding. Discuss safety precautions to be observed in carrying out gas welding Discuss the principle and application with metal arc welding. Discuss the equipment used for metal arc welding. Discuss the safety precautions to be observed in carrying out gas welding	- Oxygen cylinder acetylene cylinder regulations arc welding set goggles, shield electrode. - Diagrams and charts of various welding joints, and techniques.	Select equipment used for gas welding Prepare metal joint for gas welding Join metals together by gas welding while observing the relevant safety precautions Select equipment used for metal arc welding Select consumables used for metal arc welding Join metals together by arc welding operation while observing relevant safety precautions Produce a project that will involve the gas and metal arc welding processes	Show Students equipment used for gas welding Demonstrate how to prepare joint for welding Demonstrate gas welding operation Check for students' compliance to relevant safety precautions Show Students equipment and consumables used for metal arc welding Demonstrate the use of metal arc welding machine	Give student project and supervise them

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK MODULE: CAM 111: SERVICE STATION MECHANICS I
DURATION: 96 HOURS

GOAL: This module is designed to produce a forecourt service mechanic with a thorough knowledge of routine service and ability to carry out forecourt servicing and sales.

GENERAL OBJECTIVES

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

1. Basic automotive service tools and equipment
2. Seal and lock methods used in automobile components/parts.
3. Basic routine maintenance of automobiles.
4. Basic construction of a battery and its maintenance.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK.						
Module: - SERVICE STATION MECHANIC I				**Module Code: CAM 111**	**Contact Hours: 8hrs/week**	
Subject Specification: Theoretical Content						
Week	**General Objective: 1.0 Understand basic automotive service tools and equipment.**					
	Theoretical Content			**Practical Content**		
	Specific Objectives	**Teacher Activity**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**
1 - 2	1.1 List basic tools and equipment in the automotive workshop 1.2 List the major parts of an automobile e.g. engine, gearbox, clutch, chassis, rear axle, power transmission train, and body. 1.3 Describe in detail the functions of major parts listed in 1.2 above. 1.4 Explain the principles of operations of each component	Explain basic tools and equipment in the automotive workshop Explain the major parts of an automobile e.g. engine, gearbox, clutch, chassis, rear axle, power transmission train, and body. Explain in detail the functions of major parts listed in 1.2 above. Explain the principles of operations of each	Whiteboard Whiteboard marker Projector Duster Textbooks	Use as appropriate hand/power tools in accordance with safe working practices to remove and replace oil filter Use and maintain; • Hand tools • Ancillary equipment • Safety aids. Demonstrate work skills to select correct materials and tools for a project. Sketch a chassis layout showing relative position of the main components of a vehicle e.g. engine, transmission, propeller-shaft,	Guide students to: Use as appropriate hand/power tools in accordance with safe working practices to remove and replace oil filter Use and maintain; • Hand tools • Ancillary equipment • Safety aids. Demonstrate work skills to select correct materials and tools for a project. Sketch a chassis layout showing relative position of the main components of a vehicle	Complete Automobile tool box Model Vehicle Engine lifter (chain and Hydraulic) Hoist Floor jack Stroboscope Portable exhaust analyzer Automobile stethoscope Axle stands Engine oil retainer Grease gun Multi-meter Floor pitch Air compressor

	listed in 1.2 above	component listed in 1.2 above		rear axle, front axle, suspension and steering control linkages to road wheels, etc.	e.g. engine, transmission, propeller-shaft, rear axle, front axle, suspension and steering control linkages to road wheels, etc	

General Objective 2.0: Understand seal and lock methods used in automobile components/parts						
3-6	2.1 Explain the functions, strength and limitations of the following securing devices: • Securing devices (nuts and bolt, set screws, stud, allen, grub, Philip screw, etc • Thread types and sizes (BSW, BSF, BSP, UNC, UNF) 2.2 State the functions, strength and limitations of the following locking devices; springs, shake proof and tap washers, locking plates, castellated and self-locking nuts, split pins, circlip pins, bolt locking wire 2.3 State the functions,	Explain the functions, strength and limitations of the following securing devices: • Securing devices (nuts and bolt, set screws, stud, allen, grub, Philip screw, etc • Thread types and sizes (BSW, BSF, BSP, UNC, UNF) Explain the functions, strength and limitations of the following locking devices; springs, shake proof and tap washers, locking plates, castellated and self-locking nuts, split pins, circlip pins, bolt locking wire Explain the functions,	Whiteboard Whiteboard marker Projector Duster Textbooks	Carryout fitting of auxiliary locking and security devices. Identify seal and locking device and where they are appropriately applied. Identify how to apply locking on motor components Identify pipe union and joints; copper, flexible plastic pipes couplings, hose clips etc.	Guide students to: Carryout fitting of auxiliary locking and security devices. Identify seal and locking device and where they are appropriately applied. Identify how to apply locking on motor components Identify pipe union and joints; copper, flexible plastic pipes couplings, hose clips etc	Complete sealing and locking devices and materials Complete automotive tool box Portable hand drill machine Portable drilling and filing tools Threading tools

	strength and limitations of the following Sealing devices; gaskets, joint plugs, compounds, etc	strength and limitations of the following Sealing devices; gaskets, joint plugs, compounds, etc Pipe union and joints e.g. copper, flexible plastic pipe, straight coupling, elbow and banjo unions, formed nipple, olive and union nuts, swaged and pipe fixing, hose clips.				

General Objective 3.0: Understand the different types of automobile maintenance						
7-8	3.1 Explain the types of automobile maintenance 3.2 Explain the operations in routine vehicle maintenance, e.g. replace oil filter, spark plugs, contact breaker, clean and adjust carburetor (S.I System), check distributor leads and petrol pump.	Explain the types of automobile maintenance Explain the operations in routine vehicle maintenance, e.g. replace oil filter, spark plugs, contact breaker, clean and adjust carburetor (S.I System), check distributor leads and petrol pump.	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks	Identify lubricant types and their specific uses e.g. vegetable base grease, animal base grease, multi- purpose grease, high melting point grease. Oil – S.A.E. and API ratings, multi grade oil; Fluid – High and low boiling point fluid. Identify different filters, pre-filtration and filtrations system	Guide students to: Identify lubricant types and their specific uses e.g. vegetable base grease, animal base grease, multi- purpose grease, high melting point grease. Oil – S.A.E. and API ratings, multi grade oil; Fluid – High and low-boiling point fluid. Identify different filters, pre-filtration and filtrations system (paper filters, fabric, cyclone,	Complete Auto Mechanic tool box Engine Oil Brake fluid Brake fluid tester Grease Different types of filters -Eng ne oil retainer --Automobile diagnostic scan tool -DOT meter -Stroboscope -Induction

	3.3 List lubricant types and their specific uses e.g. vegetable base grease, animal base grease, multi- purpose grease, high melting point grease 3.4 Discuss oils and fluid and their uses; a. Oil – S.A.E. ratings, multi grade oil; b. Fluid – High and low boiling point fluid. 3.5List types of filters 3.6 Explain safety precautions in routine vehicle maintenance 3.7Explain the roles of computer in	Explain lubricant types and their specific uses e.g. vegetable base grease, animal base grease, multi- purpose grease, high melting point grease 3.4 Explain oils and fluid and their uses; a. Oil – S.A.E. ratings, multi grade oil; b. Fluid – High and low boiling point fluid. Explain types of filters Explain safety precautions in routine vehicle maintenance		(paper filters, fabric, cyclone, wire-mesh filters etc.). Work in a way which minimizes the risk of damage to the Automobile and its systems and the surrounding area. Use suitable PPE and automobile coverings throughout all automobile maintenance activities. Identify and use appropriate diagnostic tools and equipment for routine automobile maintenance Show the students different types of lubricants and fluids. Show the Students different types of filters, pre-filtration and filtration system	wire-mesh filters etc.). Work in a way which minimizes the risk of damage to the Automobile and its systems and the surrounding area. Use suitable PPE and automobile coverings throughout all automobile maintenance activities. Identify and use appropriate diagnostic tools and equipment for routine automobile maintenance Show the students different types of lubricants and fluids. Show the Students different types of filters, pre-filtration and filtration system Demonstrate how to work safely to minimize	tester -Spark plug tester Sparkplug cleaner -Exhaust gas analyzer -Hoist -Floor jack -Bearing puller -Coil spring compressor -Hydraulic jack -Axle stand

	modern automobiles. 3.8Explain the applications of computer in automobile workshop. 3.9Describe how to use diagnostic scanner in reading, interpreting and erasing diagnostic trouble code (DTC) on vehicles. 3.10 Explain the uses of exhaust gas analyzer in diagnosing faults on a vehicle.	Explain the roles of computer in modern automobiles. Explain the applications of computer in automobile workshop. Describe how to use diagnostic scanner in reading, interpreting and erasing diagnostic trouble code (DTC) on vehicles. Explain the uses of exhaust gas analyzer in diagnosing faults on a vehicle.		Demonstrate how to work safely to minimize risk to equipment and surroundings Show students PPE and covering of vehicle during maintenance activity Demonstrate the use of diagnostic tools and equipment for routine Automobile maintenance. Read, interpret and erase DTCs on Vehicles Demonstrate the uses of exhaust gas analyzers in diagnosing faults on a vehicle.	risk to equipment and surroundings. Show students PPE and covering of vehicle during maintenance activity Demonstrate the use of diagnostic tools and equipment for routine Automobile maintenance. Read, interpret and erase DTCs on Vehicles Demonstrate the uses of exhaust gas analyzers in diagnosing faults on a vehicle.	

General Objective 4.0: Understand the Basic Construction of a Battery and its Maintenance.						
9-10	4.1 Explain the function of battery in an automobile	Explain the function of battery in an automobile	Whiteboard Whiteboard marker Projector Duster Textbooks	Check Battery acid level and condition. Test charging condition of Battery	Guide students to: Check Battery acid level and condition. Test charging condition	-Used battery model -Battery charger -Hydrometer -Distill water

	4.2 Mention types of batteries and their capacity ratings. 4.3 Describe the basic construction of a battery and its components. 4.4 List battery faults	Explain types of batteries and their capacity ratings. Explain the basic construction of a battery and its components. List battery faults		Identify hazard associated with Battery and its materials	of Battery Identify hazard associated with Battery and its materials	-Battery acid -Battery discharge meter -Jump start cable -Test lamp -Digital multi meter -Sand bucket -Battery journals -Battery tester

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK MODULE: CAM 122: SERVICE STATION MECHANICS II
DURATION: 96 HOURS

GOAL: This module is designed to produce a forecourt service mechanic with a thorough knowledge of routine service and ability to carry out forecourt servicing and sales.

GENERAL OBJECTIVES

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

1. Basic principles of the Automobile and general maintenance.
2. Combustion process in spark and compression ignition engines.
3. Service station operation procedures.
4. Safety precautions relating to the handling and storage of fuels and oils.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK.						
Module: - SERVICE STATION MECHANIC II				**Module Code: CAM 122**		**Contact Hours: 8hrs/week**
Subject Specification: Theoretical Content						
Week	**General Objective: 1.0 Understand the Basic Principles of the Automobile and General Maintenance**					
	Theoretical Content			**Practical Content**		
	Specific Objectives	**Teacher Activity**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**
1 -2	1.1 List basic Automobile maintenance activities 1.2 Explain the basic operating principles of brakes, clutch and cooling systems 1.3 Explain the causes of leakages in brakes, clutch and cooling system components	Explain basic Automobile maintenance activities Explain the basic operating principles of brakes, clutch and cooling systems Explain the causes of leakages in brakes, clutch and cooling system components Record and communicate findings to the relevant personnel	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Manufacturers' specifications/recommendations ▪ (Hand book, and Electronic Manuals e.g. All-Data, Auto-Data, Michell on demand and Identifix).	Use suitable sources of technical information to support all automobile maintenance activities. Remove and replace brakes, clutch and cooling system components Identify causes of Leakages in brakes, clutch and cooling system components Demonstrate the ways of minimizing the risk of damages to automobile, its systems and the surrounding area. Use manufacturer's routine maintenance	Guide students to: Use suitable sources of technical information to support all automobile maintenance activities. Remove and replace brakes, clutch and cooling system components Identify causes of Leakages in brakes, clutch and cooling system components Demonstrate the ways of minimizing the risk of damages to automobile, its systems and the surrounding area. Use manufacturer's	▪ Complete Auto Mechanic tool box ▪ Engine Oil ▪ Brake fluid ▪ Grease ▪ Different types of filters ▪ Engine oil retainer ▪ Automobile scan tool ▪ DOT meter ▪ Stroboscope ▪ Induction tester ▪ Spark plug tester ▪ Spark plug cleaner ▪ Gas emission analyzer ▪ Hoist ▪ Floor jack ▪ Bearing puller ▪ Coil spring presser

				checklist accurately. Dismantle and assemble components in a way which minimizes the risk of damage to the automobile and its systems. Use suitable and accurate testing methods to evaluate the performance of all replaced and adjusted components/system.	routine maintenance checklist accurately. Dismantle and assemble components in a way which minimizes the risk of damage to the automobile and its systems. Use suitable and accurate testing methods to evaluate the performance of all replaced and adjusted components/system	▪ Hydraulic jack ▪ Axle stand ▪ Torque wrench ▪ Washing pan ▪ Live vehicle ▪ Vehicle simulator
	General Objective 2.0: Understand the Basic Combustion Process in Spark and Compression Ignition Engines					
3-6	2.1 Mention the main components/parts of a multi cylinder engine. 2.2 Explain the Constructional details of cylinder blocks, heads and gaskets, cylinder liners and sumps. 2.3 Explain the working sequence of two,	Explain the main components/parts of a multi cylinder engine. Explain the Constructional details of cylinder blocks, heads and gaskets, cylinder liners and sumps. Explain the working sequence of two, and four stroke engines.	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks	Sketch parts of four-cylinder engine. Sketch cylinder head of an engine showing details, and explain the importance of gasket and cylinder liners Draw/sketch the	Guide students to: Sketch parts of four-cylinder engine. Sketch cylinder head of an engine showing details, and explain the importance of gasket and cylinder liners	▪ Complete engine (Petrol and diesel) ▪ Diesel and petrol engine simulator s ▪ Exhaust Gas Analyzer ▪ Engine valve grinder ▪ Grinding paste

	and four stroke engines. 2.4 Explain the faults that can occur due to incorrect tightening of cylinder head. 2.5 Explain the viscosity of lubricants, its variation with temperature and viscosity index. 2.6 Explain the use of additives to control detonation and deposits.	Explain the faults that can occur due to incorrect tightening of cylinder head. Explain the viscosity of lubricants, its variation with temperature and viscosity index. Explain the use of additives to control detonation and deposits.		lubricating systems of an engine showing valve arrangements and camshaft drives. Sketch lubricating system of an engine and show all the important points of lubrication	Draw/sketch the lubricating systems of an engine showing valve arrangements and camshaft drives. Sketch lubricating system of an engine and show all the important points of lubrication	
	General Objective 3.0: Understand Service Station Operation Procedures					
Week 7-10	3.1 List safety precautions necessary in handling fuels and lubricants 3.2 State the features, applications and properties of fuels and lubricants. 3.3 Explain the procedures to be carried out in battery charging and beam setting operations.	Explain safety precautions necessary in handling fuels and lubricants Explain the features, applications and properties of fuels and lubricants. Explain the procedures to be carried out in battery charging and beam setting operations.	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks	Discuss safety applications on handling fuels and lubricants. Discuss the features of fuels and lubricant. Carry out battery charging, beam setting, etc. Operate forecourt equipment such as battery charger, air	Guide students to: Discuss safety applications on handling fuels and lubricants. Discuss the features of fuels and lubricant. Carry out battery charging, beam setting, etc. Operate forecourt equipment such as battery charger, air	Complete service station equipment Charts, Hand tools Battery charger Beam setter etc. Complete toolbox Fuels (diesel and gasoline) Lubricants (different grades/ratings)

	3.4 Explain forecourt/service station operations	Explain forecourt/service station operations		compressor, water compressor, vehicle light/beam setter, etc.	compressor, water compressor, vehicle light/beam setter, etc	
	General Objective 4.0: Understand the Safety Precautions Relating to the Handling and Storage of Fuel and Lubricants					
11-12	4.1 Explain safety precautions in using fuels and lubricants. 4.2 Enumerate the precautions to avoid fuel and lubricants contamination when stored or handled. 4.3 . Describe the health hazards due to handling of fuel, oil and the required precautions. 4,4 Mention the safety precautions to be observed when dealing with high pressure fuel injection system and when using test equipment. 4,5 Explain the action of an agglomerator/sedimentor filter	Explain safety precautions in using fuels and lubricants. Explain the precautions to avoid fuel and lubricants contamination when stored or handled. Explain the health hazards due to handling of fuel, oil and the required precautions. Explain the safety precautions to be observed when dealing with high pressure fuel injection system and when using test equipment. Explain the action of an agglomerator/sedimentor filter	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks	▪ Sketch a cross section of a sedimentor and indicate the fuel flow path ▪ Sketch the fuel flow circuit of an Automobile. ▪ Sketch a typical fuel filter and state the need for constant maintenance ▪ Demonstrate Engine oil and fuel filter replacement procedures	Guide students to: Sketch a cross section of a sedimentor and indicate the fuel flow path Sketch the fuel flow circuit of an Automobile. Sketch a typical fuel filter and state the need for constant maintenance Demonstrate Engine oil and fuel filter replacement procedures	▪ Typical fuel pump models and oil pump models. ▪ Oil filter ▪ Fuel filter ▪ Viscometer ▪ Fuel and oil pressure gauge

ROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK. MODULE: CAM 133 TYRE AND WHEEL SERVICES I.
DURATION: 96 HOURS.

GOAL: This module aims to provide trainees with both theoretical knowledge and practical skills to perform precise tyre repair and vulcanization activities and understand legal and safety consideration in tyre repair works**.**

GENERAL OBEJCTIVES

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

1. Understand the maintenance of tyres

2. Understand Tyre repairs and vulcanization

3. Understand Legal and Safety Considerations in tyre repair works

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK.						
Module: - TYRES AND WHEEL SERVICE I				**Module Code: CAM 133**	**Contact Hours: 8hrs/week**	
Subject Specification: Theoretical Content						
Week	**General Objective: 1.0** Understand the Maintenance of Tyres					
	Theoretical Content			**Practical Content**		
	Specific Objectives	**Teacher Activity**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**
1-3	1.1 Explain markings and codes on tyres e.g. load/speed ratings, tyre size /aspect ratio, manufacturing date. 1.2 Explain the materials used in wheel manufacture and reasons for their use. 1.3 Outline procedures involved in tyre removal and refitting. 1.4 State reasons for tyre wear 1.5 1.6 Identify safety precautions in tyre maintenance.	Explain markings and codes on tyres e.g. load/speed ratings, tyre size /aspect ratio, manufacturing date. Explain the materials used in wheel manufacture and reasons for their use. Explain procedures involved in tyre removal and refitting. State reasons for tyre wear Identify safety precautions in tyre maintenance.	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks	Identify tyre construction e.g. radial, bias and belted. Identify different tyres, wheel and wheel construction. Perform tyre change service operation,	**Guide students to:** Identify tyre construction e.g. radial, bias and belted. Identify different tyres, wheel and wheel construction Perform tyre change service operation,	Sample tyres
	General Objective: 2.0: Understand tyre repairs and vulcanization					
4 -8	2.1 Explain types of tyre damage (punctures,	Explain types of tyre damage (punctures,	Whiteboard Whiteboard marker	Recognize and classify different types of tyre	Guide students to: Recognize and	Sample damaged tyres

	cuts, sidewall damage, tread separation). 2.2 Explain Tyre Repair Techniques 2.3 Differentiate temporary vs. permanent repair 2.4 Explain retreading and re-grooving processes 2.5 Explain visual inspection techniques	cuts, sidewall damage, tread separation). Explain Tyre Repair Techniques Differentiate temporary vs. permanent repair Explain retreading and re-grooving processes Explain visual inspection techniques	Projector Duster Textbooks	damage. Assess severity and determine repair or replacement. Identify the correct repair process for specific damages Perform Tyre Repair and Vulcanization	classify different types of tyre damage. Assess severity and determine repair or replacement. Identify the correct repair process for specific damages Perform Tyre Repair and Vulcanization	Images/videos Tyre manufacturer manuals. Tyre repair kits, Demonstration videos Manuals Vulcanizing machine
	General Objective: 3.0 Understand Legal and Safety Considerations in Tyre repairs					
9-12	3.1 Discuss safety consideration 3.2 Explain industry safety standards 3.3 Discuss hazards of improper tyre repair. 3.4 Discuss Legal Considerations	Explain safety consideration Explain industry safety standards Explain hazards of improper tyre repair. Explain Legal Considerations	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks	Conduct post-repair quality checks. Perform pressure tests procedures. Provide case studies on safety violations. Demonstrate correct safety procedures Supervise quality inspection	Guide students to: Conduct post-repair quality checks. Perform pressure tests procedures. Provide case studies on safety violations. Demonstrate correct safety procedures	Industry safety manuals, government regulations PPE.

	3.5 Explain key tire regulations e.g. tire disposal and recall, usage etc 3.6 Explain Quality Control in Tyre Repair	Explain key tire regulations e.g. tire disposal and recall, usage etc Explain Quality Control in Tyre Repair		activities. Carryout maintaining repair records.	Supervise quality inspection activities. Carryout maintaining repair records	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK MODULE: CAM 211 PETROL ENGINE MAINTENANCE I
DURATION: 96 HOURS

GOAL: This module is designed to produce a petrol engine maintenance craftsman who should understand the basic principles of operation, carry out general maintenance and reconditioning work on petrol engines.

GENERAL OBJECTIVES

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

1. Understand general safety precautions.
2. Understand basic working principles of petrol engines
3. Understand the working principles of valves

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK.						
Subject : PETROL ENGINE MAINTENANCE I		**Subject Code : CAM 211**		**Contact Hours: 8hrs/week**		
Subject Specification: Theoretical/Practical Content						
General Objective 1.0: Understand General Safety precautions						
Theoretical Content				**Practical Content**		
Week	**Specific Objectives**	**Teacher Activity**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**
1-3	1.1 Explain the use of appropriate Personal protective equipment (PPE). 1.2 Explain health, safety and environmental regulations and guidelines. 1.3 State own responsibility in the health and safety Act as it relates to own occupation. 1.4 State Employers' responsibility in health and safety act.	Explain the use of appropriate Personal protective equipment (PPE). Explain health, safety and environmental regulations and guidelines. Explain own responsibility in the health and safety Act as it relates to own occupation. Explain Employers' responsibility in health and safety act.	Whiteboard Whiteboard marker Projector Duster Textbooks	▪ Demonstrate the use of correct safety wear in the workshop ▪ Demonstrate the use of charts and drawings to remind students of safety ▪ Demonstrate the importance of using workshop service manual for correct adjustments and detailed technical information	Guide students to: ▪ Demonstrate the use of correct safety wear in the workshop ▪ Demonstrate the use of charts and drawings to remind students of safety ▪ Demonstrate the importance of using workshop service manual for correct adjustments and detailed technical information	Automotive tool box Service manual Workshop manual Charts
General Objective 2.0: Understand basic Working Principles of a Petrol Engine						
4-7	2.1 Explain in detail the working principles of petrol engine e.g. ▪ two stroke ▪ four stroke cycle engines	Explain in detail the working principles of petrol engine e.g. ▪ two stroke ▪ four stroke cycle engines	Whiteboard Whiteboard marker Projector Duster Textbooks	Identify two and four stroke engines Sketch two/four stroke engines	Guide students to: Identify two and four stroke engines Sketch two/four stroke engines	Charts Simulators Petrol engine Fuel pump Complete Toolbox

	2.2 State the difference between two stroke and four stroke engines 2.3 List advantages and disadvantages of each type of engine 2.4 State the types and functions of piston rings and gudgeon pins used in an automobile engine 2.5 Explain the operational principles of different types of fuel injection systems used in Automobiles 2.6 Explain the process of valve and ignition timing of an engine 2.7 State the general principles and types of combustion chamber designs.	Explain the difference between two stroke and four stroke engines Explain advantages and disadvantages of each type of engine Explain the types and functions of piston rings and gudgeon pins used in an automobile engine Explain the operational principles of different types of fuel injection systems used in Automobiles Explain the process of valve and ignition timing of an engine Explain the general principles and types of combustion chamber designs.		Demonstrate the operation of electric and mechanical fuel pump Demonstrate the process of setting valve and ignition timing	Demonstrate the operation of electric and mechanical fuel pump Demonstrate the process of setting valve and ignition timing	

	General Objective: 3.0 Understand the working principles of Valves					
Week 8-10	3.1 Explain the function of valve 3.2 Explain the basic principles of inlet and exhaust	Explain the function of valve Explain the basic principles of inlet and	Whiteboard Whiteboard marker Projector Duster Textbooks	Identify various types of Valves Identify faulty inlet and	Guide students to: Identify various types of Valves Identify faulty inlet	Inlet valves Exhaust valves Valve grinder Grinding paste

	valves 3.3 Explain the layout of various engine valve gear arrangements, e.g. overhead, side and underhead valve.	exhaust valves Explain the layout of various engine valve gear arrangements, e.g. overhead, side and underhead valve.		exhaust valve Demonstrate the arrangement of various engine valve gears, e.g. overhead, side and underhead valve. Describe with aid of sketches the valve train and the methods of driving the camshaft.	and exhaust valve Demonstrate the arrangement of various engine valve gears, e.g. overhead, side and underhead valve. Describe with aid of sketches the valve train and the methods of driving the camshaft	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK MODULE: CAM 222 PETROL ENGINE MAINTENANCE II
DURATION: 96 HOURS

GOAL: This module is designed to produce a petrol engine maintenance craftsman who should understand the basic principles of operation and carry out general maintenance and reconditioning work on petrol engines.

GENERAL OBJECTIVES

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

1. Understand servicing of fuel system of an automobile
2. Understand operations of an ignition system
3. Understand the working principles of engine cooling system

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK.						
Module: - PETROL ENGINE MAINTENANCE II				**Module Code: CAM 222**	**Contact Hours: 8hrs/week**	
Subject Specification: Theoretical Content						
Week	**General Objective 1.0:** Understand servicing of fuel system of an automobile					
	Theoretical Content			**Practical Content**		
	Specific Objectives	**Teacher Activity**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**
1-3	1.1 Explain the components of an automobile fuel system and their functions eg fuel tank, fuel pump, fuel filter and carburetors/Injectors nozzles 1.2 Discuss the types of carburetors/ Injectors nozzles and the way they function giving examples of the applications of each. 1.3 State the difference between constant choke and constant vacuum carburetors. 1.4 Discuss the effect of fuel starvation on engine performance 1.5 Explain the effect of dirty fuel tank on engine performance and how to clean the dirty tank	Explain the components of an automobile fuel system and their functions eg fuel tank, fuel pump, fuel filter and carburetors/Injectors nozzles Explain the types of carburetors/ Injectors nozzles and the way they function, giving examples of the applications of each. Explain the difference between constant choke and constant vacuum carburetors. Explain the effect of fuel starvation on engine performance Explain the effect of dirty fuel tank on engine performance and how to	Whiteboard Whiteboard marker Projector Duster Textbooks	Sketch the components of fuel system Identify the methods of mixture correction, and slow running devices/ electronic fuel system devices Carryout checks on fuel injection system. Use appropriate tools and equipment to test the condition of fuel injection system components Identify the effect of faulty fuel injectors nozzles	Guide students to: Sketch the components of fuel system Identify the methods of mixture correction, and slow running devices/ electronic fuel system devices Carryout checks on fuel injection system Use appropriate tools and equipment to test the condition of fuel injection system components Identify the effect of faulty fuel injectors nozzles	Sample carburetors Fuel pump

		clean the dirty tank				
General Objective 2.0 Understand operations of an ignition system						
4 - 7	2.1 Explain the working principles of the ignition system of an automobile. 2.2 Discuss the function of the coil ignition system of a motor car 2.3 Explain firing orders and firing intervals 2.4 Discuss the different types of spark plugs 2.5 Discuss the operating principles of magnetic induction 2.6 Explain the types of electronic ignition system 2.7 Explain the action of a simple Coil ignition system- advantages and disadvantages	Explain the working principles of the ignition system of an automobile. Explain the function of the coil ignition system of a motor car Explain firing orders and firing intervals Explain the different types of spark plugs Explain the operating principles of magnetic induction Explain the types of electronic ignition system Explain the action of a simple Coil ignition system- advantages and disadvantages	Whiteboard Whiteboard marker Projector Duster Textbooks	Demonstrate the operating principles of conventional and electronic ignition system on a vehicle. Carry out fault diagnosis, and services of ignition system.	Guide students to: Demonstrate the operating principles of conventional and electronic ignition system on a vehicle. Carry out fault diagnosis, and services of ignition system.	Experimental equipment in electromagnetic and basic transformer Modern vehicles appropriate devices Spark plugs
General Objective 3.0: Understand the working principles of engine cooling system						
8-12	3.1 Explain the working principles and the functions of an automobile cooling System e.g water- a n d	Explain the working principles and the functions of an automobile cooling system e.g water and air	Whiteboard Whiteboard marker Projector Duster Textbooks	Identify components of the cooling system Diagnose faulty cooling	Guide students to: Identify components of the cooling system	Model cooling fan Radiator Complete tool box Anti-frozen tester Radiator pressure

	a i r - c o o l i n g system. 3.2 Describe main features of the air cooled and water- cooled engine 3.3 Explain how heat is dissipated in air-cooled engine 3.4 List the faults attributable to air cooled engine and how to rectify those faults. 3.5Explain the working Principles and testing techniques of thermostat. 3.6Explain the functions of the different types of water pumps. 3.7State the principles and action of impeller and pressurized cooling system 3.8 Explain temperature control of the cooling system 3.9 Explain safety rules associated with cooling system.	cooling system. Explain main features of the air cooled and water-cooled engine Explain how heat is dissipated in air-cooled engine Explain the faults attributable to air cooled engine and how to rectify those faults. Explain the working Principles and testing techniques of thermostat. Explain the functions of the different types of water pumps. Explain the principles and action of impeller and pressurized cooling system Explain temperature control of the cooling system Explain safety rules associated with cooling system	Chart	system: ▪ water pump. ▪ Thermostat. ▪ Radiator Cap. Carry out work on faulty cooling system safely. Demonstrate safe working procedure while working of faulty cooling system.	Diagnose faulty cooling system: ▪ water pump. ▪ Thermostat. ▪ Radiator Cap. Carry out work on faulty cooling system safely. Demonstrate safe working procedure while working of faulty cooling system	tester Thermometer Belt tension gauge Electric kettle Special tools

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK MODULE: CAM 223: TRANSMISSION SYSTEM
DURATION: 96 HOURS

GOAL: This module is designed to provide the trainee with knowledge and skills to carry out effectively clutch, gearbox and final drive reconditioning**.**

GENERAL OBJECTIVES:

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

1.0 Understand the principles of Clutch operation and diagnose clutch faults.
2.0 Understand the principles of Synchronization and gearboxes.
3.0 Understand the Procedure for Assembling Gear and Selector Mechanism to Manufacturer's Specifications
4.0 Understand the principles of operations of Propeller/drive shaft, propeller/drive shaft joint couplings and center bearings.
5.0 Understand the principles of operations of Final drive and differential assembly.
6.0 Understand the Principles of Operation and Function of Multi Drive Axles and Four-Wheel Drive

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK						
SUBJECT : TRANSMISSION SYSTEM			**Subject Code : CAM 223**		**Contact Hours: 8hrs/week**	
Subject Specification: Theoretical and Practical Content						
General Objective 1.0: Understand the Principles of Clutch Operation and Diagnose Clutch Faults						
Theoretical Content				**Practical Content**		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Discuss the function of clutches 1.2 Explain the working principles of mechanical and hydraulic clutch systems. 1.3 Discuss the Characteristics and various types of clutches used in automobiles e.g. single, multi-plate and Hydraulic clutches 1.4 Explain the construction and operation of the single and multi-plate clutch system 1.5 Explain faults in clutch system (drag, slip, judder etc.)	Explain the function of clutches Explain the working principles of mechanical and hydraulic clutch systems. Explain the characteristics and various types of clutches used in automobiles e.g. single, multi-plate and Hydraulic clutches Explain the construction and operation of the single and multi-plate clutch system Explain faults in clutch system (drag, slip, judder etc.	Whiteboard Whiteboard marker Projector Duster Textbooks Wall charts	Demonstrate the construction and operation of the clutch system Carry out removal and replacement of clutch system components Use appropriate tools and equipment to carry out inspection of clutch system components and rectify faults	Guide students to: Demonstrate the construction and operation of the clutch system Carry out removal and replacement of clutch system components Use appropriate tools and equipment to carry out inspection of clutch system components and rectify faults	Clutches Clutch special tools Wall charts Manufacturer's manual Gear box simulator Complete toolbox

General Objective 2.0: Understand the Principles of Synchronization and Gear Boxes						
Week 3-5	2.1 Explain the construction and operation of a four speed constant mesh type of gear box. 2.2 State the principles of synchronization, gear ratio, driving torque, bearing load and various types of locking devices. 2.3 Explain the importance of lubrication 2.4 Explain the difference between manual and automatic gearboxes	Explain the construction and operation of a four speed constant mesh type of gear box. Explain the principles of synchronization, gear ratio, driving torque, bearing load and various types of locking devices. Explain the importance of lubrication Explain the difference between manual and automatic gearboxes	Whiteboard Whiteboard marker Projector Duster Textbooks •	Identify various tools and equipment for removal, repair and adjustment of gear box. Demonstrate with diagrams the synchromesh gear box, gear arrangements and methods of engagement. Demonstrate procedures for repairing and/or replacing component parts of a gear box. Demonstrate the lubrication methods of the rotating parts of a gear box.	Guide students to: Identify various tools and equipment for removal, repair and adjustment of gear box. Demonstrate with diagrams the synchromesh gear box, gear arrangements and methods of engagement. Demonstrate procedures for repairing and/or replacing component parts of a gear box. Demonstrate the lubrication methods of the rotating parts of a gear box.	Gear boxes (manual/Automatic) S.A.E oil grade Charts Different types of gears Wall charts Complete toolbox Gearbox simulators (Manual and Automatic)

General Objective 3.0: Understand the Procedure for Assembling Gear and Selector Mechanism to Manufacturer's Specifications						
6-10	3.1 Define gear assembly 3.2 Discuss different types of gearing systems;	Explain gear assembly Explain different types of gearing systems; ▪ compound gear	Whiteboard Whiteboard marker Projector Duster Textbooks	Illustrate various layouts of gear trains	Guide the students to: Illustrate various layouts of gear trains	Gear train models. Engineering drawing equipment

	▪ compound gear train, ▪ gear reverse mechanism etc 3.3 List the basic principles of gearing. 3.4 State the purpose of locking and interlocking devices in the selector mechanism 3.5 State the function of final drive gears and differential assembly 3.6 Explain the gear selector mechanism including interlocking arrangement. Direct and remote-control mechanism 3.7 Discuss the types of bearings used in gearboxes. 3.8 Discuss the function of the final drive gear and differential gearing	train, ▪ gear reverse mechanism etc Explain the basic principles of gearing Explain the purpose of locking and interlocking devices in the selector mechanism **Explain** the function of final drive gears and differential assembly Explain the gear selector mechanism including interlocking arrangement. Direct and remote-control mechanism Explain the types of bearings used in gearboxes. Explain the function of the final drive gear and differential gearing		Illustrate gear layout in a gearbox. Demonstrate with models the operation of gear selector mechanisms Demonstrate with models the operation of final drive and differential assemblies	Illustrate gear layout in a gearbox. Demonstrate with models the operation of gear selector mechanisms Demonstrate with models the operation of final drive and differential assemblies	Wall charts Gear box (Manual/Autos) Complete toolbox Special toolbox Drive axle unit

General Objective 4.0: Understand the principles of operations of Propeller/Drive Shaft, Joint Couplings, center bearing and their Reconditioning.						
7-8	4.1 Explain the method of construction, layout and assembly of propeller/drive shafts and their principles of operation. 4.2 Explain the constructional details of the propeller shaft. 4.3 State the purpose of sliding joints. 4.4 Describe the types of universal joints used on a vehicle. 4.5 Explain the principle of front wheel drive and its advantages and Disadvantages over other arrangements 4.6 State the function of propeller shaft in transmitting power from engine to road wheels	Explain the method of construction, layout and assembly of propeller/drive shafts and their principles of operation. Explain the constructional details of the propeller shaft. Explain the purpose of sliding joints. Explain the types of universal joints used on a vehicle. Explain the principle of front wheel drive and its advantages and disadvantages over other arrangements Explain the function of propeller shaft in transmitting power from engine to road wheels	Whiteboard Whiteboard marker Projector Duster Textbooks	With the aid of a diagram demonstrate the transmission of power from engine to road wheel. Identify components of front wheel drive arrangement Carryout sketch in good proportion of the various parts of the transmission system Carry out inspection on drive/propeller shafts using appropriate tools and equipment Identify the faults in drive shaft and propeller shaft by road test and/or visual inspection. Demonstrate the procedure for assembling the propeller/drive shaft	Guide students to: With the aid of a diagram demonstrate the transmission of power from engine to road wheel. Identify components of front wheel drive arrangement Carryout sketch in good proportion of the various parts of the transmission system Carry out inspection on drive/propeller shafts using appropriate tools and equipment Identify the faults in drive shaft and propeller shaft by road test and/or visual inspection. Demonstrate the procedure for assembling the propeller/drive shaft	Propeller Drive shaft Wall charts. Universal joint models Simulator vehicle layout Complete toolbox Special tools

General Objective 5.0: Understand the Principles of Operation of Final Drive and Differential Assembly						
9-10	5.1 List the basic functions of the differential in power transmission 5.2 Explain the transmission of power from the engine to the road wheels 5.3 State how to calculate pre- load torque 5.4 Check pre-load with spring balance 5.5 State the principles of operation of the differential and final drives.	Explain the function of the differential in power transmission Explain the transmission of power to the road wheels Explain how to calculate pre- load torque Explain pre-load with spring balance Explain the principles of operation of the differential and final drives.	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks	Sketch component parts of final drive in good proportion in relation to the transmission system Identify various types of drive axle arrangements e.g. fully floating, 3/4 floating and semi floating. Dead axle – Didion type. Demonstrate methods of supporting axle shaft and arranging wheel bearings	Guide students to: Sketch component parts of final drive in good proportion in relation to the transmission system Identify various types of drive axle arrangements e.g. fully floating, 3/4 floating and semi floating. Dead axle – Didion type. Demonstrate methods of supporting axle shaft and arranging wheel bearings	Vehicle layout simulator Engineering drawing equipment Drive axle unit Spring balance

General Objective 6.0: Understand the Principles of Operation and Function of Multi Drive Axles and Four-Wheel Drive						
11-12	6.1 Explain The operation of a double reduction axle and other axle drives 6.2 Discuss the method of	Explain The operation of a double reduction axle and other axle drives Explain the method of adjustment and maintenance of a multi-	Whiteboard Whiteboard marker Projector Duster Textbooks	Illustrate the double reduction type axle involving worm and wheel gears Illustrate with the aid of sketches, the principle of two	Guide students to: Illustrate the double reduction type axle involving worm and wheel gears Illustrate with the aid of	Double reduction axle Manufacturers' manual Wall chart or diagram Engineering

	adjustment and maintenance of a multi-drive axle 6.3 Explain the operation of the four-wheel drive 6.4 State the materials used for axle shafts 6.5 Discuss the necessary adjustment and repair on a four-wheel drive.	drive axle Explain the operation of the four-wheel drive Explain the materials used for axle shafts Explain the necessary adjustment and repair on a four- wheel drive		and four- wheel drive Demonstrate procedures for adjusting and repairing four-wheel drives using manufacturers specifications	sketches, the principle of two and four- wheel drive Demonstrate procedures for adjusting and repairing four-wheel drives using manufacturers specifications	drawing equipment Vehicle layout simulator Four-wheel drive train Axle fuller Transmission jack Drive shaft angle gauge Car lifter

ROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK. MODULE: CAM 234: TYRE AND WHEEL SERVICES II.
DURATION: 96 HOURS.

GOAL: This module aims to provide trainees with both knowledge and skills to perform precise wheel balancing and alignment operations and understand the interaction between suspension and steering systems in wheel alignment**.**

GENERAL OBEJCTIVES

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

1. Understand the Concept and practice of wheel balancing

2. Understand the Concept and practice of Wheel alignment

3. Understand the Interaction between Suspension and Steering System components in Wheel Alignment

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK						
Subject: TYRE AND WHEEL SERVICES II		**Subject Code : CAM 234**		**Contact Hours: 8hrs/week**		
Subject Specification: Theoretical Content and Practical Content						
General Objective: 1.0 Understand the Concept and Practice of Wheel Balancing						
Theoretical Content				**Practical Content**		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**
1-4	1.1 Explain the meaning, importance and concept of wheel balancing 1.2 Identify types of wheel balancing 1.3 Explain the operation of wheel balancing equipment 1.4 Differentiate between static and dynamic balancing. 1.5 Implement safety precautions in wheel balancing	Explain the meaning, importance and concept of wheel balancing Explain types of wheel balancing Explain the operation of wheel balancing equipment Implement safety precautions in wheel balancing	Whiteboard Whiteboard marker Projector Duster Textbooks	Identify and use wheel balancing tools and machines correctly. Demonstrate mounting and balancing wheels. Inspect and diagnose wheel imbalance-related issues. Apply corrective measures such as adding/removing weights. Use a safety checklist to evaluate wheel balancing operation Follow industry safety procedures when balancing wheels.	Guide students to: Identify and use wheel balancing tools and machines correctly. Demonstrate mounting and balancing wheels. Inspect and diagnose wheel imbalance-related issues. Apply corrective measures such as adding/removing weights. Use a safety checklist to evaluate wheel balancing operation Follow industry safety procedures when balancing wheels.	Charts, diagrams of wheel balancing concepts, Pictorials, Training manuals Wheel balancing machine Tyre changer Wheel weights, Pressure gauges Sample unbalanced wheels Vibration testing equipment, Troubleshooting charts Safety gloves, protective eyewear, Workshop safety manuals
	General Objective: 2.0 Understand the Concept and Practice of Wheel Alignment					
5-8	2.1 Discuss the basic concept of wheel alignment	Explain the basic concept of wheel alignment	• Whiteboard • Whiteboard marker • Projector	Identify components involved in wheel alignment (tires,		• Caster, Camber and toe gauges • Turn plates

	2.2 Explain the importance of correct wheel alignment on tire wear, fuel efficiency and vehicle safety. 2.3 Explain the types of Wheel alignment 2.4 Explain the types of Alignment angles: • Toe • Caster • Camber • Pivot/King pin inclination (KPI)/steering axis inclination (SAI) • Thrust angle • Setback 2.5 Mention the tools and equipment used in wheel alignment practice 2.6 Discuss the procedures for carrying out wheel alignment	Explain the importance of correct wheel alignment on tire wear, fuel efficiency and vehicle safety. Explain the types of Wheel alignment Explain the types of Alignment angles: • Toe • Caster • Camber • Pivot/King pin inclination (KPI)/steering axis inclination (SAI) • Thrust angle • Setback Explain the tools and equipment used in wheel alignment practice Explain the procedures for carrying out wheel alignment	• Duster • Textbooks • Books, manuals and Guides	suspension, steering, and chassis) Identify signs of misalignment through visual inspection Describe the tools used in measuring wheel alignment angles Demonstrate the procedure for performing wheel alignment operation; a. Set up a vehicle for wheel alignment b. Measure alignment angles c. Adjust alignment angles d. Check/fine-tuning e. Test drive Identify signs of a poor wheel alignment Use gauges to identify alignments issues		• Mechanical tool box • Tie-rod pullers • Turn plate • Wheel alignment systems (mechanical, laser-beam, camera based) • Jack • Wheel spacers • Alignment lift

	2.7 Discuss the effect of poor wheel alignment on vehicle handling	Explain the effect of poor wheel alignment on vehicle handling				
	General Objective 3.0: Understand Suspension and Steering System Interaction in Wheel Alignment					
9-12	3.1 Understand suspension and steering system components and their interaction with vehicle wheel alignment.	▪ List key suspension and steering system components and explain how they interact/influence wheel alignment (e.g. control arm, ball joints, springs, struts, steering rack, pitman arm, steering column, tie rod etc. ▪ Review key alignment angles (Caster, camber and toe) and how they interact with wheel geometry and stability. ▪ Explain common steering and suspension problems and	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Wheel alignment machine ▪ Camber and caster gauges ▪ Toe plates ▪ Laser alignment tools ▪ Hydraulic/pneumatic jack ▪ Spring compressor ▪ Ball joint press ▪ Control arm removal tool ▪ Suspension strut nut wrenches ▪ Tie rod puller ▪ Steering wheel puller ▪ Steering rack and pinion tool set ▪ Steering angle sensor calibration tool ▪ Hydraulic press	▪ Identify key suspension and steering system components that interact with vehicle wheel alignment	▪ Show student a basic suspension and steering system model to identify components and demonstrate how they interact with wheel alignment angles. ‘	Identify components and demonstrate how they interact with wheel alignment angles.

	3.2 Understand steering and suspension problems that lead to wheel misalignment. 3.3 Understand how to adjust suspension and steering components to correct wheel misalignment 3.4 Understand how to perform Post-adjustment tests on steering and suspension components.	their impact on wheel alignment ▪ Explain the effect of adjusting suspension and steering system components on toe, caster and camber angles. ▪ Explain how to verify wheel alignment accuracy ▪ Explain how to assess steering response and handling ▪ Explain how to identify and rectify any remaining alignment issue	▪ Safety equipment	▪ Identify steering and suspension problems (worn ball joints, bushings, tierod ends, worn-out or broken suspension springs etc) ▪ Show the impact of steering and suspension problems on wheel alignment and tire wear ▪ Provide hands-on experience in adjusting suspension and steering components to correct misalignment ▪ Verify accuracy of alignment angle adjustments ▪ Evaluate vehicle ride handling. ▪ Demonstrate how to perform visual and manual post-adjustment inspections on	▪ Guide students on the inspection of a vehicle suspension and steering system component to identify problems using a. Visual inspection b. Component movement check c. Steering geometry checks/test drive ▪ Guide students on the practice of adjusting toe, caster and camber angles by adjusting suspension and steering system components. a. Toe adjustment by adjusting tie rods b. Camber adjustment -control arms etc etc c. Caster adjustment – moving control	Perform inspection of vehicle suspension and steering system component to identify problems

				steering and suspension system components	arms etc ▪ Compare post adjustment readings to vehicle specifications ▪ Perform straight-line test drive to check for proper steering wheel centering and stability ▪ Perform visual and manual inspection for play or damage components confirming that all components are securely tightened.	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK. MODULE: CAM 235 SUSPENSION, STEERING AND BRAKE SYSTEMS.

DURATION: 96 HOURS.

GOAL: This module is designed to produce trainee with the theoretical knowledge and skills to carry out repairs and overhaul the suspension, steering and brake systems.

GENERAL OBEJCTIVES

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

1. **Layout of the chassis in relation to frame and suspension system**
2. **Basic principles of steering System and Carry out Necessary Repairs Adjustment to its Units**
3. **Basic Principles of Brake System and Carry out Necessary Repairs Adjustment to its Units**

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK		
Subject: Suspension, Steering and Braking Systems	**Subject Code : CAM235**	**Contact Hours: 8hrs/week**
Subject Specification: Theoretical Content and Practical Content		
General Objective: 1.0 Understand the Layout of Chassis in Relation to frame and Suspension system		

Theoretical Content				Practical Content		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
Week 1-2	1.1 Explain the chassis layout and its types. 1.2 States the types of suspension system 1.3 Explain the basic working principles of various suspension system 1.4 List the basic types of springs and their applications	• Discuss the chassis layout and its types. • Use sketches to show detail parts of the suspension system. • Discuss the operationsof various suspensi on s y s t e m s used on Automobiles • Explain various suspension system and their applications • Explain the types of	• Whiteboard • Whiteboard marker • Projector • Duster • Textbooks • Charts • Leaf spring • Dampers • Coil Spring • Laminated Spring • Torsion bar • Independent Front Suspension • Independent Rear Suspension • Complete tool box • Spring compressor • Spring grip • Suspension testing	▪ Sketch the chassis layout ▪ Identify the suspension systems used in various types of vehicle e.g. pneumatic, hydraulic, laminated spring, coil spring, torsion bar and bonded (rubber) suspension unit. ▪ Sketch the following: Independent front suspension, air suspension, rubber suspension, metal springs, the damper and the independent rear suspension ▪ Select tools and equipment for various repair and adjustment operations related to chassis, suspension	• show chassis layout • show the construction and functions of the following; Independent front suspension, air suspension, rubber suspension, metal springs, the damper and the independent rear suspension • Guide the students on how to select tools and equipment for various repair and adjustment operations related to chassis, suspension and steering work.	List and state the functions of suspension components. Identify components of the suspension systems

		suspensi on systems used on Front and rear wheel vehicles • Describe the types of springs employed on suspension system. • State advantages and disadvantages of solid beam and independent suspension systems	equipment • Wheel balancer • Suspension Simulators • Tie rod end • Ball joint puller	and steering work.		

General Objective 2.0: Understand the Basic Principles of Steering System and Carry out Necessary Repairs Adjustment to its Units						
Week 5	2.1 Explain the principles of steering construction in an automobile 2.2 State "ACKERMAN" Principle in relation to steering linkage 2.3 Enumerate the effect of defects in chassis, suspension and steering on tyre wear 2.4 Explain the function of the followings: a Ackerman principle b Camber and caster c King pin inclination d Toe-in, toe-out e Under-steering f Oversteering 2.5 Explain the rack and pinion steering assembly with respect to: - a Components b Adjustment c Attachment to vehicle	▪ Explain the function and mechanism of the steering system of automobiles ▪ Explain the type of steering used in beam axle and independent suspension system ▪ Explain steering geometry and the effect of steering angles (toe, camber etc) on vehicle handling ▪ Explain Steering faults and its likely remedies ▪ Explain the main component parts of the Steering systems using diagrams ▪ Explain how wheel alignment setting	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Charts ▪ Overhead Projector and Transparencies ▪ Front wheel Alignment Gauge ▪ Engineering drawing equipment ▪ Wheel alignment gauge ▪ Camber gauge ▪ Castor gauge ▪ Steering angle meter ▪ Complete tool box ▪ Special tools; Power steering testing equipment ▪ Steering wheel	▪ Identify the steering gear layout of: a. beam type b. Independent front suspension ▪ Carry out steering geometry checks and adjustments e.g. toe-in, toe- out, King Pin Inclination, Camber, caster, etc. ▪ Demonstrate how to perform wheel alignment.	▪ Show with diagrams all the characteristics of the steering system. ▪ Guide the student on how to carry out steering geometry checks and adjustments e.g. toe- in, toe- out, King Pin Inclination, Camber, caster, etc. ▪ Sketch in good proportion the layout and construction of the Component of steering systems. ▪ Guide the student on how to perform wheel alignment. ▪ Demonstrate the action of the main types of steering gear box in use today e.g. a Worm and sector b Screw and nut; c Cam and peg: d Worm and roller e Rack and pinion f Recirculating balls	State the "ACKERMAN" Principle in relation to steering linkage. With the aid of a diagram explain the construction of the automobile steering system. Use appropriate tools and equipment to carry out adjustment and repairs of steering system components

	d Lubrication e Operation 2.6 State the operation of other types of steering gear boxes being used on Automobiles 2.7 Explain why the rack and opinion steering are more popularly used on motor cars these days 2.8 State possible methods of adjustment for each of the steering system	can affect the steering. ▪ Explain how a rack and pinion steering can be adjusted, lubricated and the common faults associated with it. ▪ Explain the operation of other types of steering gear boxes being used on Automobiles ▪ Explain why the rack and opinion steering is more popularly used on motor cars these days ▪ Explain possible methods of adjustment for each of the steering system	lock			

General Objective 3.0: Understand the Basic Principles of Brake system and Carry out Necessary Repairs Adjustment to its Units						
Week 8-9	3.1 State the various types of brake systems 3.2 Explain the basic concept of friction and its applications on braking system 3.3 State the working princples of brake syst	▪ Discuss the function of the brake system, types and the way they are operated	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Charts ▪ Transparencies ▪ Decelerometer ▪ Tyres ▪ Pressure gauge ▪ Brake fluid ▪ DOT meter ▪ Complete tool box ▪ Special tool box	3.1 Draw the Conventional brake system. 3.2 Identify the components of hydraulic brake systems. 3.3 Carryout hydraulic quality test on brake fluid.	▪ With the aid of diagrams describe the function of various brake system. ▪ Show t h e s t u d e n t s Hydraulic brake system component.	With the aid of a diagram explain the operating principle of brake system Identify components of the brake System
	3.4 Explain the concept of friction and coefficient of friction on brake performance in various weather conditions 3.5 State safety precautions associated with brake fluid and its effect on body works e.g. paint and upholstery 3.6 State the properties of good brake fluid.	with emphasis s on safety precautions ▪ Discuss the role of friction in the braking system ▪ Explain how the hydraulic brake works. ▪ Explain the	▪ Engineering drawing equipment ▪ Brake testing equipment ▪ Brake spring pliers ▪ Brake drum adjustment tool	3.4 Inspect brake system components for wears, corrosion and leakage. 3.5 Sketch the following a. Fixed and floating caliper, drum brake b. Single and multi-piston master cylinder c. Single and multi-piston types of hydraulic wheel	▪ Demonstrate how to carryout hydraulic quality test on brake fluid. ▪ Demonstrate how to inspect for wears, corrosion and leakages. ▪ With the aid of sketches, describe the operation of the following; a. Fixed and floating caliper, b. Drum brake	Use appropriate tools and equipment to carry out removal and replacement of brake system components Perform checks on wears, corrosion and leakages in brake system

		factors that affects brake efficiency. ▪ Explain the following braking systems a. Disc brakes b. drum brakes c. Air (pneumatic) brakes. ▪ State the advantages of each system		cylinder	c. Single and multi-piston master cylinder d. Single and multi-piston types of hydraulic wheel cylinder	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK MODULE: CAM 311 DIESEL ENGINE MAINTENANCE I

DURATION: **96 HOURS**

GOAL: **This module is designed to produce a diesel engine maintenance craftsman who will be able to carry out general maintenance work on a fuel injection system and other diesel engine components.**

GENERAL OBJECTIVES:

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

1. **Operations of the compression ignition engine**
2. **Working principles of inline and rotary fuel injection pumps**
3. **Working principles of a diesel engine**
4. **Working principles of fuel injection pumps and fuel injection bleeding procedure**
5. **Electronic components in the C.I engine and their function.**
6. **Constructional differences between S.I and C.I. engine main component parts.**

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK.						
SUBJECT : DIESEL ENGINE MAINTENANCE I		**Subject Code : CAM 311**		**Contact Hours: 8hrs/week**		
Module: Specification: Theoretical and Practical Content.						
General Objective: 1.0 Understand the Operations of the Compression Ignition (C.I) Engine						
Theoretical Content				**Practical Content**		
Wee k	**Specific Objectives**	**Teacher Activity**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Describe diesel Pump room and testing equipment 1.2 Explain the Principles of atomization and how this is use in automobile engine. 1.3 Explain the characteristics of various types of nozzle design and Pressure breaking Points of injector nozzles. 1.4 Explain the types Combustion chamber 1.5 Explain the functions of the combustion chamber as related to compression ignition engine.	▪ Discuss Pump room machines (e.g. Injector pump tester, nozzle tester). ▪ Explain the necessary safety precaution s to be observed when handling diesel fuels. ▪ Discuss atomization as related to automobile engine. Discuss the functions and types of combustion ▪ chambers	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Model Diesel Engine ▪ Injector Pump and nozzle testers. ▪ Injectors. ▪ Complete tool box ▪ Diagnostic tools ▪ Calibration and phasing equipment ▪ Injector nozzle washing equipment ▪ Diesel fuel injector pump tester ▪	1.1 Identify the various tools and equipment for removing, assembling, adjustment and testing of injectors. 1.2 Use correctly the various tools and equipment for removing, assembling, adjustment and testing of injectors. 1.3 Carry out bleeding on injector fuel system. 1.4 Draw various types of nozzle	▪ Demonstrate the uses of various types of tools and equipment for testing injectors. Ask questions on injector testing. ▪ Show how to bleed air trapped in injector pump ▪ With neat diagrams illustrate characteristics of various nozzle designs and pressure breaking points of injector nozzles.	List the tools and equipment for testing injectors Carry out bleeding operation on injector fuel system.

General Objective 2.0: Understand the Working Principles of Inline and Rotary Fuel Injection Pumps						
3-4	2.1 State the working principle of in-line and rotary pumps of diesel engines. 2.2 Explain the need and process of phasing the in-line pump. 2.3 Explain the type of injectors and their functions. 2.4 Describe the provision for adjustment of the following types of governors. a. hydraulic; b. mechanical; c. pneumatic; 2.5 Describe the method of timing in-line pump on C.I. engine. 2.6 Explain with the aid of diagrams the operations of the distributor type of	▪ Discuss the functions of in-line and rotary pumps. ▪ Explain the meaning of the term Phasing and calibration . ▪ Discuss reasons for high precision of component parts of diesel fuel injection System	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ In-line and rotary pumps. ▪ Injectors. ▪ Hydraulic, ▪ Mechanical and Pneumatic governors. ▪ In-line pump. ▪ Model Diesel Engine ▪ Injector Pump and nozzle testers. ▪ Injectors. ▪ Complete tool box ▪ Diagnostic tools ▪ Calibration and phasing equipment ▪ Injector nozzle washing equipment.	2.1 Sketch in good proportion the various components of the diesel fuel injection systems. 2.2 Carry out adjustment of the following types of governors. a. hydraulic; b. mechanical; c. pneumatic 2.3 Carry out timing of an in-line diesel injection pump on C.I. engine. 2.4 Draw sketches of governors in use on C.I engines.	• List types of injectors. Draw neat sketch of each type. • Demonstrate adjustment of various types of governors and why the need for adjustment • Demonstrate timing in-line pump on C.I. engine. 6 With neat sketches, explain the action of mechanical and hydraulic governors in relationship to the distributor	Sketch the diesel fuel injection systems showing the various components. List the common faults associated with each type of diesel pumps and give possible remedies Carry out the following: a) adjustment of governors b) timing of in-line pump on C.I. engine.
	pump. 2.7 Explain the action of the mechanical (centrifugal) governor in relationship to the distributor type pump. 2.8 Explain common	. ▪ Explain the need for adjustment of various types of governors. . ▪ Discuss advantage s				

	faults which would make mechanical governor in- operative	and disadvantages of in- line and distributor type of pump. ▪ Discuss the common faults associated with each type of governor and give possible remedies.				
General Objective 3.0: Understand the Working Principles of a Diesel Engine						
5-6	3.1 Explain the principles of operation of the diesel engines.	▪ Discuss the 4-stroke cycle and	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Diesel engines. ▪ Feeler gauge, assorted hand tools and	3.1 Inspect engine valve clearance setting. 3.2 Carry out cylinder	▪ Demonstrate procedure for accurate valve clearance setting	Explain the 4-stroke cycle and 2
	3.2 Explain the concepts of pressure, (negative and positive) and relationship between volume and pressure. 3.3 Explain the working of the diesel fuel injection system.	2 stroke cycle principles of operation of diesel engine. ▪ Discuss the concepts of pressure (negative and positive) and	equipment. ▪ In-line and rotary pumps. ▪ Injectors. ▪ Hydraulic, ▪ Mechanical and Pneumatic governors. ▪ In-line pump. ▪ Model Diesel	operation test to meet the manufacturers specification. 3.3 Carryout injector pressure test for optimal performance.	to maker's specifications. ▪ Demonstrate cylinder operation test to meet the manufacturers specification ▪ Demonstrate injector pressure test for optimal performance	stroke cycle principles of operation of diesel engine. State the functions of the fuel injection

	3.4 Explain the need for correct engine valve clearance setting to minimize engine noise.	relationship between volume and pressure. ▪ Discuss the functions of the fuel injection components in diesel engines. ▪ State procedure for accurate valve setting to maker's Specifications.	Engine ▪ Injector Pump and nozzle testers. ▪ Injectors. ▪ Complete tool box ▪ Diagnostic tools ▪ Calibration and phasing equipment ▪ Injector nozzle washing equipment.			components in a C.I engine Perform the following activities on a C.I. engine ▪ valve clearance setting ▪ injector pressure test ▪ Cylinder operation test
General Objective 4.0: Understand the Working Principles of Different Types of Fuel Injection Pumps and Fuel Injection Bleeding Procedure						
7-8	4.1 Explain the working principle of different types of fuel injection pumps. 4.2 Explain the purpose of bleeding a diesel engine. 4.3 Explain how the presence of air in the fuel system affects the performance of an engine. 4.3 Describe the common faults and symptoms attributed	▪ Explain the working principle of different types of fuel injection pumps. ▪ Define the term bleeding and explain why it is necessary to carry it out. ▪ List diesel engine common	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Injection pump. ▪ Fuel lift pump ▪ Live diesel engine ▪ spanners and screw drivers. ▪ Complete live diesel engine ▪ Complete tool box	4.1 Carry out bleeding of a diesel engine. 4.2 Describe how to clear faults identified in a diesel engine. 4.3 Carryout calibration and phasing operation. 4.4 Remove injector assembly in the correct sequence. 4.5 Strip injectors correctly, clean and inspect the component parts for wear. 4.6 Replace defective parts of an injector. 4.7 Assemble component	▪ Demonstrate bleeding of diesel engine ▪ Demonstrate how to clear faults in a diesel engine ▪ Demonstrate how to carryout phasing and calibration operation. ▪ Show how to remove injector assembly in the correct sequence ▪ Demonstrate how to strip injector clean and inspect the component parts for wear ▪ Demonstrate	State the common faults and symptoms attributed to a diesel engine Carry out the following activities on a C.I. engine a) bleeding of a diesel engine b) calibration and phasing c) Inspection and cleaning of

	to diesel engine fuel systems. 4.4 Explain the difference between phasing, calibration and their relevance	faults and symptoms (e.g. engine emitting black smoke etc.). ▪ Explain Phasing, Calibration and their relevance.		parts correctly and carry out injector test with standard equipment. 4.8 Repair in-line and rotary pumps.	component parts correctly and carry out injector test with standard equipment. ▪ Show how to repair in-line and rotary pumps.	injectors
General Objective 5.0: Understand the Electronic Components in the C.I Engine and their Functions						
9-10	5.1 List the electronic components in C.I engines and states their functions 5.2 Explain the working relationship between ECU, Sensors and actuators. 5.3 Explain a safe procedure in handling electronic components when carrying out repairs.	• Explain the electronic components in C.I engines and state their functions • Discuss the working relationship between ECU, Sensors and actuators. • Explain a safe procedure in handling electronic components when carrying out repairs.	• Whiteboard • Whiteboard marker • Projector • Duster • Textbooks • ECU • Complete tool box • Multimeter • Scan tool • Different types of sensors	5.1 Identify the electronic components in C.I engines 5.2 Carryout components parameter reading. 5.3 Identify faults in a diesel engine using scan tool. 5.4 Identify and rectify the faults following appropriate procedure.	▪ Show students the electronic components of C.I engines ▪ Demonstrate how to carryout components parameter reading. ▪ Demonstrate the use of scan tools to identify faults in a diesel engine. ▪ Demonstrate how to rectified faults in diesel engine.	List the electronic components in C.I engines and states their functions Identify faults in a diesel engine using a scan tool Use appropriate tools and equipment to test the condition of diesel engine components and rectify any fault

General Objective 6.0: Understand the Differences between Spark Ignition and Compression Ignition Engine						
11-12	6.1 Compare the following engine components of the spark and compression ignition engines stating differences in construction and materials used: a. Injection pumps b. Injectors c. Air Horn d. Governors e. Crankshafts f. Valves g. Cylinder head h. Cylinder blocks i. Connecting Rods j. Pistons etc. 6.2 Explain the difference between the combustion process of spark ignition and compression ignition engine. 6.3 Explain the advantages of a spark ignition engine	▪ Discuss reasons for differences in the physical construction of main engine components of petrol and diesel engines. ▪ Explain the difference between the combustion process of spark ignition and compression ignition engine.	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Injection pumps ▪ Live diesel and petrol engines. ▪ Complete tool box ▪ Vacuum leak detector.	6.1 Identify petrol and diesel engine. 6.2 Identify the components in spark ignition engine 6.3 Identify the components in compression ignition engine	• Show the students petrol and diesel engine. • Show the components of spark ignition engine • Show the components of compression ignition engine	Enumerate the differences between spark ignition and compression ignition engines. Identify and state the functions of component s in S.I. and C.I. engines.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK MODULE: CAM 322 DIESEL ENGINE MAINTENANCE II

DURATION: **96 HOURS**

GOAL: **This module is designed to produce a diesel engine maintenance craftsman who will be able to carry out general maintenance work on lubrication system and other diesel engine components.**

GENERAL OBJECTIVES:

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

7. **Engine wet sump lubrication system layout and methods of oil distribution in diesel engine**
8. **Dry sump lubrication system, crank case ventilation and the action of pressure gauges and oil warning lights.**
9. **Cams and camshafts drive arrangements for side and overhead camshafts.**
10. **Valve and valve port timing diagrams for both spark and compression ignition engine.**
11. **Procedure of crankshaft balancing and vibration damping.**

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK.						
Module: - DIESEL ENGINE MAINTENANCE II				**Module Code: CAM 322**		**Contact Hours: 8hrs/week**
Subject Specification: Theoretical Content						
Week	**General Objective 7.0: Understand the Wet Sump Lubrication System Layout and Methods of Oil Distribution in Diesel Engine**					
	Theoretical Content			**Practical Content**		
	Specific Objectives	**Teacher Activity**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-3	7.1 Explain how oil is distributed by splash mist and pressure feed Systems 7.2 Explain the operation of oil pressure relief valves. 7.3 Describe with the aid of sketches the types of gasket and seals used in the retention of engine oil. 7.4 Explain the importance of using correct type and grade of oil. 7.5 State the effect of incorrect oil level in an engine 7.6 State the sources of oil contamination and the necessity of regular renewal of oil on a time or mileage basis.	• Explain how oil is distributed by splash mist and pressure feed Systems ▪ Explain the need for efficient oil filtration in engines. ▪ Describe with the aid of sketches the types of gasket and seals used in the retention of engine oil. ▪ Explain properties of oil and their significance ▪ Explain the causes and effects of incorrect oil level • Explain the	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Oil pumps ▪ Diesel Engine ▪ Live diesel engine with wet sump lubrication ▪ Complete tool box	Identify the major differences between full flow and by-pass flow system of lubrication. 7.2 Draw a line diagram to show the layout of wet sump engine, lubrication for full flow and by-pass flow. 7.3 Sketch three types of oil pump 7.4 Sketch the oil flow path through engine oil lubricating filters. 7.5 Practice how to Monitor oil level 7.6 Change Oil in Diesel Engine and gauge oil level	▪ Show major differences between full flow and by-pass flow system of lubrication. ▪ Draw various type of oil pumps ▪ Draw oil flow path through engine oil lubricating filters oil lubricating filter. ▪ Draw neat diagram to explain the function of pressure relief valve	With the aid of sketches explain the layout of wet sump lubrication system Identify and select proper oil grade for engine lubrication Carry out engine oil change in a diesel engine

		need for strict adherence to manufacturers' service manual on oil change			▪ Demonstrate how to change and gauge engine Oil	

	General Objective 8.0: Understand the Dry Sump Lubrication System, Crankcase Ventilation and the Action of Pressure Gauges and Oil Warning Lights.					
4-5	8.1 Explain the operation of dry sump lubrication system 8.2 Explain the need for crankcase ventilation system 8.3 Describe the operating principle of an oil cooler.	▪ Discuss the construction and operation of Dry sump lubrication . ▪ Discuss crankcase ventilation system ▪ Explain operation of oil cooler	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Oil pressure switch ▪ Oil pump ▪ Oil cooler ▪ Dry sump engine. Complete tool box	8.1 Sketch a line diagram of a dry sump 8.2 Illustrate with sketch crankcase oil ventilation system. 8.3 Illustrate with the aid of a sketch the operation of an oil pressure gauge and switch. 8.4 Draw a line diagram of an oil warning light circuit. 8.5 Draw a cross- sectional view of an oil pressure switch. 8.6 Identify valve timing	• Show with drawing the principle of dry sump lubrication. • Draw a typical crankcase ventilation system • Show students to draw – oil warning light circuit, oil pressure switch and describe the principles of oil cooler • Identify oil pressure switch and gauge • Read oil pressure gauge • Show student valve timing	With the aid of a labeled diagram explain a typical crankcase ventilation system Draw a line diagram of the oil warning light circuit.

General Objective 9.0: Understand the Cams and Camshafts Drive Arrangements for Side and Overhead Camshafts.						
6-7	9.1 Explain how end float of the camshaft is controlled. 9.2 Describe the methods of camshaft drive (e.g chain gear or toothed belt). 9.3 Describe methods of camshaft lubrication.	▪ Explain the construction, function and operation of cams and camshaft drives. ▪ Explain the method of camshaft lubrication .	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Camshaft ▪ Valves ▪ Live engine. ▪ Complete tool box	9.1 Locate camshaft drive gears correctly 9.2 Draw a chain tensioner and fix tensioner. 9.3 Sketch and label a typical cam shape showing valve lift, valve open period and its variation. 9.4 Check for wear on valve operating mechanism using feeler gauge and by visual inspection.	▪ Show students camshaft drive gears ▪ Show the method of locating drive gear to the camshaft. ▪ Demonstrate valve timing and chain tensioner settings ▪ Inspect valve arrangements and operating mechanism. ▪ Show how to check wear on valve using appropriate tools/equipment t and by visual inspection	Describe methods of camshaft lubrication. Use appropriate tools and equipment to carry out wear checks on valve operating mechanism
	General Objective 10.0: Understand the Valve Timing Diagram for Both Spark and Compression Ignition Engine					
8-10	10.1 Sketch and label a typical valve timing diagram for spark ignition engine.	▪ Explain the functions of valves,	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Overhead projector and transparencies ▪ Inlet valves	10.1 Show the valve overlap, valve lead and valve lag on the giving engine.	Demonstrate the operation to show valve overlap, vale lead and valve lag.	Explain the following terms: a) valve
	10.2 Distinguish between valve timing diagram for compression ignition engine with that of	Valve construction and valve timing ▪ Explain the	▪ Exhaust valves ▪ Valve timing diagrams ▪ Complete tool box			overlap b) valve lead c) valve lag

	spark ignition engine. 10.3 Explain the following terms: a. Valve overlap b. Valve lead c. Valve lag	effects of 10.3 on engine performance. ▪ Discuss the following; valve overlap, valve lead, valve lag				Sketch and label a typical valve timing diagram for spark ignition engine
	General Objective 11.0: Understand the Procedure of Crankshaft Balancing and Vibration Damping					
11 - 12	11.1 Explain the procedure of crankshaft balancing. 11.2 Describe the causes of crankshaft vibration. 11.3 Describe the method of mounting crankshaft-damper.	▪ Discuss the functions of crankshaft and the need for engine crankshaft balancing ▪ Discuss the causes of crankshaft vibration. ▪ Explain the effects of unbalanced crankshaft	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Crankshaft ▪ Measuring tools (e.g. gauge) ▪ Overhead Projector and transparencies ▪ Pump ▪ calibrating/phasing machine ▪ Testing and/or servicing tools. ▪ Complete toolbox ▪ live vehicle	11.1 Check for unbalanced crankshaft 11.2 Carryout crankshaft balancing on the crankcase following the appropriate sequence.	▪ Show how to check unbalanced crankshaft ▪ Demonstrate crankshaft balancing on the crankcase following the appropriate sequence.	Carry out tests to ascertain unbalanced crankshafts Carry out crankshaft balancing

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK MODULE: CAM 323: ENGINE RECONDITIONING: PETROL & DIESEL
DURATION: 96 HOURS

GOAL: **This module is designed to provide the trainee with the theoretical knowledge and practical ability to carry out effectively petrol and diesel engine reconditioning.**

GENERAL OBJECTIVES:

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

1. **Safety procedure and their applications in relation to automobile engine reconditioning**
2. **Operation of all types of automobile engine and reconditioning.**
3. **Process of carrying out cylinder reboring**
4. **Process of grinding crankshaft to correct specifications**

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK.						
SUBJECT: ENGINE RECONDITIONING: PETROL & DIESEL		**Subject Code : CAM 323**		**Contact Hours: 8hrs/week**		
Module Specification: Theoretical and Practical Content:						
General Objective 1.0: Understand the Safety Procedure and their Applications in Relation to Automobile Engine Reconditioning						
Theoretical Content				**Practical Content**		
Week	**Specific Objectives**	**Teacher Activity**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
Week 1	1.1 Explain Safe working condition 1.2 State the importance of service manual to an engine 1.3 List the advantages of using correct tools in engine reconditioning 1.4 Explain the danger of ignoring manufacturers' specifications	▪ Discuss the safety in the workshop with volatile liquid in the engine system. ▪ Explain the importance of service manual to ensure the long life of the engine ▪ Explain the advantages of using the correct tools ▪ Explain the danger of ignoring manufacturers' specifications	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ PPE Equipment ▪ Wall charts ▪ Service manual ▪ Complete tool box ▪ Manufacturer's data	1.1 Identify the PPE 1.2 Show the correct use of PPE in an automobile workshop 1.3 Explain the use of service Manual 1.4 Show the importance of using correct service Tools 1.5 Complete jobs to manufacturers' specifications 1.6 Explain how to care for engine components, oils on the floor and gang ways	▪ Use PPE in an automobile workshop ▪ Demonstrate how to use service manual ▪ Demonstrate how to use service tools ▪ Demonstrate how to complete jobs to manufacturers' specifications ▪ Show Care of engine components ▪ Demonstrate how to care for measuring tools ▪ Show student the danger of oils on the floor and gang ways	Source for technical data for engine recondition operations Use appropriate PPE in relation to automobile engine reconditioning works
	GENERAL OBJECTIVE 2.0: Understand the Operation of all Types of Automobile Engine and Reconditioning					
Week 2-3	2.1 Explain the Operation of different automobile engines	**Discuss:** ▪ The 4-stroke spark ignition	▪ Whiteboard ▪ Whiteboard marker ▪ Projector	▪ Diagnose faults by inspection ▪ Sketch	• Demonstrate how to diagnose faults by inspection and by	

	2.2 Explain the use of lifting devices 2.3 Describe the procedure for removal of engine from vehicle 2.4 Explain dismantling procedure 2.5 State the operations involved in engine overhauling. 2.6 Explain how to diagnose faults by inspection 2.7 Apply the concept of limits and fits in relation to effects and requirements of engine components and other parts in assembling operations e.g. Piston free play, crank shaft sizes etc. 2.5 Explain how to assess suitability of existing parts for possible re-use. 2.6 State how to measure and determine sizes of worn crank shaft journals and crank pins	engine construction and operating principles ▪ The diesel engine design features ▪ The Four Stroke Diesel Engine Operating principle ▪ how to assess suitability of existing parts for possible re- use. ▪ the use of lifting devices ▪ the procedure for removal of engine from vehicle ▪ dismantling procedure ▪ how to measure and determine sizes of worn crank shaft journals and crank pins ▪ the process of examining and measuring parts using manufacturers' manual as a guide	▪ Duster ▪ Textbooks ▪ Petrol engine ▪ Diesel engine ▪ Tools catalogue ▪ A functional Automobile ▪ Endoscope ▪ Micrometer/Vernier caliper ▪ Scan tool ▪ Complete tool box ▪ Performance tester ▪ Engine compression tester ▪ Radiator pressure tester ▪ Fuel pressure tester Engine oil tester ▪ Engine Hoist ▪ Limits and Fits (special tools) ▪ Measuring tools ▪ Service manuals ▪ Wall charts ▪ Camshaft and model	the different cylinder arrangements, principle of fitting cylinder liners, valves, valve guide, and set tappets ▪ Remove engine from vehicle for overhauling ▪ Dismantle engine following a proper sequence ▪ Select tools for identified jobs ▪ Identify types of limits and fits, interference fits, push fits etc. ▪ Measure the extent of wear on a component making reference to service manual. ▪ Carry out Pistons assembling and rings using clamp ▪ Carry out fitting of cylinder liners ▪ Carry out fitting of valve guides and valve seat inserts ▪ Carry out fitting of roller & ball bearing,	road test • show the different cylinder arrangements, principle of fitting cylinder liners, valves, valve guide, and set tappets • Demonstrate how to Select tools for identified jobs • Demonstrate the procedure for removal of engine from vehicle ▪ Show different types of limits and fits, interference fits, push fits, etc, and relate its applications to various components of the automobile system e.g. Piston and cylinder ▪ Demonstrate the use of measuring instruments such as Vernier caliper, micrometer, dial gauge to determine the extent	Carry out removal and replacement of engine from a vehicle Carry out sequential overhaul of an engine and make necessary adjustments to manufacturers specifications. Assessment on correct use of tools and equipment

	2.7 Explain the different types of limits and fits; interference fits, push fits etc, 2.8 Discuss the applications of limit and fits in various components of the automobile system e.g. Piston and cylinder 2.9 Explain the process of examining and measuring parts using manufacturers' manual as a guide			▪ Reassemble engine components with necessary adjustments	of wear on a component making reference to service manual. • Demonstrate the processes of assembling Pistons and rings using clamp • Show fitting of cylinder liners • Show fitting of valve guides and valve seat inserts • Show fitting of roller & ball bearing, • Demonstrate sequentially the reassembling of engine components and how to make necessary adjustments.	
	General Objective 3.0: Understand the Process of Carrying out Cylinder Reboring					
Week 4	3.1 State the reasons for cylinder reboring 3.2 Describe the use of service manuals to determine bore size 3.3 Describe how to rebore cylinder to the required specification	▪ Explain the reasons for cylinder reboring ▪ Discuss the use of service manuals to determine bore size ▪ Discuss how to rebore cylinder to the required	• Whiteboard • Whiteboard marker • Projector • Duster • Textbooks • Service manual • Flip chart • Boring machine	3.1 Carryout cylinder measurement using the correct tool. 3.2 Carryout cylinder reboring 3.3 Use service manual to determine the correct	▪ Demonstrate how to use service manual to determine the correct bore size ▪ Demonstrate the process of: - -Setting the cylinder on reboring machine -Setting the boring tools	Explain the reasons for cylinder reboring Use service e manual to determine bore sizes

	and select rings and piston sizes to match	specification and select rings and piston sizes to match	• Vernier calipers • Chalk board • Sizing tools • Pistons Rings etc.	bore size 3.4 Select appropriate rings and piston size to match the rebored cylinder.	on the reboring machine -Checking the accuracy of the boring tool and cylinder Setting ▪ Show how to select correct sizes of rings, and pistons from the manufacturer's manual	Carry out Cylinder Reboring to manufacturers specification
	General Objective 4.0: Grind Crankshaft to Correct Specifications					
Week 5	4.1 Explain the process of crank shaft grinding 4.2 Explain the selection of bearing sizes to fit crankshafts 4.3 Explain how to check crank shaft sizes before grinding 4.4 Explain how to grind crankshaft to appropriate sizes and fits	▪ Discuss the process of crank shaft grinding ▪ Discuss the selection of bearing sizes to fit crank shafts ▪ Discuss how to check crank shaft sizes before grinding ▪ Discuss how to grind crankshaft to appropriate sizes and fits	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbook ▪ Crankshaft, Grinding tools ▪ Service manual chalk board ▪ Service manual Micrometer ▪ models Crankshaft Grinding tools ▪ complete tool box	4.1 Select tools for crankshaft grinding 4.2 Check for crankshaft size 4.3 Mount crankshaft on the crankshaft grinding machine 4.4 Grind crankshaft to appropriate sizes and fits.	▪ Demonstrate, using diagrams and models the process of crank shaft grinding ▪ Using the manufacturer's manual, find the size of bearing to suit the crankshaft size ▪ Show how to measure the crankshaft size using micrometer ▪ Demonstrate the	Use service manual to select bearing sizes to fit crankshaft Carry out grinding operation on crankshaft to the correct size using appropriate tools and equipment

					process of Mounting crankshaft on the crankshaft grinding machine. ▪ Show how to grind crankshaft to the correct size.	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK MODULE: CAM 334 AUTO-ELECTRICITY/ELECTRONICS
DURATION: 96 HOURS

GOALS: The trainee will be able to trace faults in the electrical system of automobile and effect necessary repairs. GENERAL OBJECTIVES:
On completion of this module, the trainee should be able to understand the:

1. **Principles of electricity generation as applicable to automobiles**
2. **Procedure for effective maintenance in an Automobile**
3. **Operation of the starter motor**
4. **Operation of all electrical components of a vehicle**
5. **Operation of the coil ignition system**
6. **Operation of the transistorized and electronic control ignition system.**

PROGRAMMES: NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANIC's WORK						
SUBJECT: AUTO-ELECTRICITY/ELECTRONICS			**Subject Code : CAM 334**		**Contact Hours: 8hrs/week**	
MODULE SPECIFICATION: THEORETICAL CONTENTS						
General Objective 1.0: Understand the Principles of Electricity Generation as Applicable to Automobiles						
	Theoretical Content			**Practical Content**		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Define A.C and D.C 1.2 List the process of current generation in both A.C and D.C 1.3 List storage procedure for batteries 1.4 Explain the chemical reaction that take place during charge and discharge processes in the battery.	▪ Explain A.C and D.C ▪ Explain the process of current generation in both A. C and D.C generators. ▪ Explain the chemical reaction that take place during charge and discharge processes in the battery. Emphasize basic battery maintenance ▪ Explain the process of storing electricity in chemical form and physical storage of the battery	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Battery ▪ Battery charger ▪ Volt meter ▪ Hydro meter ▪ 12-13 Spanner ▪ Charts ▪ Sulphur acid ▪ Distilled ▪ Battery discharge meter ▪ Tachometer ▪ Digital multi meter	1.1 Demonstrate how current is generated in both A.C and D.C generators. 1.2 Demonstrate how to use cluster in checking charging system.	▪ Show students how current is generated in both A.C and D.C generators. ▪ Guide the students on how to use multi-meter in checking charging system	Define A.C and D.C Explain storage procedures for batteries Carry out inspection on charging system using multi-meter
General Objective 2.0: Understand the Procedure for Effective Maintenance of Charging System in an Automobile						
3-4	2.1 Describe the function of a charging system.	▪ Explain the charging system and the function of its components.	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster	2.1 Identify the common faults related to charging system.	▪ Demonstrate how to identify common faults related to	With the aid of a diagram explain the charging

	2.2 State the function of different components of a charging system. 2.3 Explain the principles of electromagnetism in generation of electricity (A.C and D.C.) 2.4 Explain the principles of commutation, rectification and regulation of electricity 2.1 Explain the operating principle of an alternator.	▪ Explain the process of generating electric current using electro-magnetism in A.C and D.C. ▪ Explain how the commutators are used to rectify current output from the alternator. ▪ Explain the operating principle of an alternator	▪ Textbooks ▪ Chart ▪ Alternator ▪ Volt meter ▪ Ammeter ▪ Semiconductor ▪ Alternator ▪ Battery ▪ Battery charger ▪ Volt meter ▪ Hydro meter ▪ 12-13 Spanner ▪ Charts ▪ Sulphur acid ▪ Distilled ▪ Battery discharge meter ▪ Tachometer ▪ Digital multi meter ▪ Impact screw driver	2.2 Check the functionality of the component of the charging system 2.3 Carryout repair or replacement of faulty components in a charging system.	charging system ▪ Demonstrate how to check the functionality of the component of the charging system ▪ Show how to carryout repair or replacement of faulty components in a charging system.	system Identify components of a vehicle charging system Carry out inspection of vehicle charging system using appropriate tools and rectify faults
General Objective 3.0: Understand the Operation of the Starter Motor						
5-6	3.1 State the principles of operation of the starter motor **3.2** Describe the main part of a starter motor and their functions.	▪ Explain the principles of operation of the starter motor ▪ Explain the parts of starter motor and their functions	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Charts ▪ Armature Growler ▪ Ammeter ▪ Voltmeter ▪ Starter motor ▪ Complete tool box ▪ Special tool box	3.1 Identify starter motor and its components 3.2 Remove and replace a starter motor	• Show the students starter motor and its components • Demonstrate how to remove and replace a	Identify components of a vehicle starting system.

	3.3 Explain the basic construction of a starter motor.			3.3 Diagnose faults associated with a starter motor 3.4 Rectify faults of a starter motor	starter motor • Show how to diagnose faults associated with a starter motor • Show how to rectify faults of a starter motor	With the aid of a diagram explain the construction of the starter motor Carry out inspection on starting system component using appropriate tools and rectify faults
General Objective 4.0: Understand the Operation of Electrical Components of a Vehicle						
7-8	4.1 State the principles of light reflection and refraction 4.2 State the characteristics of various types of lamp unit, e.g. sealed beam flash unit 4.3 Explain a wiring diagram as it applies to the automobile. 4.4 Explain the advantages and	▪ Explain the principles of light reflection and refraction. ▪ Explain how to set headlamp beam. ▪ Explain the characteristics of various types of lamp unit ▪ Describe a wiring diagram as it applies to the automobile. ▪ Explain the advantages and disadvantages o f earth return and	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Digital multimeter ▪ Testing lamp ▪ Induction tester ▪ Electrical wiring diagram (Charts) ▪ Complete tool box ▪ Special tool box	4.1 Sketch wiring diagrams of an automobile 4.2 Identify the symbols used in electrical wiring 4.3 Show students the various systems of wiring e.g. insulated and earth return system.	▪ Identify the various systems of wiring e.g. insulated and earth return system ▪ Guide the students on how to identify the symbols used in electrical wiring diagram ▪ Interpret wiring diagrams	List and explain the symbols used in vehicle electrical system components Sketch the wiring diagram of two (2) vehicle systems Interpret the wiring

	disadvantages of earth return and insulated return systems	insulated return systems		4.4 Demonstrate how to trace and rectify faults in all electrical components of a vehicle.	of an automobile ▪ Guide the students on how to trace and rectify faults in. electrical components of a vehicle	diagram of a vehicle system Perform fault tracing using a wiring diagram
General Objective 5.0: Understand the Operation of The Coil Ignition System						
9-10	5.1 Explain the theory of current generation by electro-magnetic induction. 5.2 State the operation of the coil ignition system 2.4 Explain the relationship between correct gap size and dwell angle for distributor contact breaker points. 2.5 Describe the action of a speed sensitive advance and retard mechanism. 2.6 Describe the distribution	▪ Explain with diagram how a magnet is used to generate current. ▪ Explain the function of coil ignition system. ▪ Explain how to set contact breaker points and how it affects the dwell angle ▪ Explain the need for advancing and retarding the ignition in relation to the speed of the engine ▪ Explain the	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Distributor ▪ Charts ▪ Plugs ▪ Dwell angle meter ▪ Relevant measuring tools ▪ Circuit diagram ▪ Coil ▪ Condenser/accumulator ▪ C.B Points/CDI ▪ Overhead slides ▪ Measuring instruments ▪ diagrams ▪ diodes circuits ▪ ignition coil tester ▪ wire brush ▪ digital multi meter	5.1 Sketch the coil ignition system. 5.2 Identify the components of coil ignition system and wiring methods. 5.3 Draw the operation of the distributor 5.4 Identify the process of measuring forward and reverse resistance of typical diodes	▪ With the aid of sketch, explain t h e function of coil ignition system ▪ Show the Students the components and wiring methods ▪ Demonstrate how spark plugs are adjusted .	With the aid of a diagram describe the ignition system Identify components of a vehicle ignition system Carry out inspection of vehicle ignition system using appropriate tools and

			▪ stroboscope ▪ complete tool box			

	high-tension supply. 2.7 Describe the function of the spark plug and the importance of correct gap setting. 2.8 Explain the need for correct ignition timing and the effect of incorrect ignition timing. 2.9 State the use of capacitors for a. Spark quenching e.g. as surge absorbers. b. By-passing alternating currents c. Timing purposes e.g. as neon lamp flashers	distribution high-tension supply. ▪ Explain the process of ignition and understand the firing order of a four and six-cylinder engine. ▪ Explain in detail the safety precaution necessary when working on ignition systems ▪ Explain the wiring system namely; - Series wiring, Parallel wiring ▪ Explain how capacitors can be used to: Absorb electrical surge, by-pass alternating current etc ▪ Explain the function of diodes ▪ Discuss methods of measuring electrical resistance		5.5 Identify the methods of measuring electrical resistance.	▪ Demonstrate the process of measuring forward and reverse resistance of typical diodes ▪ Demonstrate the methods of measuring electrical resistance.	rectify faults

	2.12 List the types of diodes and its functions. 2.13 List the method of measuring electrical resistance.					
General Objective 6.0: Understand the Operation of the Transistorized and Electronic Control Ignition System						
11-12	6.1 Discuss safety when working on ignition system. 6.2 Explain the operation and function of high tension (HT) capacitor ignition 6.3 Compare different methods of the transistorized ignition systems 6.4 Explain the function/operation of magneto ignition system 6.5 Describe the process of high-tension capacitor magneto ignition 6.6 State the functions	▪ Explain the safety to be observed when working on ignition system. ▪ Discus the operation of different types of ignition system ▪ Explain the different methods of transistorized ignition system ▪ Explain the operation of; a. High tension capacitor ignition b. magneto ignition system c. high tension capacitor magneto ignition	▪ Whiteboard ▪ Whiteboard marker ▪ Projector ▪ Duster ▪ Textbooks ▪ Wall charts ▪ Distributor ▪ Charts ▪ Plugs ▪ Dwell angle meter ▪ Relevant measuring tools ▪ Circuit diagram ▪ Coil ▪ Condenser/accumulator ▪ C.B Points/CDI ▪ Overhead slides ▪ Measuring instruments ▪ diagrams ▪ diodes circuits ▪ ignition coil tester ▪ wire brush ▪ digital multi meter ▪ stroboscope ▪ complete tool box ▪ Scan tool	6.1 Sketch the methods of transistorized ignition system 6.2 Show the operation of transistorized ignition. 6.3 Identify the operation of magneto ignition system. 6.4 Sketch different types of high energy ignition system.	▪ Illustrate with the aid of sketches different methods of transistorized ignition system ▪ Demonstrate the operation of transistorize d ignition. ▪ Sketch the operation of magneto ignition system. ▪ With the aid of sketches illustrate different types of high energy ignition	State safety precaution when working on Ignition system List the types of ignition system Use appropriate tools to trace and rectify faults in ignition system. Use a spark plug tester to test the

	of major components of high energy ignition system such as a Electronics spark control (ESC) b Electronic module retard (EMR) c Electronic spark selection (ESS)	▪ Explain the functions of major components of high energy ignition system.			System	strength of spark

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK MODULE: CMV 20: MAJOR ENGINE REPAIR WORK

PRE-REQUISITES: NATIONAL TECHNICAL CERTIFICATE DURATION: 216 HOURS

GOALS: This module is designed to provide the trainee with more advanced knowledge and skills to carry out major engine repair work.

GENERAL OBJECTIVES

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

1. **Understand the working principles of a multi injector**
2. **Understand the construction and operation of C.I. engine fuel system.**
3. **Understand cams and camshaft drive arrangements**
4. **Understand valve and valve port timing for both spark and compression ignition engines.**
5. **Understand the construction and operation of the types of combustion chambers.**
6. **Understand the principles of crankshaft balancing and vibration damping.**
7. **Understand the dry sump lubrication system, crank case ventilation and action of oil pressure gauges.**
8. **Understand the construction and action of the components in a pressurized water-cooling and vehicle heating system.**
9. **Understand the operation and wiring of the coil ignition system.**

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK						
SUBJECT MAJOR ENGINE REPAIR WORK			**Subject Code : CMV 20**		**Contact Hours: 18hrs/week**	
MODULE SPECIFICATION: THEORETICAL AND PRACTICAL CONTENT						
General Objective 1: Understand the Working Principles of a Multi Injector						
Theoretical Content				**Practical Content**		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
Week 1-2	1.1 State the basic principles and construction of multi injector. 1.2 Explain the operation of the anulus. 1.3 State the advantages and disadvantages of a single and multi-hole injector nozzles. 1.4 Explain the operation of an electrical petrol lift pump 1.5 Explain how air max flow sensor, oxygen sensor and fuel regulator valves can be varied 1.6 Describe the action and purpose of the hot spot 1.7 State the main methods of air cleaning and silencing 1.8 Describe the flow and	• Explain the basic principles and construction of multi injector e.g Pintle, pintaux and multi holes. • Explain the operation of the anulus. • Explain the advantages and disadvantages of a single and multi-hole injector nozzles. • Explain the operation of an electrical petrol lift	▪ -Single and Multi-injector nozzles ▪ Electronic equipment ▪ Fuel injection equipment ▪ Live diesel and petrol engines. ▪ Diagrams and components ▪ Scan tool ▪ Complete tool box ▪ Special tool box	1.1 Identify common fuel injection systems problems 1.2 Demonstrate procedures for removing and installing fuel injection system components 1.3 Demonstrate procedures for repairing and replacing fuel injection components 1.4 Carryout cleaning on injector nozzles	• Show students how to identify common fuel injection systems problems • Show the students the procedures for removing and installing fuel injection system components • Show the students the procedures for repairing and replacing fuel injection components • Guide the students on how to Carry out cleaning on injector nozzles	State the basic principles and construction of multi injector. List the advantages and disadvantages of a single and multi- hole injector nozzles. Remove and service injector

	action of air in the inlet and exhaust manifolds 1.9 Explain the basic principles of electronic fuel injection 1.10 List the advantages of fuel injection	pump • Explain how air max flow sensor, oxygen sensor and fuel regulator valves can be varied • Describe the action and purpose of the hot spot • State the methods of air cleaning and silencing • Describe the flow and action of air in the inlet and exhaust manifolds • Explain the basic principles of electronic fuel injection • Explain in details the advantages of fuel injection				
General Objective 2.0: Understand Compression Ignition Engine Fuel System						
Week 7-9	2.1 Explain the need for phasing the inline pump. 2.2 Explain the operation of an idle/maximum speed	▪ Explain when calibration of inline pump becomes	▪ Appropriate working tools and equipment. (e.g Injection pump	2.1 Apply correct information tools and equipment for inspecting diesel	Show how to apply correct information tools and equipment for inspecting diesel fuel system.	State the meaning of phasing and calibration

	mechanical governor suitable for use on an in-line pump. 2.3 State the provision for adjustment of governor linkages and stops 2.4 Explain the operation of the distributor type pump with regard to: a. transfer valve, b. regulating valve; c. metering valve; d. pump plungers; e. fuel distribution 2.5 State the advantages and disadvantages of the distributor type pump when compared to the inline pump 2.6 Explain the actions of: a. the mechanical governor b. the hydraulic governor in relation to the distributor type pump 2.7 Describe the action of a pneumatic governor 2.8 Explain the need for and	necessary ▪ List possible diesel engine faults attributable to governor on a running diesel engine ▪ Describe the procedures for governor adjustment ▪ Explain reasons for efficient operation of items listed in 2.4 (a-e) ▪ List application of distributor type pump and in-line pump. ▪ Mention common governor faults on C.I engine. ▪ Discuss the advantages	dismantling tools) ▪ Pneumatic governors ▪ Fuel Injection pump ▪ Injector nozzles ▪ Cold starting devices ▪ Diesel Engine. ▪ Fuel pressure gauge ▪ Fuel filters ▪ Cubical tubes ▪ Phasing machine (portable) ▪ Videos aids/ charts	fuel system. 2.2 Diagnose faults in a convention diesel fuel system 2.3 Demonstrate procedures for dismantling and assembling diesel fuel system components. 2.4 Demonstrate procedures for repairing and replacing diesel fuel system components 2.5 Carryout adjustment and operational test on diesel fuel system components.	Guide the students on how to diagnose faults in a convention diesel fuel system Show to the students the procedures for dismantling and assembling diesel fuel system components. Show to the students the procedures for repairing and replacing diesel fuel system components Guide the students on how to carryout adjustment and operational test on diesel fuel system components.	State tools and procedures for phasing and calibration Use appropriate tools to remove injection pump Test fuel injector

	the method of bleeding the fuel injection pumps. 2.9 Describe with the aid of sketches the types of injector nozzles to suit direct and indirect injectors 2.10 Explain the need for cold starting devices and state the legal requirements. Describe the operation of the following types of cold starting devices: a. Starter plugs; b. decompression devices; c. induction manifold starters d. ether sprays 2.11 Explain the operation of electronic fuel injection system 2.12 Explain the components and functions of the electronic injection systems. 2.13 List the advantages and disadvantages of an electronic fuel injection system	of pneumatic governor over other governors ▪ List possible causes of air entering the fuel system of diesel engine ▪ Explain the advantages and disadvantage s of direct and indirect injectors ▪ State the advantages of cold starting devices on diesel engine. ▪ Explain the operation of electronic fuel injection system ▪ Explain the components and functions of the electronic injection systems.				

		▪ Discuss the advantages and disadvantage s of an electronic fuel injection system				
General Objective 3.0: Understand Cams and Camshaft Drive Arrangements						
	3.1 Discuss the meaning and operation of VVTI 3.2 Determine variations in valve lifts and valve opening periods. 3.2 Locate the drive gear to the camshaft. 3.3 Explain how end float of the camshaft is controlled. 3.4 Describe the methods of camshaft drives including single overhead valve, single overhead cam and twin overhead cam	▪ Explain the meaning and operation of variable valve timing control (VVTI) ▪ Explain the operation and purpose of valves in rotating the camshaft. ▪ Explain the position and purpose of the camshaft gear. ▪ With the aid of a diagram explain how the end float of camshaft is controlled ▪ With the wall chart/model,	▪ Cam shaft ▪ Use measuring tools (e.g. micrometer) ▪ Wall chart ▪ Diagrams ▪ Complete tool box ▪ Special tool box ▪ VVTI live engine ▪ VVTI engine simulator	3.1 Identify camshaft layout and timing arrangement.	• Show camshaft layout and timing arrangement. .	Sketch a side and overhead cam shaft arrangement Explain the meaning and operation of VVTI Remove and install overhead cam shaft correctly

		explain the function and operation of camshaft drive showing how the camshaft actuates other components				
General Objective 4.0: Understand Valve and Valve Timing for Both Spark and Compression Ignition Engines.						
	4.1 Draw and label a typical valve timing diagram for a spark ignition engine. 4.2 Compare valve timing diagram for C.I. engine with that of a spark ignition engine. 4.3 State the meaning of the following terms: a valve overlap; b valve lead; c valve lag	▪ Explain the diagram of spark ignition system. ▪ Explain the importance of timing system ▪ Illustrate with the aid of sketches the difference between compression ignition and spark ignition system ▪ Explain the effects of: valve overlap valve lead valve lag	▪ -Wall chart ▪ -Chalkboard ▪ -Inlet valves ▪ -Exhaust valves ▪ Audio visual aids ▪ C.I engine/Petrol engine simulator	4.1 Identify common defects on valve and valve seats 4.2 Measure valve lengths and valve head merging thickness 4.3 Check valve seat contacts 4.4 Carryout valve seat cutting and grinding 4.5 Carryout leakage test	Show common defects on valve and valve seats Guide the students on how to measure valve lengths/valve head merging thickness Show the students how to check valve seat contacts Show the students how to carryout valve seat cutting and grinding Carryout leakage test .	Draw and label a typical valve timing diagram for a spark ignition engine. Draw and label a typical valve timing diagram for a compression ignition engine. Carryout valve grinding

General Objective 5.0: Understand the Construction and Operation of Various Types of Combustion Chambers.						
	5.1 Explain the factors to be considered when designing combustion chambers e.g: a shape; b size; c lift; d location; e number of valves; f position of sparking plugs 5.2 State the advantages and disadvantages of three types of the petrol engine combustion chambers. 5.3 Explain the combustion process for: a) Spark ignition engine 5.4 The three phases of combustion process in C.I engine	▪ Illustrate with diagrams the configuration of the combustion chamber; its action and operation. ▪ Discuss in detail the function of the combination chamber. ▪ State faults that can occur and state how they can be rectified ▪ Discuss the advantages and disadvantage s of the three types of petrol engine combustion chamber ▪ Explain by	▪ Manufacturer's manual ▪ Oil filters ▪ Filter wrench ▪ Crank case ▪ Dead engine ▪ Pressure gauge ▪ Measuring tools ▪ circuit diagram ▪ Ammeter etc. ▪ Complete engine ▪ Engine simulator ▪ Engine cylinder head ▪ Cylinder head crack detector	5.1 Demonstrate procedure for decarburizing cylinder head and its components. 5.2 Check cylinder head for flatness and measure the cylinder bore diameter for roundness 5.3 Check cylinder head for cracks 5.4 Inspect pushrods, studs and rocker arm for wear.	Show the procedure for decarburizing cylinder head and its components Guide student to check the cylinder head for flatness and measure cylinder bore diameter for roundness Guide student to check cylinder head for cracks Guide student to Inspect pushrods, studs and rocker arm for wear	State factors to be considered when designing combustion chambers List the three types of combustion chamber and sketch anyone. Check cylinder head for cracks
		illustration the combustion process in (a) S.I engine (b) three phases of combustion process in C.I engine				

General Objective 6.0: Understand the Principles of Crankshaft Balancing and Vibration Damping						
	6.1 Explain the principles of crankshaft balancing 6.2 Describe the causes of crankshaft vibration 6.3 State the types of crankshaft vibration dampers. 6.4 Sketch the methods of mounting crankshaft dampers 6.5 Explain reasons for use of dampers	▪ Discuss in detail the principles of crankshaft balancing and why it should be balanced. ▪ Explain the causes of crankshaft vibration and the purpose of dampers ▪ With the aid of sketches explain the types of vibration dampers ▪ Explain systematicall y how to mount crankshaft dampers ▪ Explain in detail why dampers are installed in the system. ▪ Explain how vibration is dampened out.	▪ Crankshaft ▪ Crankshaft Dampers ▪ Complete tool box ▪ Measuring devices	6.1 Carryout crankshaft balancing 6.2 Demonstrate how to inspect crankshaft for vibration 6.3 Mount crankshaft dampers	• Guide the students on how to carryout crankshaft balancing • Inspect crankshaft for vibration • Show how to mount crankshaft dampers	Explain the principles of crankshaft balancing Sketch the methods of mounting crankshaft dampers Use micrometer to test crankshaft journal for wear.

General Objective 7.0: Understand the Dry Sump Lubrication System, Crankcase Ventilation and Action of Oil Pressure Gauges.						
	7.1 Explain the operation of a dry sump lubrication system 7.2 Explain the need for crankcase ventilation 7.3 Explain the operation of an oil pressure gauge. 7.4 Draw a line diagram of an oil gauge/light circuit 7.5 Describe the operating principles of an oil cooler	▪ With the aid of a sketch, illustrate the principle of dry sump lubrication. Explain why and where this is applied. ▪ Explain how the crank case is ventilated ▪ Explain how the oil pressure gauge works. ▪ State the purpose of the gauge ▪ With the aid of a diagram, show and explain the operation of oil gauge/light circuit ▪ State the purpose of the oil cooler	▪ Manufacturer's manual ▪ Oil filters ▪ Filter wrench ▪ Crank case ▪ Dead engine ▪ Pressure gauge ▪ Measuring tools	7.1 Monitor oil pressure gauge 7.2 Identify Oil pressure switch 7.3 Sketch crankcase oil ventilation.	• Demonstrate how to monitor oil pressure gauge • Guide the students on how to identify Oil pressure switch • Illustrate with sketch crankcase oil ventilation.	With the aid of a sketch, explain dry sump lubrication. State the reason for crankcase ventilation Remove and replace oil pressure gauge.

General Objective 8.0: Understand the Construction and Action of the Components in a Pressurized Water Cooling and Vehicle Heating System						
	8.1 Explain the need for water pump 8.2 Describe the action of water pump	▪ Discuss the importance and application of water pump ▪ Explain the operation, action	▪ Model or actual pump ▪ Complete engine ▪ Complete tool box ▪ Wall chart or	8.1 Check the cooling system for faulty components 8.2 Carryout removal and replacement of a	• Guide the students on how to check the cooling system for faulty components	State functions and type of water pump Sketch a layout of water-

	8.3 Sketch the construction of the impeller shaft seal 8.4 Explain types of radiator construction including methods of water sealing 8.5 Explain the action of separate header tanks vertical and cross flow systems	of water pumps ▪ Discuss the constructional details of impeller type pump with the shaft seal ▪ Discuss the constructional details of a radiator and state common faults and their remedies Discuss the action and operation of separate header, vertical and cross tanks. State the use and the importance of the header tank.	Diagram ▪ Tools and equipment ▪ Radiator pressure tester ▪ Complete engine ▪ Header tank ▪ Complete tool box ▪ Block crack tester ▪ Anti-freeze tester ▪ Thermometer	water pump 8.3 Carry out replacement of a radiator 8.4 Carry out replacement of timing belt. 8.5 Carryout testing on thermostat and radiator. 8.6 Sketch a typical water pump	• Demonstrate how to carryout removal and replacement of water pump • Show how to replace radiator. • Guide the student on how to carry out replacement of timing belt. • Guide the students on how to carryout testing on thermostat and radiator.	cooling system Remove and test thermostat for correct operation
General Objective 9.0: Understand the Operation and Wiring of Coil Ignition System						
	9.1 Explain the theory of spark generation by electro-magnetic induction 9.2 Explain the need for and the action of a capacitor 9.3 Draw the ignition system to show how spark is transmitted to the combustion chambers 9.4 Explain the theory of	▪ Explain the low-tension circuit and the high-tension circuit of the coil ignition system ▪ Discuss the action of the condenser and its contribution to the system ▪ Explain the process by which current flows from the battery	▪ Lesson plan ▪ Chart ▪ Coil ▪ Capacitor ▪ Overhead projector ▪ Plugs ▪ Complete live Petrol engine ▪ Engine Analyzer ▪ Timing light	9.1 Identify common faults with the ignition system. 9.2 Sketch the layout of coil ignition system	▪ Show how to Identify common faults with the ignition system. ▪ Illustrate with the aid of diagrams, the layout of coil ignition system and emphasize how spark is distributed to the various cylinders	Explain the theory of spark generation by electro-magnetic induction Sketch the layout of coil ignition system

	spark ignition system	through the low-tension circuit, and the high-tension circuit to produce spark at the plugs.				

ADVANCED NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE EMCHANICS' WORK. MODULE: CMV 21: TRANSMISSIONSYSTEM II
DURATION: 72 HOURS

GOAL: **The goal of this module is to provide the trainees with advanced skills in transmission repair work to enable him carry out repairs to fluid flywheel, all types of gearboxes and other latest designs in transmission.**

GENERAL OBJECTIVE:

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

1. **Understand the operating principlesof automatic transmission gearbox.**
2. **Understand the operation of synchromesh gear and assemblies**
3. **Understand the construction, methods and adjustments of the components of single-plate, multi-plate and centrifugally operated clutches.**
4. **Understand the functions and operations of double reduction final drive differential assembly**
5. **Understand the purpose and operation of the components of propeller and drive shafts.**

POGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK.						
Subject : TRANSMISSION System II			**Subject Code : CMV 21**			**Contact Hours: 6HRS/WEEK**
Subject Specification: THEORETICAL CONTENT						
General Objective: 1.0 Understand the Operating Principles of Automatic Transmission Gear Box						
Theoretical Content				**Practical Content**		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
Week 1-2	1.1 Explain the principles of operation of automatic transmission. 1.2 Explain various types of automatic transmission system 1.3 List the advantages and disadvantages of automatic transmission system 1.4 Differentiate between manual and automatic transmission system 1.5 Explain the major components of automatic transmission system. 1.6 States the requirement of an automatic transmission fluid	▪ Describe with the aid of sketches the major parts of Automatic transmission and how they function ▪ Explain the concept of automatic transmission ▪ List the advantages and disadvantages of automatic transmission.	▪ Chart ▪ Automatic transmission on ▪ Complete toolbox ▪ Special tools ▪ Audio visual aid ▪ Scan tool	1.1 Demonstrate the procedures for inspecting the automatic transmission system. 1.2 Demonstrate procedures for adjusting automatic transmission system components. 1.3 Carryout replacement of filter element of an automatic transmission system. 1.4 Demonstrate the procedures for automatic transmission fluid change	• Show the procedures for inspecting the automatic transmission system. • Show the procedures for adjusting automatic transmission system components. • Guide the students on how to carryout replacement of filter element of an automatic transmission system. • Guide the student on the procedures for automatic transmission fluid change	Explain the principles of operation of automatic transmissio n. States advantages and disadvantage es of automatic transmissio n. carryout replacement t of filter element of an Automatic transmission

General Objective 2.0: Describe the Operation of Synchromesh Gear Assemblies and Describe the Type of Bearing used in them.						
Week 3-4	2.1 Describe the operation of constant load and bulk ring type of synchromesh device 2.2 Explain power flow and the operation of a synchromesh gear box. 2.3 State reasons for the use of helical gears in the gear box and the solution of problems arising from them 2.4 State types of bearings used in a gear box: a to absorb end thrust b to support gears in casing 2.5 Describe a gear control mechanism and its operation 2.6 State the reason for the utilization of the remote-control mechanism 2.7 State the purpose of overdrive units 2.8 Describe the operation of two-speed transfer box in: (a) four-wheel drive 2.9 Describe transaxle arrangement and operation	▪ Explain the operation of the constant load and baulk-ring synchromesh h devices, state the reason why the constant load is no longer in used ▪ Discuss the various types of gears that can be used inthe manual type gearbox e.g. helical gears State their faults and possible remedies ▪ Explain the type of bearings that can	▪ Charts ▪ Overdrive unit ▪ Transfer gear box ▪ Complete tool box ▪ Bearing induction heater ▪ Torque wrench ▪ Transaxle ▪ Simulator	Apply correct tools and equipment for inspecting manual gear box system. Demonstrate procedures for dismantling and assembling manual gear box and its components Identify bearings used on rear axle assemblies Apply procedures for maintaining hubs and bearings.	• Guide the student s on how to apply correct tools and equipment for inspection on manual gear box system. • Show the procedures for dismantlin g and assembling manual gear box and its component s	State types of manual gearbox Sketch the following types of gears; helical, bevel and spur gear Use correct tools and equipment to remove manual gearbox
		absorb various load imposed by the actions of the gears ▪ Explain with			• Show the student s bearing s used on rear axle	

		sketches the gear control mechanism and its operation ▪ Discuss the need for remote control mechanism and state some of its advantages. ▪ Discuss the functions and advantages of overdrive units ▪ Explain the operation and the need to have a transfer gear box on the vehicle transmission system.			assemblies • Show the procedures for maintaining hobs and bearing s.	

General Objective 3.0 Understand the Construction Methods and Adjustments of the Components of Single-Plate, Multiplate and Centrifugally Operated Clutches						
Week 5-6	3.1 Describe the construction of the typical clutch center plate 3.2 Describe the function of the following: a hub; b Centre shock absorbing spring c Dishing and slits in the center plate	▪ Explain with the aid of diagram the constructional features of the clutch plate, e.g. Friction	▪ Single plate clutch ▪ Ball bearing ▪ Chart ▪ Multiplate clutch ▪ Complete tool box	Apply correct information on tools and equipment for identifying and rectifying faults on a clutch system	• Guide the students and how to apply correct information tools and equipment for identifying and rectifying faults on	With the aid of neat diagram explain the construct ion of single plate clutch. Carryout

	d Friction linings 3.7 Describe graphite and ball bearing release bearing 3.8 Describe the properties and materials of friction lining material 3.9 Explain the need for release lever setting of multi spring clutch. 3.10 Discuss the layout and operation of the centrifugally operated clutch 3.8 Explain the operation of multi- plate clutch.	Lining, Rigid hub and spring hub ▪ Explain the flexible clutch plate ability to absorb torsional shocks resulting from engine vibration and clutch take up, which causes noise or rattle. ▪ Explain the function and the importance of a release bearing on theclutch system. ▪ Discuss the qualities of the materials used for friction lining. ▪ Explain the operation of the release lever and the effect of adjustment on it. ▪ Explain the	▪ Clutch special tools; Pilot shafts, Dial gauge, feeler gauge, Straight edge etc	Carryout dismantling and assembling of clutch and its components Show how to repair or replace components of a clutch system. Measure wear and tear on clutch components	a clutch system • Show how to carryout dismantling and assembling of clutch and its components • Demonstrate procedures for repairing or replacing components of a clutch system. • Show how to measure wear and tear on clutch components	dismantling and assembling of multi clutch Select the appropriate te tools to remove and replace single plate clutch

		operations andthe advantages and disadvantages of a centrifugal clutch ▪ Explain the operation, advantages and disadvantages of a multi-plate clutch over the single plate clutch				

General Objective 4.0: Understand the Functions and Operations of Double Reduction Final Drive Differential Assembly						
Week 7-8	4.1 Explain the basic principles of double reduction final drive differential and front wheel drive assembly 4.2 Describe the means of lubrication and oil retention of the final drive unit 4.3 Describe the action of the bevel gear differentials 4.4 Describe the banjo axle casing 4.5 Describe differential arrangement under different driving condition	▪ Describe the principles of power versus speed as applied to double reduction and differential gearing. Explain how the final drive unit is lubricated and the type of lubricant used and provision to take care of pressure	▪ Constant velocity joint ▪ Banjo axle casing ▪ Chart ▪ Complete tool box ▪ Vernier calipers ▪ Micrometers ▪ Special tools ▪ Lubricant ▪ Marking paste e.g Engineer's blue ▪ Jack stand ▪ Final Drive unit	4.1 Carryout inspection of a differential assembly 4.2 Dismantle and assemble the differential assembly 4.3 Carryout functionality test of differential assembly component 4.4 Measure wear and tear on the	• Show how to carryout inspection of a differential assembly • Guide the Students on how to dismantle and assemble the differential assembly • Show how to carryout functionality test of differential assembly component • Guide the students on how to measure wear and tear on the component of differential assembly. • Show the procedure for repairing or replacing	State the basic principle s of double reduction final drive differenti al assembly Sketch the final drive and label its part. Use appropria

		build-up in the axle casing ▪ Explain the action of the differential gearing during cornering		component of differential assembly. 4.4 Demonstrate the procedure for repairing or replacing component of a differential assembly.	component of a differential assembly.	te tools to check final drive gears for wear or damage
		and straight motion ▪ Explain the banjo axle casing and how it differs from other casings				

General Objective 5.0: Understand the Purpose and Operation of the Components of Propeller and Drive Shafts.						
Week 9-10	5.1 Describe the purpose of constant velocity universal joints on the drive shafts of vehicles 5.2 Describe the following constant velocity joints, tracts, double – hooks. 5.3 Describe the followings: Lay rub and rubber cruciform coupling pots joints 5.4 Explain the use on front wheel drive of: Solid drive shafts, tubular drive shafts	▪ Explain the forces acting on the front wheel drive axle e.g cornering, driving and braking forces ▪ Explain with the aid of sketches their advantages	▪ Chart ▪ Propeller shaft ▪ Universal joints ▪ Complete toolbox ▪ Bearing pullers ▪ Special tools ▪ Bearing induction testers ▪ Constant velocity joints	5.1 Identify common faults associated with drive shaft 5.2 Dismantle drive shaft and assemble drive shaft 5.3 Check for wear and tears on drive shaft components	• Show the common faults associated with drive shaft • Guide students on how to dismantle drive shaft and assemble drive shaft • Identify wear and tears on drive shaft components • Lubricate drive shaft and bearings	State functions of universal joint Carryout removal and services of constant velocity joint.

	5.5 Explain the reason for the usage of torque – tube drive 5.6 Describe the arrangement of drive shafts when a transfer box is fitted in transmission	and disadvantages ▪ Explain with the aid of sketches, couplings. ▪ State the advantages and disadvantages one has over the other and state their differences Explain the torque tube features and the reasons they are used on some vehicles ▪ Explain the layout and operation of the various parts of the transfer box.		5.4 Lubricate drive shaft and bearings.		Lubricate drive shaft and bearings.

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS WORK MODULE: CMV 22: CHASSIS, STEERING, SUSPENSION AND BRAKE SYSTEMS.

DURATION: 72 HOURS

GOAL: This module is designed to provide the trainees with further knowledge and skills to repair and maintain chassis, power steering system, air and hydraulic suspensions, tractor trailer coupling and power brake system.

GENERAL OBJECTIVES:

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

1. **Understand the characteristics of various types of tractor/trailer couplings.**
2. **Understand the operations of a power take off (PTO) system and its maintenance.**
3. **Understand the working principle of both hydraulic and air suspensions.**
4. **Understand the principles of operation of a power steering mechanism.**
5. **Understand the working principles of power (air) brake system.**

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK						
SUBJECT CHASSIS STEERING, SUSPENSION AND BRAKING SYSTEMS		**Subject Code : CMV 22**		**Contact Hours: 6hrs/week**		
Module Specification: Theoretical and Practical Content						
General Objective:1.0: Understand the Characteristics of Various Types of Tractor/Trailer Couplings						
Theoretical Content				**Practical Content**		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
	1.1 State the characteristics of various types of tractor /trailer couplings, e.g. semi-automatic and landing 1.2 Describe various tools and equipment used for removal and adjustment of the fifth wheel coupling. 1.3 Explain coupling devices and safety aspects involved in coupling and uncoupling.	▪ Explain coupling devices. ▪ State the functions of automatic and semi- automatic couplings. ▪ Explain the advantages and disadvantages of automatic and semi- automatic coupling. ▪ List advantages of universal joints in transmitting torque	▪ Tractor with couplings	Identify various tools and equipment used for removal and adjustment of the fifth wheel coupling.	Show student various tools and equipment used for removal and adjustment of the fifth wheel coupling.	Mention some coupling devices. Use appropriate tools and equipment to remove and adjust the fifth wheel coupling.
General Objective: 2.0 Understand the Operations of a Power Take Off (P.T.O) System and its Maintenance						
	2.1 Explain the operation of a P.T.O on a tractor 2.2 List handling and tipping body. 2.3 Explain the standard speed of the P.T.O	▪ Describe the functions of a P.T.O on a tractor ▪ Explain safety precautions in using P.T.O. and tipping body.	▪ A model P.T.O. ▪ Sketches ▪ Chalkboard ▪ Tractor	• Demonstrate procedures for inspecting P.T.O system components • Diagnose faults in a P.T.O system • Dismantle and assemble P.T.O components • Demonstrate procedure	• Show the procedures for inspecting P.T.O system components • Guide the students on how to diagnose faults in a P.T.O	State the operation of a P.T.O on a tractor

		▪ Discuss the standard speed of the P.T.O.		for repairing and replacing P.T.O system components. • Service P.T.O system and associated components	system • Show how to dismantle and assemble P.T.O system components Show the procedures for repairing and replacing P.T.O system components	
General Objective 3.0: Understand the Working Principle of Both Hydraulic and Air Suspensions.						
	3.1 Explain the working principle of air and hydraulic suspensions. 3.2 Explain the basic types of springs 3.3 Explain the construction and function of shock absorbers 3.4 Explain the construction and function of a height	▪ Describe the functions of air and hydraulic suspensions. ▪ Explain air suspension system. ▪ Explain hydraulic suspension system ▪ Name all the	▪ Charts ▪ Air suspension ▪ Transparencies ▪ Hydraulic suspension ▪ Shock absorbers ▪ Complete toolbox ▪ Tie and puller ▪ Hoist	3.1 Demonstrate procedures for inspecting suspension system components 3.2 Diagnose faults in a conventional suspension system 3.3 Demonstrate procedures for repairing suspension system components	• Show the procedures for inspecting suspension system components • Show how to diagnose faults in a conventional suspension	State the differences between hydraulic and air suspension Use appropriate tools and equipment to dismantle and assemble hydraulic suspension system
	control suspension	parts of both air and hydraulic suspension systems. ▪ List faults commonly found on both air and hydraulic suspension systems		3.4 Dismantle and assemble suspension system components.	system • Show the procedures for repairing suspension system components • Guide the students on how to dismantle and assemble suspension	

					system components.	
	Examinations: Practical 70% Theory 30%					
General objective: 4.0 Understand the Operation Principles of a Power Steering Mechanism						
	4.1 State the principles of operation of power steering system 4.2 Explain common faults in steering mechanism 4.3 Explain the layout and construction of component parts of power steering and gear assembly to illustrate the oil passages in the steering shaft. 4.4 Define the term oversteer and	▪ Explain the operation of the power steering system and its requirements, advantages and care. ▪ Illustrate with appropriate diagrams the operation of power steering. ▪ Explain common faults	▪ Complete power steering mechanism ▪ Charts ▪ Complete toolbox ▪ Special tools	4.1 Demonstrate procedures for inspecting steering system components 4.2 Diagnose faults in a steering system 4.3 Dismantle and assemble steering system components 4.4 Demonstrate procedures for repairing and replacing steering system components.	• Show the procedures for inspecting steering system components • Guide the students on how to diagnose faults in a steering system • Show how to dismantle and assemble steering	Explain the principles of operation of power steering system With the aid of sketches, explain the construction/operation of rack and pinion steering Use appropriate tools and equipment to repair faulty power steering system
	understeer 4.5 Describe the arrangement of worm type power steering.	associated with power steering and possible remedies ▪ With the aid of sketches, explain the constructional features of power steering and the fluid qualities in the system			system components • Show the procedures for repairing and replacing steering system components.	
General Objectives: 5.0 Understand the Working Principles of Power Brake System						
	5.1 Explain the working principles of exhaust brake system 5.2 Sketch layout of an air brake system	▪ Explain with diagrams, the operation of the exhaust brakes system, state its advantages and	▪ Chart ▪ Power braking system components ▪ Complete toolbox	5.1 Carryout brake system wear assessment 5.2 Diagnose faults in a power brake system 5.3 Dismantle and assemble	• Guide the students on how to carryout brake system wear assessment	Make a neat sketch of an air brake system showing the components in their relative positions.

	showing the components in their relative positions. 5.3 State the constructional features of power (air) brake system 5.4 State the advantages and disadvantages of power braking system.	disadvantages ▪ With the aid of diagram, illustrate the layout of air brake system ▪ State possible faults associated with the system and suggest	▪ Brake bleeding machine	brake system components 5.4 Demonstrate procedure for repairing and replacing brake system components. 5.5 Service brake system and associated components 5.6 Measure wears of	• Show the students how to diagnose faults in a power brake system • Guide students on how to dismantle and assemble brake system components	Diagnose fault in brake system. Dismantle, repair and assemble the brake system components.
	5.5 Explain the arrangement of a power brake system.	possible remedies.		components of a power brake system.	• Show the procedures for repairing and replacing brake system components. • Guide the students on how to service brake system and associated components • Show how to measure wear of components of a power brake system.	
Week 13	Examinations: Theory 30% Practical - 70%					

PROGRAMME: **ADVANCED NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANIC WORKS MODULE: CMV 23: AUTOMOTIVE AIR CONTIDIONING SYSTEM**

DURATION: **72 HOURS**

GOAL: **This module is designed to provide the trainee with further knowledge and skills to repair and maintain automobile air conditioning systems**

GENERAL OBJECTIVES:

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

1. **Understand the working Principles of automobile air-conditioning system**
2. **Understand how to diagnose and rectify faults in air conditioning system.**
3. **Understand how to Install new auto air conditioning unit**
4. **Understand how to carry out routine maintenance.**

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK						
Subject: AUTOMOBILE AIR CONDITIONING			**Subject Code: CMV 23**		**Contact Hours: 6hrs/week**	
Subject Specification: Theoretical and Practical Content						
WEEK	**General Objective 1.0: Understand the Working Principles of a Car Air Conditioning System**					
	Theoretical Contents			**Practical Contents**		
	Specific Learning Objectives	**Teachers Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teachers Activities**	**Evaluation**
	1.1 Explain the working principles of automobile air-conditioning system 1.2 List the components of the system as well as explaining their functions 1.3 Explain the necessary precautions to take when working on air conditioning system.	Explain the activities 1.1. to 1.3.				State the principles of automotive air-conditioning Mention the necessary precautions to take when working on air conditioning system.
1-8	1.1 Principles of automobile air-conditioning system 1.2 Explain the working principles of automobile air-conditioning system 1.3 Explain the components of the unit such as: a. Compressor b. Condenser c. Liquid receiver/sight glass d. Evaporators/fan e. Refrigerant control f. Thermal Expansion	Explain the activities 1.1. to 1.5.	▪ Air-conditioned car ▪ Whiteboard ▪ Charts ▪ Liquid receiver ▪ Site glass ▪ Video ▪ Thermal Expansion Valve (TEV) ▪ Thermostat ▪ Compressor ▪ A. C Pressure gauge ▪ Refrigerant R134a ▪ AC leak detector ▪ AC refrigerant	1.1 Demonstrate the working principles of a car air-conditioning system 1.2 Identify the components of the unit such as: i. Compressor j. Condenser k. Liquid receiver/sight glass l. Evaporators/fan	▪ Guide the student to perform activities 1.1 to 1.2	▪ Ask the students to: ▪ Draw and explain the working principles of a car air-conditioning system ▪ Identify the components of a car air-conditioning system (in a car)

	Valve (TEV) g. Thermostat (thermostatic switch) h. Relay 1.4 Explain the function of each component of the system. 1.5 Describe the operation of a car air-conditioning system		charging and evacuating machine ▪ Vacuum pump ▪ Automotive air conditioning and climate control simulator TPS-3574	m. Refrigerant control (TEV) n. Thermostat (thermostatic switch) o. Relay ▪		
	General Objective: 2.0 Understand how to Diagnose and Rectify Faults in Automobile Air Conditioning System					
9-16	2.1 Explain how to Diagnose any fault in an automobile Air- Conditioning system and rectifying same 2.2 Explain the correct tools and equipment required in diagnosing faults in automobile Air Conditioning system 2.3 Explain how perform	Describe the activities 2.1 to 2.8.	▪ Faulty air-conditioned car ▪ Gauge sets ▪ Ratchet sets ▪ R-134 ▪ Lubricating oil ▪ sight glass ▪ leak detector ▪ tool box ▪ charts ▪ video	2.1 Explain how Diagnose any fault in an automobile Air-Conditioning system and rectifying same 2.1 Explain the correct tools and equipment to use 2.2 Explain discharging, purging, evaluating and charging the system 2.3 Explain how to carry out installation and testing new automobile air conditioning system. 2.4 Explain how	Guide the student to perform activities 2.1 to 2.8 Emphasize the need for purging the system and evacuating it after repairs to leaks, replacement of components before charging it with refrigerant	Ask the students to draw and explain the functions of the components of a car air-conditioner
	discharging, purging, evaluating and charging the system. 2.1 Explain how to carry out installation and testing of a new automobile air conditioning system. 2.2 Explain how to carry out routine maintenance of					

	an air conditioning system. 2.3 Explain how to diagnose faults such as: a. shortage of gas b. blockage of air-filter c. faulty evaporator/condenser fans d. faulty compressor e. leakage of gas hose/tube, etc. 2.7 Explain how to rectify faults such as: a. shortage of gas (topping up or complete charge) b. cleaning the filter c. replacing the compressor d. replacement of leaking hose, etc. 2.8 Explain how to charge air conditioning unit with lubricating oil.			to carry out routine services of an air conditioning system. 2.5 Diagnose faults such as: a. shortage of gas b. blockage of air-filter c. faulty evaporator/condenser fans d. faulty compressor e. leakage of gas hose/tube, etc. 2.7 Rectify faults such as: a. shortage of gas (topping up or complete charge) b. clearing the filter c. replacing the compressor d. replacement of leaking hose.\, etc.		

				2.8 Charge air conditioning unit with lubricating oil.		
	General Objective: 3.0Understand how to Install New Auto Air Conditioning System					
17-20	3.1 Explain how to design the layout of the equipment within the car 3.2 Explain how to install the components. Connect the components together (compressor, condenser, receiver, and evaporator) 3.3 Explain how to wire the circuit 3.4 Explain how to pressure test the system 3.5 Explain how to vacuum the system 3.6 Explain how to charge the system 3.7 Explain how to carry out efficiency test on the system.	Explain the activities 2.1 to 3.7.	▪ All the components to be installed ▪ Oxy-acetylene set ▪ Protective clothing	3.1 Describe design the layout of the equipment within the car 3.2 Install the components. Connect the components together (compressor, condenser, receiver, and evaporator) 3.3 Wire the circuit 3.4 Pressure test the system 3.5 Vacuum the system 3.6 Charge the system 3.7 Carry out efficiency test on the system.	Guide the student to perform activities 3.1 to 3.7	▪ Asses student ▪ Ask the students to draw the wiring circuit of a car A/C

	General Objective: 4.0 Carry out Routine Maintenance					
21-24	4.1 Explain the importance of routine service of air-conditioning and refrigeration systems. 4.2 Explain how to design a routine maintenance chart for use in the maintenance of air-conditioning and refrigeration system 4.3 Explain how to carry out maintenance of the following air conditioning system components: a. Cleaning of condenser, filters, evaporator, etc. b. checking of joints for leaks c. check oil evaporator fan motor d. check and clear water drain pipe, and e. check the operation of the system	▪ Explain the activities 4.1 to 4.3.	▪ Blowers ▪ Water pressure machine ▪ Tool box ▪ Chart	4.1 Identify the importance of routine maintenance to air-conditioning and refrigeration systems. 4.2 Design a routine maintenance chart for use in the maintenance of air-conditioning and refrigeration system 4.3 Demonstrate how to carry out maintenance of the following air conditioning system components: Cleaning of condenser, filters, evaporator, etc. a. checking of joints for leaks b. check oil evaporator fan motor c. check and clear water drain pipe, and d. check the operation of the system	Guide the student to perform activities 4.1 to 4.3	1. Ask the students to design a routine service chart for air-conditioning and refrigeration systems. 2. Questions and Answers 3. Written tests 4. End of Module examination 5. Ask to carry out performance test and stabilize the system.

ADVANCED NATIONAL TECHNICAL CERTIFICATE IN AUTOMOBILE MECHANICS' WORK SUBJECT/MODULE: CME 26 PROJECT
PRE-REQUISITE: CMV 20, CMV 21, CMV 22 AND CBM 22

DURATION: 54 HOURS

GOAL: This module is designed to help a master craftsman practice working alone and to carry out a project with minimum supervision.

GENERAL OBJECTIVES:

On completion of this module the trainee should be able to: Carry out a detailed study on his own and present an extended essay on a suitable topic.

PROJECT

The following are examples of suitable projects:

1. **Investigation of local authority transportation structure and functions.**
2. **Investigation of the service department of a company, its structure and functions.**
3. **Market survey of trends in motor trade industry.**
4. **Forecast manpower requirement in relation to vehicle population in a particular State.**
5. **Vehicle statistics in States or at national level.**

NATIONAL TECHNICAL CERTIFICATE (NTC) AND ADVANCED NATIONAL TECHNICAL CERTIFICATE (ANTC)

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 subjects.

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.

One book should be produced for each syllabus

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

LIST OF BOOKS AND REFERENCES

1. Automobile Technology and Practical Work by J.A Dolan
2. Automotive handbook- BOSCH (Current edition)
3. Automotive mechanics by Williams H. Chrouse/Donald N. Aglin (Current edition)
4. Fundamentals of Automobile Technology by Hillier, Book 1,2, & 3
5. Technology for Motor Mechanics: 1-5 By S.C. Mudd
6. Automobile Workshop Practice by Staton Abbey
7. Automotive Fault-Tracing by Staton Abbey
8. Automotive Technology: A System Approach 5th Edition by Jack Erjavec
9. Automotive Technology Principles, Diagrams and Services by James S. Halderman
10. Advance Automotive Fault Diagnosis by Tom Denton
11. Automotive Suspension and Steering Systems by Don Knowles
12. Automobile Electrical and Electronic System by Ton Denton
13. Engine Repairs published by Delmer Cengage
14. Fundamentals of Automotive Technology; Principles and practice by Kirk VanGelder, published by CDX
15. Automotive Heating and air-condition by James S. Halderman.
16. Today's Technician: Banio Automotive System and Semica by Chris Hadfield, 6th Edition 2020.
17. Automotive Engine Repair by Jack Erjavec 2005
18. Automotive Technology: Principles, Diognosis and Service by James D.derman 2003
19. Automotive Mechanics 1993
20. Diesel Engine Electronics and Fuel Management System by John F. Kershaw 2005
21. Steering, Suspension and Alignment James D Halderman 2006

AUTOMOBILE MECHANICS WORK TOOLS AND EQUIPMENT FOR NTC AND ANTC

S/No (1)	Tools/Equipment (2)	Minimum Quantity Required (3)	Quantity Available in Workshop (4)	Additional Quantity Required (5)
	15 tool boxes with keys each comprising one of the following items:			
1.	Set of flat, round, half round and triangular files	15 each		
2.	Set of warden files	15 sets		
3.	Flat chisels	15		
4.	Cross cut chisels	15		
5.	Diamond point chisels	15		
6.	Set of pin punches parallel and taper	15 each		
7.	Hollow punches of various sizes	15 each		
8.	Ball peen hammer	15		
9.	Plastic hammers/mallets	15		
15.	Hacksaws with extra blades	15		
11.	300mm engineers' rule	15		
12.	Centre punch	15		
13.	6-32mm socket spanner sets with ratchet, brace, extension, U.J and handles	15		
14.	6-32mm open and flat spanners	15 sets		
15.	6-32mm ring spanners	15 sets		
16.	Emery stone/block or cloth	15		
17.	Plug spanners	15		
18.	Magneto spanners	15		
19.	Allen keys	15 sets		
20.	Philips screw drivers	15 sets		
21.	Feeler gauges	15		
22.	Oil cans	15		
23.	Grease guns	15		

24.	Mole grip	15		
25.	File card or cleaner	15		
26.	Spark plug files	15		
27.	Combination pliers	15		
28.	Long nose pliers	15		
29.	Wire cutter and stripper	15		
30.	Tyre pressure gauges	15		
31.	Metal scrappers	15		

DRILLING AND SCREW CUTTING				
1.	Electric Hand Drill	4		
2.	Drill bits	5 sets		
3.	Set of stock and dies – UNC, UNF and metric	3 sets		
4.	Taps and wrenches – UNC, UNF and metric	3 sets		
5.	Thread file	3		
6	Pedestal drilling machine	1		
7	Roller type thread restorer	3		
8.	Screw (stud) extractor set	3		

MEASURING TOOLS				
1.	Vernier caliper	5		
2.	Vernier calipers with clock	5		
3.	Surface plates	2		
4.	Vee blocks	10		
5.	Vernier height gauge	2		
6.	Vernier calipers (metric)	5		
7.	Micrometer 0-25m 25-50mm, 50-75mm Internal & external 25-50mm; 75-150	3 3		
8.	Dial indicator (gauge) with magnetic stand	3		

MACHINE TOOLS				
1.	Grinding machine with assorted wheels	1		
2.	Bench grinder with wheels	2		
3.	Workshop plain goggles	20		
4.	Grinder (straight and 90-degree angle grinder)	1		
5	Brake lathe machine	1		
6	Cooling system tester	1		
7	Compression tester	1		
8	Brake fluid tester	1		
9	Shock absorber testing machine	1		

JOINING METAL				
1.	Blow lamps	5		
2.	Soldering iron	5		
3.	Electric soldering iron	5		
4.	Solder and flux	1pkt/tin		

LUB. BAY TYRE/WHEEL SERVICE				
1.	Compressor (3 phase motor driven type complete with spray gun, grease, horse reels)	1		
2.	Air impact ratchet, wrenches, hammer and drills.			
3	Wheel balancer (rim 13-15)	2		
4.	Airline gauge	2		
5.	Portable tyre inflator	3		
6.	Steam cleaner (complete) oil fired or electric	1		
7.	High pressure washer	1		
8.	Weld master vulcanizer	1		
8.	Various sizes wheel braces	3 sets		
9.	Tyre changer complete with bead breaker	1		
10	Heavy duty tyre changer (air separated type)	1		

11	Tyre spreader	1		
12	Wheel alignment car lift	1		
13	Car wheel alignment machine	2		
14	Tyre Iron (or Lever)	5		
15	Bead Breaking Tool	3		
16	Wheel Balancing Machine	2		
17	Valve Core Remover/Installer	5		
18	Tyre Pressure Monitoring System (TPMS) Tool	5		
19	Bead Sealer	5		
20	Cutter or Tyre Knife	5		
21	Tyre Patch and Plug Kit	5		
22	Rim Protector			
23	Tire Mounting Lubricant			
24	Tyre & Wheel Tester	2		
25	Computerized Wheel Alignment System	2		
26	Tyre Inflation System	2		
27	Tyre Storage Rack	2		
28	Tyre Demounting Tool	2		
29	Industrial Air Compressor	2		
30	Electric or Hydraulic Tyre Press	5		
31	Diagnostic Tool for TPMS	5		
32	Wheel Rim Inspection Station	5		
33	Tyre string insert tool	5		
34	Stich ruler	5		
35	Inner tool vulcanizer	1		
36	Rim straightening machine	1		
37	Tyre repair kit comprising: rasp. Scissors, tyre knife, stitcher, spiral wound wire brush etc.	5 sets		
38	Wire brush set	5 sets		
39	Battery charger	2		

40	Service station set of tool kit plus special wrenches for removal of oil filter	2 sets		
41	Pipe wrench, clamp or vice	3 sets		
42	Pipe cutter	2		
43	Wheel alignment gauge	3		
44	Plug spanners (long and short)	2		
45	Battery service kit	3 each		
46	Adjustable wrench	5		
47	Clutch alignment gauge	5		
48	Clutch set-screw gauge	2		
49	Valve grinders	2		
50	Injector repair machine	1		
51	Injector cleaner	2		
52	Fuel injector tester	2		
53	Injector needle service kit	1		
54	Hydrometers	4		
55	Vacuum tester	4		
56	Pullers (different sizes)	3		
57	Spark plug tester	5		
58	Work bench with vices	3		
59	Portable engine hoist	3		
60	Four post car lift	1		
61	Fluid drain pan	4		
62	Funnel	5		
63	Jack and jack stands	5		
64	Impact Gun	2		
65	Thermometer	5		

	GENERAL SERVICING & RECONDITIONING			
1.	Diesel phasing & calibration machine	1		
2.	Electrical test bench	1		
3.	Cylinder boring machine with accessories and assorted tools	1		
4.	Honing machine with accessories and assorted cutters	1		
5.	Bottle jack (hydraulic) light vehicle type	5		
6.	Bottle jack (hydraulic) heavy vehicle type	2		
7.	Ram up to 6-ton capacity	2		
8.	Trolley jacks	3		
9.	Chassis dynamometer	1		
10	Motor scope (engine analyzer)	2		
11	Engine decarbonizing machine	1		
12	Timing light	4		
13.	Tachometer	2		
14.	Hydraulic press	1		
15.	Inspection pits	2		
16.	Dwell angle tester	2		
17.	Armature growler	1		
18.	Compression gauge	2		
19.	Ammeter	2		
20.	Digital Multimeter (DMM)	5		
21.	Ohmmeter	2		
22.	Avometer (Multimeter)	2		
23	Digital Oscilloscope (Pico scope)	1		
23.	Auto Electrical system instructional chassis	1		
24	Valve spring compressor kit	2		
25.	Coil spring compressor	2		

26.	Torque wrench pre-set type (metric graduation)	2		
26.	Torque wrench dial type (metric)	2		
27.	Hydraulic nipple forming tool	1		
28.	Flaring tool for steel tubing	1		
29.	Small bore pipe bending tool	1		
30.	Carburetor service kit	2		
31.	Piston ring compressor	2		
32.	Exhaust gas analyzer	1		
33.	Smoke tester (Opaque) for diesel compression ignition engines	1		
33.	Axle stands	10		
34.	Wheel chocks	10		
35.	Mechanic's Stethoscope	3		
36.	Scan tool or code reader (OBD II)	5		
37	Autel/Lunch(all system) Diagnostic Equipment	1		
38.	Pry bar	5		
39.	Pick set	5		
40.	Punches and chisels	5		
41.	Vise-Grip	5		
42	Scissors	5		
43.	Test Light	5		
44.	Jumper Cables	5		
45	Oil extractor	2		
46	Oil filter range	5		
47	Oil pressure gauge	3 sets		

SIMULATORS				
1	Petrol Engine trainer/simulator	5		
2	Diesel Engine trainer/simulator	5		

3	Ignition system simulator	5		
4	Manual transmission simulator	5		
5	Automatic gear box simulator	5		
6	Drive axle simulator	5		
7	Four wheel drive trainer	5		
8	Suspension and Steering simulator	5		
9	Air-condition System trainer	5		
10	Starting System Simulator	5		
11	Charging System simulator	5		
12	Lighting System simulator	5		
13	Power Door lock System	5		
14	Automotive Electrical/Electronic System trainer	5		
15	Brake system Simulator	5		

SERVICE REPAIRS MANUAL				
1	Manufacturers' handbooks			
2	All data Electronic manual			
3	Auto data Electronic manual			
4	Identifix Online Electronic manuals			
5	Mitchell on-demand Electronic manual			

OTHER UTILITIES				
1.	Fire extinguishers	5		
2.	Sand buckets	5		
3.	Water buckets	5		
4.	First aid box	3		
5.	Safety Glasses	20		

6.	Safety Shoes	20		
7.	Safety Dress	20		
8	Ear Protection	5		
9	Dust Mask	5		
10	Work Gloves	5		

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