



NATIONAL VOCATIONAL TRAINING INSTITUTE

TESTING DIVISION

TRADE TESTING REGULATIONS AND SYLLABUS

TRADE: MOTOR VEHICLE MECHANIC

LEVEL: CERTIFICATE ONE

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A. INTRODUCTION

- i. The review of this syllabus has been generally influenced by the demands of industries due to its continuous change as a result of technological advancement and the changing needs of society. It was also influenced by the TVET reforms under the directions of the new educational reform with the view to opening up further education and training opportunities to TVET graduates.

The certificate ONE syllabus is designed to respond to the following level descriptors:

QUALIFICATION	KNOWLEDGE LEVEL	SKILLS AND ATTITUDE:
Certificate 1	<ul style="list-style-type: none">1. To demonstrate a broad knowledge base incorporating some technical concepts.2. To demonstrate knowledge of the theoretical basis of practical skills.3. To demonstrate knowledge in numeracy, literacy, IT and Entrepreneurial skills	<ul style="list-style-type: none">1. Require a wide range of technical skills2. Are applied in a variety of familiar and complex contexts with minimum supervision.3. Require collaboration with others in a team

- ii. The rationale of this syllabus is to establish the level of knowledge and skills required by mechanics over a wide range of applications, including the development of an ability to diagnose faults, recommend by means of rectifying these faults and to test and analyze the performance of the vehicle after repairs or modification has been completed.

B. THE GENERAL OBJECTIVES

The objectives of this course are to give the apprentices a systematic training both theoretically and practically. It is expected that much emphasis will be laid on the practical aspect of the training during in-school and on-the-job training. About 60% could be allocated to practical training centres and other institutions approved by the National Vocational Training Institute.

This training syllabus is prepared to serve as a guide for employers, instructors and other parties concerned with training in the preparation of their individual programmes. It is necessary that training become effectively planned and controlled as effectively as possible so that apprentices derive much benefit from their training.

C. THE COURSE COMPONENTS

Trade Theory
Science and Calculation
Trade Drawing
General Paper
Trade Practical

EXAMINATION: The candidates would be examined in the FIVE components listed in 'C' above.

Practical work must be carefully planned to illustrate application of the theory and to provide maximum opportunity for shop practice, laboratory work and demonstration.

D. KNOWLEDGE AND SKILLS REQUIREMENT

The prime objective of the programme is to provide knowledge and skills of the trade in a manner that will best meet the needs of the trade as well as industries using professional equipments.

E. ENTRY TO THE COURSE

Minimum education: Must have passed JHS or SHS examination/Foundation certificate. However, the selection of the students for the course is within the discretion of the head of the institution.

F. ELIGIBILITY FOR ENTRY TO EXAMINATION

Candidates may enter for examination only as internal candidate; that is those who at the time of entry to the examination are undertaking (or) have already completed the course at an approved establishment.

G. EXTERNAL EXAMINERS

The practical work of candidates will be assessed by an external examiner appointed by the Trade Testing Commissioner.

H. EXAMINATION RESULTS AND CERTIFICATES

Each candidate will receive record of performance given the grade of performance for the components Taken. These are:

- i) Distinction
- ii) Credit
- iii) Pass
- iv) Referred/Fail

Certificates would be issued to candidates who pass in all the components.

NOTE:

All Technical and Vocational trainees who aspire to take advantage of the opportunities opened to them in the educational reforms should NOTE that, for a trainee to progress to certificate Two (2) a pass in Certificate One (1) is compulsory.

I. APPROVAL OF COURSE

Institutions or other establishments intending to prepare trainees for the Examination must apply to
THE COMMISSIONER
TESTING DIVISION
NVTI, HEAD OFFICE
P.O. BOX MB 21, ACCRA

J. ACKNOWLEDGEMENT

NVTI wishes to acknowledge the preparatory material done by the team of Experts, which have been incorporated into this syllabus.

RECOMMENDED BOOKS FOR MVM

1. The Repair of Vehicle Bodies
(Allan Robinson)
2. Principles of Auto Body Repairing and repainting
(A. G. Deroche)
3. Auto Body Repair and Refinishing
(John W. Hogg)
4. Fundamentals of Motor Vehicle Technology by: V.A.W. Hillier and E. Pittuck (4th Edition)
5. Motor Vehicle Technology and Practical Work by: J.A. Dolan (Combined Volume Part 1&2)
6.
 - i. Technology for Motor Mechanic Part 1 (Book 1) Tools and Materials 3rd Edition by S.C. Mudd
 - ii. Part 2 (Book 2) Vehicle & Electrical Technology by S.C. Mudd (3rd Edition)
 - iii. Part 3. Technology for Motor Mechanics Vehicle and Electrical Technology by

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S.C. Mudd (3rd Edition)

7. Part 4 (Book 4) Vehicle Technology Diesel (C.I. Engines) By S.C. Mudd (3rd Edition)

SCIENCE AND CALCULATIONS

8. i) Motor Vehicle Science and Calculations Book 1 & 2 By R.C. Champion and E.C. Arnold (New Edition)
- ii) Motor Vehicle Science and Calculations Book 1 & 2 By Zammit, Saviour J. (3rd Edition).

9. TECHNICAL AND ENGINEERING DRAWING

- i) Engineering Drawing with CAD Applications by Ostrowsky and Edward Arnold

10. MOTOR VEHICLE ELECTRICAL AND ELECTRONICS (M.V.E.)

- i. Motor Vehicle Electrical and Electronics by V.A.W. Hillier and E. Pittuck 3rd or 4th Edition

TOOLS

1. Set of flat spanners
2. set of ring spanners
3. set of socket wrenches
4. set of Allen keys
5. set of flat screw drivers
6. set of Philip (star) screw drivers
7. Pliers
8. Adjustable spanners (small, medium and large sizes)
9. Feeler gauge
10. Torque wrench

11. Valve lapping (grinding) stick and paste
12. Ball peen hammer
13. Rawhide/mallet hammer
14. Hacksaw frame and blades
15. Chisels
16. Files (single cut, double and rasp cut)
17. Tin shears
18. Scrapers
19. Reamers and punches
20. Piston clamp
21. Oil can
22. Grease gun

EQUIPMENT

1. Vice
2. 5 tonnes hydraulic jack
3. Drilling machine
4. Surface plate
5. Vee blocks
6. Angle plate
7. Try square/steel rule
8. micrometer - 0 – 25mm range
25 – 50mm range
50 – 75mm range
9. Venier caliper
10. Internal micrometer
11. Dial gauge
12. Alignment gauge
13. Timing light (stroboscope)
14. Hydrometer

CERTIFICATE ONE – TRADE THEORY

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
1.0.	INTRODUCTION TO AUTOMOTIVE CAREERS	Use service manual to find torque specification to correctly tighten engine/vehicle components	Identify various parts in the vocation	Familiarization visit through rotational training in the shops within the training centre and automotive dealer shops.
2.0.	TOOLS AND EQUIPMENT	Select the correct tool or equipment for a given operation.	<ul style="list-style-type: none"> a. Torque wrench b. File c. Chisel d. Hammer e. Valve spring compressor. f. Spanner (assorted) etc. ii) Special purpose equipment <ul style="list-style-type: none"> a. Calipers b. Steel rule c. Feeler gauges, etc. iii) Other Workshop Equipments <ul style="list-style-type: none"> a. Drilling machine b. Air Compressor c. Axle stand d. Bench vice e. Grinding machine f. Mobile crane, etc. 	<p>Using hand tools, help students to learn the safe use of the tools.</p> <p>Discuss how the measuring instruments and other equipment listed are used in the auto industry paying attention to safety precautions.</p>

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
3.0	SAFETY PRECAUTION	3.1 Differentiate between the various types of safety in a workshop	3.2 Note types of safety in the workshop: A) Personal Safety in the Workshop. i. Good ventilation. ii. Cleanliness of shop. iii. Proper use of protective clothing. iv. Provision of guard around rotating parts. v. Proper storage of inflammable material vi. use of rigid support for raised	3.3 Discuss with the students the following: a) Importance of safety in a workshop.
4.0.	TESTING AND MEASURING INSTRUMENTS AND GAUGES	4.1 Identify types of measuring devices and gauges such as Rule, Micrometer, (inside, outside and depth digital micrometer). Viewer caliper 4.1.2 Gauges: Dial gauge, small hole gauges, go-no-go gauges, compression gauge, tyre pressure gauge and vacuum gauges. 4.1.3 Meters: Dwell meter, Tacometer and Multimeter.	4.2 Select and use feeler gauges to measure valve clearance to specification. Use a rule, micrometer to measure length, diameter of a rod and depth of a hole. Use a vernier caliper to measure diameter of a cylinder bore. Use a dial gauge to determine fly wheel concentricity and the use of compression gauge. Use multimeter to measure voltage, current and resistance, etc.	4.3 Guide students to use the various instruments and gauges to measure the various specifications mentioned in the sub-skills.

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
5.0	5.0 Materials	Appearance, properties, uses and identification of materials, e.g. Steels, cast iron, copper, aluminum, lead, tin, brass, bronze, plastics	5.2 The trainees should construct, chisel, drill, drift, spanner with a selected suitable material.	5.3 Guide students to identify and select suitable materials for the parts construction.
6.0	Securing devices	<p>6.1 Thread types and sizes; (BSF, BA, UNF, UNC). Nut, Bolts, Philip Screw, Wing and thumb nut and pins, etc.</p> <p>6.1.2 Locking devices: Locking plates and self lock nuts, pitch bolts and locking wire.</p> <p>6.1.3 Sealing devices: Gasket joints, plugs, sealing compounds, oil seals, etc.</p> <p>6.1.4 Pipe unions and joints: Copper, flexible, plastic pipes, straight coupling, elbow union, swaged and pipe fixing, lose clip, etc.</p>	<p>6.2 The trainee should be able to know the difference between various threads, bolts, nuts, locking and sealing devices, etc.</p> <p>6.2.1 Trainee should be able to identify thread pitch class, series and designation.</p> <p>6.2.2 Trainees should be able to rethread fasteners and extract broken stud or bolt</p>	Guide trainees to identify suitable taps and dies to perform rethreading operations.
	7.0 Basic Metal Works (Bench Fitting)	7.1 The trainee should be able to carry out the following: <ul style="list-style-type: none"> i. Filling. ii. Sawing iii. Drilling iv. Marking out, etc. 	7.2 Effective use of the following tools; e.g. Files, Hacksaw, Drill bit, Marking out tools, etc.	7.3 Demonstrate how to carry out the following operations: Filling, Sawing, Drilling, Marking out to construct an object such as 'Light 'G' Clamp, or Try Square

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
	8.0 Introduction to the motor vehicle	<p>8.1 The student will be able to:</p> <p>8.1.1 Identify the types of body chassis construction and drive arrangements of the motor vehicle.</p> <p>8.1.2 Describe the main components and their positions in the motor vehicle.</p> <p>8.1.3 Explain the functions if the main components of the motor vehicle</p>	<p>8.2 Body, chassis and drive arrangements of vehicles Components and position in motor vehicles: Cars and</p> <ul style="list-style-type: none"> - trucks - clutch - Gear box - Propeller shaft - Rear <p>8.2.1 Main Components and their functions:</p> <ul style="list-style-type: none"> i) Engine ii) Transmission iii) Body iv) Steering v) Suspension vi) Wheels/tyres vii) Brakes viii) Clutch ix) Gear box 	<p>8.3 Guide students to inspect and discuss the differences in the body, chassis and drive arrangement of i) Cars ii) trucks.</p> <p>Guide students to observe, describe and discuss why the main components are positioned in their various places in cars and trucks.</p> <p>Discuss the functions of the main components of cars and trucks.</p> <p>Guide students to observe the methods of securing and locking the components to the chassis.</p>
9.01	ENGINE	Purpose of an engine	-	9.3 Guide students to discuss the purpose of the engine
9.02	TYPES OF ENGINE	Identify the two types of engine	<ul style="list-style-type: none"> i) Petrol/LPG ii) Diesel /Biodiesel 	Use sketches, chart or real engines to guide students differentiate between petrol engine and diesel engine.

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
9.03	ENGINE CLASSIFICATION	Classify engines by: i) Values ii) Number and Arrangements of Cylinders iii) Methods of cooling. iv) Method of ignition v) Number of strokes. vi) Firing order		
9.04	ENGINE COMPONENTS AND FUNCTIONS	Describe the main component parts of the engine	Main parts of the engine: i) Engine block. ii) Cylinder head iii) Crash shaft iv) Fly wheel v) Connecting rod vi) Piston and rings vii) Camshaft viii) Valves ix) Tappets, etc.	Using a dismantled engine, discuss the various components listed in the sub-skills and their positions in the engine and also carry out measurement and alignment of the piston con – rod, camshaft, etc.

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
10.0	PRINCIPLES AND OPERATION OF ENGINES	<p>10.1 The student will be able to : Describe the operation of the of-stroke and 4-stroke petrol engines.</p> <p>10.1.1 State the advantages and disadvantages of petrol and diesel engines.</p> <p>10.1.2 Differentiate between the main parts of single and multi cylinder engines.</p>	<p>10.2 Principles and operation of the 2-stroke, 4-stroke internal combination engine.</p> <p>10.2.1 Advantages and disadvantages of Petrol and Diesel engines.</p> <p>10.2.2 Comparison of main parts of single and multi cylinder engines</p>	<p>10.3 Use sketches or chart to explain the construction and operation of 2 and 4-stroke Petrol and Diesel engines.</p> <p>10.3.1 Discuss the advantages of petrol and diesel engines.</p> <p>10.3.2 Guide students to dismantle 2 and 4 stroke petrol and diesel engines.</p> <p>10.3.3 Examine the cylinder bore, crank shaft, valve seat and face, etc. for wear and cracks.</p>
11.0	Valve operating mechanism	<p>11.1 The students will be able to:</p> <ul style="list-style-type: none"> - Explain the function of valve operating mechanism on an engine. - Explain the meaning of valve timing terms. - Perform valve timing on an engine. 	<p>11.2 Crankshaft positions and valve operating mechanism for</p> <ul style="list-style-type: none"> - Side valve. - Overhead valve - Overhead camshaft. <p>Valve timing</p> <ul style="list-style-type: none"> i) Lead ii) Lag iii) Overlap 	<p>11.3 Use sketches or charts to explain the operating mechanism.</p> <ul style="list-style-type: none"> - Assist students to discuss the meaning of the valve terms listed in the sub-skills. - Guide students to perform valve timing on an engine and determine the overlap period. - Students to perform valve adjustment on

NO.	TASK	CRITICAL POINTS	SUB -POINTS	INSTRUCTIONAL TECHNIQUES
				overhead and side valve engine. - Assist students to study methods of connecting camshaft and identify timing marks provided on the engine.
12.0	CYLINDER HEAD OVERHAULING (DECARBONISING)	12.1 Dismantling cleaning and examination of cylinder head. - Dismantle valves, clean and decarbonizes. - examine cylinder head for crack, bend and seat wear.	12.2 Use appropriate cleaning agents and valve seat and face grinding paste to lap in valve.	12.3 Guide students in the use of cleaning agents and appropriate tools
13.0	CRANK ARRANGEMENT AND FIRING ORDERS	13.1 Identify crank arrangements and firing orders. - State the reasons for giving valve clearance differences e.g. Exhaust and inlet valves.	13.2 Crankshaft arrangement and firing orders: - 2, 4 and 6 cylinder in-line engines - 2, 4, and 6 cylinder vice cylinder engines. - 4 cylinder opposed.	13.3 Guide students to examine the crank arrangement of a 4 and 6 cylinder in – line engines noting their firing orders.
14.0	FUEL SUPPLY SYSTEMS	14.1 The students will be able to: Explain the purpose of the fuel supply system.	14.2 Fuel supply system that is Petrol and Diesel	14.3 Use sketches or chart to explain the purpose of the fuel supply systems (Petrol and Diesel)

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
15.0	PETROL SUPPLY	<p>15.1 Sketch the layout of petrol supply system Explain the function of the main components.</p> <p>Describe the operation of petrol supply system.</p>	<p>15.2 Layout and main components:</p> <p>i) tank ii) pipeline iii. filter iv. pump v carburetor/ injector</p>	<p>15.3 Guide students to discuss the main components of a fuel supply system</p>
16.0	FUELS	<p>16.1 State the properties of petrol and diesel fuels</p>	<p>16.2 Properties of fuels.</p>	<p>16.3 Assist students to discuss the composition of petrol and diesel fuels.</p>
17.0	FUEL PUMP	<p>17.1 Describe the construction and operation of mechanical and electrical fuel pumps, sketch and label the main parts.</p> <p>State the advantages and disadvantages of mechanical and electrical fuel pumps.</p> <p>Dismantle and reassemble a mechanical fuel pump and test for satisfactory operation Sketch and label the multi-jet-carburetor and describe its operations.</p>	<p>17.2 Mechanical and Electrical fuel pumps.</p> <p>Dismantling and reassembling a mechanical fuel pump.</p>	<p>17.3 Use sketches or charts to</p> <ul style="list-style-type: none"> - explain the construction and operation of mechanical and electrical fuel pumps. - Students to sketch and label the main parts of the mechanical and electrical fuel pumps. <p>Guide students to dismantle a mechanical fuel pump, examine the parts, reassemble and test for satisfactory operation.</p>

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
18.0	EXAMINATION OF A CARBURETOR	18.1. Dismantling, examining and assembling of carburetor.	18.2.1 Examine the carburetor jet for blockage and leakage.	18.3.1 Assist trainees to dismantle and assemble a carburetor
19.0	ELECTRONIC FUEL INJECTION	19.1 The students will be able to: - Explain the purpose of the electronic fuel injection system.	19.2 Electronic injection system.	19.3 Guide students to discuss the purpose of the electronic fuel system
20.0	ELECTRONIC FUEL INJECTION	20.1 Identify and name the two petrol injection systems. Name the various components of the electronic fuel injection system and describe their role.	20.2 Types of systems: i) Single point injection ii) Multi point injection Name the role of components of the electronic fuel injection system.	20.3 Use sketches, charts or real object to guide students to examine the layout of the petrol injection system on a vehicle and identify the types. I) Single point ii) Multi point Identify and name the various components of the electronic fuel injection system i) Electronic Control Unit (ECU). ii) Sensors iii) Actuators

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUE
21.0	COMPRESSION IGNITION ENGINE (CI) FUEL SYSTEM	21.1 Basic operation and purpose of the main components. - Comparison of its advantages and disadvantages over the carburetor system. - Phasing and calibration. - Setting of maximum and minimum fuel delivery of the in-live injection pump. - Pressure setting and spray pattern. - Timing of injection pump fitted to an engine.	21.2 Consider safety precaution required in carrying out procedure.	21.3 Guide students to i) remove and replace fuel filters, bleed air from the system. ii) Explain and demonstrate the procedure of phasing and calibration of injection pump. iii) Explain the purpose of heater plugs and state their location on the engine. iv) Explain the importance of fuel filtration.

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
22.0	FUNDAMENTALS OF ELECTRONICS	<p>22.1 Explain the term electronics.</p> <p>Identify and list the electronic components on a vehicle.</p> <p>Describe the functions of each components.</p> <p>Identify the electronic symbols in a circuit.</p>	<p>22.2 Auto electronics</p> <p>Electronic Components:</p> <ul style="list-style-type: none"> i) diodes ii) transistors iii) resistors iv) capacitors v) LED vi) transducer vii) coil viii) motor <p>Functions of the components.</p> <p>Symbols in a circuit.</p>	<p>22.3 Guide students to brainstorm the meaning of the term electronics and use sketches, charts or real objects to show the various electronic components used on the motor vehicle.</p> <p>Guide students to discuss the functions of the electronic components used on motor vehicles and use chart or sketches to discuss the symbols used in electrical and electronic circuits.</p>

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
22.0	IGNITION SYSTEM	22.1 The students will be able to: - explain the purpose of the coil ignition system.	22.2 Coil ignition system include the following: - Battery - Ignition switch - Coil - Distributor - Condenser - Spark plug - Balart resistor - Dwell angle Advance and retard mechanisms	22.3 Guide students to i) Inspect and study the coil ignition circuit noting their functions of components in the system. ii) Dismantle, service and reassemble the distributor. iii) Check and trace malfunctioning simple coil ignition and rectify faults. iv) Study relationship between piston, valve opening and distributor operation. Identify any timing marks provided. v) Fixing of distributor to the engine
23.0	INTRODUCTION TO ELECTRONIC IGNITION SYSTEM.	23.1 Identify types of electronic ignition system: i) Inductive ii) Hall effect Explain the advantages of electronic ignition system as compared to the conventional type.	23.2 Advantages of Electronic Ignition System	23.3 Use sketches or charts to: i) Explain the operation of electronic ignition using the system of a) inductive ii) hall effect. Guide students to discuss the advantages of the electronic ignition system as compared to the conventional ignition system.

NO.	TASK	CRITICAL POINTS	SUB -POINTS	INSTRUCTIONAL TECHNIQUES
24.0	LUBRICATION SYSTEM COMPONENTS OF THE LUBRICATION SYSTEM.	24.1 The purpose of the lubrication system. Describe how oil is distributed in the engine. State the functions of components in lubrication system.	24.2 Purpose of lubrication system and types: i) wet sump ii) dry sump Modes of distribution i) Splash ii) Mist iii) Pressure. Identify the following components: i) oil pump ii) oil switch iii) oil gallery iv) oil filters	24.3 Use sketches or chart to show the layout and path of oil flow of the wet and dry lubrication systems. Discuss the mode of oil distribution in the engine. Guide students to service the components listed in the sub-skills.
25.0	ENGINE CRANKCASE VENTILATION	25.1 The purpose of the crankcase ventilation system. Describe the operation of the positive type ventilation system. Explain the purpose of safety warning devices: i) oil pressure relive valve ii) oil pressure warning lamp iii) oil gauge iv) dip stick	25.2 Identify their positions on the engine.	25.3 Guide students to i) Identify the type of ventilation system on an engine explain the operation of the crankcase ventilation system using sketches or chart. Guide students to identify the devices on a vehicle and explain their purposes.

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
26.0	LUBRICANTS	<p>26.1 State the purpose of lubricants.</p> <p>Identify the type of lubricants used in vehicles.</p>	<p>26.2 Lubricants:</p> <p>i) oil ii) grease</p> <p>i) engine ii) gear box iii) final drives iv) hub, steering, etc.</p>	<p>26.3 Discuss the need for lubricants in vehicles. Students should use the dipstick to check the oil level in the bump.</p> <p>Guide students to differentiate between the following lubricants</p> <p>i) engine oil ii) Gear oil iii) Grease</p>
27.0	OIL RATINGS	<p>27.1 The terms used for oil ratings.</p>	<p>27.2 Oil terms:</p> <p>i) Viscosity ii) SAE numbers iii) Viscosity index iv) API</p>	<p>27.3 Assist students to explain the following lubricating terms:</p> <p>i) Viscosity ii) SAE numbers iii) Viscosity index iv) API</p>
28.0	COOLING SYSTEM	<p>28.1 Purpose of cooling system and the function of the main components.</p> <p>Types of cooling system:</p> <p>a) Liquid cooling b) Air cooling</p>	<p>28.2 The function of the following components:</p> <p>a) radiator b) thermostat c) water pump d) fan</p> <p>Identify the construction of the</p> <p>a) Water cooling b) Air cooling</p>	<p>28.3 Guide students to dismantle, examine and reassemble the following components in the cooling system:</p> <p>a) radiator b) water pump c) fan</p>

NO.	TASK	CRITICAL POINTS	SUB -POINTS	INSTRUCTIONAL TECHNIQUES
29.0	TYPES OF LIQUID COOLING SYSTEM	29.1 Describe the operation of water cooling system.	29.2 Operation of water cooling system: i. thermosyphon ii. Pump assisted	29.3 Guide students to explain the operation of: i. Thermosyphon cooling system ii. Pump assisted (pressurized) iii. Explain the advantages and disadvantages of the two systems.
30.0	AIR COOLING SYSTEM	30.1 Describe the operation of the air cooling system. Compare the advantages and disadvantages of water and air cooling systems. State the causes of overheating in the cooling system.	Water and air cooling: Advantages and disadvantages Causes of overheating: i) air cooling system ii) water cooling system	30.3 Guide students to examine the air cooling system noting the construction of the fins and blower. Dismantle, examine and reassembled: a) air cooling system b) Pressurized cooling system

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
31.0	TRANSMISSION SYSTEM	<p>31.1 The students will be able to:</p> <ul style="list-style-type: none"> - Explain the purpose of the transmission system - Identify the types of transmission. <p>The main components of the transmission system and state their functions.</p>	<p>31.2 Types of transmission</p> <ul style="list-style-type: none"> i) manual ii) automatic <p>Transmission system main components:</p> <ul style="list-style-type: none"> i) Clutch ii) Propeller shaft iii) Gear box iv) Final drive v) Differential 	<p>31.3 Use charts or sketches to explain the basic principle of manual and automatic transmission.</p> <p>Use sketched or real object to show the layout of the conventional transmission system of a vehicle.</p>
32.0	CLUTCH	<p>32.1 Describe functions of the clutch.</p> <p>Identify the types of clutch</p>	<p>32.2 Types of clutches:</p> <ul style="list-style-type: none"> i) Single plate: <ul style="list-style-type: none"> a) multi – spring b) diaphragm spring ii) Multi - plate 	<p>32.3 Discuss the functions of a clutch in vehicles.</p> <p>Use sketches, charts or real objects to explain the construction and operation of single and multi-plate.</p>
33.0	FAULT DIAGNOSIS (CLUTCH)	<p>33.1 Diagnose and rectify minor faults.</p> <p>Bleed the hydraulic clutch system.</p>	<p>33.2 Fault diagnosis:</p> <ul style="list-style-type: none"> a) Excessive Pedal free play. b) Slip c) Drag d) Judder <p>Bleeding Hydraulic Clutch System.</p>	<p>33.3 Guide students to</p> <ul style="list-style-type: none"> i) examine the various clutch units noting any fault found. ii) Bleed the hydraulic clutch system iii) Adjust clutch pedal free play.

NO.	TASK	CRITICAL SKILLS	SUB - SKILLS	INSTRUCTIONAL TECHNIQUES
34.0	GEAR BOX	34.1 The purpose of the gear box and describe operation of various types of gearbox	34.2 Types and operation of gearboxes: i) Sliding mesh ii) Constant mesh iii) Synchromesh	34.3 Guide students to remove and dismantle sliding mesh, constant mesh and synchromesh gear boxes. ii) Check component for wear. iii) Check gear engagement mechanism. vi) Remove and refit bearings, bushing and beams.
35.0	PROPELLER SHAFT UNIVERSAL JOINT.	35.1 Identify the various types of: i) propeller shaft ii) universal joint Carry out checks on propeller shaft for bow and twist	35.2 Propeller shafts: i) open type ii) torque tube Universal joints: i) Constant velocity joint. ii) Hookes joint iii) Layrub joint	35.3 Guide students in removal and installation of the propeller shaft and universal joints etc. Guide students to use correct equipment to check a propeller shaft for i) Bow ii) twist
36.0	REAR AXLE	36.1 The purpose, the construction and operation of the rear axle. Sketch and label the main components of the rear axle.	36.2 Main components: i) Differential unit ii) Crown wheel and pinion iii) Half shaft iv) Oil seal v) Hub bearing	Guide students to observe the method of actuating the clutch on a vehicle.

NO.	TASK	CRITICAL POINTS	SUB -POINTS	INSTRUCTIONAL TECHNIQUES
		Types of rear axle gears and explain where it is used	Main types of rear axle gears i) Plain bevel ii) Spiral bevel iii) Hypoid bevel Worm gear types	Guide students to dismantle, examine and identify the function of each part of the clutch. Reassemble and adjust clutch. Check clutch pedal free play.
37.0	The differential unit	37.1 i) Detail information about differential. ii) Function of the differential unit iii) Types of hub construction	37.2 Operational principles of the differential unit.	37.3 Dismantle differential unit and study various components. Dismantle, identify parts in each type and re-assemble.
38.0	Braking System	38.1 T he purpose of the breaking system. Sketch the layout of the hydraulic braking system, label its parts and describe the operation of the system. Compare the drum brake and disc brakes and state its advantages and disadvantages.	38.2 Hydraulic brake arrangement. Layout, types and operation of hydraulic braking system: i) drum type ii) disc type comparison of drum and disc brakes.	38.3 Use sketches or charts to explain the i) purpose ii) types of the braking system. iii) discuss the operation of drum brakes using leading and trailing shoes and also the operation of the disc brake. • Guide students to inspect various of types of hydraulic braking system.

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
				<ul style="list-style-type: none"> i. Drum brakes ii. Disc brakes iii. Dismantle and reassemble
39.0	BRAKE LINING MATERIALS	<p>39.1 Analyse the composition of brake lining material and methods of attachment.</p> <p>Outline the requirements for brake fluid.</p>	<p>39.2 Brake lining material.</p> <p>Brake fluid requirements.</p>	<p>39.3 Discuss with students the composition of brake lining material and method of attachment to show pad support plate.</p> <ul style="list-style-type: none"> a) Explain the need for the use of brake fluid in the hydraulic braking system. b) Safety requirement for handling brake fluid.
40.0	FAULT DIAGNOSIS	40.1 Rectify simple brake faults	<p>40.2 Brake faults;</p> <ul style="list-style-type: none"> i) Lack of stopping power. ii) Grabbing brakes iii) Brake pulling to one side iv) Spongy pedal. 	40.3 Guide students to diagnose brake faults of vehicle and rectify.

NO.	TASK	CRITICAL POINT	SUB - SKILLS	INSTRUCTIONAL TECHNIQUES
41.0	SUSPENSION SYSTEM	<p>41.1 The purpose and identify the types of suspension systems.</p> <p>Sketch the layout of the rigid and independent suspension systems and state its working principle.</p>	<p>41.2 Types of suspension systems</p> <p>i) Rigid ii) Independent</p> <p>Layout of Rigid and independent suspension system and working principle of;</p> <p>i) Wish bone ii) Macpherson types</p>	<p>41.3 Guide students to examine different types of suspension system, taking note of arrangement and attachment to the vehicle frame, also examine the front and the rear hub bearings wear.</p> <p>- Assist students to examine an independent wheel suspension system to determine the points of wear and its effects on the steering geometry and components.</p> <p>ii) Dismantle wheel hub assembly noting special feature relating to methods of grease retention, assembly and adjustment to correct tolerances.</p> <p>iii) Check wheel alignment, castor, camber and kingpin inclination on independent and solid – beam suspension.</p>

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
42.0	SHOCK ABSORBERS	<p>42.1 The purpose of shock absorber.</p> <p>The different types of shock absorber and state their operations.</p>	<p>42.2 Dampers</p> <p>Types of shock absorbers: i) Telescopic ii) Piston</p>	<p>42.3</p> <p>i) Use sketches, chart or real object to explain the construction and operation of the telescopic and piston types of shock absorbers.</p> <p>ii) Guide student to remove and test telescopic shock absorber for serviceability.</p> <p>iii) Remove and refit shock absorbers to the vehicle and observe necessary.</p>
43.0	STEERING SYSTEM	<p>43.1 The purpose of the steering system.</p> <p>Sketch and identify the various parts of the steering system and explain its operation.</p>	<p>43.2 Front axle and steering arrangement.</p> <p>Components and operation of the steering system.</p>	<p>43.3 Use sketches chart or real object to explain the purpose of the steering system.</p> <p>Guide students to identify the parts of the steering system on a vehicle and discuss how the steering system operates.</p>
44.0	STEERING GEAR BOXES	<p>44.1 The various types of steering gear boxes and state its constructional and operational principle.</p>	<p>44.2 Types of steering gear boxes and their construction: i) Rack and pinion. ii) Recirculation ball. iii) Cam and peg.</p>	<p>44.3 Guide students to dismantle, examine and re-assemble and adjusting of the various types of steering gear boxes, also observe the necessary safety precautions.</p>

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
45.0	WHEELS AND TYRES	<p>45.1 The purposes of wheels and tyres and identify the various types of wheel rims.</p> <p>Describe the effect of faulty wheels on vehicle running.</p>	<p>45.2 Types of wheel rim</p> <p>i) pressed steel ii) wire spoke.</p> <p>Faulty wheels and vehicle running.</p>	<p>45.3 Use sketches or real objects (rims) to help students to :</p> <p>i) discuss the need for wheels and tyres on vehicles. ii) differentiate between different types of wheel rims listed in the sub-skills.</p> <p>Guide students to inspect various types wheels and tyres and determine any abnormalities.</p>
46.0	ELECTRICAL FUNDAMENTALS	<p>46.1 The basic electrical terms.</p>	<p>46.2 Basic electricity</p> <p>i) AC ii) DC</p> <p>Electrical circuits</p> <p>i) Series ii) Parallel</p>	<p>46.3 Use sketches or charts to:</p> <p>i) explain basic electrical terms. ii) discuss the difference between series and parallel circuits. iii) explain Ohm's Law.</p>

NO.	TASK	CRITICAL SKILLS	SUB - SKILLS	INSTRUCTIONAL TECHNIQUES
47.0	BASIC ELECTRICAL COMPONENTS	47.1 The functions of electrical components.	47.2 Electrical Components: i) relay ii) resistor iii) lamp iv) fuse v) switch	47.3 Guide students to i) clean electrical contacts ii) test and replace fuses and bulbs iii) test electrical circuits, cables and terminals.
48.0	ELECTRICAL WIRING	48.1 The two wiring systems and state suitable cable for a circuit. Reasons for making wires in stands. The reason for colour coding of wires.	48.2 Wiring Systems: i) Earth return system. ii) Insulated earth return. iii) Sizes of cables/wiring in strands. Colour coding of wires.	48.3 Use sketches or chart or suitable materials to explain earth and insulator return system, sizes and colour coding and reason of using different colour and sizes of wire.
49.0	BATTERY	49.1 The purpose of battery and the construction of lead acid battery. Checking the strength of battery using basic equipment and preparing electrolyte.	49.2 Battery construction i) Battery case ii) Battery plates Battery testing i) Hydrometer ii) Voltmeter iii) High rate discharge tester	49.3 Use charts, sketches or real objects to describe the constructional details of lead acid battery. Guide students to perform simple test on batteries using the equipment listed in the sub-skills.

CERTIFICATE ONE - TRADE SCIENCE AND CALCULATIONS

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
1.0	HEAT AND TEMPERATURE	1.1 Conduction, Convection and radiation. Thermal expansion, linear, superficial and cubical expansion, heat capacity and coefficient of linear expansion.	1.2 Method of measuring temperature, freezing and boil point of water and expansion and contraction of solids, liquids and gasses.	1.3 Guide students to solve simple problems related to the motor vehicle.
2.0	HEAT TREATMENT OF METALS	2.1 Annealing, normalizing, hardening, tempering. Properties of materials: elasticity, ductility, toughness, hardness and brittle.	2.2 Classification of various metals	2.3 Demonstrate with the students the various heat treatment in the workshop.
3.0	STRESS AND STRAIN	3.1 Definition of Stress and Strain. Tensile, compressive and shear stress. Hooks law, young modules and relating to the stiffness of material.	3.2 Solve problem involving direct stress and strain. Make a load extension graph for mild steel.	3.3 Guide students to solve simple problems involving stress and strain.
4.0	ENERGY	4.0 Definition of energy, types, examples potential, kinetic and chemical.	4.2 Simple calculations relating to motor vehicle. E.g. Kinetic and potential energy.	4.3 Guide students to calculate simple problems on energy relating to motor vehicle.
5.0	WORK	5.1 Definition of work (as a form of energy). Work done in linear motion and work done in angular motion.	5.2 Simple calculations relating to motor vehicle.	5.3 Assist student to calculate simple problems on work done relating to motor vehicle.
6.0	COMBUSTION AND FUELS	6.1 Definition and explanation of combustion in petrol and diesel engine composition of petrol. Composition of diesel air/fuel ratio. Properties of fuel.	6.2 Definition of forms such as calorific value, volatility, flash point, octane rating, cetane rating, ignition quality.	6.3 Guide students to know about combustion fuel.

CERTIFICATE ONE - TRADE SCIENCE AND CALCULATIONS

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
7.0	POWER	7.1 Definition of Power as a rate of doing work	7.2 Simple calculation relating to engine power at the end of the physical	Assist students to know about engine power.
8.0	MOMENTS	8.1 Definition of moments. Principle of moment Centre of gravity Torque	8.2 Classes of levers. Simple calculations on moment, centre of gravity and torque.	8.3 Guide students to solve calculations on moment and torque relating to motor vehicle.
9.0	COMPRESSION RATIO	9.1 Definition of swept volume, clearance volume, stroke, bore, TDC, BDC and Compression ratio.	9.2 Definitions, causes and effects of deterioration, pre-ignition, running-on and diesel Knock.	9.3 Assist students to solve symptoms on compression ratio.
10.0	DENSITY	10.1 Definition of density and relative density	10.2 Simple calculations on density and relative density.	10.3 Guide students to calculate simple problems on density and relative density.
11.0	THERMOMETERS	11.1 Four types of thermometers such as liquid in-glass, bimetallic gas thermometer and pyrometers.	11.2 Explain the working principles of four types of thermometers	11.3 Assist students to know about thermometers.
12.0	PRINCIPLES OF ELECTRICITY (DRY AND WET CELL)	12.1 Differentiate between DC and AC current Ohm's law	Simple calculations in series and parallel circuits	Assist students to know principles of Electricity and solve simple problems in series and parallel circuits.
13.0	MACHINES	13.1 Describe machine as a device for changing the magnitude and line of action of a force. Determination of overall gear ratio of simple machine.	13.2 Explain force ration, movement ratio and efficiency of a simple machine system.	13.3 Guide students know about simple machine and solve problems relating to motor vehicle.

CERTIFICATE ONE - TRADE SCIENCE AND CALCULATIONS

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
14.0	FRICTION	14.1 State the condition under which friction takes place. E.g Boundary and Dry friction	14.2 Kinetic and static friction. Advantages and Disadvantages of friction with special reference to motor vehicle. Explanation of co-efficient of friction.	14.3 Assist students to know friction in relation to motor vehicle.
15.0	INTRODUCTION TO DRAWING	15.1 Types of lines, construction and lettering	15.2 Firm lines, broken lines, centre lines, etc.	15.3 Assist students to construct lines
16.0	INTERPRETATION OF SIMPLE SKETCHES OF SOLIDS	16.1 The purpose and the uses of dimensions in sketches and drawing.	16.2 Uses of line diagram to illustrate various components	16.3 Guide students to use lines and simple sketches of solids
17.0	GEOMETRICAL CONSTRUCTION	17.1 Triangles, Squares, Rectangles, Ellipse, Circles and its parts, prisms and frustum of cones	17.2 Use compass, protractor, ruler, divider to construct triangles, squares, rectangles, ellipse, circles and its parts, prisms and frustum of cones	17.3 Assist students to construct Geometrical drawings.
18.0	ORTHOGRAPHIC PROJECTION	18.1 Sketching and drawing of simple component in orthographic projection (first and third angle with dimensions).	18.2 Drawing of the three views e.g. Front, end and plan.	18.3 Assist students to draw the orthographic projection.
19.0	DRAWING OF POLYGONS	19.1 Pentagon, hexagon, heptagon, octagon, etc. using of division of lines and the general method.	19.2 Drawing of bolts with a given specification.	19.3 Help student to construct the various polygons by using the division of lines or general method.
20.0	TOLERANCE	20.1 Introduction to limits and tolerance and their inclusion in the dimensioning of sketches and drawing.	20.2 Draw, indicating the upper limit and the lower limit	20.3 Assist students to draw tolerance.

CERTIFICATE ONE - TRADE SCIENCE AND CALCULATIONS

NO.	TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
21.0	EXPLODED AND SECTIONAL VIEWS	21.1 Reading of exploded and sectional view of components and assemblies.	21.2 Basic ideas in assembling various components	21.3 Assist students in assembling various automotive components.
22.0	DRAWING OF ELECTRICAL COMPONENTS.	22.1 Conventional representation of battery, earth connection, contact breaker points, fuse, resistor, capacitor, winding, lamp switch.	22.2 Draw symbols of various electrical components	22.3 Guide students to draw various electrical components.
23.0	FREE HAND SKETCH	23.1 Sketch of coil ignition system, valve timing diagram, mechanical fuel pump, water pump, petrol injection systems, line diagram of lubrication system oil pump, oil filter (By-pass and full flow) spark plugs, rear construction, hub construction, straight tooth gear, helical gear, line diagram of propeller shaft, universal joint, crown wheel and pinion assembly, drum and disc brake assembly, master cylinder, engine, gear box rear axle, braking steering and suspension, types of steering gear boxes, types of tyre design.	23.2 Sketch simple components in first and third angle projections.	23.3 Assist students to sketch simple components in first and third angle projections.