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la science et la culture

Motor Vehicle Mechanics' Work

National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC)

Curriculum and Course Specifications

NATIONAL BOARD FOR TECHNICAL EDUCATION
Federal Republic of Nigeria

UNESCO – Nigeria Project

2001

Motor Vehicle Mechanics' Work - National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC)

NATIONAL BOARD FOR TECHNICAL EDUCATION, KADUNA

NATIONAL TECHNICAL CERTIFICATE AND ADVANCED NATIONAL TECHNICAL CERTIFICATE

2001

Motor vehicle mechanics

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General Information

AIM

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

ENTRY QUALIFICATIONS

CRAFT PROGRAMME

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

ADVANCED CRAFT PROGRAMME

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

THE CURRICULUM

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

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

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

Unit Courses/Modules

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

Behavioural Objectives

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

a. General Objectives
b. Specific learning outcomes

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

a. Government in Political Science
b. Demand and supply in Economics
c. Orthographic projection in engineering/technical drawing;
d. Loci in Mathematics

Basic concepts of politics

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

General Education In Technical Colleges

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

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

National Certification

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

Trainees who successfully complete all the courses/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
2.	Advanced Craft Level	Advanced National Technical Certificate

Guidance Notes For Teachers Teaching The Curriculum

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

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

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

INTEGRATED APPROACH IN THE TEACHING OF TRADE

Theory, Trade Science And Trade 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 course. 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 course started at the beginning of a term must terminate at the end of the term.

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

Curriculum Table (NTC)

CURRICULUM TABLE - COURSE HOURS/WEEK - 12 WEEKS/TERM

COURSE: MOTOR VEHICLE MECHANICS WORK

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		Term 3		Term 1		Term 2		Term 3			
		T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P		
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	288	2.0
CCH 10	Chemistry	2		2		2	0	2	1	2	1	2	1	2	1	2	1	2	1	288	2.0
CEN 10	Eng. Lang.& Com.	2	0	2	0	2	0	3	0	3	0	3	0	3	0	3	0	3	0	288	3.00
CEC 11-13	Econ.	2	0	2	0	2	0	2	0	2	0	2	0	2	0	2	0	2	0	216	2.00
ICT 11	Intro 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 Appl. 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 Appl. 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 & Des.Geom.	0	0	0	0	0	0	0	3	0	3	0	3	0	0	0	0	0	0	108	3.00
CTD 13	Eng'g. Drawing	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	2	72	2.00
CME 11	Gen. 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	Gen. Metal Work II	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	60	5.00
CMV 10	Serv. Station Mech.	2	6	2	6															192	8.00
CMV 11	Petrol Engine Maint.							2	6	2	6									192	8.00
CMV 12	Diesel Engine Maint.													2	6	2	6			192	8.00
CMV 13	Engine Reconditioning			2	6															96	8.00
CMV 14	Transmission									2	6									96	8.00
CMV 15	Suspension Steering & Braking systems															2	6			96	8.00
CMV 16	Auto Elect/Electronics																	2	6	96	8.00
	GRAND TOTAL																			2916	103
																				48	
CBM 10	Entrepreneurship										2		2	-	-	-	-	-			
	GRAND TOTAL																			2964	

Curriculum Table (ANTC)

CURRICULUM TABLE - COURSE HOURS/WEEK - 12 WEEKS/TERM

COURSE: ADVANCED MOTOR VEHICLE MECHANICS

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE

SUBJECT CODE	MODULE	YEAR I						Total Contact Hours per Subject	Hours per Week
		Term 1		Term 2		Term 3			
		T	P	T	P	T	P		
CMA 21-22	Mathematics	2	0	2	0	0	0	48	2.00
CEM 21-22	Eng. Lang. & Com.	2	0	2	0	0	0	48	2.00
CBM 21	Entrepreneurship								
CEN 21	Technical Report Writing	0	0	2	0	0	0	24	2.00
CMV 20	Major Engine Repair Works	2	4	2	4	2	4	216	6.00
CMV 21	Transmission Repair Work	0	0	2	4	0	0	72	6.00
CMV 22	Chassis, Suspension Steering & Brake System	0	0	0	0	2	4	72	6.00
CMV 23	Car Air Conditioning	0	0	2	4	0	0	72	6.00
CMV 26	Project	0	0	0	0	0	6	72	6.00
ICT 21	Adv. AutoCAD I	0	3	0	0	0	0	36	3.00
ICT 22	Adv. AutoCAD II	0	0	0	3	0	0	36	3.00
	GRAND TOTAL							68	49

General Metal Work I

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE		
Course: General Metal Work I	**Course Code: CME 11**	**Contact Hours: 7hrs/wk**
Module Specification: PRACTICAL/KNOWLEDGE REQUIREMENTS		

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

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

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

(1) Use all tools correctly ensuring the machinery guards and protective eye shields are used at all times.

(2) Comply with the general rules for safe practice in the work environment at all this.

(3) Use and select hand tools for carrying out various bench fitting and assembly tasks

(4) Use Tools: 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 using the appropriate coolants. Drilling, reaming, counter sinking, counterboring

(8) Perform metal joining by a range of processes. Cut through the joints and investigate the depth of penetration of the metals at the Interface Processes: Soldering, brazing, and fusion welding.

(9) Mark out on metals and other materials, datum lines, angles, radii/circles and hole positions using a range of tools.

PRACTICAL TASKS

	General Objective: On completion of the following practical tasks, the trainee will demonstrate the following abilities:		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
1-3	1.1 Use and handle hand tools, portable power tools and machine 1.2 Lifting, move and store materials or completed job 1.3 Demonstrate first aid application in cases of minor cuts, electric shock, burns.	• Demonstrate safe ways of handling basic hand tools • Show a film on industrial safety • Demonstrate how to treat energy cases like artificial respiration cold compress, etc • Assess the students	• Hand tools: files, hacksaw • Television, Video machines • Posters on artificial respiration
	General Objective 2.0: Measuring, Marking, Cutting and striking tools		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
4-6	2.1 Describe the essential features and use of the following a. micrometer b. vernier calliper c. Venier height gauge d. combination set 2.2 Maintain and care for the instruments listed above 2.3 Perform marking out exercise on plane surfaces including profiles 2.4 File a piece of metal to given specifications using any of the following: Cross filing, draw filing, filing square and flat surfaces 2.5 Test surface for flatness using surface plate and try square and state precautions to be taken to avoid pinning 2.6 Maintain files in good working conditions	• Demonstrate how to use micrometer, venier caltiper, vernier height gauge, combination set • Demonstrate the maintenance and care of the instruments listed above • Perform marking out for the students to learn and practise till they become competent • Demonstrate how flat surfaces can be tested using surface plate and try square • Demonstrate how files are cleaned and state the precautions to be taken against pinning. Students to practise till they become competent • Demonstrate the application of hammers and mallets for engineering purposes	• Micrometer, vernier calipers, vernier height gauge, combination sets • Steel rules, dividers, punches, trammel, scribe angle plate, vee block center square • Flat file, try square • File card, flat file • Ball pein hammers, mallet • Hacksaw blade, Hacksaw frame

	General Objective 2.0: Measuring, Marking, Cutting and striking tools		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
4-6	2.7 Apply various hammers and mallets e.g ball pein, rubber mallets, etc for engineering purposes 2.8 Select and insert hacksaw blade correctly 2.9 Cut metal and other engineering materials to given specifications using the adjustable hacksaws, junior hacksaws, piercing saw, etc drills and Drilling. Assess the students	• Demonstrate how a hacksaw blade can be inserted correctly • Demonstrate how to use adjustable hacksaw, junior hacksaw piercing • Students should be allowed to practise till competent • Assess the students	
	General Objective 3.0: Machine Tools		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
7-9	3.1 Setting up and operate a drilling machine in given situations **Note** Setting up drilling machine should include a) change of spindle speed a adjustment of drilling table to required height and angle, to required height and angle, holding of work on drilling table using appropriate clamping devices b Install the drill bit in chuck 3.2 Sharpen a twist drill currectly to manufacturer's specification 3.3 Perform with facility the following operations: a. drilling blind holes b. drilling round stock c. counterboring and counter-sinking d. drilling large diameter holes	• Demonstrate how to set up and operate a drilling machine in given situation • Students to practise till they become competent • Demonstrate how a twist drill can be sharpened correctly • Demonstrate with the appropriate facility how to perform all the drilling operations • Students to practise till they become competent • Give notes as well as demonstrate the operation sequence in cutting internal (through and blind) and external threads by hand method • Demonstrate how riveting can be done and let the students practice same till they become competent	• Bench drill pillar drill, drill bits • Bench drill, pillar drill, twist drill, flat drill, counter sink drill, counterbore drill, center drill • Drills, taps, tap wrench, die and die stock • Rivets and sets of drill bits • Surface table, surface plate, marking solution, center/dot punches, scribing block

	General Objective 3.0: Machine Tools		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
7-9	3.4 List the operation square and cut internal (through and blind) and external threads by hand method and state precautions to be taken when taping on the bench 3.5 Rivet metals together in any given situations 3.6 Mark out only given bench work using datum points, datum lines, datum faces, chalk or marking solution center or dot, punch, scribing block or measurement transfer.	• Demonstrate the marking out procedures on bench working using datum lines, datum faces, etc • Students to practise till they become competent • Assess the students	
	General Objective 4.0: Lathe and Lathework		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
10-12	4.1 Sharpen cutting tool for plain turning, shouldering, parting off and facing operations 4.2 Set up rough and turned stock in 3-jaw-chuck 4.3 Select appropriate cutting tool and set them up to center height for turning or facing operations 4.4 Carry out chuck work involving facing, step turning, undercutting radiusing, chamfering, parting off and knuring **Note** Components should be produced to specified tolerance and finish 4.5 Produce simple components involving taper turning using the compound slide	• Guide the students to sharpen cutting tool for plain turning shouldering, parting off and facing operations and allow students to practise till competent • Demonstrate how to set-up rough and turned stock in a 3-jaw-chuck and operate lathe. Allow students to practise till they become competent • Guide the students to select appropriate cutting tools and set them up to center height for lathe work (turning or facing) • Guide students to produce simple engineering components like open ended spanner, engineers square, tool makers clamp, center square, etc.	• Point tools, grinding machine, lathe machine • 3-jaw chuck and lathe machine • Point tools lathe machine • Lathe machine and accessories • Centre lathe and accessories like catch plate, face plate, dog lathe, lathe centers fixed steady and travelling steadies

	General Objective 4.0: Lathe and Lathework		
Week	Specific Learning Outcome:	Teachers Activities	Resources
10-12		• Make a simple precision fitting project like hexagonal mild steel bar making push fit through a mild steel plate • Students should be allowed to practise till they become competent • Prepare simple exercises that will guide students to produce components involving taper turning using the compound slide. Assess the students	• Round nose turning tool, fine finishing tool, form tool, parting off tool, boring tool, bar of good length and 4mm diameter, Live/dead centers catch plates • Standard exercises or prepared jobs

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

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: General metal Work I		Course Code: CME 11	Contact Hours: 7hrs/wk
Course Specification: Knowledge Requirement			
	General Objective: 1.0 understand workshop safety rules and application in machine shop		
Week	Specific Learning Outcome	Teachers Activities	Resources
1	1.1 State sources of hazards in the workshop and how to prevent them. e.g. a. handling and using hand tools, portable power tools and machines; b. stepping on or striking obstructions left on floors or benches; c. lifting, moving and storing materials or jobs;	• State sources of hazards in the workshop. • Through questions and answer, determine whether the students grasped the topic • Show a film on industrial safety. • Through question and answer determine comprehension. • Demonstrate how to treat emergency cases like artificial respiration, cold compress etc	• Safety posters, common hard tools like files hacksaw • Television, Video machine. • Overall, goggles, gloves, hardshoes, head shield, fire extinguishers.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: General metal Work I		Course Code: CME 11	Contact Hours: 7hrs/wk
	General Objective: 1.0 understand workshop safety rules and application in machine shop		
Week	Specific Learning Outcome	Teachers Activities	Resources
1	d. using inflammable or corrosive liquids and gases; e. inhaling vapours or fumes; 1.2 Explain the applications of factory safety regulations in the machine shop. 1.3 Name safety equipment and wears essential in the machine shop, and state their application in working situations. Note: Example of safety wears and equipment should include overall, eye goggles, gloves, safety boots, helmet, fire extinguishers, etc	. • List the safety equipment and wears that are essential in the workshop. • Give detail notes and explanation in each topic a-g. • Use questions and answers to determine comprehension. • Assess the students	
	1.4 Outline safety rules and regulations relating to:- a. clothing and health hazards; b. workshop hygiene; c. movement and other behaviour of workers in the workshops; d. materials handling; e. too handling, storage and usage; f. machine operation; g. fire protection.	• Give detail notes and explanation as appropriate. • Explain the procedures to be taken in the event of workshop accident	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: General metal Work I		Course Code: CME 11	Contact Hours: 7hrs/wk
	General Objective: 1.0 understand workshop safety rules and application in machine shop		
Week	Specific Learning Outcome	Teachers Activities	Resources
	1.5 Understand appropriate procedures in the events of a workshop accident Examples of procedures may include: a. application of first aid to the victim; b. removal or rectification of the accident; c. reporting the accident to the appropriate authority; d. keeping a record of accidents for management use.		
	General Objective 2.0: Know the physical properties, manufacturing process and application of ferrous and non-ferrous metals in common use		
Week	Specific Learning Outcome	Teachers Activities	Resources
2	2.1 Explain the meaning of the following general physical properties of metals:- ductility, malleability, strength, toughness, brittleness, elasticity, plasticity.	• Give detailed notes and explanations for the topics in 2.0	
	2.2 Describe the basic composition and properties of plain carbon steels, cast iron and alloy steel and state their application in the engineering industry. Note: Specific examples of tools and equipment made from the various steel and cast iron should be mentioned.	• Give notes and specific examples of tools • and equipment made from the various • steels and cast iron.	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: General metal Work I		Course Code: CME 11	Contact Hours: 7hrs/wk
	General Objective 2.0: Know the physical properties, manufacturing process and application of ferrous and non-ferrous metals in common use		
Week	Specific Learning Outcome	Teachers Activities	Resources
	Examples of steels and cast irons should include: plain carbon steels, dead mild steels, mild steel, medium carbon steel, high carbon steel. Cast Irons - gray cast iron, malleable cast iron, alloy cast irons (spheroidal and acicular) Alloy Steels - High speed steels, high tensile steels, tungsten, carbide, stainless steels, stellite 2.3 Outline: 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. Note: A visit to a steel manufacturing plant is recommended. 2.4 Describe the physical properties and applications of non-ferrous metals below: copper, tin, zinc, aluminium and aluminium alloys brass (muntz metal, cartridge brass, gilding etc) metal, bronze (manganese bronze tunmetal, bell metal, aluminium bronze, phosphor bronze and lead.	• Examples of steels and cast irons should include plain carbon steels dead mild steels, mild steel, medium carbon steel high carbon steel, gray cast iron, malleable cast iron, alloy cast iron high speed steels, high tensile steels tungsten, carbide, stainless steels • Give notes and explanation on the cupola process, • blast furnace and the direct reduction process • manufacture of steel. This can be preceded by film show and a visit to a manufacturing plant. • Give detail notes and explanations describing the physical properties and applications of the following non-ferrous metals: copper, tin, zinc, aluminium, aluminium alloys, brass, (muntzmetal, cartridge brass gilding metal) etc. bronze, manganese bronze bell metal, aluminium bronze phosphor bronze and lead. Assess the students	• Video and television including cassettes on production processes.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: General metal Work I		Course Code: CME 11	Contact Hours: 7hrs/wk
	General Objective 3.0: Understand the selection and use common measuring, marking out, cutting and striking tools		
Week	Specific Learning Outcome	Teachers Activities	Resources
3	3.1 Select and use common measuring, marking out, cutting and striking tools. 3.2 Explain with examples the difference between “line” and “end” measurement. 3.2 Explain the use of datum points, datum lines and datum faces in marking out. 3.3 Describe, the functions and application of the following instruments used in metal-work: steel rule, dividers, calipers (inside, outside and odd-legs), trammel, scriber angle plate, vee-block, centre square. 3.4 Describe the various types of files, stating their grades and applications. Note: Types of files should include: flat, square, round, half round, three square, warding pollar, mill and rasp. 3.5 Classify the common files used in metal work and state their composition of material used for their manufacture. 3.6 Sketch the bench vice, explain its clamping power and demonstrate the technique of holding work in the vice for filing, tapping and designing operations.	• Prepare notes that will clearly differentiate between “line” and “end” measurement. • Prepare notes and examples that will explain the use of datum points, datum lines, and datum faces in marking out. • Demonstrate and give detail notes and explanations regarding the functions and application of: steel rule, dividers, calipers (inside, outside and oddleg) trammel, scriber, angle plate, vee block, centre square • Prepare notes that will describe the various types of files stating their grades and applications, by type, e.g flat, square round, halfround, three square, warding, mill and rasp. Prepare detail notes that will classify the common files used in the metal work as swell as stating the composition of materials used for their manufacture.	• Steel rule, divides calipers, trammel, scribe angle plate vee block, centre square. • Micrometer vernier callipers vernier height gauge combination set • Flat file, hard file, round file square, half round, triangular warding, mill file, rasp file. • Flat file, handfile engineers square. • Surface plate try square (engineers square) • File card • Flat file • Bench vice.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: General metal Work I		Course Code: CME 11	Contact Hours: 7hrs/wk
	General Objective 3.0: Understand the selection and use common measuring, marking out, cutting and striking tools		
Week	Specific Learning Outcome	Teachers Activities	Resources
3	3.7 Describe the functions of the various parts of a bench vice, its holding power while performing various operations on such as filing, tapping, sawing etc. 3.8 Describe and use the following tools: a. cold chisels (flat, cross, cut half round, diamond-point) b. centre punch and dot punch c. Scrapers (flat, triangular, half round) d. power hack saw		
4	3.9 Describe the various parts of a hack saw and their function. 3.10 Describe the common types of hacksaw blades, their range of pitches and their applications. 3.11 Show a bench vice and demonstrate the technique of holding work in the vice for filing, tapping and designing operations.Prepare detail notes that will describe the functions of the various parts of a bench vice, its holding power while performing various operations. 3.12 State the safety precautions to be observed when using a hand hacksaw	• Show a bench vice and demonstrate the work in the vice for filing, tapping and designing operations • Prepare detail notes that will describe the functions of the various parts of a bench vice, its holding power while performing various operations • Assess the students • Prepare detail notes and demonstrations that will describe and uses of: cold chisels, centre punch dot punch, scrapers and power hacksaw. • Prepare notes that will describe the various parts of a hacksaw and their functions.	• Bench vice. • Ball pein hammers and mallets. • Cold chisels, centre punches, dot punch, scrapers, power hacksaw blades. • Hacksaw blade • Hacksaw frame • Adjustable hacksaw junior hacksaw piercing saw. • Bench drill • Pillar drill. • Twist drill, flat drill counter sink drill, counter bore drill combination centre drill.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: General metal Work I		Course Code: CME 11	Contact Hours: 7hrs/wk
	General Objective 3.0: Understand the selection and use common measuring, marking out, cutting and striking tools		
Week	Specific Learning Outcome	Teachers Activities	Resources
4		• Show samples of hacksaw blades as well as prepare notes that will describe the common types of hacksaw blades, • their range of pitches and their applications. • Prepare notes that will show correct way of inserting blades. • Prepare detail notes and explanation, stating the safety precautions to be observed when using a hand hacksaw. • Prepare notes that will describe the uses of various hacksaws. Assess the students	
	General Objective 4.0: Understand the working principles of a drilling machine, use it to drill and ream holes on metals and other engineering materials.		
Week	Specific Learning Outcome	Teachers Activities	Resources
5-6	4.1 Identify the various types of drilling machines. 4.2 Describe, with sketches, the main features of a bench or pillar drilling machine. 4.4 Describe with sketches and state where each of the following types of drills are best suited: twist drill (taper shank, parallel shank and jobbers drill, and their relative merits), flat drill, countersink drill, counter bore drill, combination centre drill.	• Show different types of drilling machines • Make notes and drawings that will identify the various types of drilling m/cs. • Prepare detail notes and drawings that will describe the main features of a bench or pillar drilling machine. • Solve many problems for students to practise.	• Ball pein hammers, mallets, cold chisels, do center punches, hacksaw and hacksaw blades • Drilling machines and their accessories.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: General metal Work I		Course Code: CME 11	Contact Hours: 7hrs/wk
	General Objective 4.0: Understand the working principles of a drilling machine, use it to drill and ream holes on metals and other engineering materials.		
Week	Specific Learning Outcome	Teachers Activities	Resources
5-6	4.5 Explain the effects of the following faults in a ground twist drill bit: a. point angle too acute; b. point angle too abtuse; c. cutting edges at unequal angles; d. insufficient lip clearance; e. excessive lip clearance. 4.6 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 = revolutions/minute D = diameter of drill (mm) π = 3.142 4.8 State the causes and remedies of drilling faults such as:- a. drill breaking; b. drill coloured blue; c. walls of drilled hole left rough; d. chipped cutting lips. 4.9 State the safety precautions to be observed when using a drilling machine. 4.10 Explain the purpose of reaming and describe different types of hand and machine reamers. 4.11 Ream to given specifications by hand and machine method.	• Prepare notes and drawings that will describe where each of the following drills are best suited • Twist drill (taper shank, parallel shank, jobber drill and their relative merits), flat drill, counterbore drill and combination center drill. • Assess the students.	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: General metal Work I		Course Code: CME 11	Contact Hours: 7hrs/wk
	General Objective 5.0: Understand the applications of various types of screw threads, rivet and cut screws by hand.		
Week	Specific Learning Outcome	Teachers Activities	Resources
	5.1 Sketch the thread forms below and state their applications:- 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. 5.2 Sketch and state the functions of:- a. taps (taper tap, second tap, plug) b. tap wrench c. die and die stock. 5.3 Explain the meaning of tapping size or tapping drill and estimate its value in given situations using formulae such as:- T = D - P Where T = tapping diameter D = thread top diameter P = pitch	• Give detailed notes with diagrams that will show the various forms of trade and their uses. • Prepare notes that will state the functions of taps, tap wrench, die and die stock. • Give detailed notes that will explain the meaning of tapping size or tapping drill and estimate its values using the formula: T = D - P • Where T = tapping diameter • D = thread top diameter and • P = Pitch	• Diagrams/charts of thread forms • Parallel reamers, taper reamers twist drills.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: General metal Work I		Course Code: CME 11	Contact Hours: 7hrs/wk
	General Objective 5.0: Understand the applications of various types of screw threads, rivet and cut screws by hand.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
	5.4 State precautions to be taken when taping on the bench. 5.5 Describe and differentiate types of rivets. e.g. Snap and pan head, mushroom and counter-sunk head, flat head, dod rivet, etc. 5.6 Sketch the rivet set and state its use. 5.7 Calculate the diameter of rivet and riveting allowance in given situations.	• Prepare notes that will state precautions to be taken when tapping on bench. • Give notes and diagrams that will describe and differentiate types of rivets, rivet sets, and its uses and guide to calculate the diameter of rivet and riveting allowance. • Assess the students.	• Rivet sets, drills.
	General Objective 6.0: Understand the ISO tolerances and fits and its application in engineering production.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
8	6.1 Differentiate between the following:- a. nominal siz 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 in given situations.	• Give detailed notes that will differentiate between nominal size, limits, tolerance and fits. • Prepare detailed note and diagrams that will explain the importance of tolerance and fits in engineering production as well as describing the ISO systems of limits and fits. • Give notes and explanations that will guide in calculating the amount of tolerance and types of fits in given situations. • Assess the students.	• Charts on tolerances, limits and fits.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: General metal Work I		Course Code: CME 11	Contact Hours: 7hrs/wk
	General Objective 7.0: Produce simple Engineering Components on the bench.		
Week	Specific Learning Outcome	Teachers Activities	Resources
	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.	• Teachers to prepare notes and explanations to guide the students in producing simple engineering components in 7.1 • Assess the students	• Lesson notes. • Diagrams and charts.
	General Objective 8.0: Understand the essential features and working principles of the centre lathe and use it to carry out basic operations such as plain turning, stepped turning, facing taper turning, chamfering, and under-cutting		
Week	Specific Learning Outcome	Teachers Activities	Resources
	8.1 Describe the essential features of a centre lathe and state their functions e.g lathe bed, headstock, tailstock, saddle or carriage, etc. 8.2 Explain the working principles of the centre lathe. 8.3 Identify and state the functions of centre lathe accessories such as: catch or driving plate, face plate, lathe dog or carrier, lathe centres, fixed and travelling steadies. 8.4 Explain the difference between the centre lathe, capstan lathe, in terms, of their main features and functions.	• Prepare detailed notes that will describe the essential features of center lathe and their functions. • Give notes and diagrams that will explain the working principles of center lathe and functions of its accessories. • Give explanations that will show the difference between center lathe and capstan lathe in terms of their main features and functions.	• Centre lathe and accessories like catch plates, face plates, centers, fixed and travelling steadies. • Charts of center lathe and capstan lathe. • Round nose turning tool, finishing tool, site finishing, knife tools, form tools, parting off tools, and boring tools.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: General metal Work I		Course Code: CME 11	Contact Hours: 7hrs/wk
	General Objective 8.0: Understand the essential features and working principles of the centre lathe and use it to carry out basic operations such as plain turning, stepped turning, facing taper turning, chamfering, and under-cutting		
Week	Specific Learning Outcome	Teachers Activities	Resources
10	8.5 Name types of cutting fluids used for lathe turning operations and state their composition and purposes. 8.6 Outline safety precautions to be observed when working on the lathe 8.7 Sketch and describe common tools:e.g butt-brazed tool, tipped tool, bit and holder. Note: Tool description should include tool materials e.g plain carbon steel, high speed steel, satellite, cemented carbide, diamond. 8.8 Explain with sketches the functions of tool angles (rake, clearance), and state their values for different metals to be machined.	• Prepare notes that will list types of cutting fluid used for lathe turning operations and their composition and purposes. • Prepare detailed notes and explanation that will outline safety precautions, common tools and materials used in marking them. • Give detailed notes and diagrams that will explain the functions of tool angles (rake, clearance) stating their values for different metals to be machined. • Assess the students	
11-12	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. 9.10 Explain with sketches the effects of wrong setting cutting tools: e.g. vibration and chatter, tool rubbing against or digging into the job. 8.11 Define cutting speed and feed with respect to lathe operation. 8.12 Calculate the cutting speed and feed for given turning operation.	• Give notes and diagrams of various tool shapes and their uses. • Prepare detailed notes and explanations to cover 8.10 to 8.15 • Solve many problems for the students to practise. • Assess the students	• Charts on tool height • Charts and diagrams of different machining operations.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: General metal Work I		Course Code: CME 11	Contact Hours: 7hrs/wk
	General Objective 8.0: Understand the essential features and working principles of the centre lathe and use it to carry out basic operations such as plain turning, stepped turning, facing taper turning, chamfering, and under-cutting		
Week	Specific Learning Outcome	Teachers Activities	Resources
11-12	8.13 Estimate the rate of metal removal and time required for carrying out specified turning operations 8.14 State precautions to be observed when turning between centres. 8.15 Set up the lathe for and carry out basic turning operations between centres. 8.16 Compute required taper dimensions from given data using taper ratio angle formulae i.e. $\text{TaperRatio} = \frac{d2 - d1}{L}$ OR $\frac{\text{Tan}}{2} = \frac{d2\,d1}{2}$ where = taper angle d1 - small end diameter d2 = large end diameter L = length of taper		

General Metal Work II

COURSE:	GENERAL METAL WORK
MODULE:	CME 12 GENERAL METAL WORK II
PRE-REQUISITE:	CME 11
CONTACT HOUR:	5 HOURS/WEEK
GOAL:	This module is designed to introduce the trainee to basic processes in mechanical engineering such as forging, sheet-metal work and welding.

General Objectives:

On completion of this module, the trainee 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 and apply them in fabricating simple metal components.

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. Carry out gas/arc welding and apply them in fabricating simple engineering components

PRACTICAL TASKS

	General Objective 1.0: Understand the basic principles and processes of heat treatment of metal of metal in the workshop.		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
1-2	**Heat Treatment** 1.1 Carry out the following heat treatment processes Hardening, tempering, annealing, normalizing, case hardening on given plain carbon steel, engineering components or tools 1.2 Anneal copper, brass and aluminium for various purposes	• Demonstrate heat treatment processes and explain the stages • Demonstrate the annealing process on brass, copper and aluminium for various purposes. • Assess the students.	• Furnace, Forge tongs

	General Objective 2.0: Produce simple engineering components by forging		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
3-4 5-8	**Forging Processes** 2.1 Select appropriate forging tools and produce to specifications given engineering components by forging processes a. upsetting - drawing down b. setting down - twisting c. forge welding (scarf and spice welds) d. bending, turning closed ring e. forming an eye	• List and identify gas and metal arc welding equipment • Demonstrate with appropriate forging tools how to produce some engineering components and let the student practice till they become competent • Assess the students	• Anvil, swage block, leg vice, forging hammers, hot set, cold set, sets of hammer, punchers, drifts, fillers, top swage, bottom swage, flatter, open tongs, hallow bit
	General Objective 3.0: Understand the basic principles and techniques of gas and metal are welding and apply them in fabricating simple metal components		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
9-12	**Welding Processes** 3.1. Set up and operate gas or metal arc welding equipment in given situations. Note: Equipment operation should include choice of correct nozzles or electrode. Adjustment for correct gas pressure/flame or voltage 3.2 Prepare joints for welding in given situations 3.3 Weld given components by arc or gas welding methods, and state safety precautions to be observed	• List and identify gas and metal arc welding equipment • Demonstrate the use of both gas and metal are welding equipment; for all the students to practise • Demonstrate to the students how to prepare joints for welding purposes • Guide students to weld various components using both gas and arc welding processes and state safety precautions.	• Acetylene regulators • Oxygen, cylinders, welding set goggles, shield, electrodes, diagrams and charts of various welding joints

Assessment: Practical - 60% of overall assessment

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE: GENERAL METAL WORK II		MODULE CODE: CME 12	CONTACT HOURS: 5hrs/wk
	Module Specification: Knowledge Requirements		
	General Objective:1.0 Understand The Basic Principles And Processes Of Heat Treatment Of Metal In The Workshop.		
Week	Specific Learning Outcome	Teacher Activities	Resources
1-4 1.2 1.3	1.1 Explain briefly the structural behaviour of plain carbon steel as it is heated from room temperature to about 1000°C for: a. hardening b. tempering c. annealing d. normalising e. case-hardening. 1.2 Explain the meaning of hardening metal work. 1.2 Outline safety precautions relating to heat treatment processes And apply them in given situations.	• Prepare detail notes that will explain the structural behaviour of plain carbon steel as it is heated from room temperature to about 1000°C. • Prepare detail notes that will explain the meaning of hardening in metalwork. • Prepare notes that will outline safety precautions relating to heat treatment processes. • Assess the students	• Recommended Text books • Lesson notes, etc
	General Objective 2.0: Understand the techniques of producing simple engineering components by forging.		
Week	Specific Learning Outcome	Teacher Activities	Resources
5-6 7-8	2.1 Explain with outline sketch the main features and working principles of the black smith's forge. 2.2 Describe and state the functions of common forging tools.e.g anvil, swage block, leg vice, forging hammers, hot and cold sets, set hammer, punches and drifts, hardie, fullers, top and bottom swages flatter, tongs (open mouth, closed mouth, hollow bit, etc.). 2.3 Describe with sketches the following forging operations: a. upsetting	• Prepare detail notes and diagrams that will explain the main features and working principles of the black smith's forge. • Prepare notes and diagrams that will describe the functions of common forging tools. • Prepare detail notes that will describe the following forging operations: upsetting, drawing down, setting down, twisting, forge welding, bending, forming closed ring, forming an	

	b. drawing down c. setting down d. twisting e. forge welding (scarf and splice welds) f. bending g. forming closed ring, forming an eye.	eye. • Assess the students.	

Service Stations Mechanics

PROGRAMME:	NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK
MODULE:	CMV 10: SERVICE STATIONS MECHANICS
DURATION:	192 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:-

1. Understand the layout and functions of the principal components of the motor vehicle.
2. Understand the sealing and locking methods, seal and lock motor vehicle components/parts efficiently.
3. Understand the basic services involved and carry out routine maintenance on different types of motor vehicles.
4. Understand the basic construction of a battery and carry out preventive maintenance.
5. Understand the basic principles of the motor vehicle and carry out general maintenance work on them.
6. Maintain tyres in good working condition and carry out wheel alignment.
7. Understand the combustion process in spark and compression ignition engines.
8. Understand service station operation procedures.
9. Understand the properties of fuels and oils.
10. Understand the safety precautions relating to the handling and storage of fuels and oils.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: SERVICE STATION MECHANICS		Course Code: CMV 10	Contact Hours: 8hrs/week
Module Specification: Theoretical			
	General Objective: 1.0 Understand the layout and functions of the principal components of motor vehicle		
Week	Specific Learning Outcome	Teacher's Activities	Resources
1-6	1.1 Identify the principal components, auxiliaries and systems of a motor vehicle e.g. engine, gearbox, clutch, chassis, rear axle, connections to road wheels, and body. 1.2 Describe in detail the functions of each component in a motor vehicle listed in 1.1 above 1.3 Explain the principles of operations of each component listed in 1.1 above 1.4 Sketch a chassis layout showing relative position of the main components of a vehicle e.g. engine, transmission, prop-shaft, rear axle, suspension, front axle, suspension and steering control linkages to road wheels, etc.	• Introduce the students to vehicle lay-out, list the main components such as: - engine, gearbox, clutch, chassis, rear axle, connection to road wheels and the vehicle body. Explain the functions of: engine clutch gearbox propeller shaft rear axle suspension arrangement Ask student to sketch a chasses layout. Assess the students	• -Lesson plan • -Posters • -Sketches • -Model vehicle

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: SERVICE STATION MECHANICS		Course Code: CMV 10	Contact Hours: 8hrs/week
	General Objective 2.0: Understand the sealing and locking methods; seal and lock motor vehicle components/parts efficiently.		
Week	Specific Learning Outcome	Teacher's Activities	Resources
7-8	2.1 Explain the functions, strength and limitations of the following devices: a. Securing devices e.g. thread types and sizes BSW, BSF, BSP, UNC, UNF, metric in nuts and bolts, set screws, stud, allen grub, Philip screw, etc. b. Locking devices e.g. springs, shakeproof and tap washers, locking plates, castellated and self locking nuts, split pins, circlip pins, bolt locking wire. c. Sealing devices, e.g. gasket, joints, plugs, compound, etc. d. 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.	• Ask students to: • Identify types of threads and sizes used in metric for bolts and nuts, set screws, studs, allen keys. • List locking devices: springs, shakeproof and tap washers, self locking nuts, split pins, circlips etc. • Identify pipe union and joints; copper, flexible plastic pipes couplings, hose clips etc. • Assess students	• Lesson plan • Chalkboard • Sample of bolts, nuts, studs etc.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: SERVICE STATION MECHANICS		Course Code: CMV 10	Contact Hours: 8hrs/week
	General Objective 3.0: Understand the basic services involved and carry out routine maintenance on different types of motor vehicles		
Week	**Specific Learning Outcome**	**Teacher's Activities**	**Resources**
9-10	3.1 Explain the basic operations in routine vehicle maintenance, e.g. change oil filter, spark plugs, contact breaker, clean and adjust carburetor, check distributor leads and petrol pump. 3.2 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. ratings, multigrade oil; Fluid - High and low boiling point fluid	• Introduce the students to basic or routine maintenance of motor vehicle. • Explain the importance of lubricants and types, and brake fluid • Identify types of lubricants. • Explain oil grades • Assess students	• Lesson plan • Charts • Tools and oil • Brake fluid • Grease
	General Objective 4.0: Understand the basic construction of a battery and carry out preventive maintenance.		
Week	**Specific Learning Outcome**	**Teacher's Activities**	**Resources**
11	4.1 Explain the basic construction of a battery and its components	• Explain the functions of battery cells and construction • Describe a hydrometer and use. • List battery faults • Assess students:	• Lesson plan • Chalkboard • Used battery model • Hydrometer

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: SERVICE STATION MECHANICS		Course Code: CMV 10	Contact Hours: 8hrs/week
	General Objective 5.0: Understand the basic principles of the motor vehicle and carry out general maintenance work on them		
Week	Specific Learning Outcome	Teacher's Activities	Resources
12	5.1 Explain the basic processes of routine vehicle maintenance.	• Introduce and list basic processes of routine vehicle maintenance • Explain causes of leakages in brake and clutch pipelines • Check burned electrical components • Explain causes of radiator leakage • Explain method of replacing fan belt • Explain causes of brake defects • Assess students	Manufacturers' specifications/recommendations
	General Objective 6.0: Maintain tyres in good working condition and carry out wheel alignment		
Week	Specific Learning Outcome	Teacher's Activities	Resources
13-14	6.1 Explain markings and codes on tyres e.g load/speed ratings, tyre size/aspect ratio 6.2 With the aid of sketches identify tyre construction e.g radial bias belted 6.3 Identify different tyres of wheel and wheel construction e.g split rim well tyre etc. Explain reason for well 6.4 List materials used in wheel manufacture and explain reason 6.5 Explain procedure involved in tyre removal and refitting. Identify safety aspects	• Explain with appropriate aids • Ask students to explain topics • Assess students.	• Tyres and appropriate teaching materials

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: SERVICE STATION MECHANICS		Course Code: CMV 10	Contact Hours: 8hrs/week
	General Objective 7.0: Understand the combustion process in spark and compression ignition engines		
Week	Specific Learning Outcome	Teacher's Activities	Resources
15-18	7.1 Identify the names of the main components parts of a multicylinder engine and draw line diagrams of cylinder arrangements, crankthrows and vee-arrangements. 7.2 Explain constructional details of cylinder blocks, heads and gaskets, cylinder liners and sumps. 7.3 Explain the working sequence of two, and four stroke engine 7.4 Explain the functions of a cylinder gasket and state the faults that can occur due to incorrect tightening of cylinder head gasket 7.5 Explain the viscosity of lubricants, its variation with temperature and viscosity index. 7.6 Explain the use of additives to control detonation and deposits 7.7 Draw/sketch the lubricating systems of an engine showing valve arrangements and camshaft drives, fuel supply systems, air and water cooling systems and circuit diagrams for ignition and starting systems.	• List parts of a 4 cylinder engine. • Sketch an in-line 4 cylinder and V-type 4 cylinder engine • Sketch cylinder head of an engine showing details, and explain the importance of gasket. Explain cylinder liners and their important. • Describe sump and state its functions • State the firing orders/sequences of two, four, six and eight cylinder engines. • State the importance of cylinder head gasket and list its common faults. • State the importance of choosing engine oil in relation to its viscosity with temperature change • Explain the purpose of additives in engine oil. • 7.9 Sketch lubricating system of an engine and show all the important points of lubrication.	• Complete engine

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: SERVICE STATION MECHANICS		Course Code: CMV 10	Contact Hours: 8hrs/week
	General Objective 8.0: Understand Service Station Operation Procedures		
Week	Specific Learning Outcome	Teacher's Activities	Resources
	8.1 State the features, applications and properties of fuels, lubricants, tyres, batteries and vehicle accessories.	• List service station equipment. • Explain functions of a service station • List services offered at service station	• Lesson plan • Chalkboard • Poster/Charts, hand tools
	8.2 Explain forecourt procedure 8.3 Operate forecourt equipment such as battery charger, air compressor, water compressor, vehicle light/beam setter, etc.	• Explain forecourt procedure • Demonstrate the use of battery charger, beam setter, etc.	• Battery charger • Beam setter etc.
	General Objective 9.0: Understand the properties of fuels and oils.		
Week	Specific Learning Outcome	Teacher's Activities	Resources
21	9.1 Define the following properties of fuel, and oil - viscosity index, volatility, flash point, cloud point, composition, calorific value, cetane rating, octane rating, oil additives	• Define properties of fuel • Define properties of oils. • Define-viscosity index, volatility, flash point, cloud point, composition, calorific value, octane rating, octane rating and oil additives • Explain safety conditions necessary in handling or storing fuels and oils	• Lesson plan • Testing equipment • Different types of graded oils • Sketches.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: SERVICE STATION MECHANICS		Course Code: CMV 10	Contact Hours: 8hrs/week
	General Objective 10.0: Understand the safety precautions relating to the handling and storage of fuel and oil		
Week	Specific Learning Outcome	Teacher's Activities	Resources
22-24	10.1 Define safety precautions in using fuels and oils 10.2 Enumerate the precautions necessary to avoid fuel oil contamination when stored or handled 10.3 Describe the health hazards due to handling of fuel oil and the required precautions 10.4 State the safety precautions to be observed when dealing with high pressure fuel injection system in-situ and when using test equipment 10.5 Draw a cross section of a sedimentor and state its function and indicate the fuel flow path 10.6 Define or explain the action of an agglomerator filter 10.7 Sketch a typical fuel filter and state the need for constant maintenance	• Explain the functions of fuels in motor vehicles • List functions of oil in the motor vehicle • Name and sketch types of fuel pumps • Name and sketch types of oil pumps. • Explain steps in changing engine oil. • Assess students	• Use typical fuel pump models and oil pump models. • Chalkboard • Posters.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: SERVICE STATION MECHANICS		Course Code: CMV 10	Contact Hours: 8hrs/week
1-6	PRACTICAL GUIDE **Engine Maintenance** a. Carry out securing, sealing and locking operations on components parts of types of motor vehicles. b. change engine oil c. change oil filter d. change or clean spark plugs e. check distributor and set the contact breaker points f. Service the carburator g. grease the appropriate joints h. clean air filter i. check brakes and effect repairs as appropriate	• Teacher to demonstrate correct working procedures • Students to practise procedures using practical learning manual produced by teacher • Assess students	• Vehicles, service equipment and appropriate consumables
7-10	**Battery Work** a. Top up battery electrolyte of correct specific gravity b. Check, clean or replace if necessary and tighten battery terminals c. Check specific gravity of a battery with a hydrometer d. Drain discharged electrolyte and refill with good electrolyte and charge the battery	• Teacher to demonstrate for students to practise till they become competent • Assess students.	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: SERVICE STATION MECHANICS		Course Code: CMV 10	Contact Hours: 8hrs/week
	General Maintenance		
11-12	a. Remove and replace burnt electric bulbs b. Check radiator for leaks, dirt or presence of oil in the radiator c. Check and tighten clips, or replace broken radiator hoses. d. Inspect and remove, if necessary, brake drums and brake shoes for wear and wheel cylinder for leaks, then replace or repair. e. Check under body for possible repairs or tighten bolts and nuts for body, suspension/spring 'U' bolts and exhaust system.	• Teacher to demonstrate the practicals for students to practise till they become competent. • Assess students	• Live vehicles, tools box
	Wheel And Tyre Repairs		
13-18	a. Vulcanize tubes and tubeless tyres. b. Carry out wheel balancing with the appropriate equipment c. Check tyres for various wear and possible wheel distortion d. Repair or replace distorted wheels	• Teacher to demonstrate for students to practise till they become competent • Assess students	• Live vehicles, tools box

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: SERVICE STATION MECHANICS		Course Code: CMV 10	Contact Hours: 8hrs/week
13-18	e. Identify tyre sizes for categories of vehicles f. Perform wheel alignment, using appropriate equipment g. Exchange tyre positions in the correct sequence		
	Spark & Compression Ignition Engine		
19-24	Dismantle a model engine and: a. clean cylinder head b. check cylinder head c. remove and replace cylinder head gasket.	• Demonstrate for students to practise • Assess students	-do-
	EXAMINATION GUIDE		
	In order to ensure wide coverage of the module, questions should include: multiple choice, true/false, fill-ins, and Practical Tests. Practical tests should account for 60% of the overall examination marks		

Petrol Engine Maintenance

PROGRAMME:	NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK
MODEL:	CMV 11: PETROL ENGINE MAINTENANCE
DURATION:	192 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 engine.

GENERAL OBJECTIVES

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

1. Understand general safety precautions.
2. Understand the basic working principles of petrol engine and restore it to peak performance.
3. Understand the working principles of valves
4. Understand the working principles of the fuel system of the motor vehicle
5. Understand the operation of an ignition system and carry out repairs and adjustments
6. Understand the working principles of engine cooling system and restore a faulty cooling system to acceptable standard of performance.

PROGRAMME: NTC MOTOR VEHICLE MACHANICS WORK PROGRAMME:			
Course: PETROL ENGINE MAINTENANCE		Course CMV 11Code:	Contact Hours: 8hrs/week
Course Specification: Theoretical Content			
	General Objective 1.0: Understand General Safety precautions.		
Week	Specific Learning Outcome	Teachers Activities	Resources
	1.1 Apply safety and use service manual and service tools correctly with particular attention to: a. workshop manual and tools b. Service manual and tools c. Job completion to manufacturers specifications d. (Use special techniques where applicable)	• Explain the use of correct grooming safety wear in the workshop • Use charts and drawings to remind students of safety • Explain the importance of using workshop service manual for correct adjustments and detailed technical information	• Lesson plan • Charts • Workshop • Manual • Chalk Board • Chalk.
	General Objective 2.0: General Objective: Understand the basic working principles of a petrol engine and restore it to peak performance.		
Week	Specific Learning Outcome	Teachers Activities	Resources
	2.1 Explain in detail the working principles of petrol engine e.g. two stroke and four stroke cycle engine 2.2 Explain the types and function of all types of piston rings and gudgeon pins used on a motor vehicle engine 2.3 State the difference between two stroke and four stroke engines 2.4 Explain the principles of operation of different types of carburetors used in motor vehicles	• Describe the action of the main components of the four stroke cycle engines • State the functions of the three piston rings • Explain the role of the gudgeon pin in coupling the piston and the connecting rod together. • Explain the constructional differences between a two stroke and a four stroke engines. List the advantages and disadvantages of each engine	• Lesson notes • Charts • Models • Overhead projector and Transparencies • Chalk board • Chalk

PROGRAMME: NTC MOTOR VEHICLE MACHANICS WORK PROGRAMME:			
Course: PETROL ENGINE MAINTENANCE		Course CMV 11Code:	Contact Hours: 8hrs/week
	General Objective 2.0: General Objective: Understand the basic working principles of a petrol engine and restore it to peak performance.		
Week	Specific Learning Outcome	Teachers Activities	Resources
	2.5 Explain the operation and the use of contact breaker points 2.6 Describe the functions of the advanced and retard mechanisms 2.7 Explain the process of timing the valve and the ignition of an engine 2.8 Explain the general principles and types of combustion chamber designs. 2.9 Draw and explain the operation of electric and mechanical fuel pumps 2.10 Draw and label a diagram showing the correct sequence of securing the cylinder head-bolts	• Explain the operation of constant choke and variable choke carburettors • Explain the importance of correct gap setting • Assess students	
	General Objective: 3.0 Understand the working principles of valves.		
Week	Specific Learning Outcome	Teachers Activities	Resources
6	3.1 Explain the basic principles of inlet and exhaust valves 3.2 Explain the layout of various engine valve gear arrangements, e.g. overhead, side and over head value.	• Discuss the functions and operation of the inlet and exhaust valves • Explain with the aid of sketches the valve train and the methods of driving the Camshaft. • Assess students	• Inlet valves Exhaust valves

PROGRAMME: NTC MOTOR VEHICLE MACHANICS WORK PROGRAMME:			
Course: PETROL ENGINE MAINTENANCE		Course CMV 11Code:	Contact Hours: 8hrs/week
	General Objective: 4.0 Recondition the fuel system of a motor vehicle		
Week	Specific Learning Outcome	Teachers Activities	Resources
7-12	4.1 With the aid of sketches describe the general working principles of the fuel system of a motor vehicle 4.2 Explain the principles and functions of a simple and multi Jet carburettors 4.3 With the aid of sketches explain the methods of mixture correction, and slow running devices. 4.4 State the difference between constant choke and constant vacuum carburettors 4.5 Explain the effect of dirty fuel tank on engine performance and show how to clean the dirty tank	• Discuss the major components of the fuel system and their functions e.g. fuel tank, fuel pump, fuel filter and carburettors • Explain the types of carburettors and the way they function giving examples of the applications of each. • Explain the operation of the two carburetors and the slow running circuit. Mixture compensating jet. • Explain the choke device as the cold starting aid, the design of venturi, and the direction of fuel flow into the engine. • Explain fuel starvation which result in loss of power and consequently lead to Road Side break down. • Assess Students	• Lesson notes • Chart • Overhead projectorand transparencies • Chalk board • Chalk • Models of Carburettors
	General Objective:. 5.0 Understand the operation of an ignition system and carry out repair and adjustments		
Week	Specific Learning Outcome	Teachers Activities	Resources
13-17	5.1 Explain the working principles of the ignition system of a motor 5.2 Explain the action of a simple Coil ignition system: advantages and disadvantages	• With the aid of a sketch explain the function of the coil ignition system of a motor car. Also explain firing orders and firing intervals • Explain the operation of the Coil ignition system, and explain the low tension and high tension circuit	• Experimental equipment in electro magnetic and basic transformer Appropriate vehicles • Appropriate devices • Related spark plugs • Vehicles with standard ignition system, feeler gauges and dwell meters • Modern engine diagnostic equipment

PROGRAMME: NTC MOTOR VEHICLE MACHANICS WORK PROGRAMME:			
Course: PETROL ENGINE MAINTENANCE		Course CMV 11Code:	Contact Hours: 8hrs/week
	General Objective:. 5.0 Understand the operation of an ignition system and carry out repair and adjustments		
Week	Specific Learning Outcome	Teachers Activities	Resources
13-17	5.3 Explain the basic principles of magnetic induction and operating principle of the coil. (primary and secondary circuits) 5.4 Explain the working principle of the ballast resistor ignition system 5.5 Diagnose the problem with automatic advance and retard mechanisms 5.6 Explain and identify the differences in spark plug (heat range) 5.7 Explain the term dwell angle. Explain the effect of contact breaker gap on dwell angle 5.8 Explain the operating principles of the following Electronic ignition system: a. capacitor discharge system b. Inductive system c. Computerized ignition system d. Operation of ECVs	• Basic experiments in electromagnetism and performance of a transformer • Compare ballast resistor system with standard coil system on vehicles • Demonstrate the operating principle of automatic advance and retard devices • Identify spark plugs with different heat ranges • Demonstrate with appropriate equipment the effect of contact breaker gap on dwell angle and compare system on vehicles. Demonstrate testing procedure using appropriate equipment. Explain the purpose of each component. For each system, outline safety procedures	

PROGRAMME: NTC MOTOR VEHICLE MACHANICS WORK PROGRAMME:			
Course: PETROL ENGINE MAINTENANCE		Course CMV 11Code:	Contact Hours: 8hrs/week
	General Objective: 6.0 Understand the working principles of engine cooling system and restore a faulty cooling system to acceptable standard of performance		
Week	Specific Learning Outcome	Teachers Activities	Resources
18-21	6.1 Explain the working principles and the functions of the cooling system of an engine e.g. water and air-cooling system. 6.2 Describe the main features of the air cooled and water cooled engine 6.3 Explain how heat is dissipated in the air cooled engine 6.4 List the faults attributable to air cooled engine and how to rectify those faults. 6.5 Draw a fan used in air cooling assembly 6.6 Explain the working Principles and testing techniques of thermostat, immerse a thermostat in hot and/or cold water and watch reaction 6.7 Explain the functions of the different types of water pumps 6.8 State the principles and action of impeller and pressurized cooling system 6.9 Explain the temperature control of the cooling system	• Explain the thermosyphon and the pump assisted cooling system • Explain the function of main components of the air cooled engine • Discuss the role of a blower and fins attached to the sleeves of the air-cooled engine. • Explain air cooled engine faults and their remedies • Draw a fan used in air cooling assembly. • Describe the process of testing the thermostat for effective operations • Describe the operations of the major types of water pumps in use on motor vehicle engines, list cooling system faults • Explain what happens to the boiling point of water when it is under pressure (e.g increase in pressure increases the boiling) point of water • Explain the operation of temperature control devices such as thermostats, Radiator blinds etc	• Lesson notes • Chart • Models • Chalks Board • Overhead projector and - Transparencies

PROGRAMME: NTC MOTOR VEHICLE MACHANICS WORK PROGRAMME:			
Course: PETROL ENGINE MAINTENANCE		Course CMV 11Code:	Contact Hours: 8hrs/week
	General Objective: 6.0 Understand the working principles of engine cooling system and restore a faulty cooling system to acceptable standard of performance		
Week	Specific Learning Outcome	Teachers Activities	Resources
22-23	6.10 Explain the concept of pressure (negative and positive) temperature and volume relationship as related to the pressurized cooling system. 6.11 Explain the safety rules associated with working on cooling system. 6.12 Explain the danger in radiator cap when the engine is hot and under pressure which can result in scalding. 6.13 Draw a radiator showing details of water passages etc.	• Explain the concept of pressure/temperature and volume relationship. • Discuss the risks and the consequence of removing the radiator cap when the engine is hot. • Discuss other safety measures that should be taken when working on the cooling system. • Explain with the aid of sketches the various components parts of the radiator.	
1-3 4-10 11-19 15-18 19-20 21-24	PRACTICAL ACTIVITIES Obey Safety rules and regulations in the workshop Diagnose faults using listening and observation Diagnose faults using electronics equipment Service carburetors mostly used on motor vehicles. Clean and set contract breaker points to Manufacturers' ‘specifications Determine the ignition point using timing light Carry out valve adjustment to Maker's specifications Check and test condenser for serviceability	• Demonstrate each practical for the student to learn • Ensure that the students use the correct tools • Ensure the observation of safety rules • Assess students	• Stethoscope • Carburetors • Distributor with Contact Point • Screw driver • Feeler gauge • Engine analyzer • Live vehicle • Timing Light • Tools box • Condensers • Spark plugs • Wire gauge • Engine oil • Oil filter • Carburetor • Fuel • Fuel pump

PROGRAMME: NTC MOTOR VEHICLE MACHANICS WORK PROGRAMME:			
Course: PETROL ENGINE MAINTENANCE		Course CMV 11Code:	Contact Hours: 8hrs/week
	General Objective: 6.0 Understand the working principles of engine cooling system and restore a faulty cooling system to acceptable standard of performance		
Week	Specific Learning Outcome	Teachers Activities	Resources
	Adjust Spark plugs to maker's specifications Carry out complete engine tune up by doing the following a. Change oil b. Change filter c. Check valve clearance d. Service Carburetor Trace and repair leakages in the fuel system Overhaul the fuel pump Determine the correctness of dwell angle using Electronics equipment. Rewire the ignition system Remove, inspect, replace and adjust fan belt Demonstrate the ability to flush a cooling system Assessment: Practical takes 60% of overall assessment		• Dwell meter • Wires • Radiator • Dwell tester

PROGRAMME: NTC MOTOR VEHICLE MACHANICS WORK PROGRAMME:			
Course: PETROL ENGINE MAINTENANCE		Course CMV 11Code:	Contact Hours: 8hrs/week
	General Objective: 6.0 Understand the working principles of engine cooling system and restore a faulty cooling system to acceptable standard of performance		
Week	Specific Learning Outcome	Teachers Activities	Resources
	Questions which should include, objectives should be drawn up from the following areas to cover the modules: a. Safety precautions b. Principles of operation of petrol engines c. Carburettor types and their functions d. Ignition system e. Combustion chamber designs f. Fuel systems g. Cams and camshafts h. Cooling system i. Valves and valve train		

Diesel Engine Maintenance

PROGRAMME:	NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK
MODULE:	CMV 12 DIESEL ENGINE MAINTENANCE
PRE-REQUISITE:	CME 11, CME 12 AND CMV 12
DURATION:	192 HOURS
GOAL:	This module is designed to produce a diesel engine maintenance craftsman who will be able to carry out general maintenance work to a fuel injection system and other diesel engine components.

GENERAL OBJECTIVES:

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

1. Understand the operations of the compression ignition engine and carry out repairs of the components of fuel delivery system.
2. Understand the working principles of inline and rotary fuel injection pumps, effect overhaul and repairs on them.
3. Understand the working principles of a diesel engine and carry out engine tune usand test for efficiency.
4. Understand the fuel injection bleeding procedure.
5. Understand the working principles of different types of fuel injection pumps and governors.
6. Understand the constructional differences between petrol and C.I. engine main component parts.
7. Understand the engine wet sump lubrication system layout and methods of oil distribution.
8. Understand the dry sump lubrication system, crank case ventilation and the action of pressure gauges and oil warning lights.
9. Understand the cams and camshafts drive arrangements for side and overhead camshafts.
10. Understand the valve and valve port timing diagrams for both spark and compression ignition engine.
11. Understand the principles of crankshaft balancing and vibration damping.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: DIESEL ENGINE MAINTENANCE		Course Code: CMV12	Contact Hours: 8hrs/week
Module Specification: THEORETICAL CONTENT			
	General Objective: 1.0 Understand the Operations of the Compression Ignition Engine and carry out repairs of the components of fuel delivery system.		
Week	Specific Learning Outcome	Teachers Activities	Resources
1-2	1.1 Describe the Pump room and test equipment observing the safety and health Precautions associated with fuel oil testing Procedure. 1.2 Explain the Principles of atomization and how this is used in motor vehicle engine.	• Explain Pump room • machines (e.g. Injector pump tester, nozzle tester). a. State the necessary safety precautions to be observed when handling diesel fuel. • Explain atomization as related to motor vehicle engine. • Assess students	• Lesson plan • Chalk board. • Overhead projector and transparencies. • Injector Pump and nozzle testers.
3-4	1.3 Explain the types and functions of the combustion chamber as related to compression ignition engine. 1.4 Explain the characteristics of various types of nozzle design and Pressure breaking Points of injector nozzles. 1.5 Identify and correctly use the various tools and equipment for removing, assembling, adjustment and testing of injectors	• Explain the functions and types of combustion chambers • With neat diagrams illustrate characteristics of various types of nozzle designs and pressure breaking points of injector nozzles. • Explain the uses of various types of tools and equipment for testing injectors. Ask questions on injector testing. • Assess students	• Lesson plan • Chalkboard • Overhead Projector and transparencies • Injectors.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: DIESEL ENGINE MAINTENANCE		Course Code: CMV12	Contact Hours: 8hrs/week
	General Objective 2.0: Understand the working principles of inline and rotary fuel injection pumps, effect overhaul and repairs on them.		
Week	Specific Learning Outcome	Teachers Activities	Resources
6-7	2.1 State the working principle of in-line and rotary pumps 2.2 State the need and define the process of phasing the in-line pump. 2.3 Describe the functions of all types of injectors. 2.4 Sketch in good proportion the various component parts of the fuel injection system.	• Explain the functions of in-line and rotary pumps. Name their component parts • Explain the meaning of the term phasing. • List types of injectors. Draw neat sketch of each type. • Explain reasons for high precision of component parts of fuel injection system. • Assess students	• Lesson plan • Chalkboard • Overhead Projector and transparencies. • In-line and rotary pumps. • Injectors.
8-10	2.1 Describe the provision for adjustment of the following types of governors. a. hydraulic; b. mechanical; c. pneumatic; 2.2 Describe the method of timing in-line pump on C.I. engine. 2.3 Explain with the aid of diagrams the operations of the distributor type pump. 2.4 Explain the action of the mechanical (centrifugal) governor in relationship to the distributor type pump. 2.5 List common faults which would make mechanical governor in-operative	• Explain the need for adjustment of various types of governors. • Draw sketches of governors in use on engines. • Emphasize the significance of accurate pump timing on engine. Ask questions on timing process and procedures. • State advantages and disadvantages of in-line and distributor type of pump. Sketch and explain operation of distributor type pump. • With neat sketches, explain the action of mechanical and hydraulic governors in relationship to the distributor. • Explain the common faults associated with each type of governor and give possible remedies.	• Lesson plan. • Chalkboard. • Overhead Projector and transparencies. • Hydraulic, • Mechanical and Pneumatic governors. • In-line pump.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: DIESEL ENGINE MAINTENANCE		Course Code: CMV12	Contact Hours: 8hrs/week
	General Objective 3.0: Understand The Working Principles Of A Diesel Engine And Carry Out Engine Tune Up And Test For Efficiency.		
Week	Specific Learning Outcome	Teachers Activities	Resources
11-12	3.1 Explain the principles of operation of the diesel engine. 3.2 Explain the concepts of pressure,(negative and positive) and relationship between volume and pressure. 3.3 Explain the working of the fuel injection system. 3.4 Observe the need for correct engine valve clearance setting to minimize engine noise.	• With neat diagrams explain the 4 stroke cycle and 2 stroke cycle principles of operation of diesel engine. • Explain the concepts of pressure (negative and positive) and relationship between volume and pressure. • Draw and explain the functions of the fuel injection component parts. • State procedure for accurate valve setting to maker's specifications. • Assess students	• Lesson plan • Chalkboard • Diesel engines. • Feeler gauge, assorted hand tools and equipment.
	General Objective 4.0: Understand the fuel injection bleeding procedure		
Week	Specific Learning Outcome	Teachers Activities	Resources
13	4.1 Explain the purpose of bleeding a diesel engine and how the presence of air in the fuel system affects the performance of an engine.	• Define the term bleeding and explain why it is necessary to carry it out. • Assess students	• Injection pump. • Fuel lift pump • Live diesel engine • spanners and screw drivers.
	General Objective 5.0: Understand the working principles of different types of fuel injection pumps and governors.		
Week	Specific Learning Outcome	Teachers Activities	Resources
14	5.1 Describe the common faults and symptoms attributed to particular faults in a diesel engine.	• List diesel engine common faults and symptoms (e.g. engine emitting black smoke etc). • Assess students	• Lesson plan • Complete live diesel engine • Chalkboard.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: DIESEL ENGINE MAINTENANCE		Course Code: CMV12	Contact Hours: 8hrs/week
	General Objective 6.0: Understand the constructional differences between petrol and C.I engine main component parts.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
15	6.1 Compare the following engine components of the petrol and compression ignition engine 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	• Give reasons for differences in the physical construction of main engine components of petrol and diesel engines. • Sketch each component part neatly on the chalkboard. • Assess students	• Lesson plan • Chalkboard • Live diesel and petrol engines.
	General Objective 7.0: Understand the wet sump Lubrication system Layout and methods of oil distribution.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
16-18	7.1 Draw a line diagram to show the layout of wet sump engine lubrication for full flow and by-pass flow. 7.2 Explain how oil is distributed by splash mist and pressure feed systems 7.3 Sketch three types of oil pump 7.4 Explain the operation of pressure relief valves. 7.5 Sketch the construction of oil flow path through engine oil lubricating filters.	• Explain major differences between full flow and by-pass flow system of lubrication. • List application of each system • Identify each type • Draw neat diagram to explain the function of pressure relief valve • Explain the need for efficient oil filtration in engines. • List sealing devices commonly used in automobile engines.	• Lesson plan • Chalkboard • Live diesel engine with wet sump lubrication

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: DIESEL ENGINE MAINTENANCE		Course Code: CMV12	Contact Hours: 8hrs/week
	General Objective 7.0: Understand the wet sump Lubrication system Layout and methods of oil distribution.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
16-18	7.6 Describe with the aid of sketches the types of gasket and seals used in the retention of engine oil. 7.7 Explain the importance of using correct type and grade of oil. 7.8 State the effect of incorrect oil level in an engine 7.9 State the sources of oil contamination and the necessity of regular renewal of oil on a time or mileage basis.	• List and explain properties of oil and their significance • Explain the causes and effects of incorrect oil level • Explain the need for strict adherance to manufacturers' service manual on oil change. • Assess students	
	General Objective 8.0: Understand the dry sump lubrication system, Crankcase ventilation and the action of pressure gauges and oil warning lights.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
19-20	8.1 Explain the operation of dry sump lubrication system	• Explain in details, the construction and operation of Dry sump lubrication. • With neat sketches explain the principle of dry sump lubrication. • Ask questions on lubrication system in general. • Illustrate with sketch crankcase oil ventilation.	• Lesson plan • Chalkboard • Dry sump engine.
	8.2 Draw a line diagram of a dry sump 8.3 Explain the need for crankcase ventilation system 8.4 Sketch a typical crankcase ventilation system	• Ask students to draw - oil warning light circuit, oil pressure switch and describe the principles of oil cooler • Assess the students	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: DIESEL ENGINE MAINTENANCE		Course Code: CMV12	Contact Hours: 8hrs/week
	General Objective 8.0: Understand the dry sump lubrication system, Crankcase ventilation and the action of pressure gauges and oil warning lights.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
	8.7 Explain with the aid of a sketch the operation of an oil pressure gauge. 8.6 Draw a line diagram of an oil warning light circuit. 8.7 Draw a cross-sectional view of an oil pressure switch. 8.8 Describe the operating principle of an oil cooler.		
	General Objective 9.0: Understand the cams and camshafts drive arrangements for side and overhead camshafts.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
21-22	9.1 Sketch and label a typical cam shape showing valve lift, valve open period and its variation. 9.2 Sketch the method of locating the drive gear to the camshaft 9.3 Explain how end float of the camshaft is controlled. 9.4 Describe the methods of camshaft drive (e.g chain gear or toothed belt). 9.5 Draw a chain tensioner and fix tensioner. 9.6 Describe methods of camshaft lubrication. 9.7 Locate drive gear to camshaft correctly	• Inspect valve arrangements and operating mechanism. • Explain the construction, function and operation of cams and camshaft drives. • Check for wear on valve operating mechanism using feeler gauge and by visual inspection. • Ask the students to describe canshaft drive methods, draw chain tensioners and fix the • Assess the students	• Lesson plan. • Chalkboard • Overhead Projector and transparencies • Live engine.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: DIESEL ENGINE MAINTENANCE		Course Code: CMV12	Contact Hours: 8hrs/week
	General Objective 10.0: Understand the valve port timing diagram for both spark and compression ignition engine.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
23	10.1 Sketch and label a typical valve timing diagram for spark ignition engine. 10.2 Distinguish valve timing diagram for compression ignition engine with that of spark ignition engine. 10.3 Describe the following terms: a. Valve overlap b. Valve lead c. Valve lag	• Explain the functions of valves, valve construction and valve timing • Explain the effects of 10.3 on engine performance. • Ask the students to describe the following valve overlap, valve lead, valve lag	• Lesson plan • Chalkboard • Overhead projector and transparencies • Inlet valves • Exhaust valves • Valve timing diagrams
	General Objective 11.0: Understand the principles of crankshaft balancing and vibration damping.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
24	11.1 Explain the principles of crankshaft balancing 11.2 Describe the causes of crankshaft vibration. 11.3 Sketch the method of mounting crankshaft-damper.	• State the functions of crankshaft and the need for engine crankshaft balancing • List instruments available for crankshaft alignment checks • State effects of unbalanced crankshaft. • Assess the students	• Lesson plan • Chalkboard • Crankshaft • Measuring tools (e.g. gauge)
1-24 10-12	1.1 Diagnose faults by running engine on road test. 1.2 Remove injector assembly in the correct sequence. 1.3 Strip injector correctly, clean and inspect the component parts for wear. 1.4 Replace defective parts of an injector.	• Demonstrate faults diagnosis, clean and service injector pumps and nozzles. • Demonstrate each practical guide to student to learn. • Demonstrate process of injection pump overhaul, calibrate and phase pump accurately.	• Lesson plan • Chalkboard • Overhead Projector and transparencies • Pump • calibrating/phasing machine, Testing and/or servicing tools. • Complete tool box and live vehicle

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: DIESEL ENGINE MAINTENANCE		Course Code: CMV12	Contact Hours: 8hrs/week
	General Objective 11.0: Understand the principles of crankshaft balancing and vibration damping.		
Week	Specific Learning Outcome	Teachers Activities	Resources
	1.5 Assemble component parts correctly and carry out injector test with standard equipment. 1.6 Repair in-line and rotary pumps. 1.7 Overhaul and time in-line and rotary pumps to engine 1.8 Calibrate a pump and collate results. 1.9 Install and time injector pump. 1.10 Change fuel filter, drain fuel tanks and bleed system 1.11 Remove in-line or rotary injection unit from engine. 1.12 Clean, inspect component parts for wear and serviceability. 1.13 Strip and assemble in-line or rotary injection pump. 1.14 Carry out engine test and adjust to peak performance.	• Demonstrate workshop method of calculating fuel consumption. • Assess the students	
	EVALUATION GUIDE a. Tests and examinations to be set in multiple choice, True/False and essay questions to cover broader area of the curriculum and module specifications. b. The evaluation should also include practical exercises. Practical tests will account for 60% of the overall marks.		

Engine Reconditioning: Petrol & Diesel

PROGRAMME:	NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK
MODULE:	CMV 13 ENGINE RECONDITIONING: PETROL & DIESEL
DURATION:	96 HOURS
GOAL:	The trainee will acquire knowledge and skills to recondition a worn out engine (petrol or diesel) to a satisfactory working condition.

GENERAL OBJECTIVES:

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

1. Understand the safety procedures and their applications in relation to automobile engine reconditioning.
2. Understand the operation of all types of automobile engine and recondition worn out engine to good working condition.
3. Understand the process of carrying out cylinder reboring.
4. Understand the method of grinding crankshaft to manufacturer's specifications.

PROGRAMME: NTC IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: ENGINE RECONDITIONING: PETROL & DIESEL		Course Code: CMV 13	Contact Hours: 8hrs/week
Course Specification: Theoretical			
	General Objective 1.0: Understand the safety procedure and their applications in relation to automobile engine reconditioning		
Week	Specific Learning Outcome	Teachers Activities	Resources
1	1.1 Understand safety and observe safety working condition 1.2 Use of service Manual 1.3 Use service Tools 1.4 Complete jobs to manufacturers' specifications	• Discuss the safety in the workshop with volatile liquid in the engine system. • Care of engine components • Care of measuring tools • Danger of oils on the floor and gang ways • Correct Dressing • 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 • Assess the students	• Lesson plan • Wall charts • Films • Chalk board • Service manual

PROGRAMME: NTC IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: ENGINE RECONDITIONING: PETROL & DIESEL		Course Code: CMV 13	Contact Hours: 8hrs/week
	General Objective 2.0: Understand the operation of all types of automobile engine and recondition worn out engine to good working condition		
Week	Specific Learning Outcome	Teachers Activities	Resources
2	2.1 Explain the operation of all types of automobile engines 2.2 State the operations involved in engine overhaul 2.3 Identify and use various tools and equipment for repair or adjustment of components parts of the engine assembly 2.4 Explain how to diagnose faults by inspection and by Road Test	• Explain:- • The 4-stroke spark ignition engine construction and operating principles • The diesel engine design features • The Four Stroke diesel Engine Operating principle • Explain the different cylinder arrangements, principle of fitting cylinder liners, valves, valve guide, and set tappets	• Lesson plan, wall charts • Chalk board • Petrol engine • Diesel engine • Tools catalogue • A functional motorvehicle
4-5	2.5 Remove engine from vehicle for overhauling 2.6 Dismantle engine following a proper sequence 2.7 Apply the concept of limits and fits in relation to effects and requirements of engine components and other parts in assembling operation e.g. Piston free play, crank shaft sizes 2.8 Know how to assess suitability of existing parts for possible re-use. 2.9 Know how to measure and determine sizes of worn crank shaft journals and crank pins	• Select tools for identified jobs • Select special tools for special jobs • Explain the procedure for removal of engine from vehicle • Explain the use of lifting devices • Explain dismantling procedure • Explain and demonstrate different types of limits and fits, interference fits, push fits, clearance jobs, and relate its applications to various components of the automobile system e.g. Piston and cylinder • Explain the process of examining and measuring parts using manufacturers' manual as a guide • Explain the use of measuring instruments such as vernier caliper, micrometer, dial gauge to determine the extent of wear on a component making reference to service manual.	• Lesson plan • Wall charts • Chalk board • Engine Hoist • A Vehicle • on limits and Fits • Measuring tools • Service manuals

PROGRAMME: NTC IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: ENGINE RECONDITIONING: PETROL & DIESEL		Course Code: CMV 13	Contact Hours: 8hrs/week
	General Objective 2.0: Understand the operation of all types of automobile engine and recondition worn out engine to good working condition		
Week	Specific Learning Outcome	Teachers Activities	Resources
6-7	2.10 Describe cam shaft arrangements for side and overhead camshafts 2.11 Explain the concept of force, torque and brake horse power as applicable to motor vehicle 2.12 Explain the process of replacement of defective components e.g. bearings, cylinder sleeves, Pistons, crank shafts, connecting rods, valve assembly etc 2.13 Explain ways of reassembling engine components in given sequence, adjust and test run engine	• Explain the methods of drawing cam shaft • Describe simple treatment of bell cranked pivoted levers to show (a) the perpendicular forces and (b) Inclined forces. Simple calculations involving moments as applied to clutch and brake mechanisms, calculation of torques • Explain and demonstrate the processes of • Assembling Pistons and rings using clamp • Fitting of cylinder liners • Fitting of valve guides and valve seat inserts • Fitting of roller & ball bearing, • Use of torque wrenches • Describe sequentially the reassembling of engine components, how to make necessary adjustments. Explain the test run procedure • Assess the students	• Lesson plan • Chalk board • Wall charts • camshaft and model • Chalk board
	General Objective 3.0: Understand the process of carrying out cylinder reboring		
Week	Specific Learning Outcome	Teachers Activities	Resources
8-9	3.1 Explain the processes of cylinder reboring 3.2 Explain the use of sizes in determining the bore size 3.3 Explain how to rebore cylinder to the required specification and select rings and piston sizes to match	• Explain the process of:- Setting the cylinder on reboring machine Setting the boring tools on the reboring machine Checking the accuracy of the boring tool and cylinder setting Using service manual to determine the correct bore size Selecting correct sizes of rings, and pistons from the manufacturer's manual Assess the students	• Lesson plan • Service manual • Flip chart • Boring machine • Vernier calipers • Chalk board • Sizing tools • Pistons • Rings etc.

PROGRAMME: NTC IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: ENGINE RECONDITIONING: PETROL & DIESEL		Course Code: CMV 13	Contact Hours: 8hrs/week
	General Objective 4.0: Grind Crankshaft to correct specifications		
Week	Specific Learning Outcome	Teachers Activities	Resources
10-12	4.1 Explain the process of crank shaft grinding 4.2 Explain the sizes of bearing to fit what sizes of crank shafts 4.3 Explain how to check crank shaft sizes before grinding 4.4 Explain how to grind crankshaft to appropriate sizes and fits	• Explain, 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 • Ask the students to: • Measure the crankshaft size using micrometer looking up for next correct size from manual • Demonstrate the process of mounting crankshaft on the crankshaft-grinding machine. Grind to the correct size using outside micrometer to check • Assess the students	• Lesson plan, Chalk board, Crankshaft, Grinding tools • service manual chalk board • Lesson plan, Service manual Micrometer • models Crankshaft Grinding tools

Course Specification: PRACTICAL CONTENTS			
	General Objective 1.0: To carryout maintenance operations in motor vehicle		
Week	Specific Learning Outcome:	Teachers Activities	Resources
1 2-4 5-7 8-9 10-12	• Check the alignment and realignment of connecting rods • Check big-end bearing clearances • Assemble big end bearings Use of torgue wrench • Use instruments and special fixtures to diagnose engine faults • Dismantle, inspect, assemble and adjust diesel engine	• The teacher should demonstrate each • Demonstrate each of the practical items • Ensure that student use the correct tools • Ensure that the students work with the correct procedure and standard practice	• **Pistons** • Gudgeon pins • Feeler gauges • Engine blocks • Connecting rods • Big end bearing • Torque wrench • Live engine • Engine oil • Oil filter • Injectors • Spark plugs

Course Specification: PRACTICAL CONTENTS			
	General Objective 1.0: To carryout maintenance operations in motor vehicle		
Week	Specific Learning Outcome:	Teachers Activities	Resources
	• Examination of engines having different arrangement of cylinder: a. Fitting of cylinder liners b. Fitting of valve guides c. Fitting of valve seat inserts d. Fitting big end bearings e. Dismantling, examination of rocker and bearing for wear f. Dismantling, examining, assemblingand testing of petrol pumps EVALUATION GUIDE Questions should include Essays, and multiple choice questions to cover the following areas (1) Engines (a) Spark ignition engine (2) Compression ignition engine(2) Valves (3) Cylinder (4) Crank shafts (5)Lubrication (6) Camshafts(7) Pistons and rings (8) Valve timing (9) Ignition timing etc Practical Assessment should account for 60% of assessment profile		

Transmission (ANTC)

PROGRAMME:	NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK
MODULE:	CMV 14: TRANSMISSION
DURATION:	96 HOURS
GOAL:	This module is designed to provide the trainee with the theoretical knowledge and practical ability to carry out effectively clutch, gearbox and final drive reconditioning.

GENERAL OBJECTIVES:

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

1. Understand the principles of clutch operation, diagnose clutch faults and carry out repairs or replacements of clutch assembly.
2. Understand the principles of synchronization and carry out major repairs on units of gearboxes.
3. Understand the procedure for assembling gear linkages and selector mechanism to manufacturers' specification.
4. Understand the principles of operation of propeller/drive shaft reconditioning, propeller/drive shaft joint couplings and center bearings.
5. Understand the principles of operation of final drive and differential assembly and carry out its reconditioning.
6. Understand the principles of operation and function of multi-drive axles and four wheel drive.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: TRANSMISSION		Course Code: CMV 14	Contact Hours: 8hrs/week
Module Specification: THEORY			
	General Objective 1.0: Understand the principles of clutch operation, diagnose clutch faults and carry out repairs or replacements of the clutch assembly.		
Week	Specific Learning Outcome	Teachers Activities	Resources
1-2	1.1 Explain the construction and operation of the single and multiplate clutch system 1.2 Identify and state the characteristics, various types of clutches used in motor vehicles e.g. single and multiplate clutches. Hydraulic clutches etc. 1.3 Explain the disengagement process of clutches by mechanical and hydraulic means 1.4 Sketch components in good proportion in relation to various parts of the transmission system	• Explain the characteristics of the I.C.engines which demand the use of clutch in moving the vehicle from rest. • Explain the construction and action of single and multiplate clutch systems. • State the function s of clutches. • Show with diagram: • the multi-, single plate clutches. • Hydraulic clutches • Materials for clutches • State the advantages and disadvantages of each type. • Illustrate the two methods of clutch operation, that is, mechanical and hydraulic methods • Illustrate with models, the transmission from engine to the gear box via clutches. • Explain how clutch transmits torque from engine to gear box. Use sketches to illustrate clutch mechanisms.	• Lesson plan • Wall charts • Clutch models or actual • Chalk board • Clutches • clutch
	1.5 Identify various tools and equipment used for the removal, replacement and adjustment of a clutch assembly, e.g. jigs for equalizing springs.	• Illustrate the methods of rectifying different faults in clutches • State the causes of and remedies for such faults as drag, slip, judder etc. Assess the students	• Lesson plan • Wall charts • Manufacturer's manual • Chalkboard

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: TRANSMISSION		Course Code: CMV 14	Contact Hours: 8hrs/week
	General Objective 2.0: Understand the principles of synchronization and carryout major repairs on units of gear boxes.		
Week	Specific Learning Outcome	Teachers Activities	Resources
3-4	2.1 Identify various tools and equipment for removal, repair and adjustment of synchromech gear box. 2.1 Describe the construction and operation of a four speed and constant mesh type of gear box. 2.2 Explain the principles of synchronization, gear ratio, driving torque, bearing load and various types of locking devices. 2.4 Describe the function of free wheel and overdrive units	• Explain the engine and load characteristics which demand the use of gear box. • Types of gear boxes • Explain the simple four speed and reverse gear box with direct acting gear lever. • Illustrate with diagrams the synchromesh gear box, gear arrangements and methods of engagement. • Illustrate gear ratio calculation • Survey with the trainee the well known types of gear box including the over drives. Show the application. • Assess the students	• Lesson plan • Chalk board • Wall charts • Gear boxes. • Models • Sectional views taken from wall charts.
	2.5 Describe the lubrication methods of the rotating parts of a gear box.	• Illustrate different methods of gear boxes, lubrication in engineering such as splash lubrication. • State the importance of lubrication • State types of oils for gearboxes as distinct from engine oils • Assess the students	• Lesson plan • Chalk board • S.A.E oil grade charts
	2.6 Explain the principle of operations of the different types of epicyclic gearing	• Explain the principles of spur gears, helical gears, epicyclic gears • Assess the students	• Lesson plan • Different types of gears or models • Chalk board • Wall charts

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: TRANSMISSION		Course Code: CMV 14	Contact Hours: 8hrs/week
	General Objective 3.0: Understand the procedure for assembling gear and selector mechanism to manufacturer's specifications.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
5-6	3.1 Explain the basic principles of gearing 3.2 Sketch various layouts of gear trains 3.4 Sketch in good proportion the layout and construction of the component parts of chassis, suspension and steering system 3.5 State the purpose of locking and interlocking devices in the selector mechanism 3.6 State the function of final drive gears and differential assembly.	• Illustrate motion transmission by gearing • Explain different types of gearing system • Show by sketching simple gear train, compound gear train, gear reverse mechanism. • Explain and demonstrate the importance of proportional sketches of vehicle parts • Sketch chassis layout, suspension and steering systems • Sketch gear layout in gearbox. • 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 in relation to differential assembly. • Assess the students	• Lesson plan • Chalk board • Drawing board • Drawing instruments • Gear train models. • Engineering drawing equipment • Wall charts
	General Objective 4.0: Understand the Principles of operation of Propeller/Drive shaft reconditioning, Propeller/Drive shaft joint couplings and center bearings.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
	4.1 Explain the method of construction, layout and assembly of propeller/drive shafts and their principles of operation. 4.2 Explain the principles of road and drive reaction in relation to the action of the propeller shaft and drive shaft sliding joints etc. 4.2 Explain the concept of motion and change in velocity in relation to change in drive angles	• Explain the procedure for assemblying the propeller/drive shaft • Explain the constructional details of the propellershaft • Explain the purpose of sliding joints; method of checking shaft for run-out and drive angle. • Explain the practical implication of motion, and change in velocity in relation to change in drive angles.	• Lesson plan • Chalk board • Propeller/drive shaft • Wall charts. • Universal joint • Models • Diagram

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: TRANSMISSION		Course Code: CMV 14	Contact Hours: 8hrs/week
	General Objective 4.0: Understand the Principles of operation of Propeller/Drive shaft reconditioning, Propeller/Drive shaft joint couplings and center bearings.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
7-8	4.4 Describe the types of universal joints used on a vehicle. 4.6 Explain the principle of front wheel drive and its advantages and disadvantages over other arrangements 4.7 State the function of propeller shaft in transmitting power from engine to road wheels 4.7 Sketch in good proportion the various parts of the transmission system 4.8 Describe the faults in drive shaft and propeller shaft by road test and/or visual inspection.	• Explain with sketches the operation and function of the universal joint. • Explain the effects of front wheel drive • Explain the advantages and disadvantages of front wheel drive • With the aid of a diagram, illustrate the transmission power from engine to road wheel. • Explain the faults that can develop from propeller/drive shaft. • Assess the students	
	General Objective 5.0: Understand the Principles of Operation of final drive and differential assembly and carry out its reconditioning.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
9	5.1 Explain the function of the differential in the transmission of power to the road wheels	• List the basic functions of the differential unit in the transmission of power to the road wheels	• Lesson plan • Models • Diagrams
10	5.2 Identify various types of drive axle arrangements e.g. fully floating, 33//44 floating and semi floating. Dead axle - dedion type. 5.3 Sketch component parts in good proportion in relation to the transmission system 5.4 Calculate pre-load torque and check pre-load with spring balance 5.5 State the principles of operation of the differential and final drives	• With the aid of diagram, illustrate methods of supporting axle shaft and arranging wheel bearings • Illustrate the differences between semi floating, 33¤¤44 floating shafts. • State the advantages and disadvantages of semi floating and ¾ floating • Explain with the aid of sketches and in good proportion, the transmission system. • Discuss various stresses imposed on axles.	• Lesson plan • Engineering drawing equipment • Wall charts • Manufacturer's manuals. • Chalk board • Rear axle or model

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: TRANSMISSION		Course Code: CMV 14	Contact Hours: 8hrs/week
	General Objective 5.0: Understand the Principles of Operation of final drive and differential assembly and carry out its reconditioning.		
Week	Specific Learning Outcome	Teachers Activities	Resources
10		• Explain the process of calculating the pre-load torque • Explain the principle of operation of the final drive and differential • Explain the final drive system used in heavy commercial vehicles • Assess the students	
	General Objective 6.0: Understand the principles of operation and function of multi drive axles and four wheel drive		
Week	Specific Learning Outcome	Teachers Activities	Resources
10-12	7.1 Explain the operation of a double reduction axle and other axle drives 7.2 Describe the method of adjustment and maintenance of a multi-drive axle 6.3 Draw the layout of the four wheel drive 6.4 Explain the operation of the four wheel drive 6.5 Describe the necessary adjustment and repair on a four wheel drive 6.6 State the materials used for axle shafts	• Illustrate the double reduction type axle involving worm and wheel • Illustrate the method of adjusting and maintaining a multi-drive axle • With the aid of neat sketch, illustrate the principle of four wheel drive • Illustrate with sketches the operation of four wheel drive • Explain the method of adjusting the four wheel drive • State and explain the reasons for choice of materials used for manufacture of axle shafts • Assess the students	• Lesson plan • Double reduction axle • Lesson plan • Manufacturers ' manual • Chalk board • Lesson Plan • Wall chart or diagram • Chalk board • Model

PRACTICAL ACTIVITIES

Week	Specific Learning Outcome	Teachers Activities	Resources
1-7	1. Dismantle, examine and re-assemble a single dry plate friction clutch 2. Diagnose faults in any clutch assembly by inspection. 3. Dismantle and re-assemble a gear box 4. Examine gearbox synchromesh unit 5. Examine and adjust gearbox remote control mechanism 6. Diagnose gear box faults by inspection and by road test. 7. Replace synchromesh type gear box. 8. Carry out the repair on a gear box using the following procedure: a. dismantle gear box, clean and display all the parts on a neat table b. Assess wear on parts by inspection/measurement, replace worn out parts and bushes and re-assemble the unit components of gear box as appropriate. 9. Test gear box for correct gear ratio, couple the assembled gear box to engine and to the propeller shaft. 10. Dismantle, examine and assemble a two speed axle (double reduction) 11. Dismantle, examine and assemble a heavy duty rear axle of the worm and wheel type 12. Inspect a vehicle for roadworthiness and compile report	• The Teacher should demonstrate the practical • Students should practise till they become competent • Assess the students	• Lesson plan • Clutch units • Relevant tools • Service Manual • Gear box • Rear axle • Propeller shaft

Week	Specific Learning Outcome	Teachers Activities	Resources
8	13. Adjust the crown wheel and pinion into correct mesh ensuring that the back lash is within specified limits	• Explain the method of adjusting the crown wheel and pinion into correct mesh. • Discuss the causes and effects of backlash. • Assess the students	• Lesson plan • Crown wheel and pinion • Diagram • Chalkboard
9-11	14. Examine the axle shaft splines for wear and replace shaft if necessary 16. Examine hub bearing for wear, replace or adjust where necessary 18. Dismantle the differential unit, and assess the degree of wear. 19. Replace worn parts and reassemble, ensuring that the planetary gears are in correct mesh and within SPECIFICATIONS 20. Reassemble the differential assembly in the logical sequence. Carry out the road test and compile report for rectification.	• With the aid of sketches illustrate the method of detecting wear on splined shaft • Illustrate with sketches likely faults on hub bearings and discuss remedy • Explain how to diagnose faults through road test • Students should be allowed to practise till they become competent • Assess the students	• Lesson plan • Measuring tools • Splined shaft • Chalk board • Diagrams • Lesson plan • Live vehicle

EVALUATION GUIDE

The Teacher should carry out assessment to cover the following areas or topics:-

1. Different types of clutches.
2. Different types of Gear Boxes
3. Propeller/drive shafts
4. Complete transmission system
5. Different types of axles
6. Inspection, testing and report writing
7. Sketching and drawing of individual units of the transmission system
8. Sketching and drawing of the complete lay out of the transmission system.
9. Appropriate practical tests should account for 60% of the overall assessment marks
10. Questions should include - multiple choice, true/false, fill-ins and practical tests to cover all the areas

Chassis, Steering, Suspension & Braking System (ANTC)

PROGRAMME:	NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK.
MODULE:	CMV 15 SUSPENSION, STEERING AND BRAKING SYSTEMS.
DURATION:	96 HOURS.
GOAL:	This module is designed to produce the trainee with the theoretical knowledge and skills to carry out repairs and overhaul the suspension, steering and braking systems with facility.

GENERAL OBJECTIVES

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

1. Understand the layout of the chassis in relation to frame and fixing, suspension and steering and rectify faults attributable to chassis layout.
2. Understand the basic principles of steering construction and carry out necessary repairs and adjustments to its units.
3. Understand the functions of the component parts, diagnose and rectify faults in hydraulic, air, vacuum and mechanical brakes.

PROGRAMME: NTC IN MOTOR VEHICLE MACHANICS WORK			
Course: Suspension, Steering and Braking Systems		**Course Code:CMV 15**	**Contact Hours: 8hrs/week**
Course Specification: Theoretical Content			
	General Objective: 1.0 On completion of this module, the trainee should be able to understand the layout of the chassis in relation to frame and fixing,suspension and steering and rectify faults attributable to chassis layout		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
1-2	1.1 State the principles of chassis layout and sketch the layout 1.2 Explain the basic working principles of various types of suspension system 1.3 Identify the suspension used in various makes of vehicle e.g. pneumatic, hydraulic, laminated spring, coil spring, tortion bar and bonded (rubber) suspension unit. 1.4 With the aid of sketches explain the construction and functions of the following: Independent front suspension, air suspension, rubber suspension, metal springs, the damper and the independent rear Suspension.	• With the aid of diagram, explain the chassis layout • Explain the operations of various types of suspension used on motor vehicles • Explain various types of suspension system, and on the type of vehicles they are used • Explain the types of suspension systems used on (a) Front wheels (b) rear wheels • Describe the various types of springs employed on suspension system. • Use sketches to show details of the parts • State advantages and disadvantages of solid beam suspension and independent suspension • Assess the students	• Lesson notes • Charts • Chalk board • Chalk • Lesson plan • Leaf spring • Dampers • Coil Spring • Laminated Spring • Torsion bar • Independent Front Suspension • Independent Rear Suspension
	General Objective 2.0: Understand the basic principles of steering Construction and carry out necessary repairs adjustment to its units		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
3-4	2.1 Explain the principles of steering construction in a motor vehicle 2.2 Describe the steering gear layout of: a. beam type b. Independent front suspension 2.3 State “ACKERMAN” Principle in relation to steering linkage 2.4 Carry out steering geometry checks and adjustments e.g. toe-in, toe- out, King Pin Inclination, Camber, caster, etc.	• Explain the function and mechanism of the steering system of motor vehicles • Explain the type of steering used with the beam type axle and independent suspension • Explain steering geometry and the effect of too much or too little toe-in, toe-out, camber, Caster and King Pin inclination • Explain Steering faults and its likely remedies.	• Lesson notes • Charts • Overhead Projector and Transparencies • Chalk board • Chalk • Front wheel Alignment Gauge

PROGRAMME: NTC IN MOTOR VEHICLE MACHANICS WORK			
Course: Suspension, Steering and Braking Systems		**Course Code:CMV 15**	**Contact Hours: 8hrs/week**
	General Objective 2.0: Understand the basic principles of steering Construction and carry out necessary repairs adjustment to its units		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
5-6	2.7 Enumerate the effect of defects in chassis, suspension and steering on tyre wear 2.6 Sketch in good proportion the layout and construction of the Component parts of chassis, suspension and steering systems. 2.8 Describe the various methods of mounting bodies and types of vehicle bodies 2.8 Explain the function of the followings: a. ackerman principle b. Camber and caster c. King pin inclination d. Toe-in, toe-out e. Understeering f. Oversteering 2.9 Describe the setting and adjustment procedure for 2.8 -a to f above	• Explain the main Component parts of the Chassis, Suspension and Steering systems using diagrams • Discuss with the aid of diagrams how vehicle bodies are mounted on the chassis frame. • 6. Explain with diagrams all the characteristics of the steering system • Discuss how wheel alignment setting can affect the steering. • Assess the students	• Drawing board • Drawing instruments • Wheel alignment gauge • Camber gauge • Castor gauge
	2.10 Describe the rack and pinion steering assembly with respect to:- a. Components b. Adjustment c. Attachment to vehicle d. Lubrication e. Operation	• 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 motor vehicles • 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 • Assess the students	

PROGRAMME: NTC IN MOTOR VEHICLE MACHANICS WORK			
Course: Suspension, Steering and Braking Systems		**Course Code:CMV 15**	**Contact Hours: 8hrs/week**
	General Objective 2.0: Understand the basic principles of steering Construction and carry out necessary repairs adjustment to its units		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
	2.10 Describe 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		-do
	General Objective 3.0: Understand the functions of the components parts, diagnose and rectify faults in hydraulic, air, vacuum and mechanical brakes		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
8-9	3.1 State the various types of braking systems: a. Air b. Servo assisted and hydraulic c. Drum and disc brakes d. Parking brakes 3.3 Explain the basic concept of friction and its applications on braking system 3.4 State the working principles of exhaust braking system 3.5 Describe the operation of hydraulic braking system 3.6 Explain the concept of friction and co-efficient of friction, and performance of braking effort on different surfaces and in various weather conditions 3.7 Calculate stopping distance of vehicle.	• Explain with the aid of diagrams the function of the brake system, types and the way they are operated with emphasis on safety precautions • Explain the role played by friction in the braking system. e.g. lining and brake drum (tyres and the road) • Describe how the exhaust brake works, and its advantages and disadvantages when compared with the hydraulic brake • Explain the factors that affects braking efficiency of the vehicle • Discuss stopping distance and its importance to the vehicle operator. • Assess the students	• Lesson note • Charts • Overhead Projector • Transparencies • Chalk board • Chalk • Decelerometer

PROGRAMME: NTC IN MOTOR VEHICLE MACHANICS WORK			
Course: Suspension, Steering and Braking Systems		**Course Code:CMV 15**	**Contact Hours: 8hrs/week**
	General Objective 3.0: Understand the functions of the components parts, diagnose and rectify faults in hydraulic, air, vacuum and mechanical brakes		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
	3.7 Describe the operation, assembly procedure and sketch the following a. Fixed and floating Cam actuated drum brake b. Single and multi-piston master cylinder c. Single and multi-piston types of hydraulic wheel cylinder 3.8 Sketch various layout of braking system and component parts in detail 3.9 State safety precautions associated with brake fluid and its effect on body works e.g. paint and upholstery 3.10 State the properties of good brake fluid. 3.11 Explain the process and carry out wheel balancing 3.12 Explain the basic construction of tyres and different tyre sizes.	• Explain the function of a disc brake, drum brakes and an air (pneumatic) brakes. State the advantages of each system of brakes. • Explain with the aid of sketche the layout of the hydraulic brakes, important adjustment that should be made on brake system. The qualities of brake fluid used • Explain the need to balance vehicle wheels, why correct-tyre inflationary pressure should be used • Explain the different sizes of tyres and the way they are constructed e.g. Radial ply, Cross ply and Steel belted • Assess the students	• Lesson plan • Tyres • Pressure gauge • Wheel balancing Machine • Brake fluid

PRACTICAL ACTIVITIES

Week	Specific Learning Outcome	Teachers Activities	Resources
	1.1 Select tools and equipment for various repair and adjustment operations related to chassis, Suspension and steering work. 1.2 Conduct routine maintenance and mechanical adjustment on suspension system component parts e.g. Shock absorbers, ball joints, Springs, suspension arms, links, bushings and joints. 1.3 Conduct simple chassis adjustment checks. a. Assess wear on various types of gears of steering box in order to decide whether to change or re-use. b. Assess wear on joints, hubs, stub axle, and swivel pins assemblies c. Renew swivel pins, bushes and struts as required d. Conduct steering geometry checks and adjust toe-in, toe-out, King pin inclination, camber, caster, etc. e. Diagnose and rectify faults associated with the braking system e.g. brake failure, brake seizure, free play. f. Assess wear, locate and rectify leakages in the hydraulic and air systems g. Reline brake shoes, replace brake pipes and carry out brake adjustments. h. Bleed hydraulic line to exclude air from the system	• Demonstrate each practical for the students to learn • Ensure that the students use the correct tools • Ensure that the students work according to the standard practice • Encourage safe working procedure • Students to practise they are until they are competent	• Complete tool box, chassis, Dial gauge • External Micrometer • Bushings • Tool Box • Alignment jig • A live vehicle • Brake Shoes • Brake Linings • Brake Fluid • Live Vehicle • Brake pads

Week	Specific Learning Outcome	Teachers Activities	Resources
1-12	i. Adjust, maintain and recondition braking system j. Check airline pressure to ascertain that there are no air leakages k. Test vehicle braking system when the vehicle is in stationary position l. Test vehicle braking system on the road		
	EVALUATION GUIDE Question which should include multiple choice and short essays and objectives should be drawn up from the following areas, to cover the modules: a. Chassis and vehicle layout b. Working principles of various types of suspension system c. Suspension system d. Independent Front suspension Steering geometry e. Steering gear box f. Hydraulic brakes g. Working principles of exhaust brakes h. Brake servos i. Stopping distance j. Wheel alignment gauge k. Wheel balancing machine Practical assessment to account for 60% of overall Assessment		

Auto-Electricity/Electronics

PROGRAMME:	**NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK**
MODULE:	CMV 16 AUTO-ELECTRICITY/ELECTRONICS
DURATION:	96 HOURS
GOALS:	The trainee will be able to trace faults in the electrical system of motor vehicle and effect necessary repairs.

GENERAL OBJECTIVES:

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

1. Understand the principles of electricity generation as applicable to automobiles, diagnose faults and effect repairs to batteries.
2. Understand the procedure for effective maintenance and repairs of all units of the charging system in a motor vehicle without supervision.
3. Understand the operation of the starter motor, diagnose and effect repairs to a faulty one.
4. Understand the operation of all electrical components of a vehicle, trace and rectify faults in them.
5. Understand the wiring diagrams of a motor vehicle and be able to use such diagrams, symbols and signs as an aid in rewiring a faulty system.
6. Understand the operation of the coil ignition system, diagnose faults and rectify them.
7. Understand the operation of the transistorized ignition system, diagnose faults and rectify them.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: AUTO-ELECTRICITY/ELECTRONICS		Course Code: CMV 16	Contact Hours: 8hrs/week
Module Specification: Theoretical Content			
	General Objective 1.0: Understand the principles of electricity generation as applicable to automobiles, diagnose faults and effect repairs to batteries.		
Week	Specific Learning Outcome:	Teachers Activities	Resources
1	1.1 Explain the principle of electricity generation and electrolysis, chemistry of reaction in a lead acid battery e.g. vehicle battery. 1.2 Explain storage procedure for batteries	• Describe 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 • Assess the students	• Lesson plan • Battery • Battery charger • Volt meter • Hydr meter • 12-13 Spanner • Charts • Sulphuric acid • Distilled
	General Objective 2.0: Understand the procedure for effective maintenance and repairs of all units of charging system in a motor vehicle without supervision.		
Week	Specific Learning Outcome:	Teachers Activities	Resources
2	2.1 Explain the principles of electromagnetism in action and generation of electricity (A.C and D.C.) 2.2 Explain the principles of commutation, rectification and regulation of electricity	• Explain the process of generating electric current using electro-magnetism in A.C and D. forms • Explain how the commutators are used to rectify current output from the dynamo, • Explain the function of a regulator.	• Lesson plan • Chart • Chalk board • Alternator • Volt meter • Ammeter • Dynamo
	2.3 Explain the principles of operation of semi conductor devices	• Describe how the semi conductor functions • Assess the students	• Semiconductor

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: AUTO-ELECTRICITY/ELECTRONICS		Course Code: CMV 16	Contact Hours: 8hrs/week
	General Objective 3.0: Understand the operation of the Starter motor Diagnose and effect repairs to a faulty one.		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
3	3.1 State the principles of operation of the starter motor 3.2 Explain the principle of electro-magnetism 3.8 Describe the part played by electro-magnetic induction in the conversion of electrical energy to mechanical energy 3.4 Sketch the various types of starter motor system	• With the aid of sketches, explain the operation of the starter motor • Explain how magnetism is produced using electric current • Explain how magnetic field helps in generating currents • With the aid of sketches, explain the various types of starter system available, explain starter motor common faults • Assess the students	• Lesson plan • Charts • Armature Growler • Ammeter • Voltmeter • Starter motor
	General Objective 4.0: Understand the operation of all Electrical Components of a vehicle, trace and rectify faults in them		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
4	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)	• Explain how to set headlamp beam, characteristics of various types of lamp unit	• Lesson plan • Chalkboard
	General Objective 5.0: Understand the Wiring Diagrams of a motor vehicle and be able to use such diagrams, symbols and signs as an aid in rewiring a faulty system		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
5	5.1 Identify the symbols used in electrical wiring 5.2 Interpret wiring diagrams of an automobile 5.3 Interpret the various systems of wiring e.g. insulated and earth return system	• With the aid of sketches, show common electrical symbols with reference to automobile • Explain a wiring diagram as it applies to the motor vehicle. • Explain the advantages and disadvantages of earth return and insulated return systems • Assess the students	• Electrical symbols

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: AUTO-ELECTRICITY/ELECTRONICS		Course Code: CMV 16	Contact Hours: 8hrs/week
	General Objective 6.0: Understand the operation of the Coil Ignition System, diagnose faults and rectify them		
Week	Specific Learning Outcome:	Teachers Activities	Resources
6	6.1 Explain the theory of current generation by electro-magnetic induction.	• Explain with diagram how a magnet is used to generate current in the engine.	• Lesson plan • Distributor • Charts • Plugs • Tools • Dwell meter
7	6.2 Describe the operation of the coil 6.3 Explain the relationship between correct gap size and dwell angle for distributor contact breaker points. 6.4 Describe the action of a speed sensitive advance and retard mechanism. 6.5 Describe the distribution of the high tension supply. 6.5 Describe the action of the spark plug and the importance of correct gap setting. 6.6 Explain the need for correct ignition timing and the effect of incorrect ignition timing. 6.7 Describe and discuss the risks of accidents when working on electronic ignition system. 6.8 Identify and explain the items of electrical equipment and wiring methods 6.9 Explain and show the effects of open and short circuits using a number of conductors wired in series and parallel	• With the aid of sketch, 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 • With the aid of diagram, explain the function of the spark plug and how it is adjusted. • With the aid of diagrams, explain the operation of the distributor. • Explain the process of ignition and combustion 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 and identify the items of electrical equipment • State the wiring system namely;- Series wiring • Parallel wiring • Explain with diagrams and illustrations • Assess the students	• Lesson plan • Overhead • Projector with transparencies • Chalkboard • Diagrams • Relevant measuring tools • Circuit diagram • Coil • Condenser • Distributor • C.B Points

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: AUTO-ELECTRICITY/ELECTRONICS		Course Code: CMV 16	Contact Hours: 8hrs/week
	General Objective 6.0: Understand the operation of the Coil Ignition System, diagnose faults and rectify them		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
8	6.11 Explain the limitations of conventional ignition system	• List the limitation of the conventional ignition system	
	6.13. 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 6.14 Explain the process of measuring forward and reverse resistance of typical diodes 5. Explain the types and function of diodes	• Explain how capacitors can be used to: absorb electrical surge by-pass alternating current • Describe the function of diodes • Discuss methods of measuring electrical resistance • Assess the students	• Lesson plan • Overhead slides • Chalkboard • Measuring instruments • diagrams • diodes circuits
	General Objective 7.0: Understand the operation of the transistorized ignition system		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
10 - 11	7.1 Explain the operation, function and repairs of: a. Transistorised coil ignition with contact breaker control b. Breakeless transistorized coil ignition c. Transitorised coil ignition with inductive pulse generator d. Transistorised coil ignition with Hall effect generator 7.2 Explain the operation and function of high tension (HT) capacitor ignition 7.3 Compare different methods of the transistorized ignition systems 7.4 Explain the function/operation of magneto ignition system	• Discuss safety when work on this system is being done • Illustrate with the aid of sketches different methods of tranistorised ignition system • Explain with the aid of sketches, the operation of transistorized ignition system • Explain with sketches the operation of magneto ignition system	• Lesson plan • Wall charts • Overhead slides • Chalkboard

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: AUTO-ELECTRICITY/ELECTRONICS		Course Code: CMV 16	Contact Hours: 8hrs/week
	General Objective 7.0: Understand the operation of the transistorized ignition system		
Week	Specific Learning Outcome:	Teachers Activities	Resources
12	7.5 Describe the process of high tension capacitor magneto ignition 7.6 State the functions 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)	With the aid of sketches illustrate different types of high energy ignition system • Assess the students	

PRACTICAL ACTIVITIES

Weeks	Specific Learning Outcome	Teachers' activities	Resources
1-4	a. Diagnose common battery faults and their symptoms e.g. cracked case, undercharge. b. Conduct initial Battery charge and recharge c. Breakdown acid to obtain the correct electrolyte (necessary safety precautions associated with mixing acid to water in small proportion). d. Measure the specific gravity of the electrolyte using hydrometer. e. Measure voltage of cells on open circuit and under load using battery testing equipment e.g. high rate discharge tester.	• Demonstrate each practical for the students to learn • Students to practise until they become competent • Assess the students	• Battery • Battery charger • sulphuric Acid- • Distilled water • Plastic/enameled bowl • Hydrometer • Voltmeter • Ammeter • High rate discharge tester • Vaseline or grease • A live vehicle • Armature Growler • Warm Water • Battery post cleaner

Weeks	Specific Learning Outcome	Teachers' activities	Resources
1-4	f. Maintain battery terminals, post and logs using warm water and Vaseline to prevent corrosion. g. Fix and secure battery to the chassis with the appropriate private securing straps. h. Check the following for correct operation and out-put:-		
5-6	i. warning light/ ii. drive belt tension iii. terminals and cable connection for continuity iv. circuit resistance v. control box regulation (voltage regulator) vi. diodes vii. surge protection devices and relay, clean motor ventilation slots. viii. Ammature and brushes for continuity ix. Generator output (D.C and A.C) x. Generator field current (DC generator) xi. Alternator rotor coil, rectify pack sensing diodes. 1.2 Rectify faults and fit replacement units. 1.3 Determine serviceability of components 1.4 Bench test: a. D.C. generator (dynamo) b. A.C. generator (alternator) c. Control box (dynamo) d. Regulator assembly	• Demonstrate each practical for the students to learn • Students to practise till they become competent • Assess the students	• Kick starter • Voltmeter • Ohmmeter • Ammeter with shunt • Armature • Growler • Live vehicle

Weeks	Specific Learning Outcome	Teachers' activities	Resources
5-6	1.5 Determine wear on drive pinion of a starter and ring gear and adjust pinion clearance where applicable 1.6 Diagnose faults in the starter motor using test equipment, such as voltmeter, ohmmeter and ammeter with shunt.		
7-8	1.7 Determine serviceability of components e.g. armature on the growler, starter motor etc. 1.8 Assemble starter motor component appropriately and bench test starter motor (pre-engaged and co-axial) 1.9 Identify and state the characteristics of various types of lamp unit e.g. sealed beam flash unit. 1.10 Trace and rectify faults in the following circuits: a. lighting circuit/repair fuse, light units, b. direction indicator (trafficator) c. windscreen wiper circuit and drive system d. heater circuit e. windscreen washer circuit f. petrol pump circuit g. warning light circuit h. instrument panel circuit i. door glass circuit	• Demonstrate practical for the students to learn • Students to practise till they become competent • Assess the students	• Live vehicle Ammeter • Voltermeter • Ohmeter • Starter motor

Weeks	Specific Learning Outcome	Teachers' activities	Resources
9-10 11-12	j. Fit replacement units where necessary k. Select correct cable size length l. Test circuit for excessive resistance m. Renew all types of cable termination points n. Trace and rectify faults in a circuit using the appropriate instruments e.g. voltmeter, ammeter etc. o. Diagnose common coil ignition system faults and explain possible remedies. p. Carry out tests on transistorized ignition system q. Trace and rectify faults on transistorized ignition r. Use Hand Held Tester (HHT) to trace electrical/electronic faults s. Use star diagnostic machine to diagnose electronic faults in vehicle t. Carry out checks on High Energy Ignition system	• Demonstrate the process of each of the items on the practical guide • Students should be allowed to practise till they become competent • Assess the students	• Lesson plan • Relevant tools • Manufacturer's manual • Live vehicle
	Questions which should include fill-ins and objectives should be drawn up from the following areas to cover the whole modules: a. Safety precautions b. Battery maintenance c. Battery Charging process d. Common battery faults e. Electricity generation f. Electrolyte mixing g. Electrical Charging h. Starter system i. Cables		

Weeks	Specific Learning Outcome	Teachers' activities	Resources
	j. Connections k. Spark plugs l. Ignition system. m. Basic electrical wiring n. Capacitors/condenser o. Transistors p. Sensors q. Measuring instruments Practical Tests should account for 60% of the overall assessment.		

Major Engine Repair Work (ANTC)

PROGRAMME:	ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE 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 twin carburettor and apply these to restore a faulty one to obtain peak performance.
2. Understand the construction and operation of C.I. engine fuel system.
3. Understand the operating principles of gas turbine engine and wankel rotary engines.
4. Understand operation of cams and camshaft drive arrangements for side and overhead camshafts
5. Understand valve and valve port timing for both spark and C.I. engines
6. Understand the construction and operation of various types of combustion chambers.
7. Understand the principles of crankshaft balancing and vibration damping.
8. Understand the dry sump lubrication system, crank case ventilation and action of oil pressure gauges.
9. Understand the construction and action of the components in a pressurized water-cooling and vehicle heating system.
10. Understand the operation and wiring of the coil ignition system.

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE MAJOR ENGINE REPAIR WORK		Course Code: CMV 20	Contact Hours: 18hrs/week
Module Specification: THEORETICAL			
	General Objective: 1.0 Understand the working principles of a twin carburettor and apply these to restore a faulty twin carburetor to peak performance		
Week	Specific Learning Outcome	Teachers Activities	Resources
	1.1 Explain the basic principles and construction of carburettors e.g single, twin and multi barrel. 1.2 Explain the operation of the venturi 1.3 State the advantages and disadvantages of a twin carburetor	• Use visual aids e.g diagrams and real components to illustrate the principles and construction of carburetors • Explain the use of vacuum gauge for carburettor tuning • Assess the students	• -Lesson plan • -Chalkboard • -Twin carburetor • -Vacuum gauge • -Live Petrol engines • Single barret Caarburettor
2-4	1.3 Explain with the aid of diagrams the action of the constant choke type of carburettors with regard to: a. Mixture strength control; b. Cold starting; c. Slow running; d. Acceleration; e. Economic devices 1.4 Explain the operation of an electrical petrol lift pump 1.5 Explain how mixture strength 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	• State advantages and disadvantages of constant choke and constant vacuum carburetor. • Explain mixture strength requirement for the listed conditions 1.3 (a-e) • With the aid of diagram illustrate electrical petrol lift pump • Explain the uses of mixture adjusting screws on carburettors • Define hot spot • Explain the need for air cleaning and silencing	• As above

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE MAJOR ENGINE REPAIR WORK		Course Code: CMV 20	Contact Hours: 18hrs/week
	General Objective: 1.0 Understand the working principles of a twin carburettor and apply these to restore a faulty twin carburetor to peak performance		
Week	Specific Learning Outcome	Teachers Activities	Resources
	1.8 Describe the flow and action of air in the inlet and exhaust manifolds 1.9 Explain the basic principles of electronic fuel inspection 1.10 Identify main components of a fuel injection system and explain their functions 1.11 State the advantages of fuel injection	• Explain the need for better filling of induction system. Explain the need for supercharging and Turbo charging • Use appropriate visual aids to explain objectives • Assess the students	• Lesson plan • Chalkboard • Electronic equipment • Fuel injection equipment • Live diesel and petrol engines. • Diagrams and components
	General Objective 2.0: COMPRESSION IGNITION ENGINE FUEL SYSTEM		
Week	Specific Learning Outcome	Teachers Activities	Resources
5-6	2.1 Explain the need for phasing the inline pump. 2.2 Explain the operation of an idle/maximum speed 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	• Explain when phasing of inline pump becomes necessary • List possible diesel engine faults attributable to governor on a running diesel engine • Describe the and 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. • Assess the students	• Appropriate working tools and equipment. (e.g Injection pump dismantling tools) • As above

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE MAJOR ENGINE REPAIR WORK		Course Code: CMV 20	Contact Hours: 18hrs/week
	General Objective 2.0: COMPRESSION IGNITION ENGINE FUEL SYSTEM		
Week	Specific Learning Outcome	Teachers Activities	Resources
	2.6 Explain the actions of: a. the mechanical governor b. the hydraulic governor in relation to the distributor type pump		
7-8	2.7 Describe the action of a pneumatic governor 2.8 Locate the provision for adjustment on a pneumatic governor 2.9 Explain the need for and the method of bleeding the fuel injection pumps. 2.10 Describe with the aid of sketches the types of injector nozzles to suit direct and indirect injectors 2.12 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	• List the advantages of pneumatic governor over other governors • Describe the process for governor adjustment • List possible causes of air entering the fuel system of diesel engine • Explain the advantages and disadvantages of direct and indirect injectors • State the advantages of cold starting devices on diesel engine. • Illustrate each of the devices with neat diagram. • Assess the students	• As listed above • Pneumatic governors • Fuel Injection pumb • Injector nozzles • Cold starting devices • Diesel Engine.

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE MAJOR ENGINE REPAIR WORK		Course Code: CMV 20	Contact Hours: 18hrs/week
	General Objective 3.0: Understand the operating principles of gas turbine engine and wankel rotary engines.		
Week	Specific Learning Outcome	Teachers Activities	Resources
9-10	3.1 Explain the operating principles of the gas turbine engine. 3.2 List the advantages and disadvantages of gas turbine engines as compared to conventional engines 3.3 Explain the operational sequence of the wankel engine 3.9 Sketch a sectional view of the wankel engine and label it. 3.5 Describe the methods of sealing the motor of a wankel engine	• With the aid of sketch illustrate the action and operation of gas turbine engines • Explain and illustrate the function of gas turbine. Explain the advantages and disadvantages as compared to other types of engine • With the aid of a line diagram show the operation of the wankel engine sequentially. • Show with the aid of a sketch or sketches, show the sectional constructional details of a wankel engine explain the procedure for sealing the motor of wankel engine. Explain why the motor should be sealed. • Assess the students	• Lesson plan • Models of Gas Turbine • Diagrams • Chalkboard • Appropriate tools and equipment • Lesson plan • Drawing equipment • Models • Use training charts and engine models
	General Objective 4.0: Describe cams and camshaft drive arrangements for side and overhead camshafts		
Week	Specific Learning Outcome	Teachers Activities	Resources
11-12	4.1 Sketch and label typical cam shapes. 4.2 Determine variations in valve lifts and valve opening periods. 4.3 Locate the drive gear to the camshaft. 4.4 Explain how end float of the camshaft is controlled.	• Describe, with the aid of a diagram, a cam shaft and state the function of the parts. Examine wear on the cam. • 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	• Lesson plan • Cam shaft • Chalkboard • Use measuring tools(e.g. micrometer) • As above. • As above • As above

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE MAJOR ENGINE REPAIR WORK		Course Code: CMV 20	Contact Hours: 18hrs/week
	General Objective 4.0: Describe cams and camshaft drive arrangements for side and overhead camshafts		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
	4.5 Describe the methods of camshaft drives including single overhead valve, single overhead cam and twin overhead cam	• With the wall chart/model, explain the function and operation of camshaft drive showing how the camshaft actuates other components • Assess the students	• Lesson plan • Wall chart • Diagrams • Chalkboard
	General Objective 5.0: Understand valve and valve port timing for both spark and compression ignition engines.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
13-14	5.1 Drawand label a typical valve timing diagram for a spark ignition engine. 5.2 Compare valve timing diagram for C.I. engine with that of a spark ignition engine. 5.3 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 assess the students	• Lesson plan • Wall chart • Chalkboard • Inlet valves • Exhaust valves • Wall charts.
	General Objective 6.0: Understand the construction and operation of various types of combustion chambers.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
	6.1 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	• 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	• Lesson plan • Models • Service manual • Chalkboard • Complete mechanics tool box. • Lesson plan • Models • Diagrams

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE MAJOR ENGINE REPAIR WORK		Course Code: CMV 20	Contact Hours: 18hrs/week
	General Objective 6.0: Understand the construction and operation of various types of combustion chambers.		
Week	Specific Learning Outcome	Teachers Activities	Resources
	6.2 State the advantages and disadvantages of three types of the petrol engine combustion chambers.	• Discuss the advantages and disadvantages of the three types of petrol engine combustion chamber	• Chalkboard • Cylinder head
	6.3 Explain the combustion process for: a) Spark ignition engine b) The three phases of combustion process in C.I engine	• Explain by illustration the combustion process in (a) S.I engine (b) three phases of combustion process in C.I engine • Assess the students	• Complete diesel engine.
	General Objective 7.0: Understand the principles of Crankshaft balancing and vibration damping		
Week	Specific Learning Outcome	Teachers Activities	Resources
17-18	7.1 Explain the principles of crankshaft balancing 7.2 Describe the causes of crankshaft vibration 7.3 State the types of crankshaft vibration dampers. 7.4 Sketch the methods of mounting crankshaft dampers 7.5 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 systematically how to mount crankshaft dampers • Explain in detail why dampers are installed in the system. • Explain how vibration is dampened out. • Assess the students	• Lesson plan • Crankshaft • Chalkboard • Diagrams • Crankshaft Dampers • Complete tool box • Measuring devices

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE MAJOR ENGINE REPAIR WORK		Course Code: CMV 20	Contact Hours: 18hrs/week
	General Objective 8.0: Understand the dry sump lubrication system, crankcase ventilation and action of oil pressure gauges.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
19-20	8.1 Explain the operation of a dry sump lubrication system 8.2 Explain the need for crankcase ventilation 8.3 Explain the operation of an oil pressure gauge.	• 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 • Illustrate how the oil pressure gauge works. • State the purpose of the gauge	• Lesson plan • Manufacturer's manual • Oil filters • Chalkboard • Filter wrench • Crank case • Dead engine • Pressure gauge • Measuring tools
	8.4 Draw a line diagram of an oil gauge/light circuit 8.5 Describe the operating principles of an oil cooler	• With the aid of a diagram, show and explain the operation of oil gauge/light circuit • State the purpose of the oil cooler and illustrate the principles • Assess the students	• Lesson plan • circuit diagram • Chalkboard • Ammeter etc • Diagram • Complete engine
	General Objective 9.0: Understand the construction and action of the components in a pressurised water cooling and vehicle heating system		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
12	9.1 Explain the need for water pump 9.2 Describe the action of water pump 9.3 Sketch the construction of the impeller shaft seal 9.4 Sketch types of radiator construction including methods of water sealing 9.5 Explain the action of separate header tanks vertical and cross flow systems	• Discuss the importance and application of water pump • Explain the operation, action of water pumps. Sketch a typical water pump • With the aid of sketches, show the constructional details of impeller type pump with the shaft seal • With the aid of a diagram show the constructional details of a radiator. State common faults and their remedies	• Lesson plan • Model or actual pump • Chalkboard • Complete engine • Complete tool box • Lesson plan • Wall chart or Diagram • Chalkboard, tools and equipment

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE MAJOR ENGINE REPAIR WORK		Course Code: CMV 20	Contact Hours: 18hrs/week
	General Objective 9.0: Understand the construction and action of the components in a pressurised water cooling and vehicle heating system		
Week	Specific Learning Outcome	Teachers Activities	Resources
12		• Illustrate with sketches, the action and operation of separate header, vertical and cross tanks. State the use and the importance of the header tank.	• Radiator pressure tester • Complete engine • Lesson plan • Header tank • diagram • Complete tool box • Chalkboard
	General Objective 10.0: Understand the operation and wiring of the coil ignition system		
Week	Specific Learning Outcome	Teachers Activities	Resources
13	10.1 Explain the theory of spark generation by electro-magnetic induction	• With the aid of sketches, explain the low tension circuit and the high tension circuit of the coil ignition system	• Lesson plan • Chart • Coil • Capacitor • Overhead projector and transparencies • Plugs
	10.2 Explain the need for and the action of a capacitor 10.3 Draw the ignition system to show how spark is transmitted to the combustion chambers 10.4 Explain the theory of spark ignition system	• With the aid of sketches, discuss the action of the condenser and its contribution to the system • Illustrate with the aid of diagrams, the layout of coil ignition system and emphasise how spark is distributed to the various cylinders • Explain the process by which current flows from the battery through the low tension circuit, and the high tension circuit to produce spark at the plugs.	• Complete live petrol engine • Dynascope • Engine Analyser • Timing light

PRACTICAL ACTIVITIES

Week	Specific Learning Outcome	Teacher's Activities	Resources
1-3 4-8 9-15 16-14	Diagnose common carburetor faults and rectify s Overhaul the twin carburetor and other modern carburetors and adjust the jets to give the correct mixture. Calibrate inline pump and collate results Diagnose and rectify faults mechanical, hydraulic and pneumatic Conduct injector tests and collate result Remove and refit water pump-pressure test system Diagnose and rectify oil lubricating faults Change engine oil and fitter Inspect vehicle for road worthiness to meet M.O.T. requirements and prepare report. Coil Ignition: Remove, clean and set gap on spark plugs Remove - refit contact breakers and check dwell angle	• Demonstrate each item of the practical activity for students to learn • Student should practise till they are competent	• Using necessary automobile workshop tools and equipment as appropriate for each practical workshop demonstration • Practical manual live twin carburetor, Modern carburetor (Tool box), set of spanners/screw drivers, pumps, governors, vehicle
	Tests and examinations to be set in multiple choice, True/False and fill-in to cover broader area of the module specifications. The evaluation should also include practical exercise. Practical Assessment should form 60% of the overall assessment.		

Transmission (ANTC)

PROGRAMME:	ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE EMCHANICS' WORK.
MODULE:	CMV 21: TRANSMISSION
DURATION:	72 HOURS
GOAL:	The goal of this module is to provide the trainee 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 trainee should be able to:

1. Understand the operating principles automatic transmission gearbox.
2. Understand the operation of synchromesh gear, assemblies and describe the types of bearings used in them.
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, diagnose faults and rectify them.
5. Understand the purpose and the operation of the components of propeller and drive shafts.

PROGRAMME: ANTC IN MOTOR VEHICLE MACHANICS' WORK			
Course: TRANSMISSION		**Course Code:CMV 21**	**Contact Hours: 6HRS/WEEK**
Course Specification THEORETICAL CONTENT			
	General Objective: 1.0 Understand the Operating Principles of Automatic Transmission Gear Box		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
1	1.1 Explain the principles of operation of automatic transmission.	• 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. • Assess the students	• Lesson plan • Chart • Automatic transmission

PROGRAMME: ANTC IN MOTOR VEHICLE MACHANICS' WORK			
Course: TRANSMISSION		Course Code:CMV 21	Contact Hours: 6HRS/WEEK
	General Objective 2.0: Describe the Operation of Synchromesh Gear Assemblies And Describe The Type Of Bearing Used In them.		
Week	Specific Learning Outcome:	Teachers Activities	Resources
2	2.1 Describe the operation of constant load and bulk ring type of synchromesh device 2.2 State reasons for the use of helical gears in the gear box and the solution of problems arising from them 2.3 State types of bearings used in a gear box: a. to absorb end thrust b. to support gears in casing	• Explain the operation of the constant load and baulk-ring synchromesh devices, state the reason why the constant load is no longer in used • Discuss the various types of gears that can be used in the manual type gearbox e.g. helical gears State their faults and possible remedies • Explain the type of bearings that can absorb various load imposed by the actions of the gears • Assess the students	• Overhead Projector and transparencies • Chalk board • Chalk • Lesson plan • Charts
3	2.4 Describe a gear control mechanism and its operation 2.5 State the reason for the utilization of the remote control mechanism 2.6 State the purpose of overdrive units 2.7 Describe the operation of two-speed transfer box in: (a) rear wheel drive only (b) four wheel drive	• Explain with 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. • Assess the students	• Lesson plan • Chart • Chalk board • Overhead Projector and transparencies • Overdrive unit • Transfer gear box

PROGRAMME: ANTC IN MOTOR VEHICLE MACHANICS' WORK			
Course: TRANSMISSION		Course Code:CMV 21	Contact Hours: 6HRS/WEEK
	General Objective 3.0 Understand The Construction Methods And Adjustments Of The Components Of Single-Plate, Multiplate And Centrifugally Operated Clutches		
Week	Specific Learning Outcome:	Teachers Activities	Resources
4 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 d. Friction linings 3.4 Describe graphite and ball bearing release bearing 3.5 Describe the properties and materials of friction lining material 3.6 Explain the need for release lever setting of multi spring clutch. 3.7 Sketch the layout and operation of the centrifugally operated clutch 3.8 Sketch the Multi-plate clutch and state its operation	• Explain with the aid of diagram the constructional features of the clutch plate, e.g. Friction Lining, Rigid hub and spring hub • Explain the flexible clutch plate ability to absorb tortional 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 the clutch system. • Discuss the qualities of the materials used for friction lining. • With the aid of sketches, explain the operation of the release lever and the effect of adjustment on it. • With the aid of sketches, explain the operations and the advantages and disadvantages of a centrifugal clutch • Explain with the aid of diagrams, the operation, advantages and disadvantages of a multi-plate clutch over the single plate clutch • Assess the students	• Lesson plan • Single plate clutch • Ball bearing • Chart • Overhead Projector and transparencies • Chalk board • Text book • Multiplate clutch

PROGRAMME: ANTC IN MOTOR VEHICLE MACHANICS' WORK			
Course: TRANSMISSION		Course Code:CMV 21	Contact Hours: 6HRS/WEEK
	General Objective 4.0: Understand the functions and operation of, double reduction final drive differential assembly, diagnose faults and rectify them.		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
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	• Describe the principles of power versus speed, as applied to double reduction and differential gearing. State the Explain how the final drive unit is lubricated and the type of lubricant used and provision to take care of pressure build-up in the axle casing • Explain the action of the differential gearing during cornering and straight motion • Explain with the aid of diagram the banjo axle casing and how it differs from other casings • Assess the students	• Lesson plan • Constant velocity joint • banjo axle casing • Text book • Overhead projector Transparencies • Chart • Chalk board
	General Objective 5.0: Understand the purpose and the operation of the components of propeller and drive shafts		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
9-12	5.1 Describe the purpose of constant velocity universal joints on the drive shafts of vehicles 5.2 Describe the following constant velocity joints rzeppa, tracts, double - hookes. 5.3 Describe the followings: Lay rub and rubber cruciform coupling potts joints 5.4 Explain the use on front wheel drive of: Solid drive shafts, tubular drive shafts 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	• 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 and disadvantages • Explain with the aid of sketches coupling their advantages and of each coupling. • State the disadvantages one has over the other and state their differences • Explain the torque tube features and the reason why they are used on some vehicles • With the aid of sketches, explain the layout and operation of the various parts of the transfer box. • Assess the students	• Lesson plan • Chart • Chalk board • Text book • Overhead projector • Transparencies • Propeller shaft • Universal joints • Constant velocity joints

PRACTICAL ACTIVITIES

	General Objective: At the end of this module each student should be able to carry out maintenance/repair work on the transmission system		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
1-2 3-4 5-9 7-8 9-12	Identify and use various tools and equipment used for removal and repair of automatic transmission system Remove gearbox unit from vehicle Dismantle gearbox and assess wear on the components Fit replacement units and carry out necessary adjustment Road test completed job for efficiency Repair multiplate and centrifugally operated clutch Adjust multiplate clutch for correct operation Fix multi-plate and centrifugal clutch to the vehicle Select various special tools and equipment used for the removal and repair of double reduction final drive assembly Remove differential assembly, dismantle, clean and assess wear Fit replacement units, reassemble and adjust for correct operation Check the electrical operations of the operated control unit and replace if faulty Change prop-shaft or joints when required **EVALUATION GUIDE** Questions which should include multiple choice, objectives should be drawn up from the following areas to cover the module: a. Automatic Transmission b. Syndromesh gear box c. Rear axle d. Differential e. Over drive f. Shock absorber g. Propeller shafts h. Constant velocity joint Practical Assessment should form 60% of the overall assessment profile while theory takes 40%	• Demonstrate each practical for the students to follow • Ensure that the students use the correct tools • Ensure that the students work according to the correct standard practice • Ensure and encourage safe working • Students should be allowed to practise till they become competent • Assess the students	• Lesson Plan • Live vehicle • Engine analyzer • Tools box • Oil • Paraffin • Propeller shaft • Universal joints • Automatic transmission • Double reduction differential unit.

Chassis, Steering, Suspension and Braking Systems (ANTC)

PROGRAMME:	ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS WORK
MODULE:	CMV 22: CHASSIS, STEERING, SUSPENSION AND BRAKING SYSTEMS.
DURATION:	72 HOURS
GOAL:	This module is designed to provide the trainee with further knowledge and skills to repair and maintain chassis, power steering system, air and hydraulic suspensions, tractor trailer coupling and power braking system.

GENERAL OBJECTIVES:

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

1. Understand the characteristics of various types of tractor/trailer couplings and effect repairs on them.
2. Understand the operations of a power take off (PTO) system and carry out repairs and maintenance to it.
3. Understand the working principle of both hydraulic and airsuspensions.
4. Understand the principles of operation of a power steering mechanism, diagnose faults and rectify them.
5. Understand the working principles of power (air) braking system and carry out repairs on it.

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE CHASSIS STEERING, SUSPENSION AND BRAKING SYSTEMS		Course Code: CMV 22	Contact Hours: 6hrs/week
Module Specification: THEORY			
	General Objective: 1.0: Understand the Characteristics of various types of tractor/trailer couplings and effect repairs on them		
Week	Specific Learning Outcome	Teachers Activities	Resources
1-4	1.1 Identify and state the characteristics of various types of tractor/trailer couplings, e.g. semi-automatic and landing Identify various tools and equipment used for removal and adjustment of the fifth wheel coupling. 1.2 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	• Lesson plan • Chalkboard • Overhead and Projector • Transparencies • Posters • Tractor with couplings
	General Objective: 2.0 Understand the operations of a Power Take Off (P.T.O) system and carry out repair and maintenance to it		
Week	Specific Learning Outcome	Teachers Activities	Resources
5-6	2.1 Explain the operation of a P.T.O on a tractor 2.2 List handling and tipping body.	• 1. Describe the functions of a P.T.O on a tractor • List safety precautions in using P.T.O. and tipping body. • State the standard speed of the P.T.O. • Assess the students	• A model P.T.O. • Sketches • Chalkboard • Tractor
	General Objective 3.0: Understand the working principle of both hydraulic and air suspensions.		
Week	Specific Learning Outcome	Teachers Activities	Resources
7	3.1 Explain the working principle of air and hydraulic suspensions.	• Describe the functions of air and hydraulic suspensions. • Sketch air suspension system. • Sketch hydraulic suspension system • Name all the parts of both air and hydraulic suspension systems. • List faults commonly found on both air and hydraulic suspension systems • Assess the students	• Lesson plan • Posters/charts • Air suspension • Transparencies • Hydraulic suspension

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE CHASSIS STEERING, SUSPENSION AND BRAKING SYSTEMS		Course Code: CMV 22	Contact Hours: 6hrs/week
	General objective: 4.0 Understand the operation principles of a power steering mechanism, diagnose faults and rectify them.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
8-10	4.1 State the principles of operation of power steering system 4.2 Identify common faults in steering mechanism 4.3 Sketch in good proportion the layout and construction of component parts of power steering and gear assembly to illustrate the oil passages in the steering shaft.	• 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 associated with power steering and possible remedies • With the aid of sketches, explain the constructional features and power steering and the fluid qualities of fluids used in the system • Assess the students	• Lesson plan • Complete power steering mechanism • Charts • Overhead projector and transparencies • Chalkboard.
	General Objectives: 5.0 Understand the working principles of power braking system and carry out repairs on it.		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
11-12	5.1 Explain the working principles of exhaust braking system 5.2 Sketch layout of an air braking system showing the components in their relative positions. 5.3 State the constructional features of power (air) braking system 5.4 State the advantages and disadvantages of power braking system.	• Explain with diagrams, the operation of the exhaust brakes system, state its advantages and disadvantages • Assess the students • With the aid of diagram, illustrate the layout of air braking system, state possible faults associated with the system and suggest possible remedies. • Assess the students	• Lesson plan • Chart • Chalkboard • Chalk • Overhead projector and transparencies. • Power braking system components

PRACTICAL ACTIVITIES

WEEK	Student Activities	Teacher's Activities	Resources
1-6	1. Maintain and adjust couplings 2. Maintain and adjust various Power Take Off systems 3. Dismantle and re-assemble Power Take Off (P.T.O) units 4. Fit replacement units 5. Adjust and maintain couplings 6. Diagnose faults by road test and inspection and rectify them 7. Remove hydraulic suspension from vehicle and replace parts needed 8. Maintain and adjust hydraulic suspension.	• Demonstrate to the students • Students to practise until the competent • Assess the students	• Tools and equipment • Live vehicle
6-12	9. Dismantle, inspect and assess weakness in the spring, fit replacement parts. 10. Maintain and adjust suspension system. 11. Remove a steering assembly from the vehicle, dismantle, clean, inspect and fit replacement parts on it and adjust accordingly. 12. Rectify the common faults in steering mechanism. 13. Diagnose and rectify faulty power braking system. 14. Remove components from braking system taking appropriate care for the hydraulic/air pipes. 15. Assess wear and locate leakages in the air/hydraulic system. 16. Fit replacement unit such as brake valve lock actuator, road sensing valve, compressors, reservoirs and brake chamber. 17. Apply safety precautions associated with exhaust braking system. 18. Check airline system for leaks.	• Teacher to demonstrate for the students to learn • Students to practise untill they become competent • Assess the students	
	EVALUATION GUIDE Questions should include multiple choice, True/False, essays and fill-ins to cover: Tractor/Trailer coupling, Power Take Off (P.T.O), Air and hydraulic suspension maintenance, Power Steering and Power Braking system. Practical evaluation should form 60% of the overall evaluation while theory takes 40%		

Automobile Air-Conditioning (ANTC)

PROGRAMME:	ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK
COURSE:	AUTOMOTIVE AIR-CONDITIONING
DURATION:	72 HOURS
GOAL:	This module is intended to impart Automobile Air Conditioning knowledge and skills in the trainees to enable them effectively diagnose faults and rectify them.

GENERAL OBJECTIVES

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

1. Understand the basic principles of air conditioning and refrigeration
2. Understand the operation of the compressor and cycling clutch system with thermostatic expansion value (TEV) and the system with orifice tube (OT).
3. Understand the operation of evaporation pressure control system.
4. Understand the general maintenance process of automotive air conditioning.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: AUTOMOTIVE AIR-CONDITIONING		**Course Code: CMV 23**	**Contact Hours: 6hrs/week**
Module Specification: THEORETICAL CONTENT			
	General Objective 1.0: Understand the basic principles of air conditioning and refrigeration		
Week	**Specific Learning Outcome:**	**Teachers Activities**	**Resources**
1-2 3	1.1 Explain the basic refrigeration cycle 1.2 Explain five basic parts contained in the refrigeration system 1.3 Explain the types of refrigeration used in the system and state their characteristics 1.4 Explain the chemical ingredients of an automotive air condition system 1.5 Explain the primary causes of system failure	• With the aid of diagrams, explain the layout of an automotive air condition system • List and explain the functions of the five basic components of refrigeration • Explain the type of refrigerant used in the system, and the characteristics of the refrigerant • List and explain the role of each chemical ingredients used in the air conditioning system • Explain the common causes of system failure and suggest possible remedies • Assess students	• Refrigeration cycle diagram • Diagram of the five basic parts of refrigeration system • -Charts • -Overhead projector and transparencies • -Chalkboard • -Tool box • refrigerants

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: AUTOMOTIVE AIR-CONDITIONING		Course Code: CMV 23	Contact Hours: 6hrs/week
	General Objective 2.0: Understand the operation of the compressor and cycling clutch system with thermostatic expansion valve (TEV) and the system with orifice tube (OT)		
Week	Specific Learning Outcome:	Teachers Activities	Resources
4- 5	2.1 Explain the operation of the compressor in the cycling clutch system 2.2 Explain the cycling clutch system with Thermostatic Expansion \valve, (TEV) and the system with orifice tube (O.T)	• With the aid of diagram, explain the operation of the compressor used in the cycling clutch system • Explain the roles played by the thermostatic expansion value (TEV) and orifice tube (O.T) in the air conditioning system.	• Compressor • Thermostatic Expansion valve • Orifice tube
	General Objective 3.0: Understand the operation of Evaporation Pressure Control System		
Week	Specific Learning Outcome:	Teachers Activities	Resources
6-9	3.1 Describe the system using Pilot Operated Absolute (POA) value and the one using Value In Receiver (VIR) system. 3.2 Describe the system using Suction Throttle Valve (STV) and Thermal expansion valve (TXV) 3.3 Discuss the roles played by Evaporator Pressure Regulator (EPR) valve in the system chryster 3.4 Describe the various system component listed below: a. Compressors b. Condenser c. Evaporators d. Accumulators e. Expansion tube f. Receiver - Dehydrator	• Describe the function of the pilot operated absolute value and suggest its alternative • Assess the students • With the aid of diagrams explain the operation of both TXV (Thermal Expansion Valve) and STV (Suction Throtle Valve) • With the aid of sketches, explain the function of the Evaporator Pressure Regulator in the system • Explain the function and characteristic of the components. List them in their order of connection in the system. • Assess the students	• Lesson plan • Charts • Overhead projector - - Transparencies • Chalkboard • POA value • VIR value • TXV value • STV value

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: AUTOMOTIVE AIR-CONDITIONING		Course Code: CMV 23	Contact Hours: 6hrs/week
	General Objective 4.0: Understand the general Maintenance process of automotive air conditioning		
Week	Specific Learning Outcome:	Teachers Activities	Resources
10-12	4.1 Explain the process of maintaining the system stability. 4.2 Describe the operation of the system service valves 4.3 Explain the process of discharging evacuating air conditioning system 4.4 Explain the process of charging the air conditioning system 4.5 Describe the importance of testing the performance of the system	• Explain the importance of maintning an efficient operation of the system • Explain the operation of the system service valves and how to prevent them from breaking down. • Explain the process of discharging and evacuating (with the appropriate equipment) the system. • Describe the process of charging the system with correct refrigerant to the manufacturer's specifications • Assess the students	• Serve valves
	PRACTICAL ACTIVITIES		
1-3 4-7 8-12	1. Check belt tension and adjust if necessary 2. Check blower motor operation at all speeds 3. Discharge the system of refrigerant 4. Evacuate the system of refrigerant 5. Using the appropriate refrigerant and equipment, charge the system to the manufacturer's specifications. 6. Perform leakage test to determine that the system is not leaking. Use electronic leak detector 7. Detect internal leaks using electronic equipment 8. Adjust thermostat valve 9. Install air conditioning unit and test for serviceability	• Demonstrate each practical component for the students • Students to practise until they become competent • Assess the students	• Lesson plan • Tool box • Vacuum pump • R.12 • Electronic leak detector • Detergent • Live vehicle with air conditioning system. • Manufacturer's manual

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK			
COURSE: AUTOMOTIVE AIR-CONDITIONING		Course Code: CMV 23	Contact Hours: 6hrs/week
	EVALUATION GUIDE		
	Questions which should include objectives, True/False, Fill-ins and essay should be drawn from the following areas: a. Basic principles of air conditioning. b. Cycling clutch system c. Evaporation pressure control system d. Basic maintenance e. V.I.R system Practical assessment should account for 60% of overall assessment		

Project (ANTC)

PROGRAMME:	ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MOTOR VEHICLE MECHANICS' WORK
COURSE/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 craft man practise 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 a 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.

Guidelines for Textbook writers

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

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

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

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

15. The final draft version of the books should be submitted to Nigerian members of the curriculum working groups for their comments regarding the content in relation to the desired syllabus.

List of Books and References

1. Motor Vehicle Technology and Practical Work by Dolan
2. Fundamentals of Motor Vehicle Technology by Hillier
3. Technology for Motor Mechanics: 1-5 By S.C. Mudd
4. Automobile Workshop Pactice by Staton Abbey
5. Automoive Fault-Tracing by Staton Abbey

List of Equipment

MOTOR VEHICLE 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)
	10 tool boxes with keys each comprising one of the following items:			
1.	Set of flat, round, half round and triangular files	10 each		
2.	Set of warden files	10 sets		
3.	Flat chisels	10		
4.	Cross cut chisels	10		
5.	Diamond point chisels	10		
6.	Set of pin punches parallel and taper	10 each		
7.	Hollow punches of various sizes	10 each		
8.	Ball pein hammesr	10		
9.	Plastic hammers/mallets	10		
10.	Hacksaws with extra blades	10		
11.	300mm engineers rule	10		
12.	Centre punch	10		
13.	6-32mm socket spanner sets with ratchet, brace, extension, U.J and handles	10		
14.	6-32mm open and flat spanners	10 sets		
15.	6-32mm ring spanners	10 sets		
16.	Emery stone/block or cloth	10		
17.	Plug spanners	10		
18.	Magneto spanners	10		
19.	Allen keys	10 sets		
20.	Philips screw drivers	10 sets		
21.	Feeler gauges	10		
22.	Oil cans	10		
23.	Grease guns	10		
24.	Mole grip	10		

S/No (1)	Tools/Equipment (2)	Minimum Quantity Required (3)	Quantity Available in Workshop (4)	Additional Quantity Required (5)
25.	File card or cleaner	10		
26.	Spark plug files	10		
27.	Combination pliers	10		
28.	Long nose pliers	10		
29.	Wire cutter and stripper	10		
30.	Tyre pressure gauges	10		
31.	Metal scrappers	10		
	DRILLING AND SCREW CUTTING			
1.	Electric Hand Drill	2		
2.	Drill bits	3 sets		
3.	Set of stock and dies - UNC, UNF and metric	2 sets		
4.	Taps and wrenches - UNC, UNF and metric	2 sets		
5.	Thread file	2		
6.	Roller type thread restorer	2		
7.	Screw (stud) extractor set	2		
	MEASURING TOOLS			
1.	Vernier caliper	5		
2.	Vernier calipers with clock	5		
3.	Surface plates	2		
4.	Vee blocks	8		
5.	Vernier height gauge	2		
6.	Vernier calipers (metric)	3		
7.	Micrometer 0-25m 25-50mm, 50-75mm Internal & external 25-50mm; 75-100	3 3		
8.	Dial indicator (gauge) with magnetic stand	2		
	MACHINE TOOLS			
1.	Grinding machine with assorted wheels	1		
2.	Bench grinder with wheels	1		
3.	Workshop plain goggles	20		

S/No (1)	Tools/Equipment (2)	Minimum Quantity Required (3)	Quantity Available in Workshop (4)	Additional Quantity Required (5)
	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.	Wheel balance (rim 13-15)	1		
3.	Air line gauge	2		
4.	Portable tyre inflator	2		
5.	Steam cleaner (complete) oil fired or electric	1		
6.	High pressure washer	1		
7.	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 repair kit comprising: rasp. Scissors, tyre knife, stitcher, spiral wound wire brush etc.	3 sets		
12.	Wire brush set	3 sets		
13.	Battery charger	1		
14.	Service station set of tool kit plus special wrenches for removal of oil filter	2 sets		
15.	Pipe wrench, clamp or vice	3 sets		
16.	Pipe cutter	2		
17.	Wheel alignment gauge	2		
18.	Plug spanners (long and short)	2		
19.	Battery service kit	2 each		
20.	Adjustable wrench	3		

S/No (1)	Tools/Equipment (2)	Minimum Quantity Required (3)	Quantity Available in Workshop (4)	Additional Quantity Required (5)
21.	Clutch alignment gauge	5		
22.	Clutch set-screw gauge	2		
23.	Valve grinders	2		
24.	Injector repair machine	1		
25.	Injector needle service kit	1		
26.	Hydrometers	4		
27.	Vacuum tester	4		
28.	Pullers (different sizes)	2		
29.	Spark plug tester	4		
30.	Work bench with vices	2		
31.	Portable engine hoist	3		
	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	4		
6.	Bottle jack (hydraulic) heavy vehicle type	2		
7.	Ram up to 6 tonne capacity	1		
8.	Trolley jacks	2		
9.	Dynanometer	1		
10.	Motor scope (engine analyzer)	2		
11.	Timing light	4		
12.	Tachometer	2		
13.	Hydraulic press	1		
14.	Inspection pits	2		
15.	Dwell tester	2		
16.	Armature growler	1		
17.	Compression gauge	2		

S/No (1)	Tools/Equipment (2)	Minimum Quantity Required (3)	Quantity Available in Workshop (4)	Additional Quantity Required (5)
18.	Ammeter	2		
19.	Voltmeter	2		
20.	Ohmmeter	2		
21.	Avometer (multimetre)	2		
22.	Auto Electrical system instructional chassis	1		
23.	Valve spring compressor kit	2		
24.	Coil spring compressor	2		
25.	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	1		
31.	Piston ring compressor	2		
32.	Exahust gas analyzer	2		
33.	Axle stands	8		
	OTHER UTILITIES			
1.	Fire extinguishers	4		
2.	Sand buckets	4		
3.	Water buckets	4		
4.	First aid box	1		

List of Participants

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

PROJECT TEAM MEMBERS

S/No.	NAME	DESIGNATION
1	Engr. Dr. Nuru A. Yakubu	National Project Coordinator & Executive Secretary, NBTE
2	Dr. M.S. Abubakar	Technical Coordinator
3	Engr. S.C. Odumah	Curriculum Development Coordinator
4	Mr. B.N. Niriyus	Staff Development Coordinator
5	Engr. Dr. S.N. Mumah	Information & Communication Technology Coordinator
6	Isa Alhaji Sulaimanu	Project Accountant
7	Mal. A.D.K. Muhammad	Project Officer

FIRST REVIEW for NTC AN ANTC: MOTOR VEHICLE MECHANIC WORK

S/NO	NAME	ADDRESS
1.	Usman Yunusa	Kano State Science & Technical Schools Board P.m.B 3147, Kano
2.	John O. Ochedikwu	Govt. Technical College PMB 102036, Makurdi, Benue State.
3.	Emmanuel O. Ogwu	Training Department, Mercedes Benz Anammco Ltd., PMB 2523, Enugu
4.	Lawrence Lawal	Kwara State Polytechnic PMB 1375, Ilorin
5.	Jyn Adoo	National Board for Technical Education, Kaduna

PARTICIPANTS: FINAL REVIEW: MOTOR VEHICLE MECHANIC WORK

S/NO	NAME	ADDRESS
1.	Usman Yunusa	Kano State Science & Technical Schools Board, PMB 3147, Kaduna
2.	Emmanuel O. Ogwu	Training Department, Mercedez Benz ANAMMCO Ltd., PMB 2523, Enugu
3.	Jyn Adoo	National Board for Technical Education, Kaduna