

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
AUTO MECHANICS

PREAMBLE

This syllabus is intended to give the student an insight into the work of a motor mechanic, improve his attitude towards the automobile and its maintenance and enable him to appreciate the relationship between science and technology.

OBJECTIVES

The objectives are to test candidates' ability to:

1. identify, sketch and describe the systems and parts of the automobile.
2. state the functions and explain the working principles of the systems and the main parts.
3. perform simple fault diagnosis, routine maintenance, minor repairs, know and observe safety precautions.
4. adapt the basic knowledge to a wide range of situations.

RUBRIC AND SCHEME OF EXAMINATION

The Examination shall consist of two (2) papers, both of which must be taken.

Paper 1: Practical (2 hours). The practical test will comprise two compulsory questions to be attempted by candidates in two hours.

This paper carries 100 marks.

For the practical test, schools will supply materials needed locally.

Paper 2: Theory (2½ hours). This paper will be divided into two Sections, A and B.

Section A: Objective Test (1 hour). One hour will be allowed for this section which will comprise 40 multiple choice questions. This section carries 40 marks.

Section B: Essay (1½ hours). There will be five questions out of which candidates will be expected to answer any four in 1½ hours. All questions carry equal marks. This section carries 60 marks.

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DETAILED SYLLABUS

S/NO.	TOPIC	THEORY	PRACTICAL
1.	REGULATIONS AND SAFETY	1.1 Instructions in basic safety precautions. Basic tools, instruments, equipment and their maintenance	1.1.1 Identification and use of various types of fire extinguishers and other workshop machinery and equipment.
2.	LAYOUT OF A MOTOR VEHICLE	2.1 Arrangement and functions of the main components of the body and drive of conventional and alternative vehicles, engine, transmission, wheels and tyres, steering, braking, suspension and electrical systems	2.1.1 Inspection of motor vehicle layout, identification of main components for cars and commercial vehicles
3.	ENGINE (a) Main components	3.1 Arrangement and functions of the main components: cylinder head and cover; cylinder block, crankshaft, flywheel, connecting rod, piston and rings, spark plug (petrol), fuel injection pump and injector (diesel), valve, valve springs, oil seal, cam-shaft, push rod, rocker shaft/arms.	3.1.1 Identification of main components. 3.1.2 Decarbonization of cylinder head.
	(b) Principles of operation	3.2 Two stroke and four stroke cycles- petrol and diesel.	
	(c) Types of Engine	3.3 Single and multicylinder engines.	3.3.1 Inspection and classification of engines according to cylinders. 3.3.2 Measurement of the bore and crank-journals for wear.
	(d) Crank arrangement and firing order.	3.4 Crank-arrangement and firing order: 2,4 and 6 cylinder in-line engines; V-4, V-6 and 4-cylinder horizontally opposed engines.	3.4.1 Determination of firing order through valve openings.
	(e) Valve operating mechanism.	3.5 Functions and operation of valve operating mechanism, drives, layout, main components; valve timing including calculation of valve opening and closing periods.	3.5.1 Identification of main components. 3.5.2 Valve adjustments.

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4.	FUEL SYSTEMS	4.1 Fuels and combustion: Elements of combustion; air-fuel ratios; types and properties of fuel-petrol and diesel.	4.1.1. Checking fuel system troubles. 4.1.2. Inspection of exhaust gases for normal air-fuel ratios and excessively worn engine.
		4.2 Petrol: Layout and operation of petrol supply system-gravity and force-feed systems; simple carburettor, multi-jet carburettor. Air filters/cleaners. Mechanical and electrical fuel pumps.	4.2.1 Inspection of layout of petrol supply system: dismantling, examination and reassembling of a mechanical fuel pump. 4.2.2. Dismantling, inspection and reassembling of a carburettor.
		4.3 Diesel: Layout of a diesel supply system; elementary treatment of injection pumps and injectors.	4.3.1 Inspection of various types of injection pumps, servicing of injectors only.
5.	EXHAUST SYSTEM	5.1 Purpose and layout of the system. Types of silencers and manifolds.	5.1.1 Inspection of exhaust system and identification of the exhaust and inlet manifolds.
6.	LUBRICATION	6.1 Engine Lubrication: Reasons for lubrication and types; boundary layer and film lubrication. Lubricated parts and components. Types of feed-splash, forced and mist.	6.1.1 Identification of main components, changing of oil and oil filters.
		6.2 Lubricants: Applications in engines, gear boxes and final drives; viscosity rating, SAE numbers.	6.2.1 Identification of different types of lubricants. Comparing fresh and used oils. Use of the grease gun.
7.	COOLING SYSTEM	7.1 Water Cooling System: Purpose and layout of the system; functions of main components. Thermo-syphon and pump assisted systems.	7.1.1 Identification of main components, inspection of radiator and its construction; replacement of fan belt.
		7.2 Air Cooling System: Layout and functions of the system; main components. Comparison of the air and water cooling systems.	

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8.	TRANSMISSION SYSTEM		
	(a) Layout	8.1 Function of the transmission system. Types-manual and automatic (excluding twin axles and double reduction axles); merits and demerits.	8.1.1 Identification of different types of layout.
	(b) Clutch Assembly	8.2 Functions of a clutch. Types and operating principles of single plate, multiplate and introduction of fluid flywheel. Methods of actuation-hydraulic and mechanical.	8.2.1 Dismantling, identifying parts and re-assembling a clutch unit (single plate). Adjusting clutch pedal clearance and bleeding clutch unit.
	(c) Gearbox	8.3 Types, layout and operating principles of crash, constant mesh and synchromesh gearboxes; main components and their functions. Gear selector mechanism; simple calculations of gear ratios.	8.3.1 Identification of components of a gearbox. 8.3.2 Inspection of gear teeth for wear.
	(d) Propeller shaft and Universal joint.	8.4 Functions of the propeller shaft, universal joint and sliding joint.	8.4.1 Examination of the propeller shaft and universal joint bearings for bow and wear respectively.
	(e) Rear Axle	8.5 Arrangement and functions of main components-final drive gears, differential unit, half shaft, oil seal and hub bearings.	
9.	WHEELS AND TYRES	9.1 Wheels: Road wheels, common types : pressed steel, disc and wire spoke wheels, hub attachments. 9.2 Tyres: Tubed and Tubeless types; Advantages and disadvantages, Types and sizes.	9.1.1 Checking and adjustment of wheel bearing clearance; removal and changing of road wheels. 9.2.1 Tyre fitting and checking tyre pressure.
10.	BRAKING SYSTEM	10.1 Layout, functions and operation of braking system, drum and disc; mechanical and hydraulic. Brake lining materials and methods of attachment. Importance of servo-assisted brake. Advantages and disadvantages of disc and drum brakes.	10.1.1 Inspection of different types of brakes. Replacement of pads and shoes, bleeding and adjustment. "Spot-testing" of brakes.

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11.	STREERING SYSTEM	<p>11.1 General layout and functions of the front axle and steering systems.</p> <p>11.2 Steering geometry: Ackerman linkage, castor, camber, king pin inclination, toe-in and toe-out. Types of steering gearboxes-rack and pinion, recirculating balls only.</p>	<p>11.1.1 Identification of components of different layouts.</p> <p>11.2.1 Front wheel alignment, inspection of tyre wear patterns.</p>
12.	SUSPENSION SYSTEM	<p>12.1 Purpose of the suspension system, layout and types; rigid beam and independent suspension (semi-elliptic and coil springs); advantages and disadvantages, shock absorbers.</p>	<p>12.1.1 Identification of differences between the rigid beam and independent suspension.</p>
13.	<p>ELECTRICAL SYSTEMS</p> <p>(a) Fundamentals</p> <p>(b) Auto Wiring System</p> <p>(c) Ignition System</p> <p>(d) Starting System</p>	<p>13.1 Basic electrical terms and symbols. A.C. and D.C. sources, simple circuits, Ohm's law and calculations involving series and parallel circuits. Basic components and their functions-relays, resistors, lamps, fuses and switches.</p> <p>13.2 Wire gauges, colour coding-reasons for their use. Wiring system-earth and insulated return systems; ways of joining cables-jointing, terminals, connectors soldering.</p> <p>13.3 Layout of the coil ignition system. Function and operation of the main components.</p> <p>13.4 Layout and functions of the main components.</p>	<p>13.1.1 Setting up simple electrical circuits, use of simple electrical measuring instruments.</p> <p>13.2.1 Inspection and identification of various components. Simple soldering.</p> <p>13.3.1 Identification of main components; ignition timing, setting of contact breaker points and spark plug gaps.</p> <p>13.4.1 Inspection and identification of main components.</p>

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	(e) Lighting System	13.5 Layout of the system, main components and their functions. Fuses and bulbs-types and ratings.	13.5.1 Identification of main components, inspection and replacement of bulbs and fuses.
	(f) Charging System	13.6 Layout and operation. Main components and their functions; construction of the lead acid battery. Battery condition and rating. Battery maintenance.	13.6.1 Inspection and identification of the main components. Removing, testing, charging and replacing battery. Preparation of electrolyte.
	(g) Auxilliary Unit	13.7 Identification of the auxilliary units only. Instrument panel, horn, windscreen wiper.	13.7.1 Inspection and testing of main components.
14.	AUTO AIR-CONDITIONING	14.1 Elementary introduction to auto air-conditioning. (Basic principles of operation and identification of parts and their functions)	14.1.1 Inspection of air-conditioning system and the components.
15.	SAFE MOTORING	15.1 Main causes of accident, essentials of safe driving and application of highway code.	15.1.1 Identification of faults and defective components that could cause accidents. Identification and interpretation of road signs.

RECOMMENDED READING LIST

1. Technology for Motor Mechanics Volumes 1-4 by S.C. Mudd (Edward Arnold Publishers)
2. Vehicle and Engine Technology by Heinz Heister
3. Motor Vehicle Technology and Practical work by J.A. Dolan
4. Fundamentals of Motor Vehicle Technology by Hillier and Pittuk
(4th Edition)
5. Automobile Engine and Vehicle Technology by Ian Chisholm
6. Automotive Mechanics by R.K. Oguuah
7. Motor Vehicle Technology (Books I and II) by R.W. Bent
8. Motor Vehicle Mechanic's Textbook by F.K. Sulley
(New Edition)