

020 – MOTOR VEHICLE MECHANICS WORK

EXAMINATION STRUCTURE

The trade consists of the following related courses:

191 – Metal Work (CME 11 and 12)

193 – Engineering Drawing (CTD 11, 12 and 13)

This course shall be examined under one component.

021 – Motor Vehicle Mechanic Work (CMV 10, 11, 12, 13, 14, 15 and 16)

EXAMINATION SCHEME

021-1 PAPER I: Two Sections A & B

21-1 – PAPER I : This will consists of:

SECTION A: Objective. This Paper will be 40 Multiple Choice questions to be answered in 40 minutes for 40 marks.

SECTION B: Essay, comprise of seven questions out of which five questions should be answered in 3 hours for 60 marks.

21-2 PAPER II: This paper will consist of two Practical Test based on CMV 10, 11, 12, 13, 14, 15 and 16 Syllabuses. Time allotted as appropriate is 3 hours for 100 marks.

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021 – MOTOR VEHICLE MECHANIC WORK

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVCITIES/REMARK
1.	<p><u>Introduction to Motor Vehicle</u></p> <p>1. Identify and describe in detail, the principle components, auxiliaries and systems of a motor vehicle.</p> <p>2. Sketch and explain the chassis layout showing relative position of the main components of a vehicle</p>	<p>1. Principal components of motor vehicle:</p> <ol style="list-style-type: none"> i. Engine ii. Transmission system iii. Chassis iv. Steering System v. Suspension System vi. Braking System <p>2. Functions of each principal components.</p> <p>3. Principles of operations of each principal components; e.g. engine, transmission, propeller, shaft, rear axle, suspension and steering control linkages to road wheel etc.</p>	<ol style="list-style-type: none"> 1. Identify the principal components. 2. State the functions of each principal components. 3. Sketch the principal component of motor vehicle. 4. Emphasize the importance of principal components and their function.
2.	<p><u>Securing Locking and Sealing Devices</u></p> <p>1. Explain the functions, strength and limitations of the securing, locking and sealing devices.</p> <p>2. Perform securing sealing and locking operations on components of a private car and commercial vehicle.</p>	<p>1. Functions, strength and limitations of:</p> <ol style="list-style-type: none"> i. Locking Devices ii. Securing Devices iii. Sealing devices e.g. BSN, BSF, BSP, UNC etc Springs, tab washers, Gasket, joints, plugs etc <p>2. 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</p>	<ol style="list-style-type: none"> 1. Carry out securing, sealing and locking operations on components of a motor vehicle. 2. Use rubber seal and change oil filter, tighten same to stop oil leakages. Emphasize the importance of the use of correct locking and sealing devices in motor vehicle.
3.	<p><u>Routine Maintenance</u></p> <p>1. Explain the basic operations in routine vehicle maintenance.</p> <p>2. Identify lubricant types and their specific uses; grease joint and top-up gear box, rear axle etc.</p> <p>3. Clean, replace and maintain oil filters, air filter, and electrical units. Top-up brake and clutch cylinders with hydraulic fluid.</p>	<p>1. Operations in routine engine maintenance.</p> <p>2. Types of lubricant and their application e.g. grease, vegetable base grease, animal base grease, etc. Oil – SAE Rating, multi-grade oil, Fluid-High and low boiling oil fluid.</p> <p>3. Replace of oil filter.</p> <p>4. a) Cleaning of oil bath air-filter b) Replacement of pipe filter elements</p> <p>5. a) Checking and topping up brake fluid reservoir b) Checking and topping clutch fluid reservoir.</p>	<ol style="list-style-type: none"> 1. Change oil, oil filter, spark plugs, contact breaker, etc. Clean and adjust carburetor. 2. Check distributor leads and petrol pump. Grease joints; check and top up gear box, rear axle and engine (if necessary). 3. Replace oil filter. Clean oil bath filter. Replace paper filter elements. 4. Check and top us brake and clutch fluid reservoirs. Check the operation.
4.	<p><u>Battery Maintenance</u></p> <p>1. Explain the basic construction of a battery.</p> <p>2. Maintain the battery for long life.</p>	<ol style="list-style-type: none"> 1. construction of a battery and its components. 2. Topping up battery with distilled water (if necessary). 3. Securing battery terminals. 4. Specific gravity of a battery. 5. Electrolyte and battery charging. 6. Battery testing e.g. using hydrometer, voltmeter, high rate discharge tester. 	<ol style="list-style-type: none"> 1. Explain basic construction of a battery and its components. 2. Test and charge battery. 3. Check, replace and tighten battery/battery terminals (if necessary).
5.	<p><u>General Maintenance</u></p> <p>Explain the basic process of routine vehicle maintenance, name with emphasis, on</p>	<ol style="list-style-type: none"> 1. Processes of routine vehicle maintenance. 2. Electrical Components, bulbs, fuses, horns and switches. 	<ol style="list-style-type: none"> 1. Explain processes of vehicle maintenance. 2. Use screw driver etc. to replace burnt bulbs and

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	electrical units, cooling systems, brakes, clutches, and chassis.	<ol style="list-style-type: none"> 3. Radiator and radiator water. 4. Fan belt adjustment. 5. Brake pads and lining. 6. Brake and clutch pipelines. 7. Brake drums and wheel cylinders. 8. Corrosion control. 9. Bolts and Nuts. 	<p>fuses.</p> <ol style="list-style-type: none"> 3. Inspect, remove and replace the following radiator hoses, clips fan belt. 4. Inspect, remove and replace brake pads/linings and wheel cylinders. 5. Tightening all bolts and nuts. 6. Clean and apply protective chemicals. 7. Emphasize the importance of good maintenence schedule and procedure for motor vehicle.
6.	<p><u>Wheel and Tyre Repairs</u></p> <ol style="list-style-type: none"> 1. Inflate and vulcanize tyres and perform wheel balancing to accuracy. 2. Inspect and maintain road wheels. 3. Carry out wheel alignment and change tyre to balance wear. 	<ol style="list-style-type: none"> 1. Road wheels and tyre pressures. 2. Vulcanizing tubes and tubeless tyres. 3. Wheel balancing. 4. Vehicle types and tyre sizes 5. Wheel alignment. 6. Tyre rotation. 	<ol style="list-style-type: none"> 1. Vulcanize tubes/tubeless tyres and inflate to correct pressure. 2. Carry out wheel balancing with facilities. 3. Differentiate tyre sizes and match tyre to vehicle types. 4. Rotate tyres and carry out wheel alignment. Emphasize the importance of correct tyre pressure alignment, setting and tyre rotation.
7.	<p><u>Spark/Compression Ignition Engine</u></p> <ol style="list-style-type: none"> 1. Identify, draw line diagrams and explain the constructional details of main components parts of a multi-cylinder engine. 2. Explain the working sequence of engines and the courses and effect of detonation. 3. Explain the use of octane and cetance rating. 4. Explain the viscosity of lubricant and the use of additives. 5. Sketch lubricating system of an engine. 	<ol style="list-style-type: none"> 1. <ol style="list-style-type: none"> a) Identification of the main component parts of a multi-cylinder engines. b) Line diagrams of multi-cylinder engines. 2. Constructional details of cylinder blocks, heads, gaskets; cylinder lines and sumps. 3. Working sequence of two and four stroke engines. 4. <ol style="list-style-type: none"> a) Functions of a cylinder head gasket. b) The effects of detonation. 5. Causes and effects of detonation. 6. Use of octane and cetane ratings. 7. Oil viscosity and additives. 8. <ol style="list-style-type: none"> a) Engine lubricating system b) Cooling system c) Fuel supply system 	<ol style="list-style-type: none"> 1. Identify and name the main components of cylinder head, valves, crankshaft, piston etc. 2. Draw the constructional details of cylinder block, head, cylinder liners and sump. 3. Explain the sequence of operation of two four and six cylinder engines. Emphasize the importance of lubricating system
8.	<p><u>Service Station Operation Procedure</u></p> <ol style="list-style-type: none"> 1. State properties and 	<ol style="list-style-type: none"> 1. Features, application and properties of fuel, lubricants, tyres, batteries and vehicle accessories. 	<ol style="list-style-type: none"> 1. State the features, application and properties of fuel, lubricants, tyres

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	<p>application of fuels, lubricants, tyres, batteries and vehicle accessories.</p> <p>2. Explain Forecourt procedure and operate the forecourt equipment and provide efficient comprehensive forecourt salos.</p>	<p>2. Forecourt procedures.</p> <p>3. Sale of vehicle accessories and handling of cash.</p>	<p>etc.</p> <p>2. Operate the different equipment to service related jobs.</p> <p>3. Practice selling of tyres, batteries and tubes. Emphasize accurate recording and handling of cash/cash book.</p>
9.	<p>Vehicle Recovering</p> <p>1. Explain vehicle breakdown recovery procedure and list the equipment used.</p> <p>2. Carry out vehicle recovery duties using appropriate vehicle and observe necessary safety precautions.</p>	<p>1. Safety precautions, e.g. warning sign, overhead flashing, light, security of hook etc.</p> <p>2. Vehicle recovery procedures.</p> <p>3. Towing vehicles.</p>	<p>Used appropriate towing van to tow a broken down vehicle</p> <p>Emphasize the importance of safety.</p>
10.	<p>Fuel Storage</p> <p>1. Sketch a typical fuel oil installation and enumerate the precautions necessary to avoid fuel oil contamination during handling or storing.</p> <p>2. Describe the health hazard resulting from mishandling of fuel oil and the required precaution.</p> <p>3. State the safety precaution to be observed when operating high pressure fuel injection system and define the properties of fuel oil.</p> <p>4. Draw a cross section of a typical fuel filter and explain the need for constant maintenance.</p>	<p>1. Fuel, oil storage and precautions.</p> <p>2. Safety precautions in fuel injection system.</p> <p>3. Properties of fuel e.g. diesel index, viscosity, volatility, flash point, cloud point, composition, calorific value, cetance and octane rating.</p> <p>4. Fuel filtration.</p>	<p>1. Sketch a typical fuel storage installation.</p> <p>2. List safety precautions.</p> <p>3. Define each of the properties in turn and illustrate with example.</p> <p>4. Explain how the agglomerator works.</p> <p>5. Sketch a typical fuel filter and label the parts.</p> <p>6. Emphasize the importance and safety precautions required for fuel storage and handling.</p>
11.	<p>Clutch</p> <p>1. Explain the construction and operation of single and multiple clutch systems and identify and state the characteristics of the types used in vehicles.</p> <p>2. Explain the disengagement of clutch</p>	<p>1. Construction and operation of single and multiple plate systems.</p> <p>2. Identification of parts and characteristics of clutches</p> <p>3. Clutch disengagement e.g. mechanical and hydraulic means.</p> <p>4. Tools/equipment for servicing clutch system.</p> <p>5. Checking for faults in clutch.</p> <p>6. Checking clutch assembly and testing for</p>	<p>1. Explain the materials used for the construction of clutch, operations of single and multiple clutches.</p> <p>2. Identify by touch and state the characteristics of single and multi-plate, hydraulic and mechanical.</p> <p>3. Identify servicing tools/equipment for clutch</p>

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	<p>by mechanical and hydraulic means and sketch parts in good proportion system</p> <ol style="list-style-type: none"> Identify tools and equipment used on clutch and diagnose faults in any clutch assembly. Remove, dismantle and repair clutch assembly and test clutch spring. Bench test clutch assembly and fit to the vehicle and adjust free pedal clearance and road test the vehicle. 	<p>compression.</p> <ol style="list-style-type: none"> Fixing clutch unit for vehicle and testing clutch spring compression. 	<p>and sketch component parts.</p> <ol style="list-style-type: none"> Check for faults in clutch dismantle, repair, assemble and test for effectiveness. Fit clutch assembly for vehicle and adjust free pedal clearance and test drive the vehicle. Emphasize the importance of good clutch assembly.
12.	<p>Gearboxes</p> <ol style="list-style-type: none"> Identify tools and equipment used for removal, repair and adjustment of synchro mesh gear box and describe the construction and operation of a three-speed, a four-speed and constant mesh type. Explain the principles of synchronization, gear ratio, driving torque, bearing load and types of locking devices. State the purpose of locking and interlocking devices in the selector mechanism and the function of the free wheel and overdrive units. 	<ol style="list-style-type: none"> Tools/equipment for servicing of gearbox, spanner, screw drivers, pliers etc. Construction materials and operation of gearbox. Locking, interlocking and selector mechanism in gearbox Functions of free-wheel, and over drive units and lubrication method of gearbox. Principles of gears and automatic gearbox. Checking gearbox for faults, dismantle, reassemble and test for efficiency. 	<ol style="list-style-type: none"> Identify the various tools and equipment used for servicing a gearbox. <ol style="list-style-type: none"> Describe the construction and materials used for design of gearbox and gears. Sketch typical three and four-speed gearbox and label parts. State the purpose of locking, inter locking and selector mechanism and method of gearbox lubrications. State the functions of the free wheel and the over drive. Carry out repairs on a gearbox using the following procedures: <ol style="list-style-type: none"> dismantle the gearbox; clean and display all the parts on a machine table; assess wear on parts by inspection test and measurement; replace worn out parts and bushes; reasonable unit components of gearbox as appropriate. <p>Emphasize the importance of good explanation and correct coupling</p>

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			procedure.
13.	<p><u>Gear Linkages</u></p> <ol style="list-style-type: none"> 1. Explain the principles of gearing and sketch various layout of gear train. 2. Sketch the layout and construction of the parts of chassis, suspension and steering mechanism and state the purpose of locking and inter-locking devices in the selector mechanism. 3. State the function of the final drive gears and different assembly and test gearbox for correct gear ratios 4. Refit assembled gearbox to engine and road test a vehicle fitted with a reconditioned gearbox. 	<ol style="list-style-type: none"> 1. Gear trains and principles of gearing simple train, compound train and epicyclic gearing. 2. Layout and construction of component parts of suspension and steering system. 3. Selector mechanism. Locking and interlocking devices. 4. Functions of different units, final drive and gearbox. 5. Inspection of gear box for faults dismantling and road testing. 	<ol style="list-style-type: none"> 1. With the aid of a neat sketch, explain the basic principles of gearing. 2. Sketch in good proportion chassis suspension and steering systems, 3. State the purpose of the selector mechanism, locking and interlocking devices. 4. Service gearbox and toad test vehicle fitted with a reconditioned gearbox and adjust the linkage if necessary.
14.	<p><u>Propeller/Drive Shaft Reconditioning</u></p> <ol style="list-style-type: none"> 1. Explain its principles of operations mode of construction, layout, assembly. 2. Explain the principles of road and the drive reaction in relation to the action of propeller joint and identify various tools and equipment used for repair. 3. Explain the concept of motion and change in velocity in relation to change in drive angle and describe the types of universal joints used on vehicles and the principle of operations of front wheel drive and its advantages. 4. Explain and sketch the propeller shaft in transmission system and diagnose faults on it. 	<ol style="list-style-type: none"> 1. a) Principles of operation of propeller shaft and drive shaft. b) Construction of propeller shaft and drive shaft. 2. Identification of tools/equipment for servicing of propeller and drive shafts. 3. Principles of operations of front wheel and other drives. 4. Functions of propeller and sketch of component parts. 5. Faults on drive shaft, road wheel and propeller shaft. 	<ol style="list-style-type: none"> 1. Explain the principles of operations, mode of construction layout and assembly of propeller and drive shafts. 2. Use the appropriate tool/equipment to service drive shaft. 3. State the advantages of front wheel drive over other drives. 4. State the functions of propeller shaft and its component parts. 5. Display a diagram showing the related position of propeller and drive shaft.
15.	<p><u>Propeller Shaft</u></p> <ol style="list-style-type: none"> 1. Dismantle in correct sequence and assess for wear on joints, coupling, 	Dismantling universal joints for faults, repair and test for efficiency.	<ol style="list-style-type: none"> 1. Dismantling universal joints in a systematic manner and observe the faults and replace if

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	<p>bearings and replaced damaged unit.</p> <p>2. Assemble with correct procedure and road test vehicle for effectiveness after repair.</p>		<p>necessary.</p> <p>2. Using the appropriate tools, assembling universal joints following the correct procedure.</p>
16.	<p><u>Final Drive and Differential Unit</u></p> <p>1. Explain the functions of the differential and display types of axle drive and arrangements.</p> <p>2. Sketch component parts and calculate pre-load torque with spring balance and state the principles of operations of the differential and final drives.</p> <p>3. Diagnose faults, remove, repair, replace and adjust final drive assembly and dismantle and clean and assess degree of wear.</p> <p>4. Replace worn parts and reassemble.</p>	<p>1. a) Functions of the differential unit – crown wheel pinion etc. b) Types of differential unit.</p> <p>2. a) Sketching component parts of differential unit, drive shaft and propeller shaft. b) State the principles of their operations.</p> <p>3. Calculation of pre-load and torque.</p> <p>4. Inspection of differential units for faults dismantling reassemble and testing e.g. Drive Pinion Axle, Differential Case, Pinion Gear, Shaft etc.</p>	<p>1. Identification of each component and state the function of each.</p> <p>2. Dismantle the differential unit using appropriate wrench and identify the parts and types of drive axle.</p> <p>3. Sketch the differential unit drive shaft and propeller shaft.</p> <p>4. Use spring balance to check pre-load torque and carry out simple calculation of pre-load torque.</p> <p>5. Use appropriate sketch to illustrate the mode of operation of the differential and final drives.</p> <p>6. Inspect and or road test these units for faults: such as humming, Noise on Curve, slip etc. dismantle and test for efficiency.</p>
17.	<p><u>Final Drive</u></p> <p>1. Adjust the crown wheel and pinion into correct mesh ensuring required backlash and examine axle-shaft splines for wear and replace if necessary.</p> <p>2. Examine hub for wear, replace, adjust and road-test for efficiency.</p>	<p>1. Adjustment of pinion, crown wheel, shaft within the axle unit.</p> <p>2. Examination of hub back axle shaft for faults in dismantling and testing.</p>	<p>1. Use appropriate wrench to adjust the pinion against the crown wheel for effectiveness.</p> <p>2. Examine the hub bearing for wear and adjust as appropriate.</p> <p>3. Emphasize correct and adequate physical inspection fixing and adjustment.</p>
18.	<p><u>Multi-Drive Axles</u></p> <p>1. Explain the operations of double reduction and describe process of adjustment and maintenance of a multi-drive axle.</p> <p>2. Draw layout of four-wheel drive and carry out</p>	<p>1. Operation of double reduction axle and other drives.</p> <p>2. Maintenance of multi-drive axle.</p> <p>3. Sketching and explanation of four wheel drive and other axle drives</p> <p>4. a) Types of axle shaft. b) Materials for construction axle.</p>	<p>1. Use simple sketch to explain double reduction drive and other axle drives.</p> <p>2. Sketch and label a four-wheel drive.</p> <p>3. State the materials for construction of axle casing and carry out the servicing of axle.</p>

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	<p>necessary adjustment and repair.</p> <p>3. Explain the operations of four-wheel drive and the method of construction of axle casing.</p> <p>4. Describe the types of axle shafts and their construction and state the materials used.</p>		<p>4. name the three types of axle shaft.</p> <p>5. Emphasize the importance of servicing.</p>
19.	<p><u>Chassis Components and Layout</u></p> <p>1. State and sketch the principles of chassis layout and explain the basic working principles of various types.</p> <p>2. Identify the current system and select tools and equipment required and adjustment.</p> <p>3. Carry out routine maintenance on the system and fit replacement members for bracket.</p> <p>4. Carry out chassis adjustment and assess wear on gears of steering box. Also assess wear on joints, hub, stub, axle and swive pin assemblies. Renew if necessary.</p> <p>5. Explain and sketch suspension system.</p>	<p>1. Principles of chassis layout.</p> <p>2. Basic working principles of various types of suspension system.</p> <p>3. Identification and selection of tools/equipment for the maintenance of chassis suspension and steering system.</p> <p>4. Checking chassis for faults.</p> <p>5. Types of steering and steering boxes e.g worm and worm wheel.</p> <p>6. Steering faults.</p> <p>7. Principles of operations for suspension system – independent front suspension – Air suspension, metal springs etc.</p>	<p>1. Sketch and label the chassis layout.</p> <p>2. Explain the principles of operation of the suspension system.</p> <p>3. Identify and select tools/ equipment for maintenance of chassis suspension and steering system.</p> <p>4. Check chassis for faults and rectify.</p> <p>5. Emphasize correct fixing diagnose of faults and safety precaution.</p>
20.	<p><u>Steering Construction and Repair</u></p> <p>1. Explain the principles of steering construction and describe the steering gear layout.</p> <p>2. State ‘Ackerman’ angle and carry out steering geometry, check the adjustment.</p> <p>3. Enumerate the effect of defects in suspension and steering on types wear and sketch the layout and construction of the part of the suspension</p>	<p>1. Principles of steering construction in a motor vehicle.</p> <p>2. Steering layout-beam types, independent front suspension.</p> <p>3. Effects of defects in chassis suspension and steering systems.</p> <p>4. Types of vehicle body.</p> <p>5. Principles of Ackerman linkage – Ackerman angle, Camber, King Pin, Inclination, Tow-in Toe-out, under steering, over-steering slip angle and their adjustments.</p> <p>6. Rack and Pinion assembly e.g. component, adjustment, attachment to vehicle, lubrication, operation etc.</p>	<p>1. With sketch, explain the principles of steering construction.</p> <p>2. State types of steering.</p> <p>3. Explain the effects of defects in chassis suspension and steering system.</p> <p>4. Describe the various types of vehicle body.</p> <p>5. Explain Ackerman linkage and describe the rack and pinion assembly.</p> <p>6. Describe the action of steering boxes in use.</p>

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	<p>and steering system.</p> <p>4. Describe types of vehicle bodies and explain the functions of steering terms.</p> <p>5. Describe the rack and pinion steering assembly and the action of the main types of steering box in use today.</p>		
21.	<p>Braking System</p> <p>1. Explain the principles of the various braking system and the basic concept of friction and its application on hydraulic brakes</p> <p>2. State the working principles of exhaust braking system and its operation and the concept of friction and co-efficient of friction and performance of braking effort on different surfaces and weather.</p> <p>3. Calculate stopping distance of vehicle and diagnose and rectify faults with the braking system.</p> <p>4. Assess wear and locate and rectify leakages in hydraulic and air system.</p> <p>5. Repair brakes and adjust and bleed the line to expel air in the system.</p> <p>6. Describe the operation process of various braking mechanism and check airline pressure for leakage.</p> <p>7. Sketch various layout of braking system component parts in detail.</p> <p>8. State the safety precautions to be observed with brake fluid.</p> <p>9. Test vehicle braking system and road test.</p> <p>10. Explain the process of</p>	<p>1. Principles of braking system.</p> <p>2. Basic concepts of friction as applied to braking system.</p> <p>3. Working principles of exhaust braking system.</p> <p>4. Calculation of stopping distance.</p> <p>5. Assessment of braking system for faults.</p> <p>6. Servicing of braking system.</p> <p>7. Principles of operation of:</p> <p>a) Fixed and floating cam;</p> <p>b) Single and Multi-piston master.</p> <p>8. Airline pressure.</p> <p>9. Braking systems component parts.</p> <p>10. Brake fluid.</p> <p>11. Basic construction of tyres and wheel balancing.</p>	<p>1. Explain the principles of braking system and concept of friction.</p> <p>1. Explain the principles of braking system and concept of friction</p> <p>2. Calculate stopping distance.</p> <p>3. Diagnose and rectify faults in braking system and service brakes.</p> <p>4. Use sketches to describe the principles of operation in item 7 under content.</p> <p>5. State the component parts.</p> <p>6. State safety precautions associated with brake fluid.</p> <p>7. Explain the construction of tyres and carry out wheel balancing.</p> <p>8. Emphasize the importance of braking system and the importance of wheel balancing and correct tyre pressure.</p>

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	wheel balancing and the basic construction of tyres and different types sizes		
22.	<p><u>Engine Tuning, Testing and Faults Diagnosis</u></p> <ol style="list-style-type: none"> 1. Explain the working principles of petrol engines and functions of the following: piston, rings, gudgeon, pins. 2. Explain the principles of different types of carburetors and service most commonly used. 3. Explain the operations and use of contact breaker. Clean and adjust contact breakers. 4. Clean and adjust contact breakers. 5. Describe the function of a retard and advance mechanism. 6. Service and test mechanical or vacuum automatic ignition advance mechanism. 7. Explain the general principles and types of combustion chamber design. 8. Maintain and adjust spark plugs. 9. Draw and explain the operations of fuel pumps. 10. Carry out complete engine tuning. 	<ol style="list-style-type: none"> 1. Working principles of single and multi-cylinder engines. 2. Types and functions of piston, rings and gudgeon pin. 3. Differences between single and multi-cylinder engines. 4. Principles of operations of different carburetors e.g. Zenith, Solex, S. U. single and double barrel carburetors. 5. Operations and servicing of contact breaker. 6. Functions and servicing of ignition retard and advance mechanism. 7. Valve and ignition timing. 8. Types of combustion chambers design. 9. Checking and testing concave flat piston head, ignition components. 10. Servicing of spark plugs, diatrobuster. 11. Operations and testing of fuel lift pumps. 12. Compression text. 13. Tightening sequence of cylinder head studs and nut, bolts, etc. 14. Engine tuning. 15. Carburetors servicing. 	<ol style="list-style-type: none"> 1. Explain the working principles of single and multi-cylinder engines. 2. Explain the types and functions of piston, rings and gudgeon pins. 3. State the differences between single and multi-cylinder engines. 4. Explain the principles of different carburetors. 5. Service contact breaker and spark plugs. 6. Service and test ignition retard and advance mechanism. 7. Carry out valve and ignition timing. 8. Explain with sketches the different combustion chambers design. 9. Check and test spark ignition system. 10. Service and test fuel lift pumps. 11. Carry out engine compression/Vacuum test. 12. Tighten cylinder head studs/nuts. 13. Tune engine. Emphasize the importance of various tests and adjustments using appropriate tools/instruments.
22.	<p><u>Fuel System Reconditioning</u></p> <ol style="list-style-type: none"> 1. Describe the general layout and explain the working principles of the fuel system of a motor vehicle. 2. List types of carburetor and describe the actions of a lift pump. 3. Trace and repair leakages in a fuel system. 	<ol style="list-style-type: none"> 1. General layout and working principles of fuel system: tank, lines fuel pump. 2. Principles and functions of simple and multi-jet carburetors. 3. Types of carburetors and mixture control. 4. Action of a lift pump and the need for a bleed system of controlling mixture. 5. Cold starting devices – e.g. choke. 6. Servicing and testing fuel pump. 7. Tracing and Repairing of faults in fuel system. 	<ol style="list-style-type: none"> 1. Sketch and explain the working principles of fuel system. 2. Explain the principles and functions of carburetors. 3. Differentiate between constant choke and constant vacuum. 4. Describe the operation of a lift pump and the bleed system. 5. Explain the operations of cold starting devices. 6. Services fuel pump and

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			test for fuel delivery. 7. Trace and repair faults in fuel system.
23.	Valves 1. Explain the working principles of valves. 2. Recognise cams and camshafts drive arrangement. 3. Explain various engine layout. 4. Adjust valve to fine-tune engine. 5. Sketch and label a typical timing diagram for a spark ignition engine and distinguish from the timing diagram between a C.I and S.I engine. 6. Describe valve terms and carry out valve timing with special reference to the terms.	1. Basic principles of valve. 2. Cams and Camshaft drive arrangement. 3. Layout of various engine valve, gear arrangement etc. 4. Engine faults diagnosis. 5. Adjustment of valves. 6. Fine-tuning of the engine. 7. Valve timing diagram for S.I and C.I engine. 8. Define the terms: a. valve overlap. b. Valve lead. c. Valve lag. 9. Valve timing.	1. Explain the basic principles of valve. 2. Sketch and identify various cams and camshafts arrangement. 3. Explain the layout of various engine valve and gear arrangement. 4. Diagnose engine faults by testing/running and listening to the engine sound. 5. Rectify faults. 6. Check and adjust valve clearance using appropriate tools. 7. Fine-tune the engine. 8. sketch and label the valve timing diagram. a. Draw and label typical valve timing diagrams for S.I and C.I engines. b. List the differences between S.I and C.I 9. Define the terms: a. valve overlap. b. Valve lead. 10. Time and engine noting the timing mark. 11. Emphasize accurate timing of valve.
24.	Ignition System Repair 1. Explain the working principles of an ignition system. 2. Diagnose and maintain a spark ignition system.	1. Working principles of an ignition system of a motor vehicle. 2. Ignition system faults. 3. Ignition system components parts e.g. spark plugs, distributors, condense. 4. Ignition timing.	1. With a circuit diagram explain the working principles of a coil ignition system. 2. Diagnose ignition system faults. 3. Rewire the ignition system using fresh wire.
25.	Cooling System Repair Air/Water 1. Explain the functions of the cooling system. 2. Explain how heat is dissipated in air cooled engine. 3. List and describe faults attributable to air cooled engine.	1. Working principles and functions of engine cooling system. 2. Main feature of cooling system. 3. Heat dissipation in air-cooled engine. 4. Faults associated with air and liquid cooled engines and how to rectify them. 5. Fan and Cowl air cooling assembly. 6. Temperature control of the cooling system thermostat. 7. Types of water pump and their functions. 8. Adjustment of fan belts.	1. Explain how heat is dissipated in air cooled engine. 2. List the faults and rectify them. 3. Sketch a fan and cowl air cooling system. 4. Explain the working principles and testing techniques of thermostat. 5. Remove, inspect replace

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	<ol style="list-style-type: none"> 4. Describe the operation of the thermostat. 5. Maintain a water cooled system. 6. List and explain the safety rules associated with cooling system. 7. Sketch and study the parts of radiator and maintain it. 8. Rectify air and liquid cooling system problems. 	<ol style="list-style-type: none"> 9. Principles and action of impeller and pressurised cooling system. 10. Concept of pressure and relationship between volume and pressure. 11. Safety rules associated with working on the cooling system. 12. Sketch of a radiator, showing details of water passages, radiator caps, hoses etc. 	<ol style="list-style-type: none"> and adjust fan belts. 6. State the type of water pumps. 7. Explain the functions and carry out test to determine its effectiveness 8. State the principles and action of the impeller and pressurised cooling system. 9. Explain the concept of pressure. 10. Draw radiator showing details. 11. flush a radiator. 12. Emphasize the danger of removing pressurised filler cap when the engine is hot.
26.	<p><u>Safety Precaution</u> Apply safety and use manual or service tools correctly.</p>	<ol style="list-style-type: none"> 1. Safety environment. 2. Service manual and service tools. 3. Standardize jobs. 4. Correct techniques. 	<ol style="list-style-type: none"> 1. Apply safety and use manual or service tools correctly to ensure safe working condition. <p>Emphasize safe working habit and environment.</p>
27.	<p><u>Compression Ignition Engine</u></p> <ol style="list-style-type: none"> 1. Explain the principle of atomization and its usage and the types and functions of the combustion chamber as related to C. I. Engine. 2. Explain the characteristics of various types of nozzle design and pressure braking point of injector nozzle. 3. Diagnose faults and remove injector assembly and identify various hand tools and equipment for removal, assembling, adjustment and testing of injectors. 4. Inspect injector component parts for wear and replace defective ones. 5. Assemble component parts and test with standard equipment and describe the process of fuel filtration. 6. Sketch various types of injectors and nozzle. 	<ol style="list-style-type: none"> 1. Principles of atomization. 2. Types and function of C.I. engine combustion chambers. 3. Characteristics of various nozzle. 4. Fault diagnosing in engine. 5. Servicing of fuel injectors. 6. Fuel strainer primary and secondary. 7. Sketch the various types of nozzles. 	<ol style="list-style-type: none"> 1. Explain the principles of atomization as related to vehicle engine. 2. Sketch different combustion chamber designs. 3. Display different types of injector nozzle and identify each type. 4. Listen to the sound of the engine to determine whether there are faults. 5. Service fuel injectors. 6. With the aid of a near sketch describe the fuel filtration in diesel engines.

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28.	<p><u>Fuel Injector System</u></p> <ol style="list-style-type: none"> 1. State the working principles of in-line and rotary pump and define the need and process of phasing the in-line pump. 2. Explain the principle of petrol injection system and repair in-line and rotary pumps. 3. Overhaul and time the two pumps and calibrate and describe the pump rooms and test equipment. Apply the safety with fuel oil testing procedure. 4. Describe injector functions and sketch the component parts of the fuel injector. 5. Instal injector pump, changes filters, clean fuel tanks, and bleed the system. 6. Remove injector pump and inspect components parts for wear and serviceability and reassemble. 7. Phase and calibrate to the manufacturers specifications and describe the provision for adjustment on the governors. 8. Explain the method of end time in-line pump on engine and with diagram the operation of distributors type pumps. 9. Explain the action of the mechanical and hydraulic governors in relation to the distributor type pump and the common faults which would make the mechanical governors misoperative. 	<ol style="list-style-type: none"> 1. Working principles of in-line and rotary pumps. 2. Need and processes of phasing and calibrating of in-line pump. 3. Principles of petrol injection system. 4. Repairing of the in-line and rotary pumps. 5. Overhauling of in-line and rotary pumps. 6. Overhauling of in-line and rotary injector pumps. 7. Safety and health precautions. 8. Functions of injectors. 9. Component parts of fuel injector e.g. injection pump, assembly – feed pump, fuel filter etc. 10. Removal and installation of injector pump. 11. Cleaning the system parts and changing filters. 12. Provision for governors e.g. hydraulic, mechanical and pneumatic. 13. Review of DPA operations. 14. Action of the Hydraulic, mechanical governors, and distributor type pump. 15. Common faults in the Mechanical governors. 	<ol style="list-style-type: none"> 1. Display the two type of pump and state the differences between the two. 2. Use the appropriate tool to repair in-line and rotary pumps. 3. Identify main parts of a typical petrol injection system. 4. Overhaul in-line and rotary pumps. 5. Testing equipment tools etc. 6. Describe how fuel is delivered to the cylinders. 7. Sketch in good proportion the component parts of the injection pump and label them. 8. Time and install injector pump. 9. Use the equipment and tools to phase and calibrate injection pump. 10. Using the appropriate tools, service a diesel engine. 11. Sketch the rotary distributor type pump and label its parts. 12. List common faults in the mechanical governors. <p>Emphasize the importance of fixing the in-line and rotary pumps in good order.</p>
29.	<p><u>Engine Tuning, Testing and Faults Diagnosis</u></p> <ol style="list-style-type: none"> 1. Explain the operation of the diesel engine and the concept of pressure 	<ol style="list-style-type: none"> 1. The four stroke circle (diesel engine). 2. Pressure and volume. 3. Working of the fuel injection system. Pumping of fuel, meters, time and deliver. 	<ol style="list-style-type: none"> 1. Sketch of each of the four stages of the four stroke circle. 2. Explain the concepts of pressure negative and

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	<p>negative and positive and the relationship between volume and pressure.</p> <ol style="list-style-type: none"> explain the working principle of fuel injection system and replace fuel filter correctly. Service and test injectors and replace and retime the pumps to the engine. Maintain fuel lift pump and check the mechanical condition of the engine with compressed air pressure and explain the need for correct valve setting for engine noise and reset it to makers' specification with the correct tools. Test engine to adjust peak performance and fuel timing it. 	<ol style="list-style-type: none"> Fuel filter – types and materials used. Review of servicing injectors and engine, injector pump. Fuel lift pump. Assessing engine mechanical condition. Setting of valve. Testing and adjusting the engine to peak performance. 	<p>positive and relationship between volume and pressure.</p> <ol style="list-style-type: none"> Describe how fuel is drawn by the fuel pump, metered, times and delivered. Test pump for fuel delivery. Assess valve for clearance and reset with the appropriate tools to improve engine performance. Emphasize the importance of engine tuning/testing and fault diagnosis.
30.	<p><u>Fuel Injection Repair</u></p> <ol style="list-style-type: none"> Explain the purpose of bleeding of a diesel engine and how non-bleeding affects engine performance. Bleed a fuel system when the engine is running 	<ol style="list-style-type: none"> Purpose of bleeding Fuel Injection system. Bleeding of fuel injection system. 	<ol style="list-style-type: none"> Explain how to bleed a diesel engine to remove bubbles of air in the system. Carry out bleeding before starting using the appropriate tools and bleed when the engine is running.
31.	<p><u>Injection Pump and Governors</u></p> <ol style="list-style-type: none"> Explain the working principles of a fuel injection pumps and describe the components of fuel injection pump and governors and their functions. Explain the functions of the different types of governors used on diesel engine and diagnose faults in pumps and governors. Carry out repairs in a faulty pumps and governors and adjust for efficient running of the engine. 	<ol style="list-style-type: none"> Working principles of fuel injection pump. Fuel injection pump components and their functions e.g. cam, delivery valve, control sleeve, barrel, plunger etc. Speed regulation, and control of engine. Faults in pumps and governors. Repairing of faulty pumps and governors. 	<ol style="list-style-type: none"> Explain how the injection pump works. With a simple sketch, describe how the components of the injector work. Diagnose faults in pumps and governors: By listening to the sound of engine physically and how faulty one could be detected and serviced. Select the appropriate tools/equipment, carry out repairs in injector pump and governor in a dist-free room. Adjust pump/governor for efficiency Emphasize the importance of correct coupling and repair of injector pumps and governors.

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32.	<p><u>Diesel Engine</u></p> <ol style="list-style-type: none"> Describe the common faults and symptoms attributable to particular faults on a diesel engine and carry out various test to detect faults. Repair faults in a diesel engine and test for performance. 	<ol style="list-style-type: none"> Symptoms of common faults in the diesel engine. Diagnose faults. Faults and repairs in diesel engine. 	<ol style="list-style-type: none"> Describe the common symptoms and faults in the diesel engine. Detect engine faults and rectify them. Trace fault in these components and effect repair. Emphasize the importance of fault tracing.
33.	<p><u>Engine Construction</u></p> <p>Compare the engine components of the petrol and compression ignition engine stating difference in construction and materials used.</p>	<p>Comparison of components used for engine construction (petrol and diesel):</p> <ol style="list-style-type: none"> piston Connecting rods Main bearings. Big end bearings Crank shaft Valves cylinder heads Cylinder heads Cylinder blocks Fuel system. 	<ol style="list-style-type: none"> List these component parts of petrol and diesel engine and compare both on basis of size and materials for construction. Emphasize the difference in the two on the basis of sizes and nature of materials. State the materials used for the construction of each of the component parts.
34.	<p><u>Wet Sump Lubrication System</u></p> <ol style="list-style-type: none"> Draw a line diagram to show the system for full flow and by-pass and explain how oil is distributed by splash, mist, pressure feed system. Sketch oil pumps and explain the operation of relief valves and sketch the construction of an oil through an engine oil lubricating filter. Describe the gasket and retention and explain the importance of using high grade oil. State the effect of incorrect grade of oil and sources of oil contamination. 	<ol style="list-style-type: none"> Show the layout of the wet pump engine lubrication for full flow by pass. Methods of engine lubrication. Types of oil pump Eaton, Houboum gear types, eccentric rotary types. Construction of oil filter showing the direction of oil flow. Types of gaskets and seals used for engine oil retention. Grade of oil and their effects on engine lubrications. Sources of oil contamination e.g unburnt fuel. 	<ol style="list-style-type: none"> Draw a line diagram of the wet sump lubrication showing direction of flow. Explain how oil is distributed by splash mist and pressure feed system. Ssketch three types of pumps and label the parts. Describe how the relief valve operates. Sketch a typical gasket and seal used in engine oil retention. Explain the importance of grade of oil; e.g. high and low and effect of incorrect use of oil.
35.	<p><u>Dry Sump Lubrication System</u></p> <ol style="list-style-type: none"> Explain the operation of the system and draw its line diagrams and explain the needs for crankcase ventilation. Sketch a typical crankcase ventilation. 	<ol style="list-style-type: none"> Dry sump system operations etc. Crankcase ventilation. Operations of an oil pressure gauge. Oil pressure switch and warning light. Operating principles of an oil cooler. Oil filtration in lubricating turbine engine. 	<ol style="list-style-type: none"> Make a line diagram of a dry sump system and explain its operations. Sketch a typical crankcase ventilation and explain its functions. Sketch and label the oil pressure gauge and state the function.

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	3. Describe the operation of an oil pressure gauge and draw a line diagram of warning light circuit. 4. Draw a cross-sectional view of a pressure switch and describe the operating principles of an oil cooler. 5. Describe the process of oil filtration in the system.		4. Draw an oil pressure switch and oil warning light. 5. Sketch and describe the operating principles of an oil cooler. 6. Explain the process of oil filtration in engine lubricating system.
36.	<u>Cams and Cam Shaft</u> 1. Sketch and label a typical cam and the method of locating the driver gear to the cam shaft. 2. Explain how end float of the cam shaft is controlled and method of camshafts drive. 3. Draw a chain tensioner and describe camshaft lubrication and locate drive gear to camshaft correctly.	1. Shape of cam. 2. Methods of locating the drive gear to the camshaft. 3. Control of the end float of the cam shaft. 4. Chain/timing belt tensioners. 5. Methods of camshaft lubrication.	1. Sketch and label a typical cam, showing valve lift. 2. State the methods of camshaft drive. 3. Draw a chain tensioner and select appropriate tool to fix the chain tensioner. 4. Emphasize correct fixing of camshaft. 5. Describe camshaft lubrication.
37.	<u>Crankshaft</u> 1. Explain crankshaft balancing and the causes of crankshaft vibration. 2. Sketch the method of mounting crankshaft dampers and carry out crankshaft balancing.	1. Principles of crankshaft balancing. 2. Causes of crankshaft vibration. 3. Methods of mounting crankshaft.	1. Explain the principles of crankshaft balancing. 2. Describe the causes of crankshaft vibration 3. Sketch the method of mounting crankshaft dampers. 4. Emphasize correct method of balancing crankshaft.
38.	<u>Engine Overhaul, Cylinder Reboring Crankshaft Grinding</u> 1. Explain the operation of all types of automobile engines and state the operations involved in engine overhaul. 2. Identify and use various tools of repair and diagnose faults by inspection and or toad test 3. Remove engine assembly for overhauling and dismantle engine in sequence. 4. Apply the concept of limits and fits assess the	1. Types and operation of automobile engines. 2. Dismantling engine, assessment of worn out parts, decarbonization, regrinding of crankshaft and engine block. 3. Tools and equipment for component engine repairs. 4. Inspecting engine faults. 5. Overhauling of engine. 6. Sequence of dismantling engine assembly. 7. Effects and requirement of engine components e.g. piston free play, crankshaft sizes. 8. Assessment worn out parts of engine. 9. Determination of sizes of crankshaft journals and crank pins. 10. Crankshaft drive arrangement.	1. Identify the tools and equipment for engine repairs. 2. Use the appropriate tool equipment to remove engine from vehicle for overhauling. 3. Check the component parts for a possible replacement reuse. 4. Use the appropriate instrument to check the size of the main journal and crank pin. 5. Set up the overhead crankshaft gear, timing chain/belt, arrangement and time engine.

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	<p>suitability of worn out parts for possible re-use.</p> <p>5. Measures and determine size of crankshaft journals and pins and describe crankshaft drive arrangement for a crankshaft.</p> <p>6. Explain the concept of force, torque brake, horse-power as applicable to vehicle engine and the process of replacing components of engine.</p> <p>7. Reassemble engine components in sequence and adjust and test run the engine using dynamometer.</p>	<p>11. The concept of force, torque, and brake horse-power.</p> <p>12. Piston and rings, con rod.</p> <p>13. Adjustment and test of running engine e.g. by dynamometer.</p>	<p>6. Explain and show the calculation of force, torque and brake horse power as applicable to engine performance.</p> <p>7. Explain the importance of good engine re-conditioning.</p> <p>8. Explain the component parts of engine and replace if found unfit for use.</p> <p>9. Reassemble engine with the correct tools/equipment in a correct sequence and test using a dynamometer.</p>
39.	<p><u>Cylinder Reboring</u></p> <p>1. Explain the process and the use of sizes in determining bore size.</p> <p>2. Carry out cylinder rebores to specification and select piston and rings to match.</p>	<p>1. Process of reboring cylinder and determination of bore sizes e.g. using sizes.</p> <p>2. a) Reboring cylinder b) Selection of piston and ring sizes.</p>	<p>1. Explain the process of cylinder reboring and use of sizes.</p> <p>2. Carry out reboring operation and fit piston and rings of equal size against the new bore.</p> <p>3. Emphasize the goal in engine reboring.</p>
40.	<p><u>Crankshaft Grinding</u></p> <p>1. Explain the process of crankshaft brazing and grinding and the size of bearing to fit the size of crankshaft</p> <p>2. Braze crankshaft and grinding.</p>	<p>1. Process of crankshaft brazing and grinding.</p> <p>2. Selection of bearing for crankshaft.</p> <p>3. Crankshaft, grinding machine and testing instrument.</p>	<p>1. Explain the process of crankshaft brazing and grinding.</p> <p>2. Braze the crankshaft to the block to test for concentricity balance before regrinding.</p> <p>3. Emphasize the importance of grinding to size and matching it with appropriate size of main and control bearing.</p>
41.	<p><u>Safety</u></p> <p>1. Observe shop safety and safe working conditions and use service manuals.</p> <p>2. Use service tools and complete job to manufacturer's specification</p>	<p>1. Shop safety and safe working conditions.</p> <p>2. Service manuals and tools.</p> <p>3. Job completions e.g. using manufacturers specifications and timing.</p>	<p>1. Observe shop safety.</p> <p>2. Use service manual and tools.</p> <p>3. Complete jobs to manufacturer's specifications and timing.</p>
42.	<p><u>Battery Maintenance Charging</u></p> <p>1. Explain the principles of electricity generating and electrolysis chemistry of reaction in lead acid battery and diagnose common</p>	<p>1. Principles of electricity generation and electrolysis chemistry etc. in lead acid battery e.g. vehicle battery.</p> <p>2. Common battery faults and their symptoms e.g. crack case, under charged etc.</p> <p>3. Storage procedure for batteries</p>	<p>1. Explain the principles of electrolysis chemistry of reaction etc.</p> <p>2. Loosen a battery head (terminals) and carry out check on the battery casing, check the level of</p>

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	<p>battery faults and their symptoms.</p> <ol style="list-style-type: none"> 2. Explain storage procedure for batteries an carry out recharge on a battery. 3. Break down acid to obtain correct electrolyte and measure voltage of cells when not under load and when under load. 4. Measure specific gravity of the electrolyte and maintain battery terminals, post and logs using warm water and Vaseline to prevent corrosion. 5. Fix and secure battery to the chassis. 	<ol style="list-style-type: none"> 4. Initial charging and recharging of a battery. 5. Preparation of electrolyte 6. Testing of batteries. 7. Battery maintenance using anti corrosion devices. 8. Securing the battery. 	<p>electrolyte by inspection.</p> <ol style="list-style-type: none"> 3. Store batteries in an enclosed plastic container and in dry place. 4. Connect battery to battery charger and charge the battery to the manufacturer's specification. 5. Prepare an electrolyte for battery and avoid burns by observing the necessary safety precautions. 6. Use hydrometer to measure the specific gravity of electrolyte and voltmeter or high rate discharge tester to measure the open voltage of the battery. 7. Use appropriate tools to loose battery terminal. Clean, wash and use Vaseline or grease to avoid corrosion. 8. Select appropriate tool and secure battery with securing straps.
43.	<p><u>Charging System</u></p> <ol style="list-style-type: none"> 1. Explain the principles of electromagnetic action and generation of electricity (AC & DC and the principles of commutation and electrification and regulation of electricity. 2. Explain the principles of operation of electric conductor devices and diagnose faults in the charging systems and test equipment. 3. check accessories for correct operation and output and rectify faults and fix replacing unit. 4. Determine serviceability of component and bench test electrical components. 	<ol style="list-style-type: none"> 1. Principles of electromagnetic action and generation of electricity. 2. Principles of commutation and electrification etc. 3. Principles of operation of electric conductor devices. 4. Checking for operation of the following: Warning terminal and cable connection; circuit resistance; control box regulations; diodes and ammeter. 5. Faults diagnosing and rectification. 6. Determination of components for service-ability. 	<ol style="list-style-type: none"> 1. State how current is generated through the efforts of their dynamo and alternator. 2. Loose the starter motor drive and explain how it works. 3. With the appropriate tool/equipment check for overcharging, under-charging, sulphation. 4. Check each of the following with the appropriate devices to ascertain their effectiveness, warning light/ammeter, drive belt, tension circuit resistance etc. 5. Test these component parts using appropriate equipment to ascertain their effectiveness.
44.	<p><u>Starting System</u></p> <ol style="list-style-type: none"> 1. State the principles of conservation of energy and explain the 	<ol style="list-style-type: none"> 1. Principles of conservation of energy and electromagnetism. 2. Part played by electromagnetism. 3. Determination of wear on drive pinion 	<ol style="list-style-type: none"> 1. With a complete engine in place, state how the energy required for starting in a motor vehicle is conserved

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	<p>principles of electro-magnetism.</p> <ol style="list-style-type: none"> Describe the part played by electro-magnetic induction in energy conversion and check and replace starter relays and solenoids switches where necessary. Determine wear on driving mechanism and diagnose faults in the starter system using test equipment. Rectify faults and fit replacement unit of the starter motor when faulty and check the battery terminal voltage on load to get recommended reading. Check voltage drop in main inner return lines, starter motor terminal and determine circuit resistance both on the line and return circuit of the starting points. Determine if starter motor component are correctly assembled and bench-test. Sketch the various type of starting system. 	<p>starter, ring gear etc.</p> <ol style="list-style-type: none"> Diagnosing of starter, system faults and rectification of faults. Checking of voltage, and determination of circuit resistance and current flow. 	<p>through effective charging system.</p> <ol style="list-style-type: none"> Use a simple sketch to describe how electrical energy is converted to mechanical energy through the turning of the pinion to kick against the flywheel. Check and replace starter relay using the appropriate tools. a) Assess wear on starter and ring gear and adjust pinion using the appropriate tools. b) Mount the armature on the growler and check whether the armature could be services. Use the correct set of tools to dismantle clear and assess wear in the starter component for a possible repair. Replace a faulty starter. Use voltmeter to take the voltage reading when the head lamp is switched on. Connect a voltmeter to take the reading of the voltage drop across the line. Check the voltage of the starter motor. Determine the circuit resistance etc. By using the ammeter, measure the starting motor current. use appropriate tool to couple starter motor components and test as appropriate. Sketch common types of starting system and label the parts.
45.	<p>Electrical Component</p> <ol style="list-style-type: none"> State the principles of light reflection and refraction and identify the characteristics of various types of lamp unit. Trace and rectify faults in the circuit and fit 	<ol style="list-style-type: none"> Principles of light reflection and refraction. (Angle of reflection, incidence normal plane. Rays and beam of light) Characteristics of various lamp units e.g. seal beam, fuse, Hans, dazzle filament lamp etc. Fault tracing and rectification in the lighting circuit, testing lamp etc. 	<ol style="list-style-type: none"> State the principles of light reflection and refraction. Identify various lamp units and state their characteristics. Trace fault in each of these circuits and replace units. Fit headlamp bulb on others using appropriate

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	replacement units.	4. Headlamp bulbs, fused, traficator len and bulbs etc.	units. 5. Emphasize the importance of the electrical components in motor vehicle. Also stress on the need to use the correct fuse.
46.	<u>Wiring System</u> 1. Identify electrical wiring symbols and interpret wiring diagrams of automobile. 2. Select correct cable size and length and test the circuit.	1. Auto electrical symbols signs e.g battery, fuse, capacitor etc. 2. Interpretation of various diagrams e.g. insulated/earth return system. 3. Cable sizes and connections. 4. Testing of circuits. 5. Faults tracing and rectifications.	1. Sketch and label the various electrical/symbols signs. 2. Practice the line and circuit diagram. 3. Select correct cables and connectors. 4. Using appropriate instrument, trace and rectify faults in a circuit, reiterate the importance of good wiring system in motor vehicle.
47.	<u>Coil Ignition System</u> 1. Explain the theory of spark generation by electro-magnetic induction and operation of the coil. 2. Explain angle for distribution contact breakers and describe the action of a speed sensitive and advance and retard mechanism. 3. Describe the distribution of the high tension supply and the action of the sparkling plug and the importance of correct gap setting. 4. Explain the need for correct ignition fixing and the effect of incorrect ignition timing.	1. Theory of spark generation by electro magnetic and importance of correct gap setting. 2. Ignition coil operation and H.T. current distribution. 3. Relationship between gap size and dwell angle for distribution contact breaker. 4. Speed sensitive mechanism. 5. Action of the spark plug. 6. Ignition timing and its effects on timing light, distributor and good engine performance.	1. Prepare a circuit diagram to illustrate spark generation. 2. Use diagram to illustrate the working principles of a coil. 3. Explain the impact of correct gap on the spark of an S.I. engine. 4. Explain with the aid of a sketch how the spark is ignited in an S.I. engine.