DETAILEDSYLLABUS FOR THE POST OF
MOTOR MECHANIC/TRADESMAN AUTOMOBILE MECHANIC
{HEALTH SERVICES}

(Cat.No. : 398/2020, 224/2021, 765/2021)

(Total Marks- 100)

Module	Topics	Marks
1	Occupational Safety & Health, Tools and Machines, System of Measurement.	8
2	Automobile History, Introduction to Engine, Petrol Engine Basics	12
3	Engine Components, Cooling System, Lubrication System	12
4	Diesel fuel system, Emission control	10
5	Transmission system	12
6	Steering and suspension system	10
7	Wheels and Tyres, Braking system	10
8	Electric Circuits:- Ignition circuit, Charging circuit, Starting circuit	10
9	Lighting system, Heating Ventilation Air Conditioning, and accessories	10
10	Motor vehicle law, Introduction to EFI Engine Management	6
	Total	100

Detailed Syllabus

Module	Description	Mark distribution
Module 1	**Occupational Safety & Health:-** Importance of Safety and general Precautions to be observed in the shop. Basic first aid, safety signs - for Danger, Warning, caution & personal safety message. Safe handling of Fuel Spillage, Fire extinguishers used for different types of fire. Safe disposal of toxic dust, safe handling and Periodic testing of lifting equipment, Authorization of Moving & road testing vehicles. **Tools and Machines**:- Cleaning tools- Scraper, wire brush, Emery paper, Surface plates, steel rule, measuring tape, try square. Callipers- inside and outside. Dividers, surface gauges, scriber, punches-prick punch, centre punch, pin punch, hollow punch, number and letter punch. Chisel-flat, cross-cut. Hammer- ball pein, lump, mallet. Screw	**8**

	drivers-blade screwdriver, Phillips screw driver, Ratchet screwdriver. Allen key, bench vice & Cclamps, Spanners- ring spanner, open end spanner & the combination spanner, universal adjustable open end spanner. Sockets & accessories, Pliers - Combination pliers, multi grip, long nose, flat-nose, Nippers or pincer pliers, Side cutters, Tin snips, Circlips pliers, external circlips pliers. Air impact wrench, air ratchet, wrenches- Torque wrenches, pipe wrenches, car jet washers Pipe flaring & cutting tool, pullers-Gear and bearing. Drilling machine - Description and study of Bench type Drilling machine, Portable electrical Drilling machine, drill holding devices, Work Holding devices, Drill bits. Taps and Dies: Hand Taps and wrenches, Calculation of Tap drill sizes for metric and inch taps. Different type of Die and Die stock. Screw extractors. Hand Reamers – Different Type of hand reamers, Drill size for reaming, Lapping, Lapping abrasives, type of Laps. **Systems of measurement:-** Description, care & use of - Micrometers- Outside and depth micrometer, Micrometer adjustments, Vernier callipers, Telescope gauges, Dial bore gauges, Dial indicators, straightedge, feeler gauge, thread pitch gauge, vacuum gauge, tire pressure gauge.	
Module 2	**Automobile Industry** - History, leading manufacturers, development in automobile industry, trends, new product. Brief about Ministry of Road transport & Highways, The Automotive Research Association of India (ARAI), National Automotive Testing and R&D Infrastructure Project (NATRIP), & Automobile Association. Definition: - Classification of vehicles, body and load. Brief description and uses of Vehicle hoists – Two post and four post hoist, Engine hoists, Jacks, Stands. **Introduction to Engine:** Description of internal & external combustion engines, Classification of IC engines, Principle & working of 2&4-stroke diesel engine (Compression ignition Engine (C.I)), Principle & working of 2&4 stroke Spark Ignition Engine (SI), differentiate between 2- stroke and 4 stroke, C.I engine and S.I Engine, Direct injection and Indirect injection, Technical terms used in engine, Engine specification. Various gauges/instrument on a dash board of a vehicle Speedometer, Tachometer, Odometer and Fuel gauge, and Indicators such as gearshift position, Seat belt warning light, Parking-brake engagement warning light and an Engine-malfunction light. **Petrol Engine Basics:** Spark-ignition engine components- Basic engine components, Engine cams & camshaft, Engine power transfer, Scavenging, Counter weights, Piston components. Intake & exhaust systems - Electronic fuel injection systems,	**12**

	Intake system components, Carburettor, Air cleaners, EFI air cleaners, Intake manifolds, Intake air heating. Gasoline Fuel Systems: Description of Gasoline fuel, Gasoline fuel characteristics, Controlling fuel burn, Stoichiometric ratio, Air density, Fuel supply system, Pressure & vacuum. Description of Intake manifolds and material, Exhaust system components- Description and function of Exhaust manifold, Exhaust pipe, Extractors, Mufflers Reactive, absorptive, Combination., Catalytic converters, Flexible connections, Ceramic coatings, Back-pressure, Electronic mufflers. connections, Ceramic coatings, Back-pressure, Electronic mufflers.	
Module 3	**Engine Components:** Description and Constructional feature of Cylinder head, Importance of Cylinder head design, Type of Petrol and Diesel combustion chambers, Effect on size of Intake & exhaust passages, Head gaskets. Importance of Turbulence Valves & Valve Trains. Description and Function of Engine Valves, different types, materials, Type of valve operating mechanism, Importance of Valve seats, and Valve seats inserts in cylinder heads, importance of Valve rotation, Valve stem oil seals, size of Intake valves, Valve trains, Valve timing diagram, concept of Variable valve timing. Description of Camshafts & drives , Description of Overhead camshaft, importance of Cam lobes, Timing belts & chains, Timing belts & tensioners. Description & functions of different types of pistons, piston rings and piston pins and materials used Recommended clearances for the rings and its necessity precautions while fitting rings, common troubles and remedy. Compression ratio. Description & function of connecting rod, Materials used for connecting rods big end & main bearings. Shells piston pins and locking methods of piston pins. Description and function of Crank shaft, camshaft, Engine bearings classification and location – materials used & composition of bearing materials- Shell bearing and their advantages- special bearings material for diesel engine application bearing failure & its causes-care & maintenance. Crank-shaft balancing, Firing order of the engine. Description and function of the fly wheel and vibration damper. Crank case & oil pump, gears timing mark, Chain sprockets, chain tensioner etc. Function of clutch & coupling units attached to flywheel. Description of Cylinder block, Cylinder block construction, and Different type of Cylinder sleeves (liner).	**12**

	Cooling system:- Heat transfer method, Boiling point & pressure, Centrifugal force, Vehicle coolant properties and recommended change of interval, Different type of cooling systems, Basic cooling system components- Radiator, Coolant hoses, Water pump, Cooling system thermostat, Cooling fans, Temperature indicators, Radiator pressure cap, Recovery system, Thermo-switch. **Lubrication system:-** Functions of oil, Viscosity and its grade as per SAE , Oil additives, Synthetic oils, The lubrication system, Splash system, Pressure system, Corrosion/noise reduction in the lubrication system. Lubrication system components - Description and function of Sump, Oil collection pan, Oil tank, Pickup tube, different type of Oil pump & Oil filters Oil pressure relief valve, Spurt holes & galleries, Oil indicators, Oil cooler.	
Module 4	**Diesel Fuel Systems:** Description and function of Diesel fuel injection, fuel characteristics, concept of Quiet diesel technology & Clean diesel technology. Diesel fuel system components – Description and function of Diesel tanks & lines, Diesel fuel filters, water separator, Lift pump, Plunger pump, Priming pump, Inline injection pump, Distributor-type injection pump, Diesel injectors, Glow plugs, Cummins & Detroit Diesel injection. Electronic Diesel control- Electronic Diesel control systems, Common Rail Diesel Injection (CRDI) system, Hydraulically actuated electronically controlled unit injector (HEUI) diesel injection system. Sensors, actuators and ECU (Electronic Control Unit) used in Diesel Engines. Engine assembly procedure with aid of special tools and gauges used for engine assembling. Introduction to Gas Turbine, Comparison of single and two stage turbine engine, Different between gas turbine and Diesel Engine. **Emission Control:-** Vehicle emissions Standards- Euro and Bharat II, III, IV, VI, Sources of emission, Combustion, Combustion chamber design. Types of emissions: Characteristics and Effect of Hydrocarbons, Hydrocarbons in exhaust gases, Oxides of nitrogen, Particulates, Carbon monoxide, Carbon dioxide, Sulphur content in fuels Description of Evaporation emission control, Catalytic conversion, Closed loop, Crankcase emission control, Exhaust gas recirculation (EGR) valve, Controlling air fuel ratios, Charcoal storage devices, Diesel particulate filter (DPF). Selective Catalytic Reduction (SCR), EGR VS SCR .	**10**

Module 5	**Transmission System:-** **Clutches:-** Clutch principles, Single-plate clutches, Multi-plate clutches, Dual mass flywheels, Operating mechanisms Clutch components- Pressure plate, Driven/ center plate, Throw out bearing. **Manual transmissions-** Gear ratios, Compound gear trains, Gear selection, Bearings, Oil seals & gaskets, Brief about Automated Manual Transmission (AMT) Gearbox layout & operation, Gearbox layouts, Transaxle designs, Gearbox operation, Baulk-ring synchromesh unit, Transaxle synchromesh unit. Gear shift mechanism. Final Drive & Drive Shafts - Basic layouts Front-wheel drive layout, Rear-wheel drive layout, Four-wheel drive layout, All wheel drive layout, 4WD v/s AWD Front-wheel drive, Front wheel drive shafts, Front wheel final drives, Front wheel differentials Rear-wheel drive- Propeller shaft, Type of Universal joints, Type of Constant velocity Joints, Rear-wheel final drives, Salisbury axles, Rear-wheel drive differentials, Limited slip differentials. Four-wheel drive- Four wheel drive shafts, Four wheel final drive, Four-wheel drive transfer case, Freewheeling hubs, Four wheel drive differentials All-wheel drive- four wheel final drives, All-wheel drive transfer case, Transfer case differential action. **Automatic Transmissions** - Torque converters, Torque converter principles, drive plate, Converter operation, Torque multiplication, Fluid flow, Heat exchanger, Lockup converters, clutches. Planetary gearing- Planetary gears, Simple planetary gear sets, Compound planetary gear sets, Automatic transmission brake bands, Multi-disc clutches. **Electronic control transmission** -Electronic control Unit, Fully hydraulically controlled transmission, Electronic shift programs, Manual selection. Layout & operation for P,R,N&D (First & Second) Selector positions, Planetary gear set, High range power flow, Low range power flow Servos & clutches-Rear servo, Front servo, One way clutch, Multi-plate front clutch, Clutch pack, Rear clutch. Hydraulic system & controls Hydraulic system components, Spool valves, Regulating or flow control valves, Control valves, Orifices Valve types & functions Basic valve action, Regulator & control valves, Shift & governor valves Pressure regulation- The primary regulating valve, Line pressure variation, Modulator valve pressure, The governor, Governor pressure, Kick down pressure. Flow control- Gear position 1, 1-2 shift valve, 2-3 shift valve assembly, The servo orifice control valve, 3-2 kick down Continuously variable transmission (C.V.T.) - Continuously variable transmission, Drive or reverse, The steel belt, Secondary pulley shaft.	**12**

Module 6	**Steering Systems:-** Description and function of Steering systems, Principles of steering, Rack-and-pinion steering system, Recirculation ball & nut steering system, Four-wheel steering systems, collapsible steering system. Steering boxes & columns - Description and function of Steering columns, Rack-and pinion gearbox, Helix, Variable ratio steering, Worm gearbox, Power Assisted steering, Steering process, Flow-control valve, Electric power assisted steering, Basic electric power steering operation Steering arms & components- Forward control vehicle steering, Steering linkages, Joints, Bushes/bushings Wheel alignment fundamentals:- Basic principles of wheel alignment, wheel base, wheel track, king pin inclination, Caster, Camber, Scrub radius, Toe-in & toe out, Toe-out on turns, Turning radius, Thrust angle &centre lines. **Suspension Systems:-** Principles of suspension, Suspension force, Unsprung weight, Wheel unit location, Dampening. Types of suspension-Suspension systems, Solid axle, Dead axle, Description, function and advantages of non independent suspension Independent suspension, Rear independent suspension, Rear-wheel drive independent suspension, electronically controlled air suspension (ECAS), Adaptive air suspension operation. Types of springs - Description and function of Coil springs, Leaf springs, Torsion bars, Rubber springs. Shock absorber types-Description and function of Hydraulic shock absorbers, Gas-pressurized shock absorbers, Load adjustable shock absorbers, Manual adjustable-rate shock absorbers, Electronic adjustable-rate shock absorbers, Automatic load adjustable shock absorbers Front suspension types & components- Mc person Strut suspension, Short/long arm suspension, Torsion bar suspension Rear suspension types & components-Rigid axle leaf spring suspension, Rigid axle coil spring suspension, Independent type suspension, Rigid non-drive suspension.	**10**

Module 7	**Wheels & Tyres:-** Wheel types & sizes Wheels, Rim sizes & designations, Types of wheels Tyre types & characteristics Tyres, Radial ply tyres, Radial ply tyre sidewalls, Tyre pressure monitoring systems, Run flat tyres, Space-saver tyres, Tyre distortion, Center of gravity. Tyre construction-Tyre construction, Types of tyre construction, Tyre materials, Hysteresis, Tyre sizes & designations, Tyre information, Tyre tread designs, Tyre ratings for temperature & traction. Descriptions Tire wear Patterns and causes Nitrogen v/s atmospheric air in tyres. **Braking Systems:-** Principles of braking, Drum & disc brakes, Lever/mechanical advantage, Hydraulic pressure & force, Brake pad, Regenerative braking. Braking systems - Brake type - principles, Air brakes, Exhaust brakes, Electric brakes, Parking brakes, Engine brakes, Regenerative braking, Braking system components Park brake system, Brake pedal, Brake lines, Brake fluid, Bleeding, Master cylinder, Divided systems, Tandem master cylinder, Power booster or brake unit, Hydraulic brake booster, Electro hydraulic braking (EHB), Applying brakes, Brake force, Brake light switch Drum brakes & components -Drum brake system, Drum brake operation, Brake linings & shoes, Back plate, Wheel cylinders Disc brakes & components - Disc brake system, Disc brake operation, Disc brake rotors, Disc brake pads, Disc brake callipers, Proportioning valves, Proportioning valve operation, Brake friction materials Antilock braking system & components-ABS brake system, Antilock braking system operation, Principles of ABS braking, ABS master cylinder, Hydraulic control unit, Wheel speed sensors, ABS with EBD electronic control unit. The construction and operation of heavy vehicle Anti-Slip Regulation /Traction Control (ASR) system. Introduction to Electromagnetic retarder brake (EMR) and Engine exhaust brake.	**10**
Module 8	**Basic electricity,** Electricity principles, Ground connections, Ohm's law, Voltage, Current, Resistance, Power, Energy. Voltmeter, ammeter, Ohmmeter Mulitmeter, Conductors & insulators, Wires, Shielding, Length vs. resistance, Resistor ratings. Fuses & circuit breakers, Ballast resistor, Stripping wire insulation, cable colour codes and sizes, Resistors in Series circuits , Parallel circuits and Series-parallel circuits, Electrostatic effects, Capacitors and its applications, Capacitors in series and parallel. Batteries & cells, Lead acid batteries & Stay Maintenance Free (SMF) batteries, **Basic electronics:-** Description of Semi conductors, Solid state devices- Diodes, Transistors, Thyristors, Uni Junction Transistors (UJT), Metal Oxide Field Effect Transistors (MOSFETs).	**10**

	Ignition system:- Ignition principles and Faraday's laws, Primary and secondary winding of transformer, Ignition components, Spark plugs, Spark plug components, Vacuum & centrifugal units, Plug firing voltage, Induction, Inductive system operation, Induction wiring, Hall effect sensors, Hall effect operation, Optical type sensors Distributor less ignition systems, Insulated coils, Distributor less ignition system timing. **Charging system:-** The purpose of Charging system, charging system components, charging system circuit, Alternator principles, Alternating current, Alternator components, Rectification, Phase winding connections, Rotor circuit, Voltage regulation, System operating voltage, High voltage charging systems, Rotor, Stator, Alternator end frames, Slip ring & brush assembly, Rectifier assembly, Alternator cooling fan. **Starting system: -** purpose of starting system, Starting system components, Starter motor principles, study of starter control circuits. Starter motor construction, Starter magnet types, Starter motor engagement, Commutation, Switching, solenoid construction.	
Module 9	**Lighting system:-** Lamps/light bulbs, Lamp/light bulb information, LED lighting, Headlights-description of standard sealed beam, halogen sealed beam, composite and High intensity discharge (HID) headlights. Headlight & dimmer circuits, Park & tail light circuits, Brake light circuits, turn signal circuit, Cornering lights, Fog lights circuit, interior lights- courtesy, reading and instrument panel lights, Smart lighting , Reverse lights. **Heating Ventilation Air Conditioning (HVAC)**:- legislation, Vehicle heating, ventilation & cooling systems, Basic air conditioning principles, Air conditioning capacity, Air conditioning refrigerant, Humidity Description and function of Fixed orifice, Control devices, Thermostatic expansion valve system, Thermal expansion valves, Air conditioning compressors, Condensers & evaporators, Receiver drier, Lines & hoses, TX valve construction, Temperature monitoring thermostat, Refrigerants, Pressure switches, Heating elements Air-conditioning ECU, Ambient air temperature sensor, Servo motors, Electric servo motors, Automatic climate control sensors, Evaporator temperature sensor, Blower speed control, Ventilation systems. **Accessories:**- Horn circuit, wiper circuit, power window components and circuit. Power door lock circuit, automatic door lock circuit, remote keyless entry system circuit, antitheft system, immobilizer system.	**10**

	Navigation system, Car radio and cassette player, car videos. Description and function of Airbags, Seatbelt, Vehicle safety systems, Crash sensors, Seat belt pretensioners, Tire pressure monitoring systems Integrated communications, Proximity sensors, Reflective displays, Global positioning satellites, Triangulation/trilateration, Telematics. Networking & multiplexing. Introduction to Hybrid & Electronic vehicle, Hydrogen fuel cell vehicle, Electrical & Electronic architecture. Locating vehicle information, Obtaining & interpreting scan tool data, Using a repair manual, Using a shop manual, Using an owner's manual, Using a labour guide, Using a parts program, Using a service information program.	
Module 10	**Motor Vehicle Law:-** Licensing of drivers & conductors, Registration of vehicle, Traffic rules, Signals & controls, Accidents, Causes & analysis, Responsibility of driver, Offences, penalties & procedures, Different types of forms, Government administration structure, Personnel, Authorities & duties, Rules regarding construction of motor vehicles, Tax exemption & tax renewal, Insurance types & significance - Comprehensive Third party insurance, Duty of driver in case of accident. **Introduction to EFI Engine Management:-** EFI operation Modes of EFI, Electronic fuel injection, Idle speed control systems, Feedback & looping, Cold start systems, Air measurement, Air-flow monitoring, Variable intake manifold system, Electrical functions, EFI wiring diagram Electronic control unit (ECU) - EFI system ECU, Electronic control unit settings, Engine speed limiting, Malfunction indicator lamp. Importance of Diagnostic Trouble Code (DTC) & its general format. Use of scan tool and retrievals of codes. EFI sensors- Intake Temperature sensor, Mass airflow sensor, Manifold absolute pressure sensor, Air vortex sensor, Fuel system sensor, Throttle position sensor, Exhaust gas oxygen sensor, Crank angle sensor, Hall effect voltage sensor.	**6**

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper