DETAILED SYLLABUS FOR THE POST OF MECHANIC POLICE CONSTABLE IN POLICE (MOTOR TRANSPORT WING) - DIRECT RECRUITMENT

(Cat.No: 128/2023)

Module 1: Engine – Working and Constructional Details [15 Marks]

Classification of Engines – Description of internal & external combustion engines, Valve and Cylinder arrangements – Engine Terms, Compression ratio, Working and comparison of Four stroke and two stroke engines, Petrol and Diesel Engines – Engine components - Cylinder head, Block, Valves and valve operating mechanism, Valve clearance, Valve timing diagram, Tappets, Cylinder liners, Manifolds, mufflers, Cam and Crank shaft, Crank-shaft balancing, Engine bearings- classification and location – materials used & composition of bearing materials- Shell bearing and their advantages- bearing failure & its causes-care & maintenance, firing order of multi-cylinder engines. Piston – types, Connecting rod fittings, Combustion chambers, Gaskets, Timing gears, Flywheel. Engine specification, Study of 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.

Module 2: Fuel supply system – Petrol and Diesel Engines [12 Marks]

Petrol Fuel supply system: Detonation & pre-ignition, Fuel tank, Fuel pumps – Mechanical & Electrical, Carburettors – types, Air cleaners, Air-fuel ratio. EFI Engine Management - operation Modes of EFI, Idle speed control systems, Cold start systems, Air measurement, Air-flow monitoring, Variable intake manifold system, Electrical functions, EFI wiring diagram Electronic control unit (ECU) - EFI system Electronic control unit settings, 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, Cam position sensor, Exhaust gas oxygen sensor, Crank angle sensor, Hall effect voltage sensor.

Diesel Fuel supply system: Octane and Cetane rating, Diesel knock, Description of Diesel tanks & lines, Diesel filters, water separator, Lift pump, Fuel Injection pumps – Individual and Distributor type, fuel system bleeding, Governors – Types, Phasing and Calibration, Types of Diesel injectors, its testing, Glow plugs. Common rail diesel injection system Components Hydraulically actuated electronically controlled unit injector (HEUI) diesel injection system. Sensors, actuators and ECU (Electronic Control Unit) used in Diesel Engines. – Engine scanning

Module 3: Cooling and Lubrication system of Engine [8 Marks]

Cooling System: Types – Heat transfer method, Boiling point & pressure, Vehicle coolant properties and recommended change of interval, Different type of cooling systems, Air and Water cooling, Thermosyphon system, Components – Radiator, Pressure cap, Water pumps. Anti-freeze solutions, Thermostat, Temperature gauges, maintenance.

Lubrication System: Properties of lubricating oil, Viscosity and its grade as per SAE, Oil additives, Synthetic oils, Petroil system, Splash system, Pressure system, Types of oil pumps, Oil filters – types, filtering methods, oil coolers, oil pressure gauges, Crank case ventilation, Lubrication system service.

Module 4: Ignition system [5 Marks]

Ignition system – Ignition principles and Faraday's laws, Primary and secondary winding of transformer, Ignition components, Ignition coil – Types, CB point, condenser, Distributor, Spark plugs, Spark plug components – types, Vacuum & centrifugal units, Plug firing voltage, Ignition timing. Induction, Inductive system operation, Hall Effect sensors, Hall Effect operation, Optical type sensors. Magneto ignition, CDI Ignition, Electronic ignition and Distributor less ignition system.

Module 5: Auto-electrical system [12 Marks]

Battery: Ohm's law, Description of Chemical effects, Batteries & cells, Lead acid batteries & Stay Maintenance Free (SMF) batteries, Thermo-electric energy, Thermistor, Thermo couples, Electrochemical energy, Photo-voltaic energy, Piezo-electric energy, Electromagnetic induction, Relays, Solenoids, Lead-acid battery – construction, working and maintenance. Testing and charging methods.

Charging system: The purpose of Charging system, charging system components, charging system circuit, Alternator principles, Alternator components, Rectification, Phase winding connections, Rotor circuit, Voltage regulation, System operating voltage, Rotor, Stator, Alternator end frames, Drive pulley, Slip ring & brush assembly, Rectifier assembly, Alternator cooling fan. Differences between Dynamo and Alternator.

Starting system: Purpose of starting system, Staring system components, Starter motor principles, starter control circuits. Starter motor construction, Starter magnet types, Starter motor engagement types, Commutation, Switching, solenoid construction. Basics of ISG (integrated starter generator) used in hybrid vehicles.

Lighting system: Head lights – construction, types of head light bulbs, Tail lights, Brake lights, Direction indicators and other lights and its circuits, fuses, breakers and relays.
Accessories: Wiper, horn, power window, Airbag, Antitheft device.
Air conditioning system (HVAC) – components, working and service.

Module 6: Chassis, Suspension system and wheels [8 Marks]

Chassis frame – Construction of frame, Frame sections, Wheel base, wheel track, types of frame. Frame materials
Suspension system: Types of suspension systems, function and advantages of non independent suspension & Independent suspension, Front and Rear independent suspension, Types of springs – Description and function of Coil springs, Leaf springs, Helper springs, Torsion bars, Rubber springs and stabilizer. Shock absorber types - Description and function of Hydraulic shock absorbers, Gas pressurized shock absorbers, Load adjustable shock absorbers, Manual adjustable-rate shock absorbers, Front suspension types & components – Wishbone suspension,

Mac person Strut suspension, swinging arm suspension, Air suspension – components and working, Electronically controlled air suspension (ECAS), Adaptive air suspension operation.
Wheel and tyre: Types of wheels – Disc wheel, Wire wheel, Alloy wheel. Tyre – Radial and bias, Tube and tubeless – Tyre properties, designations and inflation. Tyre coding, tyre pressure monitoring systems, tyre rotation. Nitrogen v/s atmospheric air in tyres.

Module 7: Transmission system – Clutch & Gear box [12 Marks]

Clutch: Principles - Dog clutch, friction clutches - Single-plate clutches, Operating mechanisms Clutch components- Pressure plate, Clutch plate, facing materials, Clutch springs, and Throw-out bearing. Multi plate, Diaphragm clutch, Centrifugal clutch, fluid flywheel. Common troubles.
Gearbox: Manual transmissions- Gear ratios, Compound gear trains, Gearbox layout & operation - Sliding mesh, Constant mesh and Synchromesh Gearbox, Transaxle designs, Baulk-ring synchromesh unit. Gear shift mechanism, Bearings, Oil seals & gaskets, Lubrication of gearbox. Automated Manual Transmission (AMT), Dual clutch transmission (DCT), Intelligent Manual Transmission (IMT). Common troubles.
Automatic Transmissions – Torque converters, Torque converter principles, drive plate, Converter operation, Torque multiplication, Fluid flow, Heat exchanger, Lock-up converters, clutches, planetary gears. Continuously variable transmission (C.V.T.).

Module 8: Propeller shaft, Differential and Drive axle [8 Marks]

Propeller shaft, slip joint, Type of Universal joints- cross type, Constant velocity joints - types
Four-wheel drive- drive shafts, final drive, transfer case, differential action, Limited slip differential, Bearings and seals, Lubrication of differential. Basic layouts of Front-wheel drive, Rear-wheel drive, Four-wheel drive, All-wheel drive, 4WD v/s AWD. Types of rear axles and applications, full floating, three quarter floating and semi floating and casings split and banjo. Rear axle drives – Hotchkiss drive & Torque tube drive.

Module 9: Front axle and steering system [10 Marks]

Front Axle: Construction, Main axle and types of stub axles.
Steering System: Description and function of Steering systems, Principles of steering - Worm and roller, Rack and pinion, Recirculation ball & nut steering system, Four-wheel steering systems, collapsible steering system. Steering boxes & columns – Description and function of Steering columns, Hydraulic Power Assisted steering, Flow-control valve, Electric power assisted steering, Basic electric power steering operation Steering arms & components - Steering linkages, Joints, Bushes. Wheel alignment fundamentals:- Basic principles of wheel alignment king pin inclination, Caster, Camber, Scrub radius, Toe-in & toe out, Toe-out on turns, Turn in radius, Thrust angle & centre lines.

Module 10: Brake system [10 Marks]

Brake System :- Principles of braking, Type of brakes –Service & parking brakes, Drum & disc brakes – Mechanical, Hydraulic and Air brakes, Components & Working of mechanical brake, Components of hydraulic brake – Master cylinder, Tandem master cylinder, wheel cylinder, Brake booster, Brake bleeding, Brake fluid – composition and DOT grades, Brake light Switch. Drum brakes & components - Drum brake operation, Brake linings & shoes, Back plate, Brake adjuster, Wheel Cylinders- types. Disc brakes & components -Disc brake system, Disc brake

operation, Disc brake rotors, Disc brake pads, Disc brake calipers - types. Proportioning valve operation, Brake friction materials. Air brake system: Components – Air compressor, Reservoir, Bake valve, Brake chambers, spring chamber, control valves. Construction and working of air brakes. Antilock braking system & components - ABS operation, Principles of ABS braking, Hydraulic control unit, Wheel speed sensors, ABS with EBD electronic control unit. Regenerative braking in EV.

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

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