

**FURTHER DETAILS REGARDING MAIN TOPICS OF  
PROGRAMME No. 04/2020 (Item No: 12)**

**MOTOR TRANSPORT SUB INSPECTOR (TRAINEE)  
IN POLICE (MOTOR TRANSPORT WING) DEPARTMENT**

**Category Number : 013/2016**

**PART I - MECHANICAL ENGINEERING**

**MODULE – I**

PROPERTIES OF MATERIALS - Mechanical properties, physical properties, thermal properties, electrical properties and chemical properties.

TESTING OF MATERIALS - destructive and nondestructive testing.

MEASURING INSTRUMENTS – precision and non-precision instruments. Vernier caliper, micrometer, Vernier height gauge and depth gauge.

CLASSIFICATION OF GAUGES- plug gauge, ring gauge, snap gauge, screw pitch gauge, feeler gauge and standard wire gauge.

COMPARATORS - mechanical, electrical and optical comparators. (Working only).

WELDING - classification of welding, advantages and limitations of welding, principle of arc welding, arc welding machines such as DC generator and AC transformers. (working only).

GAS WELDING – oxyacetylene welding (description only), gases used types of flames (uses) other welding such as submerged arc welding, MIG and TIG welding (description only).

DEFECTS OF WELDING - causes and remedies of the defects. Soldering and brazing (brief description).

FOUNDRY - uses of different foundry tools, types of moulding sand, properties of moulding sand, different moulding processes such as bench moulding, pit moulding, floor moulding and sweep moulding.

ALLOWANCES ON PATTERN - shrinkage, draft, machining, distortion, and rapping allowances.

FORGING OPERATIONSupsetting, drawing down, setting down, punching, welding and cutting (description only).

FITTING- tools used in fitting (files, punches, vice, chisels, hammers, surface plate, surface gauge, V- Block, combination set, drills, calipers, taps and dies, reamers (uses of these tools).

METALS AND ALLOYS- Types of cast iron, properties, application of cast iron. List

the various types of steels such as low carbon steels, medium carbon steel, stainless steel, and high carbon steel and magnetic steel. Brief explanation of non-ferrous metals and alloys of aluminum and copper.

Heat treatment – annealing, normalizing, hardening, tempering, case hardening (description only).

METAL CUTTING – difference between orthogonal and oblique cutting, cutting speed, feed depth of cut (definition only), and properties of various cutting tool materials.

LATHE – Types of lathes, lathe parts, specifications, operations on lathe such as turning, taper turning, facing, boring, drilling, threading and reaming. Tool and work holding devices used in lathe.

## **MODULE – II**

PROPERTIES OF FLUIDS - Density, specific weight, specific volume, specific gravity (simple problems).

FLUID PRESSURE AND ITS MEASUREMENTS – define pressure, atmospheric pressure, absolute pressure and gauge pressure, pascal's law. Pressure measurement by piezo meter tube, simple manometer and differential manometer, (simple problems). Statement of Bernoulli's Theorem, Bernoulli's equation, continuity equation, working of venturimeter, orifice meter and Pitot tube (simple problems).

ORIFICES - Types of orifices - vena contracta - coefficient of contraction, coefficient of velocity, coefficient of discharge (simple problems).

NOTCHES - Rectangular Notch, Triangular Notch, discharge over notches (simple problems).

LOSSES OF HEAD IN PIPES - major and minor losses - loss of energy due to friction - Darcy's formula for loss of head in pipes, Chezy's formula (simple problems). Turbines - classification, Impulse and reaction turbines, classification of reaction turbines, use of draft tube, working of Pelton wheel and Francis turbine.

PUMPS - Different types of pumps (working only), function of air vessels, foot valve and strainer, slip of a pump.

STRESS AND STRAIN - definition of stress, strain, longitudinal strain, lateral strain, Poisson's ratio, factor of safety, statement of hook's law, (simple problems).

FRICITION - Types of friction, laws of friction, definition of angle of friction, coefficient of friction and limiting of friction (simple problems).

## **MODULE – III**

BOILER - define boiler, function of boiler - classification of boiler, comparison, boiler specifications, Boiler mountings and boiler accessories (working and functions only).  
PROPERTIES OF STEAM -wet steam, dry steam, super heating steam, and dryness

fraction (definition only). Working of steam engine, function of steam nozzles, working of steam turbines, classification steam turbines.

STEAM CONDENSERS - jet condensers and surface condensers (working only).  
POWER PLANTS -types of power plants such as hydroelectric, thermal, nuclear and diesel power plants.

RENEWABLE SOURCE OF ENERGY – solar energy.

MANAGEMENT - meaning of management, Taylor's scientific management, contribution of FW Taylor, Hentry Fayol's principle of management.

DIFFERENT TYPES OF OWNERSHIP - sole proprietorship, partnership, private limited company, public limited company (brief description).

ORGANIZATIONAL STRUCTURE - line organization, functional organization, line and staff organization.

OBJECTIVES OF TRAINING - explain the methods of training. WAGES - importance of good wage plan, types of wages, wage payment systems -

INCENTIVES - straight piece rate system, time rate system, piece rate system with guaranteed minimum wage - differential piece rate system (explanation only). Differentiate IC and EC engine, working four stroke petrol and diesel engine, two stroke petrol and diesel engine, comparison of petrol and diesel engine, comparison of four stroke and two stroke engine. Functions of carburetor and fuel injector.

CLASSIFICATION OF COOLING SYSTEMS - air cooling and water cooling, functions and radiator and thermostat.

GOVERNING OF IC ENGINES - quantity governing, quality governing, hit and miss governing.

TRANSMISSION SYSTEMS - function of clutch, flywheel, gear box, propeller shaft and differential.

FUNDAMENTALS OF THERMODYNAMICS – concept of system - open, closed, isolated system. Intrinsic properties and extrinsic properties - Laws of thermodynamics and laws of perfect gases - Thermodynamic processes - constant volume process, constant pressure process, adiabatic process, and isothermal process (explanation only).

REFRIGERATION - purpose of refrigeration, unit of refrigeration, concept of cop. Working of air compression refrigeration system based on reversed Carnot cycle and Bell Coleman cycle. Cop of Carnot cycle (simple problems).Working of vapor compression refrigeration system.

## **PART II - AUTOMOBILE ENGINEERING**

### **MODULE I : ENGINE CONSTRUCTION AND RELATED SYSTEMS**

#### ***Constructional details of IC Engines***

Cylinder block - Single cylinder and multi cylinder, materials, cylinder liners. Cylinder head - Materials, cylinder head gasket. Pistons -Type of pistons, Piston rings - Materials, Types of rings - compression ring, oil ring. Connecting rod - Function, materials used, big end and small end bearings. Crank shaft - different shapes, Main bearings. Fly wheel-functions. Types of valves, sodium vapour cooled valves. Valve operating mechanisms - side cam shaft and overhead cam shaft, Inlet and exhaust valve materials, valve timing diagram. Cam shaft - functions and drives

#### ***Fuel System***

Different fuel feed systems, A.C. mechanical pump, S U Electrical pump , petrol filters and air Cleaners, Carburetors, Simple carburetors - parts, principle of working, compensation, mixture strength requirement, modern carburetors, float system, idle and slow speed system, high speed system, Acceleration pump and choke system. Manifolds, silencer types.

Various components in Diesel fuel system - types of fuel. Distributor type pump, rotary type pumps, Fuel feed pump and hand priming, diesel fuel filters. Governors - purpose, types - mechanical, pneumatic and hydraulic governors, Fuel injectors-types

#### ***Lubrication and Cooling System***

Types of engine lubrication- wet and dry sump lubrication, splash and pressure feed systems. Oil pumps, pressure relief valve, oil pressure indicator Oil coolers, oil filters, oil seals, Crank case ventilation

Air and water cooling, thermo-syphon and pump circulation system, thermostat, Radiators -types, pressure cap, types of coolants, pump, antifreeze solution , cooling fan - types.

### **MODULE II: CHASSIS SYSTEMS**

#### ***Chassis and frame***

Chassis Constructional details, Types of frame. Frame sections, bumpers, sub frames. Materials used, Front Axle- Introduction, Types - dead & live axle, Construction - material - cross section, Stub axle -different arrangements

#### ***Suspension System***

Types of front suspension for two, three & four wheeler, Rear Suspension system.

Introduction to springs and Shock absorbing devices-Types, Leaf, coil springs & their arrangements, Helper spring, spring shackle, shackle pin, Telescopic type Shock - absorber.

### ***Steering System***

Principles of steering, Ackerman , Davis fifth wheel, Steering gear box - types, Worm & roller, worm & sector, Re-circulating ball, Rack & pinion, Steering linkages - arrangement - components. Power steering - integral - linkage type, Collapsible type steering column. Factors affecting wheel alignment.

### ***Brake System***

Types of brakes-mechanical, hydraulic, pneumatic, servo brake, Air brake. Drum and disc brake system -Internal expanding and externally contracting, Master cylinder, types - working principle, Wheel cylinder, brake bleeding, brake shoe. Air brake- working, working of servo brake - types, disc brake -working.

## **MODULE III: TRANSMISSION AND ELECTRICAL SYSTEMS**

### ***Transmission system***

Principle of friction clutches. Constructional features and working of-Single plate dry clutch, Diaphragm clutch, Cone clutch, Centrifugal clutch, Semi centrifugal clutch, Vacuum clutch, Hydraulic clutch, Electromagnetic clutch, Multiplate clutch (dry & wet), Fluid fly wheel, Clutch disc,, Pressure plate.

Constructional features & working of - Sliding mesh gearbox, Constant mesh gearbox, Synchro mesh gearbox, Progressive type gearbox, Epicyclic gearbox, Torque converter, Gear selector and shifting mechanism, 2 Wheeler transmissions, Gear drive-Chain drive, CVT & Automatic transmission.

Propeller shaft and universal joint, Torque tube drive, Hotchkiss drive, Constant velocity joints, Front wheel drive, Differential mechanism, Rear Axles-types

Wheels - spoked wheel, disc wheel, and alloy cast wheel, composite wheel, Tyre construction (cross sectional details), Tubeless tyre, Tyre treads patterns, Inflation pressure and its effects, Factors affecting tyre performance.

### ***Electrical System***

Constructional details of automobile dynamo, Constructional details of alternator, Charging System -necessity, Types of Regulators.

Starter switch, Starter motor - constructional features, Starter Motor Drives-Necessity, Types of starter motor drives, mechanisms of - Bendix drive (inboard & Outboard), Over running Clutch, Axial starter (sliding armature), Pre engaged type.

Types of ignition system, coil ignition, Components-Ignition coil, Contact breaker points, Cam angle, Condenser, Distributor, Spark plug - types, Spark advance & retard mechanism (centrifugal & vacuum), Magneto ignition system - Low tension & high tension, Rotating

armature & rotating magnet type, CD. ignition system, Electronic ignition systems, Transistorized ignition, Computer controlled ignition, Distributorless ignition system.

## **MODULE IV: TRANSPORTATION MANAGEMENT AND MODERN VEHICLE TECHNOLOGY**

### ***Transportation Management***

Features of M.V. Act - definition of terms -test for drivers and conductors - registration of vehicles -duties of drivers and conductors - traffic signs -M.T.O and functional wings - organization chart. Road geometry - width of high way -gradient - cross section of road - super elevation and sight distance - road intersection. Insurance surveying - companies - classification of policies- factors involved in assessing

### ***Fuel injection system in Petrol engine and Diesel engine***

Fuel injection systems in petrol and diesel engines, E.F.I-types, MPFI, Gasoline direct injection system, Throttle Body Injection, Sensors-types and construction, actuators, Common Rail Diesel Fuel System, ECM, electronic fuel injectors

### ***Automobile pollution and control***

Effect of pollutants, sources of pollution, methods to control petrol engine and diesel engines emissions, Reduction of compression ratio, blow by control system, PCV system, After burner, catalytic converter, control of oxides of nitrogen, EGR, Evaporative emission control system-Charcoal canister, Diesel smoke and its control, emission norms

### ***Modern vehicle accessories and safety devices***

Vehicle accessories-cruise control- electric seat and mirror- intelligent wind screen wiper-automatic climatic control- adaptive noise control system- Parking distance control. Restraint systems-Seat belt -Air bag, electronic stability control- ABS-key less entry & Vehicle immobilizer- automatic traction control system- GPS

## **Part III - Questions based on HDV Driving License**

## **Part IV – Constitution of India**

## **Part V – Information Technology & Cyber Laws**

**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**