FURTHER DETAILS REGARDING MAIN TOPICS OF PROGRAMME NO. 11/2016 (Item No. 12)

VOCATIONAL TEACHER (MAINTENANCE AND REPAIRS OF AUTOMOBILES)

VOCATIONAL HIGHER SECONDARY EDUCATION DEPARTMENT

(CATEGORY No.392/2013)

(Mechanical Engineering)

Module I : Thermodynamics and Fluid Mechanics
Laws of thermodynamics, thermodynamic system and processes, basic thermodynamic cycles, behaviour of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes.
Fluid properties, fluid statics, manometry, buoyancy, control-volume analysis of mass, momentum and energy, differential equations of continuity and momentum, Bernoulli’s equation, viscous flow of incompressible fluids, laminar and turbulent flow, flow through pipes, head losses in pipes, bends etc, Types of pumps and their working.

Module II : Theory of Machines
Displacement, velocity and acceleration analysis of plane mechanisms, Cams, Gears and gear trains. Flywheels, Governors, Balancing of rigid rotors, Balancing of single and multi cylinder engines, free and forced vibrations of single degree of freedom systems, effect of damping, vibration isolation, transmissibility, Critical speeds.
Free body diagrams, virtual work, Stress-strain relationship and elastic constants, Mohr’s circle for plane stresses and plane strain, shear force and bending moment diagrams, torsion of circular shafts, Thermal Stresses, failure theories, fatigue strength, principles of the design of riveted and welded joints. Design of spur gears, rolling and sliding contact bearings, brakes and clutches, screw jack, elements of CAD.

Module III : Manufacturing Process
Structure and properties of engineering materials, crystal structure, defects in crystals, iron-carbon equilibrium diagram, Phase transformation, T-T-T diagram, heat treatment processes, powder metallurgy. Design of patterns, moulds and cores, solidification and cooling, riser and gating design, forging, drawing, extrusion, shearing, bending, joining processes – welding, weldability, brazing and soldering, adhesive bonding, mechanics of machining, single and multipoint cutting tools, tool geometry, tool life and gear, economics of machining, EBM, ECM, LBM, ultrasonic machining, CIM, CNC machining, limits, fits and tolerance, linear and angular measurements, accuracy,
Module IV: Principles of Management
Functions of management, organisational structure, authority, responsibility, span of control, line, line and staff, project and matrix organizations, partnership and joint stock companies, private limited, public limited companies, cooperative organizations and Government organizations. Factors in selection of site, types of plant layout, maintenance management – objectives and functions, types of forecasting, break-even analysis, inventory control, scheduling, material requirement planning, job evaluation and merit rating, acceptance sampling, TQM, ISO standards, linear programming, simplex method, Transportation and assignment models, network flow models, CPM and PERT, elements of industrial safety, fire protection.

Automobile Engineering

Part I: Automobile Power Plant


Fuel Systems in Engines ---- Petrol: Different fuel feed systems, A. C. mechanical pump, S U Electrical pump, petrol Filters and air Cleaners, Carburettors, Simple carburettors – parts, principle of working, compensation, mixture strength requirement, modern carburettors, float system, idle and slow speed system, high speed system, Acceleration pump and choke system. Other commercial carburettors, Su, Solex and Solex – Mikuni carburettor. Exhaust system – Manifolds, silencer types, tail pipes etc.

Diesel: Various components in Diesel fuel system – types of fuel injection – air injection and mechanical injection, common rail and unit injection system. Types of combustion chamber in Diesel engines – open, turbulent and pre-combustion chamber etc. Fuel injection – single cylinder and multi cylinder. 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 – single hole, multi hole, pintle and pintox type.

**Lubrication and cooling system:** Lubrication system: Properties of lubricating oil, different ratings of lubricating oil, types of engine lubrication – wet and dry sump lubrication, splash and pressure feed systems. Oil pumps – gear type, Vane type, plunger type and lobe type, pressure relief valve, oil pressure indicator Oil coolers, oil filters, oil seals, Crank case ventilation – dilution Cooling system: - air and water cooling, thermostop and pump circulation system over cooling, under cooling and optimum cooling – thermostat radiators – types, pressure cap, types of coolants, pump, antifreeze solution, cooling fan – types.

**Part II : Autoelectrical systems and equipments**

**Battery:** Introduction, Types of battery. Brief description of lead acid and alkaline cell, Constructional details of lead acid cell, nickel alkaline cell, Active materials of lead acid cell, Chemical action of lead acid cell, Rating of Battery, Capacity of Battery – ampere hour and watt hour, Efficiency Battery – ampere hour and watt hour, Effect of discharge rate on voltage and capacity, Effect of temperature on voltage and capacity, Battery charging, Constant voltage, Constant current. Defects – Effect of overheating, Effect of overcharging, dislocation of active material, sulphation, Internal short circuits, Corrosion / sulphation of terminals. Testing of battery – Polarity test, State of charge, Specific gravity test by hydrometer, high rate discharge test by cell tester, Cadmium test, Lamp test Care and maintenance of battery – Topping up of Battery & other maintenance schedule, Storage of lead acid battery (in dry & wet condition), Maintenance free battery.


**Spark Ignition System:** Introduction, Types of ignition system – coil & magneto – study of coil ignition, Component study of ignition system – ignition coil, Contact breaker points, Cam angle, condenser, distributor, Spark plug – types, Spark plug specifications, Spark advance & retard mechanism (centrifugal & vacuum), Magneto ignition system – Low tension & high tension, Rotating armature & rotating magnet type, Polar inductor type C. D. ignition system, Electronic ignition systems, Magnetic pickup type & hall effect sensor type, Transistorized ignition, computer controlled ignition, Distributor-less ignition system.

**Lighting system & other electrical accessories:** Head light – Reflectors, lenses, Bulbs (constructional features), Dazzle and its avoidance, Focusing of head lamps, Automatic dim & bright circuit, other lights – parking light, side lamp, tail lamp, roof lamp, fog lamp, brake light, dash board light, Types of bulbs – vacuum, gas filled,

**Part III : Automobile Chassis**

**Chassis:** Introduction, constructional details, types of frame, frame for two wheeler, three wheelers and four wheeler, frame sections, bumpers, sub frames, materials used, testing of chassis – Front Axle – Introduction, types – dead & live axle, construction – material – cross section – checking the alignment of front axle, stub axle – different arrangements.

**Suspension Systems:** Types of front suspension for two, three and four wheeler, air suspension, hydro-elastic suspension, rear suspension system. Types – Introduction to springs and shock absorbing devices, Types leaf coil, springs & their arrangements, Helper spring, spring shackle – shackle pin, Telescopical type shock absorber, Hydraulic, gas filled type, twin tube type, Basic suspension movements – pitching, bouncing, rolling etc.

**Steering System & Steering Geometry:** 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, Wheel alignment – factors affecting wheel alignment.


**Part IV: Fuels and Combustion and Applied Thermodynamics**

**Fossil and non Fossil Fuels:** Properties of SI and CI engine fuels – Properties and performances – LPG, CNG, Alcohol – Hydrogen and Bio-diesel – Bi-fuel and Dual fuel systems – electric cars, hybrid vehicles – fuel cell

**Combustion Phenomenon in SI Engines:** Stages of combustion in SI engines – the effects of engine variables – ignition lag – flame propagation – abnormal combustion – detonation, pre-ignition & surface ignition.

**Combustion Phenomenon in CI Engines:** Stages of combustion in CI engines – various air fuel ratios – delay period and variables affecting the delay period – Diesel Knock and its control

**Super Charging & Air Conditioning System:** Super charging – Effects of super charging. Methods of supercharging and turbo charging. Lean burn engines – Automobile air conditioning system – working – components and their location, Refrigerants, their properties, refrigeration controls

**APPLIED THERMODYNAMICS**

**Thermodynamic Processes:** Revision of topics like, thermodynamic system, thermodynamic properties, boundary, state, process, internal energy, flow of work, enthalpy, and entropy, first and second law of thermodynamics. Specific heats at constant volume and at constant pressure. Establish the relation between specific heats and gas constant. Derivation of formulae for work, heat, change in internal energy, relation between pressure, volume and temperature during constant volume, constant pressure, constant temperature, adiabatic and polytropic processes – problems.


**Power Developed in I. C. Engines:** Indicator diagram and measurement of mean effective pressure. Engine indicators. Indicated power, brake power, friction power, indicated thermal efficiency, brake thermal efficiency, volumetric efficiency, specific fuel consumption, Morse test and preparation of heat balance sheet. Air compressors – uses of compressed air, classification of air compressors – working of single stage and multistage air compressors. Intercooler.
Part V: Automobile Service & Maintenance and Transport Management

Automobile Service & Maintenance


Vehicle Body Engineering: Car body construction details, major body sections of a passenger car – front section, centre section, rear section, construction types – conventional body over frame, unitised frame and body construction. Fibre reinforced and Metal reinforced body structures. Classification of coach work, coach and bus body styles, typical layout of bus and coach body, typical layout of commercial vehicles, vehicle body materials – steel, light alloys, plastics, textiles, glass, wood, aluminium materials, adhesives and their properties, corrosion and their prevention. Hand tool study, power tool and equipment, shop safety, minor repairs – repairing plastics, hood, bumper, fender, lid, and trim service, door, roof, glass service, passenger compartment service. Major body repair – frame repair, frame / body damage measurement, frame re-alignment. Paint materials, paint characteristics, refinishing process – paint removal,
preparing bare metal, prime coat selection, final sanding, masking, surface cleaning. Spray guns, equipment and material preparation, spray gun setup, spray booth.

**TRANSPORT MANAGEMENT**


**Bus Operation:** Factors governing bus schedule – making a bus schedule – operating characteristics – trip generation and trip distribution – Number of buses required for operation – preparation of time table for bus and crew – factors governing crew scheduling – making a crew scheduling. Intermediate public transport in Indian cities (IPT) / Para transit, Characteristics of IPT modes, Light rail transit (LRT/Tram), electric trolley bus (ETB), Magnetic levitation (MAGLEV) system, container freight station, Trailer, on flat car, Automatic Guided Vehicle (AGV).


**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.