DETAILED SYLLABUS FOR THE POST OF LECTURER IN AUTOMOBILE ENGINEERING
(TECHNICAL EDUCATION (GOVERNMENT POLYTECHNICS))

(Cat.No. : 250/2022)

Total Marks – 100)

Module 1 : Micro controllers: (5 Marks)

Micro controller modules in Automobile; Microcontroller programming – high level language, assembly language and machine language; Compiler, assembler and interpreter; Integrated development environment; Chip burning

Module 2 : Vehicle Performance and Testing: (5 Marks)

Noise vibration and Harshness: Review of vibration fundamentals, vibration control, fundamentals of acoustics, human response to sound, automotive noise criteria, Standard noise measurement methods, Noise inside and outside the vehicle, sources of vehicle noise- intake and exhaust noise, combustion noise, mechanical noise, noise from auxiliaries, wind noises, transmission noises, brake squeal, structure noise, noise control methods.
Vehicle performance: Methods for evaluating vehicle performance- energy consumption in conventional automobiles, performance, emission and fuel economy, Operation of full load and part conditions, effect of vehicle condition, tyre and road condition and traffic condition and driving habits on fuel economy, CAFÉ standards.

Module 3 : Automobile Navigation & Control: (5 Marks)

Principle of Automobile Navigation and controls in the new generation cars. Capabilities of the navigation and control in future cars. Introduction of various components in automobile navigation and control. Basic need of CAN in automobile navigation and control, vehicles, features, advantages and applications of CAN, functional concepts, hierarchical organization and implementation

Various Sensors in Automobile navigation system: Laser radar- principle and working, non contact ground velocity sensors for vehicles, major types and comparison, road surface recognition sensors, vehicle sensors for ETC systems.

Global Positioning system: History of GPS, Navistar GPS system, Fundamentals of satellite based positioning, GPS receiver technologies, Application of GPS technology.

Module 4 : Automotive Pollution and Control: (5 Marks)

Emission standards & regulations – international standards, US, European union standards, & Indian standards. Compliance with standards – certification - assembly lane testing – In use surveillance & recall.

Emission measurement and testing procedures – light and heavy duty vehicles & two wheelers. Crankcase, evaporative, refueling and on-road emissions. NDIR analyzers, FID, Chemiluminscence analyzers etc.

Technology for controlling emissions – Gasoline fueled vehicles – A/F ratio, electronic control. Catalytic convertors – two way and three way convertors – catalytic wear and poisoning. Diesel fueled vehicles – engine design – exhaust after treatment – EGR- Crankcase emission and control - evaporative emission and control – fuel dispensing and distribution emissions and control.

Emission standards for inspection and maintenance – cost and benefits – emission improvements – impact of tampering – cost effectiveness. Remote sensing of vehicle emissions – evaluation of data.

Vehicle replacement and retrofit programs – scrapage and relocation – replacement – retrofit program. Intelligent vehicle- highway systems

Module 5 : Automobile Power Plant (16 Marks)

Constructional Details of I. C. Engines : Cylinder block – Single cylinder and multi cylinder, materials, Water jackets – cooling fins, cylinder liners – wet type and dry type materials. Cylinder head – Materials, method of fixing the cylinder block, cylinder head gasket, combustion chamber of petrol engines – expansion chambers. Pistons – Trunk type pistons, composite pistons – piston materials expansion control in pistons – methods and types of piston, Piston rings – Materials, method of manufacture, types of rings – compression ring, oil ring and special purpose ring. Gudgeon pin – Types of fastening, material used. Connecting rod – Function, materials used big end and small end bearings Crank shaft – different shapes, different crank shaft arrangements Main bearings, Fly wheel functions Types of valves – Poppet, reed valve and disc valve, sodium vapour cooled valves, hydraulic tappet and free valve rotators Classification of engine according to valve arrangement I-Head, L- Head, T-Head and F-Head engines - Valve operating mechanisms – side cam shaft and over head cam shaft - Inlet and exhaust valve materials, valve timing diagram. Cam shaft –functions and drives, cam shaft bearings.

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. Electronic Fuel Injection (EFI system) - Types of petrol injection - indirect injection methods - single point injection, multi point injection, direct injection. EFI subsystems - air intake system, fuel delivery system, electronic control system, sensors and actuators - different types, idle air control, on board diagnostics of EFI. 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. Electronic diesel fuel system - working, various sensors and their working, fuel injection pump, common rail diesel fuel system, fuel tank, fuel delivery pump, high pressure fuel injection pump, fuel rail, fuel rail pressure sensor, electronic diesel fuel injector – working, injection control. 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, Turbocharging system and types.

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, thermo-siphon 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.

Module 6 : Auto-electrical systems and equipment (16 Marks)

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 1voltage, 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.

Generator and Alternator: Constructional details of automobile dynamo – special features of automobile dynamo, constructional details of alternator – special features of automobile alternator, charging system – Introduction – necessity, Types of regulators – circuit diagram, Cut out, Voltage regulator, current regulator – 3 stage, Electronic voltage regulator in alternators, Starter motor & its drive mechanism, Introduction, Starting of I. C. Engine (Petrol & Diesel) – motor characteristics, Terms like Engine torque – motor torque – cranking speed – motor locked torque etc, starter switch, starter motor – constructional features – special features of automobile starters, 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

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, halogen. Introduction, Electrical fuel pump, electric horn, wind screen wiper – types, constructional features, working, Traffic

Indicator – Electrical & Electronic, gauges like, fuel level indicator, oil pressure gauge, temperature gauge, Electrically operated – power window, solenoid operated fuel cut off, wind shield washer, constructional features & working, electronically operated central locking system.

Module 7 : Automobile Chassis (16 Marks)

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, Telescopic 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.

Brake Systems: Principle of operation, weight transfer principle, types of brakes – mechanical, hydraulic, pneumatic, servo brake, Air brake – vacuum brake – fail safe brake – dual brake – antilock brake, Drum and disc brake system – Internal expanding and externally contracting – Layout of brake system, mechanical components, hydraulic – master cylinder, types – working principle – wheel cylinder – brake bleeding, brake shoe. Air brake – construction details – working – details components – servo brakes – working of servo brake – types, vacuum and air – disc brake – constructional details and working of engine exhaust brake – testing of brake efficiency.

Transmission Systems: Various components in transmission required for a good 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 – over running clutches – Multiplate clutch (dry & wet) Fluid fly wheel – clutch disc – constructional details and functions of each part, pressure plate – constructional details and functions of each part, Clutch operating mechanism.

Necessity and functions of gearbox: Gearbox constructional features & working of –
Sliding mesh gearbox – Constant mesh gearbox – Synchromesh gearbox – progressive type gearbox – Epicyclic gearbox – Torque converter – Gear selector and shifting mechanism, two wheeler transmissions – Gear drive – chain drive – V matic transmission, CVT & ECVT – Automatic transmission in cars – Introduction of Propeller shaft and universal joint – Torque tube drive – Hotchkiss drive – Variable velocity joints – constant velocity joints – Front wheel drive – differential mechanism – Locking differential – limited slip differential – Rear Axles – types

Wheels & Tyres: Wheels – wire – spoked wheel, disc wheel and alloy cast wheel, composite wheel – wheel specification – Tyres – Tyre specification – Tyre construction (cross sectional details.) – Tubeless tyre – Tyre treads patterns – Inflation pressure and its effects (both over & under inflation) – Factors affecting tyre performance. Tube repair. Causes of tyre wear. Tyre rotation, retreading and balancing of wheels.

Module 8: Fuels and Combustion and Applied Thermodynamics(16 Marks)

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 formula 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.

Air Standard Cycles: Reversible and irreversible cycle. Available work and energy of a cycle. Theoretical thermal efficiency and air standard efficiency. Pressure-volume diagram and temperature-entropy diagram. Derivation of formulae for air standard efficiency of Carnot cycle, Otto cycle, Diesel cycle – problems to find air standard efficiency.

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. Use of Intercooler.

Module 9: Automobile Service & Maintenance and Transport Management (16 Marks)

AUTOMOBILE SERVICE & MAINTENANCE

Introduction to Servicing and Maintenance of Automobiles: Various signs showing the necessity of overhauling engine decarburizing, vacuum test, compression test and
cylinder leakage test. Causes of excessive lubricating oil consumption. Engine dismantling and assembling. Checking of engine components – causes of cylinder wear – cylinder rebooting and honing – linear replacement. Servicing of valves. Valve adjustment and defects of valves. Piston defects and reconditioning methods. Testing of connecting rods. Defects and reconditioning methods. Measurement of bearing clearance and adjustment of connecting rod bearings. Crank shaft balancing and machining

processes. Renewal of flywheel ring gear.

Servicing of Petrol Engine: Defects in coil ignition system like 'No spark', weak spark, Intermitted spark and spark at some wires. Testing of ignition system components. Setting of ignition timing. Checking of advancing units. Servicing of spark plug. Trouble shooting of fuel system. Testing of A. C. mechanical pump. Tuning of carburettor. Causes of excessive fuel consumption and defects of carburettor. Engine tuning procedure. Servicing of diesel engine – F. I. pump timing and bleeding of diesel fuel system. Testing of Nozzles. Phasing and calibration of F. I. pump. Defects of F. I. Pump and Nozzles. Troubles and diagnosis in MPFI and CRDI systems.

Servicing of Clutch Assembly and Transmission : Fitting of clutch, clutch adjustments. Removal and refitting of trans-axle. Dismantling of propeller shaft and universal joint. Defects in propeller shaft. Servicing of differential and rear axle. Removal of axles in full floating, semi floating and three quarter floating types. Differential troubles and adjustments.

Servicing of Suspension System and Brakes: Checking of wheel alignment. Adjustment of torsion bars. Care and maintenance of vibration dampers. Replacement of suspension rubber bushes. Play adjustment in steering gear boxes. Centralizing steering wheel. Troubles in steering system. Brake shoe removal and re-lining. Brake bleeding and adjustment. Servicing of master cylinder and wheel cylinder checking of braking efficiency. Troubles in hydraulic and air brake systems. Periodic and break down maintenance. Maintenance schedule. Cleaning of vehicle in a service station. Equipment used in a service station.

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

Features of M. V. Act: Definition of terms – test for drivers and conductors – registration of vehicles – duties of drivers and conductors – traffic signs – Road safety provisions in Motor vehicle act - mode of staffing in a depot – site selection and facilities in a depot – M. T. O. and functional wings – organization chart – type of co-ordination and co-coordinating factors.

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).

Fare collection – Route planning – Fare structure and table – trip sheet and way bill – ticket system – accident prevention – operational cost – fare methods – fare stage – organization of automotive business

– marketing background – functions of marketing activities – workshop management – responsibilities of dealer – duties of workshop staff – warranty, Consignment shipment.

Importance of Roads: Traffic studies and high way planning – Road geometry – width of high way – gradient – cross section of road – super elevation and sight distance – road intersection – traffic lights – location of bus stop, bus bay, zebra crossing and parking positions – traffic census. Insurance surveying – companies – classification of policies – third party insurance – factors involved in assessing – MACT

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.