

**DETAILED SYLLABUS FOR THE POST OF MECHANICAL
ENGINEER IN KERALA STATE WATER TRANSPORT**
Cat.No: 437/2022

Mechanical Engineering - 25 Marks

Module 1

Fluid statics: Atmospheric pressure, gauge pressure and absolute pressure. Pascal's Law, measurement of pressure - piezo meter, manometers, pressure gauges.

Fluid kinematics and dynamics: Types of flow, path line, streak line and stream line. Continuity equation, Euler's equation, Bernoulli's equation. Reynolds experiment, Reynold's number. Hagen- Poiseuille equation, head loss due to friction, friction, Darcy- Weisbach equation, Chezy's formula (No derivations), compounding pipes, branching of pipes, siphon effect, water hammer transmission of power through pipes (simple problems).

Module 2

Fuel supply system in IC engines : Quantity & hit and miss governing. Working of a carburetor, Introduction and fuel system circuit. Air fuel ratio requirements. Types of gasoline fuel injection system, MPFI - L Jetronic and D jetronic systems, GDI, electrical fuel pump, electronically controlled fuel supply system, electronically controlled exhaust gas re-circulation system, Diesel fuel injection systems- Engine governor, Jerk pumps, distributor pumps, types of nozzles, Electronic fuel supply system in diesel engines - CRDI.

Components of Ignition systems: Ignition system, Types of ignition, spark plug, firing order, magneto and coil ignition, constructional details, distributor, spark plugs, ignition coil, ignition timing, TAC (transistor assisted contact) ignition system, CD Ignition system, DTSi, Electronic / solid state ignition system,. Microprocessor controlled ignition system, advantages, simplified operational diagram of a distributor less ignition system, automatic ignition advance methods, ignition timing, spark plugs-construction, principle of electronic ignition and ignition advance.

Module 3

Basics in Mechanics of Solids: Types of Loads and Stresses Uniaxial, Biaxial and; Triaxial State of Stresses. Stress-Strain Concepts: Tension, Compression and Shear; Uniaxial stresses; Elastic Limit; Stress Strain relationship for mild steel; Hooke's Law; Yield point; Bars of varying sections; Bars of composite sections; Temperature Stresses; Poisson's Ratio; Stress-Strain Diagram; Working Stress; Factor of safety; Volumetric strain; Modulus of elasticity; Modulus of rigidity; Bulk Modulus Relationship between the elastic constants.

Module 4

Conduction heat transfer: Introduction to heat transfer- thermodynamics and heat transfer-typical heat transfer situations- modes of heat transfer- mechanism of heat transfer- basic laws of heat transfer- thermal conductivity-effect of temperature on thermal conductivity- combined heat transfer mechanism-real life situations of combined heat transfer. Differential equations of heat conduction-boundary conditions and initial conditions, one dimensional steady state situations – plane wall, cylinder, sphere -concept of thermal resistance, critical radius, conduction with heat generation-Two-dimensional steady state situations, transient conduction, Lumped capacitance model, concept of Heisler chart and Schmidt Plot-Conduction shape factor Numerical methods of analysis-thermal analysis of rectangular fins.

Module 5

Introduction- free vibration of single degree undamped systems- natural frequency-energy method- Newton's second law (free body diagram)-damped systems-logarithmic decrement. Forced vibration-single degree of freedom systems-harmonic excitation-vibration isolationtransmissibility-whirling of shafts.

Marine Engineering (Total Marks : 25)

Conventions & Regulations:

IMO conventions, SOLAS, MARPOL, Loadline, Verification of compliance of various conventions and National legislations. Surveys and Certification requirements.

Systems & Equipments onboard:

Properties and suitability of various Lubricants. Types of vibrations, resonance and critical speed. Practical heat balance diagram and thermal efficiency of diesel engines.

Ventilation and air-conditioning of various compartments. Pumping and piping systems for bilge, ballast, lub oil, fuel oil, fresh water & bunker fuel oil.

Alternators, emergency generators, Main and Emergency switchboards, Electrical Safety, Transformers, A/C & D.C Motors, Circuit breakers.

Operation & Maintenance of equipments:

Troubleshooting and maintenance of Marine diesel engines, Maintenance of various types of pumps, and flow control devices.

Methods of dry-docking of ships, removal and refitting of propellers, measurement of clearances and drops for propeller and rudder, steering gear equipment, methods of shaft alignment, maintenance of gearbox and thrust bearing. Inspection and maintenance of various under water fittings.

Freeboard and Draft marks, Anchor and cable arrangements, Stern frame and Rudder, shafting, Shaft tunnel and stern tube bearing, bulkheads and water tight openings, hatches and other openings, Bilge keel, hull condition monitoring and thickness measurement.

Safety equipments & procedures:

Basic Safety concepts onboard vessel, stowage, securing arrangements and launching of Lifeboats and life rafts, Fire detection and fire fighting equipments onboard. Signalling and communication equipments onboard.

Automobile Engineering - 25 Marks

Module I: Air standard Cycles, Fuels and Combustion

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. Air standard efficiency of Carnot cycle, Otto cycle, Diesel cycle. 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

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 and CI Engines: Stages of combustion in SI engines – the effects of engine variables – ignition lag – flame propagation – abnormal combustion –detonation, pre-ignition & surface ignition - Stages of combustion in CI engines – various air fuel ratios – delay period and variables affecting the delay period – Diesel Knock and its control

Module II : Automobile Chassis

Chassis and Suspension system: 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, 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, 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.

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 – electromagnetic clutch – over running clutches – Multiplate clutch (dry & wet) Fluid fly wheel – clutch disc – 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 – 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.

Module III: Components of I. C. Engines

I.C Engine Construction: 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.

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 IV: 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: 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. Tube repair. Causes of tyre wear. Tyre rotation, retreading and balancing of wheels.

Servicing of Suspension System: 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.

Naval Architecture (25 Marks)

Module 1: Hydrostatics and Stability of Ships

Archimedes Principle, Weight and Buoyancy, Main Dimensions, Lines Plan, Equilibrium Conditions, Form Coefficients, Hydrostatic Parameters, Effect of adding/removing weights, Free Surface Effect, Statical Stability, GZ Curve, Trim, Stability Criteria.

Module 2: Powering of Ships

Effective Power, Types of Resistance, Propeller Thrust and Torque, Shallow Water Resistance, Types of Propellers, Propulsive efficiency, Model Tests, Cavitation, Electric Propulsion.

Module 3: Sea keeping and Manoeuvrability

6 Degrees of Freedom (surge, sway, yaw, heave, pitch and roll), Sea state definition, Principle of Rudder action, Types of Manoeuvres – Turning Circle, Zig-Zag, Pull-Out and Spiral Manoeuvres, Motion Stabilizers, Sea-Keeping Criteria.

Module 3: Ship Design

Forces on Ship Structure (static and dynamic loads), Design Spiral, Hogging and Sagging, Section Modulus, General Arrangement, Inclining Experiment, Fire fighting systems, Anchoring and mooring arrangement.

Module 5 : Ship Construction

Shipbuilding Materials (ferrous and non ferrous) and their properties, Framing System, Bottom, Deck, Side, bulkhead, fore end and aft end structures, Super Structure, Types of Welding, Weld Defects, Weld Quality Control, Non-Destructive Tests, Corrosion and its Prevention Methods.

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.