

KERALA PUBLIC SERVICE COMMISSION

DETAILED SYLLABUS FOR THE POST OF JUNIOR INSTRUCTOR (MECHANIC TRACTOR) - INDUSTRIAL TRAINING

CAT. NO. 078/2026

(TOTAL MARKS-100)

MODULE- 1: TOOLS, MEASURING INSTRUMENTS & FASTENERS — 15 MARKS

Hand & Power Tools: Marking material- chalk, prussian blue. Cleaning tools- scraper, wire brush, emery paper. Surface plate, steel rule, measuring tape, try square. Calipers- inside and outside, dividers, surface gauges, scribe, punches- prick punch, center punch, pin punch, hollow punch, number and letter punch, chisels- flat and crosscut. Hammer- ball peen, lump, mallet, screwdrivers- blade screwdriver, phillips screwdriver, ratchet screwdriver, allen key. Bench vice & C-clamps. Spanners- ring spanner, open end spanner, combination spanner & universal adjustable open-end spanner. Sockets & accessories. Pliers - Combination pliers, multi grip, long nose, flat-nose, nippers or pincer pliers, side cutters, tin snips, circlip pliers, external circlip pliers. Air impact wrench, air ratchet, torque wrenches & pipe wrenches. Car jet washers, pipe flaring & cutting tools, pullers- gear and bearing. Cutting tools- different types of cutting tools like hacksaw, file (parts of file, specification, grade, shape, different type of cut and uses). Off-hand grinding with sander, bench and pedestal grinders, safety precautions while grinding.

Care & use of micrometers- outside and depth micrometer, micrometer adjustments, vernier calipers, telescope gauges, dial bore gauges, dial indicators, straightedge, feeler gauge, thread pitch gauge, vacuum gauge, tire pressure gauge.

Fasteners- different types of screws, nuts, studs & bolts, locking devices- nuts, cotter, split pins, keys, circlips, lock rings, lock washers and application. Washers & chemical compounds used to secure these fasteners. Function of gaskets, selection of materials for gaskets and packing, oil seals.

MODULE-2: DRILLING, TAPPING, REAMING, LAPPING, WELDING, HYDRAULICS & PNEUMATICS — 15 MARKS

Limit, fits & tolerances in auto components. Drilling machine – bench type drilling machine, portable electrical drilling machine. Drill holding devices and work holding devices, drill bits.

Taps and Dies: Hand taps and wrenches, tap drill sizes for metric and inch taps. Different types of die and die stock. Screw extractors. Hand reamers- different types of hand reamers, drill size for reaming. Lapping- lapping abrasives, type of laps.

Introduction to welding and heat treatment. Welding processes- oxy-acetylene welding principles, equipments, welding parameters, edge preparation and welding techniques. Introduction of Arc, MIG and TIG welding- its applications.

Basic difference between hydraulic and pneumatic systems. Pascal law, pressure, force, viscosity. Gear Pump-Internal & External, single acting, double acting & double ended cylinder. Directional control valves- 2/2, 3/2, 4/2, 4/3 way valve, pressure relief valve, non return valve, flow control valve used in automobiles. Classification of vehicles as per motor vehicle rule. Uses of vehicle hoists - two post and four post hoists, engine hoists, jacks, stands.

MODULE- 3: ENGINE FUNDAMENTALS — 15 MARKS

Classification of engines, principle & working of 2 & 4- Stroke diesel engine (Compression Ignition engine (C.I), principle of Spark Ignition engine (SI), differentiate between 2-stroke and 4-stroke, C. I engine and S.I engine, Direct injection and Indirect injection. Common rail direct injection engine. Engine output, compression pressure, Compression ratio.

Engine components– working principle & construction of cylinder heads, types of combustion chambers. Function of engine valves, different types, materials. Type of valve operating mechanisms. Importance of valve seats & inserts, valve movement, valve stem, oil seals, valve-timing diagram and concept of variable valve timing. Cylinder block- cylinder block construction, types of cylinder blocks & cylinder liners. Description and functions of different types and materials of piston, piston rings and piston pins. Used recommended clearances for the rings and its necessity precautions while fitting rings, common troubles and remedies. Description & functions of connecting rod, importance of big end split obliquely. Materials used for connecting rods, big end & main bearings. Piston pins and locking methods of piston pins. Recommended clearances for the cylinder liners & rings. Bearing failure & its causes-care & maintenance. Crank shaft & cam shafts. Types of their drives. Description of Overhead camshaft, importance of camlobes. Crank case ventilation (PCV). Camshaft, crank-shaft balancing, firing order of the engine. Description and functions of the fly wheel and vibration damper. Timing mark.

MODULE-4: COOLING & LUBRICATION, INTAKE, EXHAUST & DIESEL FUEL SYSTEMS — 15 MARKS

Cooling systems: - Coolant properties, preparation and recommended change interval, use of anti-freezer. Cooling system components- water pump, thermostat, pressure cap, recovery system & thermostitch. Functions & type of radiator.

Lubrication system: -purposes & characteristics of oil, type of lubricants, grade as per SAE, & their application, oil additives, types of lubrication system. Lubrication system components-different types of oil pump, oil filter & oil cooler. Probable reasons for low/ high oil pressure, high oil consumption and their remedies.

Diesel fuel characteristics, concept of quiet diesel technology & clean diesel technology. Fuel feed system used in tractor's- description and layout components. Diesel fuel system components. Description and functions of diesel fuel injection system, types of fuel injection pumps, type of drive, injectors -types and function. Governor and their types. Distributor-type injection pump, glow plugs, Cummins & Detroit diesel injection. Diesel electronic control systems (DEC). Method of bleeding fuel supply system.

Intake & exhaust systems, description & functions of air compressor, supercharger, inter coolers, turbo charger, variable turbo charger mechanism. Intake system components- description and functions of air cleaners, type of air cleaners, intake manifold and material. Exhaust system components- description and function of exhaust manifold, exhaust pipe, mufflers- reactive, absorptive, combination, electronic mufflers, catalytic converters, back pressure, diesel particulate filter, EGR (Exhaust Gas Recirculation).

MODULE-5: CLUTCH, GEARBOX & TRANSMISSION, WHEELS & TYRES — 15 MARKS

Clutch: - types, construction and functions. Components of clutch -driver & driven plates, torsion spring, cushion springs, operating fingers, clutch shaft, slave cylinder & oil seal. Clutch release bearing & linkage.

Manual transmissions:- function, description, types and their application. Gear box- components of tractor gear box. Principle of epicyclical gear box. Necessity of torque converter, need of 4 x 4-wheel drive/ front wheel drive, low & high gear ratio, universal joint and propeller shaft.

Final drive & drive Shafts: Differential carriers double reduction gearing, differential lock, crown wheel and pinion adjustments, function and types of power take off (PTO) mechanism. Types of front & rear axles. Common trouble and their remedies, care and maintenance.

Wheels & Tyres:- Description, construction and function of wheel. Rim sizes. Types & sizes of tyres. Solid, pneumatic & radial ply rating. Tyre materials, tyre information, tyre tread designs, tyre ratings for temperature & traction. Importance of inflating tyres to correct pressure. Repair and maintenance of tyres and tubes. Tire wear Patterns and causes . Nitrogen vs atmospheric air in tyres.

MODULE- 6: STEERING SYSTEM & BRAKE SYSTEM — 15 MARKS

Steering Systems: Function and types of steering system. Description, construction and functions of mechanical steering system. Steering wheel, steering gear box, tie-rod, arms link, ball and socket joints etc. their movement and adjustments. Description and mechanism of foot steer age pedal as incorporated in tractors. Description, working and principle of hydraulic steering system. Different parts such as pump, distributor valves, pipeline, hoses etc. Development of mechanical framing. Use of power tiller, tractor & bulldozer, chassis frame of tractor.

Braking Systems- Principles of braking, drum & disc brakes, lever/mechanical advantage, hydraulic pressure & force, brake fade. Braking systems - Brake type used on tractors.

Braking system components- park brake system, brake pedal, brake lines, brake fluid, bleeding, master cylinder, divided systems, tandem master cylinder, power booster or brake unit, hydraulic brake booster, applying brakes, brake force and brake light switch.

Drum brakes & components - Drum brake system, drum brake operation, brake linings & shoes, backing plate, wheel cylinders. Disc brakes & components-disc brake system, disc brake operation, disc brake rotors, disc brake pads, disc brake calipers, proportioning valves, proportioning valve operation, brake friction materials.

MODULE- 7: POWER TILLER, TRACTOR EQUIPMENTS AND TRACTOR ELECTRICAL SYSTEM— 10 MARKS

Description, working principle & use of power tiller (two-wheel tractor) power unit. Method of power transmission to wheel from engine, clutch/ brakes mechanism, method of power transmission to implement (Rotation). Hitching of M.B. Plough, trailer disc harrow.

Tractor equipment: - Description, function of harrows, cultivators, seed drills & tractor trailer. Hitching of equipment. Danger in overloading & incorrect field operation. Average life of agriculture implements. Description and function of tractor accessories such as draw bar, top link & belly pulley. Setting the drawbar to the correct height. Use of hydraulic lift. Maintenance of tractor accessories.

Tractor electrical maintenance: Lighting arrangement in tractors. Description of charging circuit. Operation of alternator, regulator unit, ignition warning lamp, troubles and remedy in charging system. Fault finding in electrical system. Description of starter motor circuit, common troubles and remedies in starter circuit. Description of lighting circuit. Charging & discharging of lead acid batteries. Stay Maintenance Free (SMF) batteries, thermistors, thermo couples, relays, solenoids. Charging system circuit. Fuses & circuit breakers, ballast resistor, stripping wire insulation, cable colour codes and sizes. Resistors in series circuits, parallel circuits and series-parallel circuits. Capacitors and its applications.

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.