Syllabus for the Post of Junior Technician (Diesel)-Level A1

Essential Qualification: High School or Class X Equivalent Board Examination with Science and Trade Certificate in Diesel.

Part (A): General Mental Ability and Aptitude	20% (20 questions carrying 1 mark each)

General Mental Ability and Aptitude to test the following:

- Interpersonal Skills
- Logical reasoning/Analytical/Comprehension ability
- Basic Numeracy and Data Interpretation Skills
- General Awareness

Part (B): Subject/Domain Related	80 % (80 questions carrying 1 mark each)

1. Importance & scope of Mechanic Diesel Trade Training. General discipline in the Institute; Elementary First Aid, Occupational Safety & Health; Knowledge of Personal Safety &Safety precautions in handling Diesel machine ; Concept about House Keeping & 5S method. ; Energy conservation process ; Safety disposal of Used engine oil ; Electrical safety tips ; Safe handling of Fuel Spillage ; Knowledge of Fire Safety & Fire extinguishers used for different types of fire ; Safe disposal of toxic dust ; safe handling and Periodic testing of lifting equipment.
2. **Hand & Power Tools**: Marking scheme, marking material - chalk, Prussian blue ; Cleaning tools - Scraper, wire brush, Emery paper ; Description, care and use of Surface plates, steel rule, measuring tape, try square. Callipers;inside and outside. Dividers, surface gauges, scriber ; Punches - prick punch, centre punch, pin punch, hollow punch, number and letter punch. Chisel - flat, cross-cut. Hammer - ball pein, lump, mallet. Screw drivers - blade; Screwdriver, Phillips screw driver, Ratchet screwdriver. Allen key, bench vice & C - clamps ; Spanners - ring spanner, open end spanner & the 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 circlips pliers ; Air impact wrench, air ratchet, wrenches - Torque wrenches, pipe wrenches,Pipe flaring & cutting tool, pullers - Gear and bearing.
3. **Systems of measurement -** Description, Least Count calculation, care & use of - Micrometers; Outside, and depth micrometer ; Micrometer adjustments ; Description, Least Count calculation, care & use of Vernier Calliper ; Telescope gauges, Dial bore gauges, Dial indicators, straightedge, feeler gauge, thread pitch gauge, vacuum gauge, tire pressure gauge.
4. Different types of metal joint (Permanent, Temporary), methods of Bolting, Riveting, Soldering, Brazing, Seaming etc.

   Fasteners - Study of different types of screws, nuts, studs & bolts, locking devices, Such as lock nuts, cotter, split pins, keys, circlips, lock rings, lock washers and locating where they are used. Washers & chemical compounds can be used to help secure these fasteners. Function of Gaskets, Selection of materials for gaskets and packing, oil seals. Types of Gaskets – paper, multilayered metallic, liquid, rubber, copper and printed; Thread Sealants - Various types like, locking, sealing, temperature resistance, antilocking, lubricating etc.

Cutting tools - Study of different type of cutting tools like Hacksaw, File - Definition, parts of a file, specification, Grade, shape, different type of cut and uses., OFF-hand grinding with sander, bench and pedestal grinders, safety precautions while grinding.

Limits, Fits & Tolerances - Definition of limits, fits &tolerances with examples used in auto components .

5. **Drilling machine** - Description and study of Bench type Drilling machine, Portable electrical Drilling machine, drill holding devices, Work Holding devices, Drill bits.

   Taps and Dies : Hand Taps and wrenches, Calculation of Tap drill sizes for metric and inch taps. Different type of Die and Die stock. Screw extractors.

   Hand Reamers: Different Type of hand reamers, Drill size for reaming, Lapping, Lapping abrasives, type of Laps.
6. **Sheet metal** - State the various common metal Sheets used in Sheet Metal shop Sheet metal operations ; Shearing, bending, Drawing, Squeezing Sheet metal joints ; Hem & Seam Joints Fastening Methods - Riveting, soldering, Brazing. fluxes used on common joints. Sheet and wire gauges. ; The blow lamp its uses and pipe fittings.
7. **Basic electricity** - Electricity principles ; Ground connections ; Ohm's law ; Voltage, Current, Resistance, Power, Energy ; Voltmeter, ammeter, Ohmmeter, Multimeter ; Conductors & insulators, Wires, Shielding, Length vs. resistance, Resistor ratings; Fuses & circuit breakers, ; Ballast resistor ; Stripping wire insulation, ; cable colour codes and sizes, Resistors in Series circuits , ; Parallel circuits and Series - parallel circuits, ; Electrostatic effects, Capacitors and its applications, ; Capacitors in series and parallel.
8. Description of Chemical effects, Batteries & cells, Lead acid batteries & Stay Maintenance Free (SMF) batteries, ; Magnetic effects, Heating effects, Thermo - electric energy, Thermistors, Thermocouples, ; Electrochemical energy, Photo- voltaic energy, Piezo-electric energy, Electromagnetic induction, ; Relays, Solenoids, Primary & Secondary windings, Transformers, stator and rotor coils.
9. **Introduction to welding and Heat Treatment**

   Welding processes - Principles of Arc welding, brief description, classification and applications. ; Manual Metal Arc welding principles, power sources, electrodes, weldingparameters, edge preparation & fit up and welding techniques; Oxy – Acetylene welding - principles, equipment, welding parameters, edge preparation & fit up and welding techniques;. Basic knowledge about advance welding process & equipments like MIG, TIG, Spot Welding, Plasma Cutter.

   Heat Treatment Process - Introduction, Definition of heat treatment, ; Definition of Annealing, Normalizing, Hardening and tempering. ; Case hardening, Nitriding, Induction hardening; Flame Hardening process used in auto components with examples.
10. **Non - destructive Testing Methods** : Importance of Non Destructive Testing In Automotive Industry, Definition of NDT, ; Liquid penetrant and Magnetic particle testing method – Portable Yoke method

    Introduction to Hydraulics & Pneumatics : Definition of Pascal law, pressure, Force, viscosity; Description, symbols and application in automobile of 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 automobile.
11. Auto Industry - History, leading manufacturers, ; Development in automobile industry, trends, new product. ; Brief about Ministry of Road transport &Highways,; The Automotive Research Association of India (ARAI), National Automotive Testing and R&D Infrastructure Project (NATRIP), & Automobile Association. ; Classification of vehicles on the basis of load as per central motor vehicle rule, wheels, final drive, and fuel used, axles, position of engine and steering

transmission, body and load. Brief description ; Uses of Vehicle hoists – Two post and four post hoist, Engine hoists, Jacks, Stands.

12. **Introduction to Engine**: Description of internal & external combustion engines, Classification of IC 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, ; Main Parts of IC Engine ; Direct injection and indirect injection, Technical terms used in engine, Engine specification. ; Study of various gauges/ instrument on a dash board of a vehicle; Speedometer, Tachometer, Odometer and Fuel gauge, and Indicators such as gearshift position, Seat belt warning light, Parking-brake-engagement warning light and an Engine-malfunction light. ; Different type of starting and stopping method of Diesel Engine ; Procedure for dismantling of diesel engine from a vehicle.
13. **Diesel Engine Components**: Description and Constructional feature of Cylinder head, Importanceof Cylinder head design, ; Type of Diesel combustion chambers, ; Effect on size of Intake & exhaust passages, Head gaskets. ; Importance of Turbulence.

    Valves & Valve Actuating Mechanism : Description and Function of Engine Valves, different types, materials, ; Type of valve operating mechanism, Importance of Valve seats, Valve seats inserts in cylinder heads, ; importance of Valve rotation, Valve stem oil seals, size of Intake valves, Valve trains, Valve- timing diagram, concept of Variable valve timing. ; Description of Camshafts & drives , ; Description of Overhead camshaft (SOHC and DOHC), importance of Cam lobes, Timing belts & chains, Timing belts & tensioners.
14. Description & functions of different types of pistons, piston rings and piston pinsand materials. ; Used recommended clearances for the rings and its necessity precautions while fitting rings, common troubles and remedy. ; Compression ratio. ; Description & function of connecting rod, ; importance of big - end split obliquely ; Materials used for connecting rods big end & main bearings. Shells piston pins and locking methods of piston pins.
15. Description and function of Crank shaft, camshaft, ; Engine bearings; classification and location – materials used &composition of bearing materials - Shell bearing and their advantages; special bearings material for diesel engine ; Application bearing failure & its causes-care & maintenance. ; Crank -shaft balancing, firing order of the engine.
16. Description and function of the fly wheel and vibration damper. ; Crank case & oil pump, gears timing mark, Chain sprockets, chain tensioner etc. ; Function of clutch & coupling units attached to flywheel.
17. Description of Cylinder block, ; Cylinder block construction, ; Different type of Cylinder sleeves (liner).
18. Engine assembly procedure with aid of special tools and gauges used for engine assembling. ; Introduction to Gas Turbine, Comparison of single and two stage turbine engine, ; Different between gas turbine and Diesel Engine.
19. **Need for Cooling systems** : Heat transfer method, Boiling point &pressure, ; Centrifugal force, ; Vehicle coolant properties and recommended change of interval, ; Different type of cooling systems,

    Basic cooling system components : Radiator, Coolant hoses, ; Water pump, ; Cooling system thermostat, Cooling fans, ; Temperature indicators, ; Radiator pressure cap, Recovery system, Thermo switch.

    Need for lubrication system: Functions of oil, Viscosity and its grade as per SAE , ; Oil additives, Synthetic oils, The lubrication system,

    Splash system: Pressure system; Corrosion/noise reduction in the lubrication system. ; Lubrication system components ; Description and function of Sump, Oil collection pan, Oil tank,

Pickup tube, ; different type of Oil pump & Oil filters Oil pressure relief valve, Spurt holes & galleries, Oil indicators, Oil cooler.

20. **Intake & exhaust systems –** Description of Diesel induction & Exhaust systems. Description & function of air compressor, exhauster, Super charger, Intercoolers, turbo charger, variable turbo charger mechanism.

    Intake system components : Description and function of Air cleaners, Different type air cleaner, Description of Intake manifolds and material,

    Exhaust system components: Description and function of Exhaust manifold, Exhaust pipe, Extractors, Mufflers; Reactive, absorptive, Combination of Catalytic converters, Flexible connections, Ceramic coatings, Backpressure, ; Electronic mufflers.

21. **Fuel Feed System in IC Engine(Petrol & Diesel)** : Gravity feed system, Forced feed system, main parts, Fuel Pumps - Mechanical & Electrical Feed Pumps. Knowledge about function, working & types of Carburettor.

    Diesel Fuel Systems : Description and function of Diesel fuel injection, fuel characteristics, concept of Quiet diesel technology &Clean diesel technology.

    Diesel fuel system components : Description and function of Diesel tanks & lines, Diesel fuel filters, water separator, Lift pump, Plunger pump, Priming pump, ; Inline injection pump, Distributor-type injection pump, Diesel injectors, Glow plugs, Cummins & Detroit Diesel injection.

    Electronic Diesel control :Electronic Diesel control systems, Common Rail Diesel Injection (CRDI) system, hydraulically actuated electronically controlled unit injector (HEUI) diesel injection system. Sensors, actuators and ECU (Electronic Control Unit) used in Diesel Engines.

22. **Marine & Stationary Engine**: Types - double acting engines, opposed piston engines, starting systems, cooling systems, lubricating systems, supplying fuel oil, hydraulic coupling, ; Reduction gear drive, electromagnetic coupling, ; Electrical drive, generators and motors, supercharging.

23. **Emission Control**- **Vehicle emissions:** Standards- Euro and Bharat II, III, IV, V Sources of emission, Combustion, Combustion chamber design. Types of emissions: ; Characteristics and Effect of Hydrocarbons, Hydrocarbons in exhaust gases, Oxides of nitrogen, Particulates, Carbon monoxide, Carbon dioxide, Sulphur content in fuels Description of Evaporation emission control, Catalytic conversion, Closed loop, Crankcase emission control,; Exhaust gas recirculation (EGR) valve, controlling airfuel ratios, Charcoal storage devices, Diesel particulate filter (DPF). Selective Catalytic, Reduction (SCR), EGR VS SCR

24. Basic Knowledge about DC Generator & AC Generator. ; Constructional details of Alternator ; Description of charging circuit operation of alternators, regulator unit, ignition warning lamp; troubles and remedy in charging system. ; Description of starter motor circuit, ; Constructional details of starter motor solenoid switches, common troubles and remedy in starter circuit.

25. **Troubleshooting** : Causes and remedy for ; Engine Not starting Mechanical & Electrical causes, ; High fuel consumption, Engine overheating, ; Low Power Generation, ; Excessive oil consumption, ; Low/High Engine Oil Pressure, Engine Noise.

26. **Workshop Science and Calculation** :
    - Introduction to Iron and Steel. Differences in Iron & steel.
    - Introduction to Property and uses of C.I. and wrought Iron. , Iron and steel properties and uses.
    - Properties and uses of plain carbon steel and alloy steel.
    - Properties and uses of non ferrous metals and alloys Fraction and decimal - conversion fraction decimal and vice-versa.
    - Properties and uses of copper, zinc, lead, tin, aluminum.
    - Composition, properties and uses of brass, bronze, solder, bearing material, timber, rubber etc.

- System of units, British, metric and SI units for length, area, volume capacity, weight, time, angle, their conversions. , Effect of alloying elements in the properties of C.I. & steel.
- Unit of temperature for & related problems. Standard & absolute temp.
- Mass, volume, density, weight, sp. Gravity & specific weight. S.I. M.K.S. and F.P.S. units of force, weight etc. their conversion to related problems.
- Inertia, rest and motion, velocity and acceleration.
- Types of forces, its units and Weight calculation.
- Revision & Test , Power and roots Factor, Power base exponents number. Multiplication and division of power and root of a number. Square root of number and problems.
- Heat & temperature, thermometric scales, their conversions.
- Work energy and power, their units and applied problems.
- Percentage, changing percentage to decimal and fraction and vice versa. Applied problems.
- Problem on percentage related to trade.
- Different types of loads, stress, strain, modulus of elasticity. Ultimate strength, different types of stress, factor of safety, examples.
- Ratio & proportion- Ratio, finding forms ratio proportions, direct proportion and indirect proportion. Application of ratio and proportion & related problems.

27.**Engineering Drawing** :

- Engineering Drawing - introduction to Engg. Drawing and its importance.
- Use of drawing instruments –Drawing of straight, inclined and curved lines.
- Exercise on linear and angular measurements.
- Types of lines their meaning & application as per BIS SP: 46-2003.
- Simple conventional symbols for material and parts as per BIS SP: 46-2003. , Geometrical construction of rectangles, square, circles.
- Geometrical construction of polygon and ellipse, parabola & hyperbola.
- Geometrical construction of involutes, oval, and helix.
- Free hand sketching of straight lines, rectangles, circles, square, polygons, ellipse.
- Standard printing style for letters and numbers as per BIS : SP: 46-2003 using stencils
- Free hand sketching of simple geometrical solids, cube, cone, prism, cylinder, sphere, pyramids.
- Scales- Types & its use.
- Revision & Test, Construction of diagonal scale.
- Simple dimensioning technique, size and location, dimensions of parts, holes angles, taper, screw etc. as per BIS SP: 46-2003.
- Transferring measurements for linear, angular, circular dimensions form the given object to the related free hand sketches using different measuring instruments.
- Pictorial drawings, isometric drawings of simple geometrical solids.
- Oblique/orthographic projection of simple geometrical solids.
- Orthographic drawings: Application of both the first angle and third angle. Isometric drawing of simple machined & casting blocks.
- Free hand sketches of trade related hand tools and measuring tools

Note: The above syllabus is indicative and the questions in the test may include similar other topics pertaining to the level and content of essential qualification.