SYLLABUS FOR INSTRUCTOR

(AUTOMOBILE ENG./MECHANIC)

(D) (A)

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Trade Syllabus

SYLLABUS- MECHANIC MOTOR VEHICLE (Automobile) (Instructor)		
Learning Outcome	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
Check & perform Measuring & marking by using various Measuring & Marking tools (Vernier Calipers, Micrometer, Telescope gauges, Dial bore gauges, Dial indicators, straightedge, feeler gauge, thread pitch gauge, vacuum gauge, tire pressure gauge.) following safety precautions.	1. Familiarization with institute, Job opportunities in the automobile sector, Machinery used in Trade. Types of work done by the students in the shop floor. 2. Importance of maintenance and cleanliness of Workshop. 3. Practice operation of different workshop equipment. 4. Demonstrate Energy saving Tips of ITI electricity Usage. 5. Practice using all marking aids, like steel rule with spring callipers, dividers, scriber, punches, Chisel etc. 6. Layout a work piece- for line, circle, arcs and circles. 7. Practice to remove wheel lug nuts with use of an air impact wrench. 8. Practice on General workshop tools & power tools. 9. Carryout Measuring practice on Cam height, Camshaft Journal dia, crankshaft journal dia, Valve stem dia, piston diameter, and piston pin dia with outside Micrometers. 10. Carryout Measuring practice on the height of the rotor of an oil pump from the surface of the housing or any other auto component measurement with depth micrometer.	**Admission & introduction to the trade:** Introduction to the Course duration, course content, study of the syllabus. General rule pertaining to the Institute, facilities available– Hostel, Recreation, Medical and Library working hours and time table **Occupational Safety & Health** Importance of Safety and general Precautions to be observed in the shop. Basic first aid, safety signs - for Danger, Warning, caution & personal safety message. Safe handling of Fuel Spillage, Fire extinguishers used for different types of fire. Safe disposal of toxic dust, safe handling and Periodic testing of lifting equipment, Authorization of Moving &road testing vehicles. Electrical safety tips. **Introduction to road safety and Automotive emissions.** **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 screw driver, Phillips screw driver, Ratchet

	11. Carryout Measuring practice on valve spring free length. 12. Carryout Measuring practice on cylinder bore for taper and out-of- round with Dial bore gauges. 13. Perform Measuring practice to measure wear on crankshaft end play, crankshaft run out, and valve guide with dial indicator. 14. Perform Measuring practice to check the flatness of the cylinder head is warped or twisted with straightedge is used with a feeler gauge. 15. Perform Measuring practice to check the end gap of a piston ring, piston-to-cylinder wall clearance with feeler gauge. 16. Practice to check engine manifold vacuum with vacuum gauge.	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, Circlips pliers, external circlips pliers. Air impact wrench, air ratchet, wrenches- Torque wrenches, pipe wrenches, car jet washers Pipe flaring & cutting tool, pullers-Gear and bearing. **Systems of measurement**, Description, care & use of - Micrometers- Outside and depth micrometer, Micrometer adjustments, Vernier callipers, Telescope gauges, Dial bore gauges, Dial indicators, straightedge, feeler gauge, thread pitch gauge, vacuum gauge, tire pressure gauge. (12 hrs)
Plan & perform basic fastening & fitting operation by using correct hand tools, Machine tools & equipment.	17. Practice on Marking and Drilling clear and Blind Holes, Sharpening of Twist Drills Safety precautions to be observed while using a drilling machine. 18. Practice on Tapping a Clear and Blind Hole, Selection of tape drill Size, use of Lubrication, Use of stud extractor. 19. Practice Cutting Threads on a Bolt/ Stud. Adjustment of two piece Die, Reaming a hole/ Bush to suit the given pin/ shaft, scraping a given machined surface.	**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.

Test various electrical/ electronic components using proper measuring instruments and compare the data using standard parameters.	20. Practice in joining wires using soldering Iron, Construction of simple electrical circuits, measuring of current, voltage and resistance using digital multimeter, practice continuity test for fuses, jumper wires, fusible links, and circuit breakers.	**Basic electricity**, Electricity principles, Ground connections, Ohm's law, Voltage, Current, Resistance, Power, Energy. Voltmeter, ammeter, Ohmmeter Mulitmeter, Conductors & insulators, Wires, Shielding, Length vs. resistance, Resistor Ratings.
	21. Diagnose series, parallel, series-parallel circuits using Ohm's law, Check electrical circuit with a test lamp, perform voltage drop test in circuits using multimeter, measure current flow using multimeter /ammeter, use of service manual wiring diagram for troubleshooting.	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.
	22. Carryout Cleaning and topping up of a lead acid battery, testing battery with hydrometer. 23. Connect battery to a charger for battery charging, Inspecting & testing a battery after charging, Measure and Diagnose the cause(s) of excessive Key-off battery drain (parasitic draw) and do corrective action. Testing of relay and solenoids and its circuit.	Description of Chemical effects, Batteries & cells, Lead acid batteries & Sealed Maintenance Free (SMF) batteries, Magnetic effects, Heating effects, Thermo- electric energy, Thermisters, Thermo couples, Electrochemical energy, Photo-voltaic energy, Piezo- electric energy, Electromagnetic induction, Relays, Solenoids, Primary & Secondary windings, Transformers, stator and rotor coils.
	24. Test diode for functionality.	**Basic electronics:** Description of Semi conductors, Solid state devices- Diodes, Transistors.
	25. Identify Hydraulic and pneumatic components used in vehicle.	**Introduction to Hydraulics & Pneumatics: -** Definition of Pascal law, pressure, Force, viscosity. Description, Trace hydraulic circuit on hydraulic jack, hydraulic power steering, and Brake circuit. Identify components in Air brake systems.

		symbols and application in automobile of Gear pump- Internal & External, single acting, double acting & Double ended cylinder; Pressure relief valve, Non return valve, Flow control valve used in automobile. Pneumatic Symbols, Description and function of air Reciprocating Compressor. Function of Air service unit (FRL-Filter, Regulator & Lubricator).
Check & Interpret Vehicle Specification data & VIN and Select & operate various Service Station Equipments.	26. Carryout Identification ofdifferent type of Vehicle. 27. Perform Demonstration of vehicle specification data. 28. Perform Identification of vehicle information Number (VIN). Demonstration of Garage, Service station equipments.- Vehicle hoists – Two post and four post hoist, Engine hoists, Jacks, Stands.	Definition: - 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 and uses of Vehicle hoists – Two post and four post hoist, Engine hoists, Jacks, Stands.
Dismantle & assemble of Engine from vehicle (LMV/HMV) along with other accessories.	31. Identify parts in a Diesel engine of LMV/ HMV. 32. Identify parts in a Petrol engine of LMV/ HMV. 33. Practice on starting and Stopping of engines. 34. Observe and report the reading of Tachometer, Odometer, temp and Fuel gauge under ideal and on load condition. 35. Practice identification of difference in components of Petrol and Diesel Engines. 36. Practice on dismantling engine of LMV/HMV as per procedure.	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, 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. Petrol Engine Basics: 4-stroke spark-ignition engines- Basic 4-stroke principles. Spark-ignition engine components- Basic engine components, Engine cams & camshaft, Engine power transfer, Scavenging, Counter weights, Piston components. Intake & exhaust systems - Electronic fuel injection systems, Exhaust systems. Intake system components, Air cleaners, Carburettor air cleaners, EFI air cleaners, Intake manifolds, Intake air heating. Gasoline Fuel Systems: Description of Gasoline fuel, Gasoline fuel characteristics, Controlling fuel burn, Stoichiometric ratio, Air density, Fuel supply system, Pressure &vacuum.

Overhaul Engine and check functionality .	37. Overhauling of cylinder head assembly, use of service manual for clearance and other parameters, Practice on removing rocker arm assembly manifolds. 38. Perform Checking valve seats & valve guide – Replacing the valve if necessary check valve overlap. Testing leaks of valve seats for leakage – Dismantle rocker shaft assembly - clean & check rocker shaft-and levers, for wear and cracks and reassemble. 39. Check valve springs, tappets, push rods, tappet screws and valve stem cap. 40. Reassemble valve parts in sequence, refit cylinder head and manifold & rocker arm assembly, adjustable valve clearances, starting engine after adjustments. . 41. Practice Overhauling piston and connecting rod Assembly. Use of service manual for clearance and other parameter 42. Practice on removing oil sump and oil pump – clean the sump. Practice on removing the big end bearing, connecting rod with the piston. 43. Practice on removing the piston rings; Dismantle the piston and connecting rod. Check the side clearance of piston rings in the piston groove & lands for wear. Check piston skirt and crown for damage and scuffing, clean oil holes. 44. Measure -the piston ring close gap in the cylinder, clearance between the piston and the liner, clearance between crank pin and the connecting rod big end bearing. 45. Check connecting rod for bend and twist. Assemble the piston and connecting rod assembly.	**Engine Components:** Description and Constructional feature of Cylinder head, Importance of Cylinder head design, Type of Petrol and Diesel combustion chambers, Effect on size of Intake & exhaust passages, Head gaskets. Importance of Turbulence **Valves & Valve Trains-** Description and Function of Engine Valves, different types, materials, Type of valve operating mechanism, Importance of Valve seats, and Valve seats inserts in cylinder heads, 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, importance of Cam lobes, Timing belts & chains, Timing belts & tensioners. Description & functions of different types of **pistons**, piston rings and piston pins and 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.

	46. Carryout Overhauling of crankshaft by referring service manual for clearance and other parameters. 47. Practice on removing damper pulley, timing gear/timing chain, flywheel, main bearing caps, bearing shells and crankshaft from engine checking oil retainer and thrust surfaces for wear. 48. Measure crank shaft journal for wear, taper and ovality, Checking crankshaft for fillet radii, bend & twist.	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.
	49. Perform Checking of flywheel and mounting flanges, spigot, bearing. 50. Check vibration damper for defects, Practice on removing cam shaft from engine block, Check for bend & twist of camshaft. 51. Perform Inspection of cam lobe, camshaft journals and bearings and measure cam lobe lift. 52. Practice Fixing bearing inserts in cylinder block & cap check nip and spread clearance & oil holes & locating lugs fix crank shaft on block- torque bolts - check end play remove shaft - check seating, repeat similarly for connecting rod and Check seating and refit. 53. Practice Cleaning and Checking of cylinder blocks. 54. Check cylinder blocks Surface flatness visually. 55. Measure cylinder bore for taper & ovality, clean oil gallery passage and oil pipe line, Bore – descale water passages.	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. Description of Cylinder block, Cylinder block construction, and Different type of Cylinder sleeves (liner).

Trace, Test & Repair Cooling and Lubrication System of engine.	56. Practice on Checking &Top up coolant, 57. Drain & refill coolant, Checking / replacing a coolant hose, testing cooling system pressure, Practice on Removing & replacing radiator/ thermostat. 58. Inspect the radiator pressure cap, testing of thermostat. 59. Perform Cleaning & reverse flushing. 60. Carryout overhauling water pump and refitting.	**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.
	61. Practice on Checking engine oil, Draining engine oil, Replacing oil filter, Refilling engine oil. 62. Carryout Overhauling of oil pump, oil coolers, air cleaners and air filters and adjust oil pressure relief valves, repairs to oil flow pipe lines and unions if necessary.	**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.
Trace & Test Intake and Exhaust system of engine.	63. Carryout Dismantling & assembling of turbocharger check for axial clearance as per service manual. 64. Check Exhaust system for rubber mounting for damage, deterioration and out of position; for leakage, loose connection, dent and damage. 65. Practice on Exhaust manifold removal and installation. 66. Practice on Catalytic converter removal and installation.	**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., Catalytic converters, Flexible connections, Ceramic coatings, Back-pressure, Electronic mufflers.

Service Fuel System and check proper functionality.	67. Practice Testing of MPFI components and replacement if necessary. 68. Check delivery from fuel Pump. Replacing a fuel filter.	Diesel Fuel Systems- Description and function of Diesel fuel injection, fuel characteristics, concept of Quiet diesel technology &
	69. Bleed air from the fuel lines, Servicing primary & secondary filters. 70. Remove a fuel injection pump from an engine- refit the pump to the engine re- set timing - fill lubricating-oil start and adjust slow speed of the engine.	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, Electronic Diesel control- Electronic Diesel control systems, Common Rail Diesel Injection (CRDI) system, Sensors, actuators and ECU (Electronic Control Unit) used in Diesel Engines.
Test Engine Performance and set idling speed.	71. Reassemble all parts of engine in correct Sequence and torque all bolts and nuts as per workshop manual of the engine. 72. Perform Engine component assembly procedures- Testing cylinder compression, checking idle speed, Removing & replacing a cam belt, Inspecting & adjusting an engine drive belt, Replacing an engine drive belt. 73. Practice on Start engine adjust idling speed and damping device in pneumatic governor and venture control unit checking 74. Test Performance of engine with off load adjusting timings. 75. Start engine- adjusting idle speed of the engine fitted with mechanical governor checking- high speed operation of the engine. 76. Check performance for missing cylinder by isolating defective injectors and test- dismantle and replace defective parts and reassemble and refit back to the engine	Engine assembly procedure with aid of special tools and gauges used for engine assembling.

Monitor emission of vehicle and execute different operation to obtain optimum pollution as per emission norms.	77. Practice Monitoring emissions procedures by use of Engine gas analyser or Diesel smoke meter. 78. Checking & cleaning a Positive crank case ventilation (PCV) valve. Obtaining & interpreting scan tool data. 79. Perform Inspection of EVAP canister purge system by use of scan Tool. 80. Perform EGR /SCR Valve Removal and installation for inspection.	**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 air- fuel ratios, Charcoal storage devices, Diesel particulate filter (DPF). Selective Catalytic Reduction (SCR), EGR VS SCR
Carryout overhauling of Alternator and Starter Motor.	81. Practice on removing alternator from vehicle dismantling, cleaning checking for defects, assembling and testing for motoring action of alternator & fitting to vehicles. 82. Practice on removing starter motor Vehicle and overhauling the starter motor, testing of starter motor	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.
Diagnose & rectify the defects in LMV/HMV to ensure functionality of vehicle.	83. Practice on troubleshooting in LMV/HMV 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.	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.

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Read and apply engineering drawing for different application in the field of work.	**ENGINEERING DRAWING:** **Introduction to Engineering Drawing and Drawing Instruments –** Conventions Sizes and layout of drawing sheets Title Block, its position and content Drawing Instrument **Lines- Types and applications in drawing** Free hand drawing of – Geometrical figures and blocks with dimension Transferring measurement from the given object to the free hand sketches. Free hand drawing of hand tools and measuring tools. **Drawing of Geometrical figures:** Angle, Triangle, Circle, Rectangle, Square, Parallelogram. Lettering & Numbering – Single Stroke. **Dimensioning** Types of arrowhead Leader line with text Position of dimensioning (Unidirectional, Aligned) **Symbolic representation –** Different symbols used in the related trades. **Concept and reading of Drawing in** Concept of axes plane and quadrant Concept of Orthographic and Isometric projections Method of first angle and third angle projections (definition and difference) **Reading of Job drawing** of related trades

WORKSHOP CALCULATION & SCIENCE	
Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**WORKSHOP CALCULATION & SCIENCE:** **Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, substraction, multiplication &division Decimal fractions - Addition, subtraction, multiplication& division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and square root Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non ferrous metals

	Physical and mechanical properties of metals Introduction of iron and cast iron Difference between iron & steel, alloy steel and carbon steel Properties and uses of rubber, timber and insulating materials Mass, Weight, Volume and **Density** Mass, volume, density, weight and specific gravity Related problems for mass, volume, density, weight and specific gravity **Speed and Velocity, Work, Power and Energy** Speed and velocity - Rest, motion, speed, velocity, difference between speed and velocity, acceleration and retardation Speed and velocity - Related problems on speed & velocity Work, power, energy, HP, IHP, BHP and efficiency Potential energy, kinetic energy and related problems with assignment **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Thermal conductivity and insulators Concept of pressure - Units of pressure, atmospheric pressure, absolute pressure, gauge pressure and gauges used for measuring pressure **Basic Electricity** Introduction and uses of electricity, electric current AC,DC their comparison, voltage, resistance and their units Conductor, insulator, types of connections - series and parallel Ohm's law, relation between V.I.R & related problems Magnetic induction, self and mutual inductance and EMF generation **Mensuration** Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder **Levers and Simple machines** Lever & Simple machines - Lever and its types

SYLLABUS- MECHANIC MOTOR VEHICLE (Automobile) (Instructor)

Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
Plan & perform maintenance, diagnosis and servicing of transmission system.	84. Identify different major components of Heavy vehicle and their function & placement study of different make lorry/busin Institute with different dealers or organizations. 85. Practice on adjusting clutch pedal play- removing gearbox and clutch assembly from Light & Heavy Vehicle. 86. Perform Dismantling clutch assembly, cleaning inspecting parts. 87. Carryout Removing & fitting of new pilot bearing, removing & fitting of ring gear in fly wheel relining a clutch plate, checking condition of flywheel and pressure plate surface for reconditioning. 88. Perform Assembling of pressure plate adjusting the fingers checking run out of fly wheel and aligning clutch assembly with flywheel. 89. Perform Dismantling cleaning and assembling of gearshift mechanism changing oil in gear box. 90. Practice Dismantling a synchromesh gear box, cleaning, inspecting parts replacing worn out defective parts assembling & testing for correct performance identifying noises from gear boxes and rectifying.	Introduction: Study of different major components & assemblies of heavy vehicle, and different make (indigenous). Name plate-constructional differences and their merits. leading manufacturers in Heavy vehicle Industry **Clutches & Manual Transmissions**-Clutch principles, Single-plate clutches, Multi-plate clutches, Dual mass flywheels, Operating mechanisms **Clutch components**- Pressure plate, Driven/ centre plate, Throw- out bearing. **Manual transmissions-** Gear ratios, Compound gear trains, Gear selection, Bearings, Oil seals & gaskets, Brief about Automated Manual Transmission (AMT) **Gearbox layout & operation-** Gearbox layouts, Transaxle designs, Gearbox operation, Baulk-ring synchromesh unit, Transaxle synchromesh unit. Gear shift mechanism.

	91. Practice on Removing open type propeller shaft from vehicle, Practice on removing universal joints, cleaning replacing worn out parts, re- assembling & refitting to vehicle- and their alignment, including front wheel drive and all wheel drive of LMV. 92. Practice on FWD Driveshaft Removal and Replacement. 93. Practice on overhauling & inspection of rear axle. 94. Practice on overhauling & inspection of differential assembly. 95. Perform Trouble shooting – causes and remedy for clutch slip, clutch noise, clutch binding, hard clutch, gearbox noise, gear slip, rear axle noise, propeller shaft noise, universal joint noise, differential noise.	Final Drive & Drive Shafts - Basic layouts Front-wheel drive layout, Rear-wheel drive layout, Four-wheel drive layout, All- wheel drive layout, 4WD v/s AWD Front-wheel drive, Front- wheel drive shafts, Front- wheel final drives, Front- wheel differentials Rear-wheel drive- Propeller shaft, Type of Universal joints, Type of Constant velocity Joints, Rear-wheel final drives, Salisbury axles, Rear-wheel drive differentials, Limited slip differentials. Four-wheel drive- Four- wheel drive shafts, Four- wheel final drive, Four-wheel drive transfer case, Freewheeling hubs, Four- wheel drive differentials All-wheel drive- four wheel final drives, All-wheel drive transfer case, Transfer case differential action.
	96. Identify Automatic transmission components 97. Check automatic transmission fluid and replace transmission fluid & filter. Practice on oil pressure control cable play adjustments, Inspection of shift lever switch, throttle position sensor, speed sensor and automatic transmission wiring harness coupler.	Automatic Transmissions - Torque converters, Torque converter principles, drive plate, Converter operation, Torque multiplication, Fluid flow, Heat exchanger, Lock- up converters, clutches. Planetary gearing- Planetary gears, Simple planetary gear sets, Compound planetary gear sets, Automatic transmission brake bands, Multi-disc clutches, Electronic control transmission -Electronic control Unit, Fully hydraulically controlled transmission, Electronic shift programs, Manual selection. Layout & operation for P,R,N&D (First & Second) Selector positions, Planetary gear set, High range power flow, Low range power flow Servos & clutches-Rear servo, Front servo, One way clutch, Multi-plate front

		clutch, Clutch pack, Rear clutch. Hydraulic system & controls- Hydraulic system components, Spool valves, Regulating or flow control valves, Control valves, Orifices Valve types & functions- Basic valve action, Regulator & control valves, Shift & governor valves Pressure regulation- The primary regulating valve, Line pressure variation, Modulator valve pressure, The governor, Governor pressure, Kick down pressure. Flow control- Gear position 1, 1-2 shift valve, 2-3 shift valve assembly, The servo orifice control valve, 3-2 kick down Continuously variable transmission (C.V.T.) - Continuously variable transmission, Drive or reverse, The steel belt, Secondary pulley shaft.
Plan & perform maintenance, diagnosis and servicing of Vehicle Control System.	99. Practice on removing the drop arm, Check and adjust the turning angle, align the drop arm and steering wheel with the front wheel. Check and correct toe-in. 100. Practice on removing steering wheel, steering gearbox. 101. Inspect and overhaul steering boxes, adjusting steering gear backlash, pre-load and adjust toe-in, toe-out, camber angle, castor angle, kingpin inclination and wheel run out.	Steering Systems: - Description and function of Steering systems, Principles of steering, Rack-and-pinion steering system, Recirculation ball & nut steering system, Four-wheel steering systems, collapsible steering system. Steering boxes & columns - Description and function of Steering columns, Rack-and-pinion gearbox, Helix, Variable ratio steering, Worm gearbox, Power Assisted steering, Steering process, Flow-control valve, Electric power assisted steering, Basic electric power steering operation

	102. Check &top up power steering fluid, 103. Carryout Pressure testing a power steering system, Flushing a power steering system, 104. Carryout Inspecting & adjusting an engine drive belt, 105. Carryout Servicing a steering system, 106. Practice servicing wheel bearings. 107. Perform Troubleshooting- Causes and remedy for abnormal wear of tyre, wheel wobbling, poor self centring, hard steering, and vehicle pulling to one side.	Steering arms & components- Forward control vehicle steering, Steering linkages, Joints, Bushes/bushings Wheel alignment fundamentals:- Basic principles of wheel alignment, wheel base, wheel track, king pin inclination, Caster, Camber, Scrub radius, Toe-in & toe out, Toe-out on turns, Turning radius, Thrust angle & centrelines.
	Following practical to be Practiced On Light & Heavy Vehicle : 108. Practice on visual Inspection of chassis frame for crack, bent and twists. 109. Carryout Overhauling and Inspection of shackle, leaf spring, front & rear suspension. 110. Practice on removing, inspection and assembling of shock absorber 111. Practice Lubricating a suspension system. 112. Perform Trouble shooting for Suspension system defects: Wheel hop, ride height (unequal and low), noises under operation, fluid leakage, excessive travel, bounce, worn dampers, worn joints/damaged linkages, vehicle "crabbing".	Suspension Systems:- Principles of suspension, Suspension force, Unsprung weight, Wheel unit location, Dampening. Types of suspension-Suspension systems, Solid axle, Dead axle, Description, function and advantages of non independent suspension Independent suspension, Rear independent suspension, Rear-wheel drive independent suspension, electronically controlled air suspension (ECAS), Adaptive air suspension operation. Types of springs - Description and function of Coil springs, Leaf springs, Torsion bars, Rubber springs. Shock absorber types- Description and function of Hydraulic shock absorbers, Gas-pressurized shock absorbers, Load-adjustable shock absorbers, Manual adjustable-rate shock absorbers, Electronic adjustable-rate shock absorbers, Automatic load- adjustable shock absorbers Front suspension types & components- Mc person Strut suspension, Short/long arm suspension,

	113. Practice on removing wheels from light & Heavy vehicle, dismantling tyres and tubes checking puncture. 114. Practice Assembling & inflating tyres to correct pressure. 115. Check & adjust tire pressure by use of air or by Nitrogen 116. Rotate the wheels in vehicle minor repairs to wheels and tyres, wheel balancing & alignment. 117. Check for tyre wear patterns. 118. Practice on Adjusting brake pedal play, Overhauling and inspection of tandem master cylinder assembly. 119. Perform Overhauling and inspection of front and rear brake assembly, overhauling and inspection of wheel cylinder assembly.	Torsion bar suspension Rear suspension types & components- Rigid axle leaf spring suspension, Rigid axle coil spring suspension, Independent type suspension, Rigid non-drive suspension. Wheels & Tyres-Wheel types & sizes Wheels, Rim sizes & designations, Types of wheels Tyre types & characteristics- Tyres, Radial ply tyres, Radial ply tyre sidewalls, Tyre pressure monitoring systems, Run flat tyres, Space-saver tyres, Tyre distortion, Center of gravity. Tyre construction-Tyre construction, Types of tyre construction, Tyre materials, Hysteresis, Tyre sizes & designations, Tyre information, Tyre tread designs, Tyre ratings for temperature & traction. Descriptions Tirewear Patterns and causes Nitrogen v/s atmospheric air in tyres Braking Systems :- Principles of braking, Drum & disc brakes, Lever/mechanical advantage, Hydraulic pressure & force, Brake pad, Regenerative braking. Braking systems - Brake type - principles, Air brakes, Exhaust brakes, Electric brakes, Parking brakes, Engine brakes, Regenerative braking

	120. Bleed hydraulic brakes &Disk brakes 121. Carryout Overhauling and inspection of vacuum assisted brake assembly. 122. Perform Overhauling and inspection of disc brake. 123. Practice Adjusting Air brakes-repair to tank unit, air compressor, wheel brake adjuster- locating air leaks in the brake lines and rectifying – general maintenance and care. 124. Perform Brakes service procedures-Checking & adjusting brake fluid, Replacing brake fluid, Checking brake pads, Replacing brake pads, Removing & replacing a rotor, Replacing brake linings, Adjusting a parking brake cable. 125. Carryout Trouble tracing in braking system of a heavy vehicle adjusting all four wheel brakes, precautions to be observed while testing brakes points to be remember while preparing the vehicle for brake certificate. 126. Practice of maintaining of ABS system.	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, Electro hydraulic braking (EHB), Applying brakes, Brake force, Brake light switch Drum brakes & components -Drum brake system, Drum brake operation, Brake linings & shoes, Back plate, Wheel cylinders Disc brakes & components - Disc brake system, Disc brake operation, Disc brake rotors, Disc brake pads, Disc brake callipers, Proportioning valves, Proportioning valve operation, Brake friction materials Antilock braking system & components-ABS brake system, Antilock braking system operation, Principles of ABS braking, ABS master cylinder, Hydraulic control unit, Wheel speed sensors, ABS with EBD electronic control unit. The construction and operation of heavy vehicle Anti-Slip Regulation / Traction Control (ASR) system. Introduction to Electromagnetic retarder brake (EMR) and Engine exhaust brake Engine trouble shooting

Troubleshoot vehicle Engine components and ascertain repair.	127. Perform Trouble shooting Practice with Heavy vehicle 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.	
Plan & service of electronic control system and check functionally.	128. Carryout Identification of Electronic control Unit. 129. Perform Set up for testing, Testing of Electronic Control Circuit. 130. Perform Identification of various sensors installed in engine & it's mounting 131. Check instruments &Gauges on dash board& replace defective gauges. 132. Test Temperature sensor, Pressure senor, potentiometer, magnetic induction sensor, cam shaft sensor, crankshaft position sensor.	Introduction to EFI Engine Management - EFI operation Modes of EFI, Electronic fuel injection, Idle speed control systems, Feedback & looping, Cold start systems, Air measurement, Air-flow monitoring, Variable intake manifold system, Electrical functions, EFI wiring diagram Electronic control unit (ECU) - EFI system ECU, Electronic control unit settings, Engine speed limiting, Malfunction indicator lamp. Importance of Diagnostic Trouble Code (DTC) & its general format. Use of scan tool and retrievals of codes. EFI sensors- Intake Temperature sensor, Mass airflow sensor, Manifold absolute pressure sensor, Air vortex sensor, Fuel system sensor, Throttle position sensor, Exhaust gas oxygen sensor, Crank angle sensor, Hall effect voltage sensor.

Diagnose & rectify the defects in vehicle to ensure functionality of vehicle.	133. Carryout Diagnosis- Possible causes and remedy for Engine cranks, but will not or hard to start, Poor fuel economy or engine performance. 134. Practice Checking ignition timing, Checking & changing a spark plug, Identification and testing of Hall Effect sensor, Optical sensor. Tracing and testing of sensor circuits.	Ignition principles and Faraday's laws, Primary and secondary winding of transformer, Ignition components, Spark plugs, Spark plug components, Vacuum & centrifugal units, Plug firing voltage, Induction, Inductive system operation, Induction wiring, Hall effect sensors, Hall effect operation, Optical type sensors Distributor less ignition systems, Insulated coils, Distributor less ignition system timing.
Carryout overhauling of charging system.	135. Check charging system for the cause of undercharge, No charge, and over charge conditions. 136. Perform Removing & replacing an alternator, Inspection of rotor for ground, open circuit – field coil resistance, slip ring surface, Fan, bearing. Inspection of stator for ground, open circuit, Inspection of Drive end bearing rotation, Rectifier, brush length compare with service manual. Slip ring surface. 137. Practice Inspecting & adjusting an engine drive belt, Replacing an engine drive belt/ pulleys / Tensioner and their alignments. 138. Carryout Trouble shooting, possible causes and remedy for warning lamp does not glow when ignition switch is on, Warning lamp glows dim when ignition switch is on, warning lamp 'on' while the alternator is running, Warning lamp glows 'dim' while the alternator is running, warning lamp flickers considerably.	Charging system- The purpose of Charging system, charging system components, charging system circuit, Alternator principles, Alternating current, Alternator components, Rectification, Phase winding connections, Rotor circuit, Voltage regulation, System operating voltage, High voltage charging systems, Rotor, Stator, Alternator end frames, Slip ring & brush assembly, Rectifier assembly, Alternator cooling fan.

Carryout overhauling of starting system.	139. Remove starter motor from vehicle, and carryout Performance test for pull-in test, Hold- in test, pinion (plunger) return test, No-load performance test. 140. Perform Trouble shooting, possible causes and remedy for starter motor not running, Starting motor running but too slow (small torque), staring motor running, but not cranking engine. Noise, starting motor does not stop running. Growler testing for rotors. 141. Check a starting system, Jump-start a vehicle.	Starting system- purpose of starting system, Staring system components, Starter motor principles, study of starter control circuits. Starter motor construction, Starter magnet types, Starter motor engagement, Commutation, Switching, solenoid construction.
Troubleshoot electrical components of vehicle and ascertain repair.	142. Trace the light circuit - test bulbs, align head lamps, aiming headlights. Changing a headlight bulb, checking of a head light switch and to replace if faulty. 143. Perform Trouble shooting and remedy for turn signal and hazard warning lights -Flash rate high or one side only flashes, No Flashing, flash rate low. 144. Perform Trouble shooting and remedy for clearance, tail and license plate lights - All lights do not light up, some lights do not light up. Perform Trouble shooting and remedy for fuel meter and fuel gauge unit - Fuel meter shows no operation or incorrect operation. 145. Perform Trouble shooting and remedy for Engine coolant Temp (ECT) meter and ECT Sensor – Engine coolant temp meter shows no operation or incorrect operation.	Lighting system, Lamps/light bulbs, Lamp/light bulb information, LED lighting, Headlights-description of standard sealed beam, halogen sealed beam, composite and High intensity discharge (HID) headlights. Headlight & dimmer circuits, Park & tail light circuits, Brake light circuits, turn signal circuit, Cornering lights, Fog lights circuit, interior lights-courtesy, reading and instrument panel lights, Smart lighting , Reverse lights

	146. Perform Trouble shooting and remedy for oil pressure light – Oil pressure warning light does not light up when ignition switch is on at engine off. 147. Perform Trouble shooting and remedy for brake and parking brake warning light- Brake warning light does not light up when fluid flow level, Brake warning light does not light up when parking brake pull up, Brake warning lights stay on. 148. Perform Trouble shooting and remedy for interior light- Interior light do not light up. 149. Perform Trace the wiring circuit of traffic signal flashers light circuit- tracing defects in the flasher circuits, replacing fuse bulb. 150. Perform Trouble shooting and remedy for Horn- No horn operation, poor sound quality, horn sounds continuously and to replace the horn if faulty. 151. Remove and install wiper motors and wiper switches. Checking & replacing wiper blades. 152. Perform Trouble shooting and remedy for windshield wiper and washer - no operation, intermittent operation, continuous operation, and wipers will not park. 153. Diagnose causes for improper operation of the windshield washer system and to replace the pump if faulty. 154. Diagnose the power window system for – all power window motors do not operate, some switches do not operate. 155. Diagnose the power door lock control for – All power door locks do not operate, only one power door lock not operate. 156. Diagnose for remote keyless entry and immobilizer system. 157. Diagnose automatic seat belt systems, Diagnose air bag system and service warnings.	Accessories: Horn circuit, wiper circuit, power window components and circuits. Power door lock circuit, automatic door lock circuit, remote keyless entry system circuit, antitheft system, immobilizer system. Description and function of Airbags, Seatbelt, Vehicle safety systems, Crash sensors, Seat belt pre-tensioners, Tire pressure monitoring systems Integrated communications, Proximity sensors, Introduction to Hybrid & Electronic vehicle, Hydrogen fuel cell vehicle.

Overhaul, service and testing Vehicle Air Conditioning system, its parts and check functionality.	159. Identify Air conditioning components, Performance test on A/c unit 160. Check Charged state of refrigerant, Inspecting & adjusting an engine drive belt, Replacing an engine drive belt. 161. Perform Refrigerant recovery –evacuating – charging of A/c system. Replenishing compressor oil level. Troubles diagnose and remedy for No cooling or warm air, Cool air comes out only intermittently, Insufficient cooling, 162. Check abnormal noise from compressor, Magnetic clutch, condenser, evaporator, Blower motor. 163. Carryout Diagnosis test for High pressure gauge – pressure high and low, Low pressure gauge for pressure high and low.	Heating Ventilation Air Conditioning (HVAC) legislation, Vehicle heating, ventilation & cooling systems, Basic air-conditioning principles, Air- conditioning capacity, Air- conditioning refrigerant, Humidity Description and function of Fixed orifice, Control devices, Thermostatic expansion valve system, Thermal expansion valves, Air- conditioning compressors, Condensers & evaporators, Receiver drier, Lines & hoses, TX valve construction, Temperature monitoring thermostat, Refrigerants, Pressure switches, Heating elements Air-conditioning ECU, Ambient air temperature sensor, Servo motors, Electric servo motors, Automatic climate control sensors, Evaporator temperature sensor, Blower speed control, Ventilation systems.

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Drive vehicle following Traffic Regulations and maintenance of good road conduct.	Driving Practice : 164. Practice in straight driving on wide roads. 165. Driving through lanes and curves. 166. Practice in reversing. 167. Practice overtaking another vehicle. 168. Practice in driving through sand and wet surfaces. Practice in parking and Diagonal parking.	Traffic rules, Signals & controls. Locating vehicle information, Obtaining & interpreting scan tool data.
Identify and study of Electricvehicle components and Performance comparison of EV and IC engine vehicles. *(Components of Electric Vehicle such as Motor, Motor Controller, Battery Pack, Battery Management System, Charging System etc.)*	169. Study report on current adoption status of BEV,HEV, PHEV, FCEV type vehicles. 170. Identify and study performance of Electric vehicles, in comparison to IC engine vehicles. 171. Identification and study of basic components of EV 172. Identify various gauges/ instrument on dashboard of an electric vehicle and identify differences in instrumentation panel with IC engine vehicle. 173. Basic motor power calculation. 174. Identify and test different types of Batteries, diodes and transistors	Introduction to Electric Vehicle Technology, EV Terminology Comparison of Electric Vehicle with IC engine vehicle based on emissions, range, fuel type. Types of electric vehicle, BEV, HEV, PHEV and FCEV. Architecture of Electric Vehicle, working principle of fully electric vehicle, Major component, performance parameter, Basics of Motors, Selection, sizing and characteristic of Motor, calculation for motor effort, electric transmission. Principle, working and operation of propulsion system, DC Motor - Drives Armature Voltage, chopper circuit, step up, Step down chopper, control strategy, chopper amplifier. Brushless DC Motor – principle working, features, speed control system of brushless DC motor, efficiency, calculation. Battery management system

Engineering Drawing:	
Read and apply engineering drawing for different application in the field of work.	**Engineering Drawing:** Reading of Electrical, Electronic & Mechanical Sign and Symbols used in Automobile. Sketches of Electrical, Electronic & Mechanical components used in Automobile. Reading of Electrical wiring diagram and Layout diagram used in Automobile Drawing of Electrical circuit diagram used in Automobile. Drawing of Block diagram of Instruments & equipment of trades
Workshop Calculation & Science:	
Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**Workshop Calculation & Science:** **Friction** Friction - Advantages and disadvantages, Laws of friction, co- efficient of friction, angle of friction, simple problems related to friction Friction - Lubrication Friction - Co- efficient of friction, application and effects of friction in workshop practice **Centre of Gravity** Centre of gravity - Centre of gravity and its practical application **Area of cut out regular surfaces and area of irregular surfaces** Area of cut out regular surfaces - circle, segment and sector of circle Related problems of area of cut out regular surfaces - circle, segment and sector of circle **Elasticity** Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus Elasticity - Ultimate stress and working stress **Heat Treatment** Heat treatment and advantages **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade Estimation and costing - Problems on estimation and costing

SYLLABUS FOR MECHANIC DIESEL TRADE (Instructor)		
Learning Outcome	Professional Skills (Trade Practical)	Professional Knowledge (TradeTheory)
Check & perform Measuring & marking by using various Measuring & Marking tools (Vernier Calipers, Micrometer, Telescope gauges, Dial bore gauges, Dial indicators, straight edge, feeler gauge, thread pitch gauge, vacuum gauge, tire pressure gauge.) Following safety precautions.	1. Demonstration of Machinery used in the trade. 2. Identify safety Gear/ PPE (Personal Protective Equipment) and their uses. 3. Importance of maintenance of safety equipment used in Workshop. 4. Demonstration on safe handling and Periodic testing of lifting equipment, and Safety disposal of used engine oil. 5. Demonstration on health hazards, occupational safety &first Aid. 6. Demonstration fire service station to provide demo on Fire safety. 7. Perform use of fire extinguishers. 8. Perform marking using all marking aids, like steel rule with spring calipers, dividers, Scriber, punches, chisel etc. on MS Flat/Sheet Metal. Measure a wheel base of a vehicle with measuring tape. 9. Perform to remove wheel lug nuts with use of an air impact wrench. 10. Operate General workshop tools & power tools.	- 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 & 5Smethod. - Safety disposal of Used engine oil, - Electrical safety tips. - Safe handling of Fuel Spillage, - Safe disposal of toxic dust, safe handling and Periodic testing of lifting equipment. 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, trysquare. 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- ballpein, lump, mallet. Screwdrivers-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, Side cutters, Tinsnips, Cir clip pliers, external cir clips pliers. - Air impact wrench, air ratchet, wrenches- Torque wrenches, pipe wrenches, Pipe flaring & cutting tool, pullers- Gear and bearing.
	11. Perform measuring practice on Cam height, Camshaft Journal dia, crankshaft journal dia, Valve stem dia, piston diameter, and piston pin dia with outside Micrometres. 12. Perform measuring practice on cylinder bore for taper and out- of-round with Dial bore gauges. 13. Perform measuring practice to measure wear on crankshaft end play, crankshaft run out, and valve guide with dial indicator and magnetic stand. 14. Perform measuring practice to check the flatness of the cylinder head is warped or twisted with straightedge is used with a feeler gauge.	Systems of measurement, - Description, Least Count calculation, care & use of - Micrometers- Outside, and depth micro meter, - Micrometer adjustments, - Description, Least Count calculation, care & use of Vernier Calliper. Telescope gauges, Dial bore gauges, Dial indicators, straight edge, feeler gauge, thread pitch gauge, vacuum gauge, tire pressure gauge.

	15. Perform measuring practice to check the end gap of a piston ring, piston-to- cylinder wall clearance with feeler gauge. 16. Perform practice to check engine manifold vacuum with vacuum gauge. 17. Perform practice to check the air pressure inside the vehicle tyre is maintained at the recommended setting.	-
Plan & perform basic fastening & fitting operation by using correct hand tools, Machine tools & equipments.	18. Perform removal of stud/bolt using stud extractor. 19. Perform practice on cutting tools like Hacksaw, file, chisel, Sharpening of Chisels, center punch, safety precautions while grinding. 20. Perform practice on Hacksawing and filing to given dimensions. 21. Perform practice on Marking and Drilling clear and Blind Holes, Sharpening of Twist Drills Safety precautions to be observed while using a drilling machine. 22. Perform practice on Tapping a Clear and Blind Hole, Selection of tape drill Size, use of Lubrication, Use of stud extractor. 23. Perform practice cutting Threads on a Bolt/ Stud. Adjustment of two piece Die, Reaming a hole/ Bush to suit the given pin/ shaft, scraping a given machined surface.	Different types of metal joint (Permanent, Temporary), methods of, Soldering, etc. **Fasteners** Study of different types of screws, nuts, studs & bolts, locking devices, Such as locknuts, cotter, split pins, keys, cir clips, 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, multi layered metallic, liquid, rubber, copper and printed. -Thread Sealants- Various types like, locking, sealing, temperature resistance, anti-locking, 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. 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.

Trace and Test all Electrical & Electronic components & circuits and assemble circuit to ensure functionality of system.	24. Perform practice in joining wires using soldering iron. Prepare simple electrical circuits, measuring of current, voltage and resistance using digital multimeter. 25. Perform practice continuity test for fuses, relay and diodes. 26. Check circuit using of service manual wiring diagram for troubleshooting.	**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.
	27. Execute cleaning and topping up of a lead acid battery. 28. Perform testing battery with hydrometer. 29. Perform connecting battery to a charger for battery charging and checking & testing a battery after charging. 30. Perform test of relay and solenoids and its circuit.	- Description of Chemical effects, Batteries & cells, Lead acid batteries & Stay Maintenance Free (SMF) batteries, - Magnetic effects, Heating effects, Thermo- electric energy, Thermistors, Thermo couples, - Electrochemical energy, Photo-voltaic energy, Piezo- electric energy, Electromagnetic induction, - Relays, Solenoids, Primary & Secondary windings, Transformers, stator and rotor coils.

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Trace & Test Hydraulic and Pneumatic components.	31. Identify of Hydraulic and pneumatic components used in vehicle. 32. Tracing of hydraulic circuit on hydraulic jack, hydraulic, and Brake circuit. 33. Identify components in Air brake systems.	Introduction to Hydraulics &Pneumatics - Description, symbols and application in automobile of Gear pump-Internal & External, single acting, double acting & Double ended cylinder; Directional control, Pressure relief valve, Non return valve, Flow control valve used In automobile.
Check & Interpret Vehicle Specification da ta and VIN. Select &operate various Service Station Equipment.	34. Identify of different types of Vehicle. 35. Demonstrate of vehicle specification data. 36. Identify of vehicle information Number (VIN). 37. Demonstrate of Garage, Service Station equipment - Vehicle hoists- Two post and four post hoist, Engine hoists, Jacks, Stands.	- 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.
Dismantle & assemble of Diesel Engine from vehicle (LMV/HM V) along with other accessories.	38. Identify the different parts of IC Engine. 39. Identify the different parts in a diesel engine of LMV/ HMV. 40. Perform practice on starting and stopping of diesel engines. Observe and report the reading of Tachometer, Odometer, temp and Fuel gauge under ideal and on load condition. 41. Practice on dismantling Diesel engine of LMV/HMV as per procedure.	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.
Over haul & service Diesel Engine, its parts and check functionality.	42. Perform Over hauling of cylinder head assembly, Use of service manual for clearance and other parameters. 43. Perform practice on removing rocker arm assembly manifolds. 44. Perform practice on removing the valves and its parts from the cylinder head, cleaning. 45. Inspection of cylinder head and manifold surfaces for warping, cracks and flatness. Checking valve seats & valve guide– Replacing the valve if necessary. 46. Check leaks of valve seats for leakage– Dismantle rocker shaft assembly- clean & check rocker shaft-and levers, for wear and cracks and reassemble.	Diesel Engine Components: - Description and Constructional feature of Cylinder head, Importance of 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, - Description of Camshafts & drives ,

	47. Check valve springs, tap pets, pushrods, tappet screws and valve stem cap. Reassembling valve parts in sequence, refit cylinder head and manifold & rocker arm assembly, adjustable valve clearances, starting engine after adjustments.	- importance of Valve rotation, Valve stem oil seals, size of Intake valves, Valve trains, Valve- timing diagram, concept of Variable valve timing. - Description of Overhead camshaft (SOHC and DOHC), importance of Cam lobes, Timing belts & chains, Timing belts &tensioners.
	48. Perform Overhauling piston and connecting rod assembly. Use of service manual for clearance and other parameters. 49. Perform Practice on removing oil sump and oil pump – clean the sump. 50. Perform removing the big end bearing, connecting rod with the piston. 51. Perform removing the piston rings; Dismantle the piston and connecting rod. Check the side clearance of piston rings in the piston groove & lands for wear. Check piston skirt and crown for damage and scuffing, clean oil holes. 52. Measure -the piston ring close gap in the cylinder, clearance between the piston and the liner, clearance between crank pin and the connecting rod big end bearing. 53. Check connecting rod for bend and twist. Assemble the piston and connecting rod assembly. Perform Overhauling of crankshaft, Use of service manual for clearance and other parameters.	- Description & functions of different types of pistons, piston rings and piston pins and 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. - 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.

	54. Perform removing damper pulley, timing gear/timing chain, flywheel, main bearing caps, bearing shells and crank shaft from engine. 55. Inspect oil retainer and thrust surfaces for wear. 56. Measure crank shaft journal for wear, taper and ovality. 57. Demonstrate crank shaft for fillet radii, bend & Twist. 58. Inspect flywheel and mounting flanges, spigot and bearing. 59. Check vibration damper for defect. 60. Perform removing cam shaft from engine block, Check for bend & twist of camshaft. Inspection of cam lobe, cam shaft journals and bearings and measure cam lobe lift. 61. Fixing bearing inserts in cylinder block & cap check nip and spread clearance & oil holes & locating lugs fix crank shaft on block 62. Torque bolts- check end play removes haft-check seating, repeat similarly for connecting rod and Check seating and refit. 63. Perform cleaning and checking of cylinder blocks. Surface for any crack, flatness measure cylinder bore for taper & ovality, clean oil gallery passage and oil pipeline. 64. Perform re assembling all parts of engine in correct sequence and torque all bolts and nuts as per workshop manual of the engine. 65. Perform testing cylinder compression, Check idle speed. 66. Perform removing & replacing a cam belt, and adjusting an engine drive belt, replacing an engine drive belt.	- Application bearing failure & its causes-care & maintenance. - Crank-shaft balancing, firing order of the engine. - 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. - Description of Cylinder block, - Cylinder block construction, - Different type of Cylinder sleeves (liner).

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Trace, Test & Repair Cooling and Lubrication System of engine	67. Perform practice on checking & top up coolant, draining & refilling coolant, checking / replacing a coolant hose. 68. Perform test cooling system pressure. 69. Execute on removing & replacing radiator/ thermostat check the radiator pressure cap. 70. Test of thermostat. 71. Perform cleaning &reverse flushing. 72. Perform overhauling water pump and refitting. 73. Perform checking engine oil, draining engine oil, replacing oil filter, & refilling engine oil 74. Execute overhauling of oil pump, oil coolers, air cleaners and air filters and adjust oil pressure relief valves, repairs to oil flow pipe lines and unions if necessary.	**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.
Trace & Test Intake and Exhaust system of engine.	75. Execute dismantling Air Compressor and exhauster and cleaning all parts - measuring wear in the cylinder, reassembling all parts and fitting them in the engine.	**Intake & exhaust systems–** - Description of Diesel induction & Exhaust systems. Description & function of air compressor, exhauster, Super charger, Intercoolers, turbo charger, variable turbo charger mechanism.

	76. Execute dismantling & assembling of turbocharger, check for axial clearance as per service manual. 77. Examine exhaust system for rubber mounting for damage, deterioration and out of position; for leakage, loose connection, dent and damage. 78. Perform practice on exhaust manifold removal and installation, practice on Catalytic converter removal and installation.	**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, Back- pressure, - Electronic mufflers.
Service Diesel Fuel System and check proper functionality.	79. Perform work on removing & cleaning fuel tanks, checking leaks in the fuel lines. 80. Execute overhauling of Feed Pumps (Mechanical & Electrical). 81. Perform bleeding of air from the fuel lines, servicing primary & secondary filters. 82. Execute removing a fuel injection pump from an engine-refit the pump to the engine re- set timing – fill lubricating- oil start and adjust slow speed of the engine. 83. Execute overhauling of injectors and testing of injector. 84. General maintenance of Fuel Injection Pumps (FIP).	**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 Carburetor. **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.
Plan & overhaul the stationary engine and Governor and check functionality.	85. Execute Start engine Adjusted ling speed and damping device In pneumatic governor and venture control unit checking. 86. Verify performance of engine with off load adjusting timings. Start engine adjusting idle speed of the engine fitted with mechanical governor checking- high speed operation of the engine. 87. Check performance for missing cylinder by isolating defective injector 88. Sand test- dismantle and replace defective parts and reassemble and refit back to the engine.	**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.
Monitor emission of vehicle and execute different operation to obtain optimum pollution as per emission norms.	89. Monitor emissions procedures by use of Engine gas analyser or Diesel smoke meter. 90. Checking & cleaning a Positive crank case ventilation (PCV) valve. Obtaining & interpreting scan tool data. Inspection of EVAP canister purges system by use of scan Tool.	**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,

	91. EGR/SCR Valve Remove and installation for inspection.	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 air- fuel ratios, Charcoal storage devices, Diesel particulate filter (DPF). Selective Catalytic, Reduction (SCR), EGR VS SCR.
Carryout overhauling of Alternator and Starter Motor.	92. Perform removing alternator from vehicle dismantling, cleaning checking for defects, assembling and testing for motoring action of alternator & fitting to vehicles. 93. Practice on removing starter motor Vehicle and overhauling the starter motor, testing of starter motor.	- 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.
Diagnose & rectify the defects in LMV/HMV to ensure functionality of vehicle.	Execute troubleshooting in LMV/HMV 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.	- 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.

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ENGINEERING DRAWING	
Read and apply engineering drawing for different application in the field of work.	ENGINEERING DRAWING: Introduction to Engineering Drawing and Drawing Instruments • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument 2. Lines- Types and applications in drawing Free hand drawing of – • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches. • Free hand drawing of hand tools and measuring tools. 3. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Lettering & Numbering – Single Stroke. 4. Dimensioning • Types of arrowhead • Leader line with text • Position of dimensioning (Unidirectional, Aligned) 5. Symbolic representation – • Different symbols used in the related trades of Mechanic Auto Body Repair / Electrical and Electronics / Diesel / Tractor / Two and Three-wheeler. 6. Concept and reading of Drawing in • Concept of axes plane and quadrant • Concept of Orthographic and Isometric projections • Method of first angle and third angle projections (definition and difference) 7. Reading of Job drawing related to Mechanic Auto Body Repair / Electrical and Electronics / Diesel / Tractor / Two and Three-wheeler trades.

WORKSHOP CALCULATION & SCIENCE	
Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	WORKSHOP CALCULATION & SCIENCE **Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, substraction, multiplication & division Decimal fractions - Addition, subtraction, multiplication& division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and square root Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non-ferrous metals Physical and mechanical properties of metals Introduction of iron and cast iron Difference between iron & steel, alloy steel and carbon steel Properties and uses of rubber, timber and insulating materials **Mass, Weight, Volume and Density** Mass, volume, density, weight and specific gravity, **numerical related to L,C,O section only** Related problems for mass, volume, density, weight and specific gravity **Speed and Velocity, Work, Power and Energy** Speed and velocity - Rest, motion, speed, velocity, difference between speed and velocity, acceleration and retardation Speed and velocity - Related problems on speed & velocity Work, power, energy, HP, IHP, BHP and efficiency

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	Heat & Temperature and Pressure Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Concept of pressure - Units of pressure, atmospheric pressure, absolute pressure, gauge pressure and gauges used for measuring pressure **Basic Electricity** Introduction and uses of electricity, electric current AC,DC their comparison, voltage, resistance and their units Conductor, insulator, types of connections - series and parallel Ohm's law, relation between V.I.R & related problems **Mensuration** Area and perimeter of square, rectangle and parallelogram Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder Finding the lateral surface area, total surface area and capacity in litres of hexagonal, conical and cylindrical shaped vessels **Levers and Simple machines** Simple machines - Effort and load, mechanical advantage, velocity ratio, efficiency of machine, relationship between efficiency, velocity ratio and mechanical advantage Lever & Simple machines - Lever and its types **Trigonometry** Measurement of angles Trigonometrical ratios Trigonometrical tables