SYLLABUS - MECHANIC MOTOR VEHICLE			
First Year			
Week No.	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
1-2	Recognize & comply with safe working practices, environment regulation and housekeeping.	1. Familiarisation with institute, Job opportunities in the automobile sector, Machinery used in Trade. Types of work done by the students in the shop floor. (10 Hrs) 2. Importance of maintenance and cleanliness of Workshop. (10 Hrs) 3. Interaction with health centre and fire service station to provide demo on First aid and Fire safety, Use of fire extinguishers.(10 Hrs) 4. Practice operation of different workshop equipments. (10 Hrs) 5. Demonstrate Energy saving Tips of ITI electricity Usage(10 Hrs)	**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. **Energy conservation**-Definition, Energy Conservation Opportunities (ECOs)-Minor ECos and Medium ECOs, Major ECOs), Safety disposal of Used engine oil, Electrical safety tips**.** **Introduction to road safety and Automotive emissions.**
3-5	Check & perform Measuring & marking by using various Measuring & Marking tools (Vernier Calliper, Micrometer, Telescope gauges, Dial bore gauges, Dial indicators,	6. Practice using all marking aids, like steel rule with spring callipers, dividers, scriber, punches, Chisel etc. (15 Hrs) 7. Layout a work piece- for line, circle, arcs and circles. (5 Hrs) 8. Practice to measure a wheel base of a vehicle with measuring tape. (10 Hrs)	**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,

	straightedge, feeler gauge, thread pitch gauge, vacuum gauge, tire pressure gauge.)	9. Practice to measure valve spring tension using spring tension tester. (10 Hrs) 10. Practice to remove wheel lug nuts with use of an air impact wrench. (15 Hrs) 11. Practice on General workshop tools & power tools. (20 Hrs)	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, 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.
6-7	Check & perform Measuring & marking by using various Measuring & Marking tools(Vernier Calliper, Micrometer, Telescope gauges, Dial bore gauges, Dial indicators, straightedge, feeler gauge, thread pitch gauge, vacuum gauge, tire pressure gauge.)	12. Carryout Measuring practice on Cam height, Camshaft Journal dia, crankshaft journal dia, Valve stem dia, piston diameter, and piston pin dia with outside Micrometers. (5 Hrs) 13. 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. (5 Hrs) 14. Carryout Measuring practice on valve spring free length. (5 Hrs) 15. Carryout Measuring practice on cylinder bore, Connecting rod bore, inside diameter (ID) of a camshaft bearing with Telescope gauges. (5 Hrs) 16. Carryout Measuring practice on cylinder bore for taper and out-of-round with Dial bore gauges. (5 Hrs) 17. Perform Measuring practice to measure wear on crankshaft end	**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.

		play, crankshaft run out, and valve guide with dial indicator. (5 Hrs) 18. Perform Measuring practice to check the flatness of the cylinder head is warped or twisted with straightedge is used with a feeler gauge. (5 Hrs) 19. Perform Measuring practice to check the end gap of a piston ring, piston-to-cylinder wall clearance with feeler gauge. (5 Hrs) 20. Practice to check engine manifold vacuum with vacuum gauge. (5 Hrs) 21. Practice to check the air pressure inside the vehicle tires is maintained at the recommended setting. (5 Hrs)	
8-9	Plan & perform basic fastening & fitting operation by using correct hand tools, Machine tools & equipments.	22. Practice on Marking and Drilling clear and Blind Holes, Sharpening of Twist Drills Safety precautions to be observed while using a drilling machine. (20 Hrs) 23. Practice on Tapping a Clear and Blind Hole, Selection of tape drill Size, use of Lubrication, Use of stud extractor. (20 Hrs) 24. 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. (10 Hrs)	**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.
10-11	Trace and Test all Electrical & Electronic components & circuits and assemble circuit to ensure functionality of system.	25. 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. (50 Hrs)	**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

12	-do-	26. 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. (25 Hrs)	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.
13-14	-do-	27. Carryout Cleaning and topping up of a lead acid battery, Testing battery with hydrometer, (15 Hrs) 28. 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. (20 Hrs). 29. Test diode for functionality. (10 Hrs) 30. Practice checking Transistors. (5 Hrs)	Description of Chemical effects, Batteries & cells, Lead acid batteries & Stay 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. **Basic electronics**: Description of Semi conductors, Solid state devices-Diodes, Transistors, Thyristors, Uni Junction Transistors (UJT), Metal Oxide Field Effect Transistors (MOSFETs).
15-16	-do-	31. Identify Hydraulic and pneumatic components used in vehicle. (20 Hrs) 32. Trace hydraulic circuit on hydraulic jack, hydraulic power steering, and Brake circuit. (20 Hrs) 33. Identify components in Air brake systems. (10 Hrs)	**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. Pneumatic Symbols, Description and function of air Reciprocating Compressor. Function of Air service unit (FRL-Filter, Regulator & Lubricator).
17-18	Check & Interpret Vehicle Specification	34. Carryout Identification of different type of Vehicle. (20 Hrs)	Auto Industry - History, leading manufacturers, development in

	data and VIN. Select & operate various Service Station Equipments.	35. Perform Demonstration of vehicle specification data(20 Hrs) 36. 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. (10 Hrs)	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. 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.**
19-21	Dismantle & assemble of Engine from vehicle (LMV/HMV) along with other accessories.	37. Identify parts in a Diesel engine of LMV/ HMV. (10 Hrs) 38. Identify parts in a Petrol engine of LMV/ HMV. (10Hrs) 39. Practice on starting and stopping of engines. (10 Hrs) 40. Observe and report the reading of Tachometer, Odometer, temp and Fuel gauge under ideal and on load condition. (10 Hrs) 41. Practice identification of difference in components of Petrol and Diesel Engines. (10 Hrs) 42. Practice on dismantling engine of LMV/HMV as per procedure. (25 Hrs)	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.
22-23	**Project Work/ Industrial Visit** **Broad Area:** a) Simple electrical circuits b) Testing of Battery c) Testing of Ignition Circuit d) Dismantling and assembling of Petrol and Diesel engines.		
24-26	**Revision**		
27-28	Overhaul Engine and check functionality.	43. Overhauling of cylinder head assembly, Use of service manual for clearance and other parameters, Practice on removing rocker arm assembly manifolds. (10 Hrs) 44. Practice on removing the valves and its parts from the cylinder head, cleaning. Inspection of cylinder head and manifold surfaces for warping, cracks and flatness. (10 Hrs) 45. 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. (10 Hrs) 46. Check valve springs, tappets, push rods, tappet screws and valve stem cap. (10 Hrs)	**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**,** 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**,** importance of Cam lobes**,** Timing belts & chains**,** Timing belts & tensioners.

		47. Reassemble valve parts in sequence, refit cylinder head and manifold & rocker arm assembly, adjustable valve clearances, starting engine after adjustments. (10 Hrs)	
29	-do-	48. Practice Overhauling piston and connecting rod Assembly. Use of service manual for clearance and other parameters(5 Hrs) 49. Practice on removing oil sump and oil pump – clean the sump. Practice on removing the big end bearing, connecting rod with the piston. (5 Hrs) 50. 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. (5 Hrs) 51. 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. (5 Hrs) 52. Check connecting rod for bend and twist. Assemble the piston and connecting rod assembly. (5 Hrs)	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.
30-31	-do-	53. Carryout Overhauling of crankshaft by referring service manual for clearance and other parameters(10 Hrs) 54. 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 (10 Hrs) 55. Measure crank shaft journal for	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.

		wear, taper and ovality, Checking crankshaft for fillet radii, bend & twist. (5 Hrs)	
32-33	-do-	56. Perform Checking of flywheel and mounting flanges, spigot, bearing. (10 Hrs) 57. Check vibration damper for defects, Practice on removing cam shaft from engine block, Check for bend & twist of camshaft. (10 Hrs) 58. Perform Inspection of cam lobe, camshaft journals and bearings and measure cam lobe lift. (10 Hrs) 59. 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. (20 Hrs)	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.
34-35	-do-	60. Practice Cleaning and Checking of cylinder blocks. (10 Hrs) 61. Check cylinder blocks Surface flatness visually. (10 Hrs) 62. Measure cylinder bore for taper & ovality, clean oil gallery passage and oil pipe line, Bore - descale water passages. (10 Hrs) 63. Practice Removing cylinder liners from scrap cylinder block, practice in measuring and refitting new liners as per maker's recommendations precautions while fitting new liners. (20 Hrs)	Description of Cylinder block, Cylinder block construction, and Different type of Cylinder sleeves (liner).
36-37	Trace, Test & Repair Cooling and Lubrication System of engine.	64. Practice on Checking &Top up coolant, (5 Hrs) 65. Drain & refill coolant, Checking / replacing a coolant hose, Testing cooling system pressure, Practice on Removing & replacing	**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**

		radiator/ thermostat. (5 Hrs) 66. Inspect the radiator pressure cap, testing of thermostat. (5 Hrs) 67. Perform Cleaning & reverse flushing. (5 Hrs) 68. Carryout overhauling water pump and refitting. (10 Hrs) 69. Practice on Checking engine oil, Draining engine oil, Replacing oil filter, Refilling engine oil. (10 Hrs) 70. 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. (10 Hrs)	**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.
38-39	Trace & Test Intake and Exhaust system of engine.	71. Carryout Dismantling & assembling of turbocharger check for axial clearance as per service manual. (15 Hrs) 72. Check Exhaust system for rubber mounting for damage, deterioration and out of position; for leakage, loose connection, dent and damage. (10 Hrs) 73. Practice on Exhaust manifold removal and installation. (13 Hrs) 74. Practice on Catalytic converter removal and installation. (12 Hrs)	**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**.**
40-41	Service Fuel System and check proper functionality.	75. Practice Testing of MPFI components and replacement if necessary. (10 Hrs) 76. Check delivery from fuel Pump. Replacing a fuel filter. (10 Hrs) 77. Bleed air from the fuel lines, Servicing primary & secondary filters. (15 Hrs) 78. 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. (15 Hrs)	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.
42-43	Test Engine Performance and set idling speed.	79. Reassemble all parts of engine in correct Sequence and torque all bolts and nuts as per workshop manual of the engine. (10 Hrs) 80. 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. (15 Hrs) 81. Practice on Start engine adjust idling speed and damping device in pneumatic governor and venture control unit checking (5 Hrs) 82. Test Performance of engine with off load adjusting timings. (5 Hrs) 83. Start engine- adjusting idle speed of the engine fitted with mechanical governor checking- high speed operation of the engine. (5 Hrs) 84. Check performance for missing cylinder by isolating defective injectors and test- dismantle and replace defective parts and reassemble and refit back to the engine (10 Hrs)	**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.
44	Monitor emission of vehicle and execute different operation to obtain optimum pollution as per emission norms.	85. Practice Monitoring emissions procedures by use of Engine gas analyser or Diesel smoke meter. (5 Hrs) 86. Checking & cleaning a Positive crank case ventilation (PCV) valve. Obtaining & interpreting scan tool data. (5 Hrs) 87. Perform Inspection of EVAP canister purge system by use of scan Tool. (5 Hrs)	**Emission Control:- Vehicle emissions** Standards- Euro and Bhart 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

		88. Perform EGR /SCR Valve Removal and installation for inspection. (10Hrs)	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
45-46	Carryout overhauling of Alternator and Starter Motor.	89. Practice on removing alternator from vehicle dismantling, cleaning checking for defects, assembling and testing for motoring action of alternator & fitting to vehicles. (25 Hrs) 90. Practice on removing starter motor Vehicle and overhauling the starter motor, testing of starter motor (25 Hrs)	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.
47	Diagnose & rectify the defects in LMV/HMV to ensure functionality of vehicle.	91. 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. (25 Hrs)	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.
48-49	**Project Work/ Industrial Visit: -** **Broad Area:** a) Testing of engine after assembling. b) Intake and Exhaust System. c) Emission control d) Charging system e) Vehicle Troubleshooting		
50-51	**Revision**		
52	**Examination**		

Note:

1. *Some of the sample project works (indicative only) are given at the mid and end of each year.*

2. *Instructor may design their own project and also inputs from local industry may be taken for designing such new project.*
3. *The project should broadly covered maximum skills in the particular trade and must involve some problem solving skill. Emphasis should be on Teamwork: Knowing the power of synergy/ collaboration, Work to be assigned in a group (Group of at least 4 trainees). The group should demonstrate Planning, Execution, Contribution and application of Learning. They need to submit Project report.*
4. *If the instructor feels that for execution of specific project more time is required then he may plan accordingly in appropriate time during the execution of normal trade practical.*
5. *More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of both conventional & CNC turning operation, production of different components, turning of complex job, etc., may be shown to the trainees to give a feel of Industry and their future assignment.*

SYLLABUS - MECHANIC MOTOR VEHICLE			
Second Year			
Week No.	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
53-56	Plan & perform maintenance, diagnosis and servicing of transmission system	92. Identify different major components of Heavy vehicle and their function & placement study of different make lorry/bus in Institute with different dealers or organizations. (25 Hrs) 93. Practice on adjusting clutch pedal play-removing gearbox and clutch assembly from Light & Heavy Vehicle. (10 Hrs) 94. Perform Dismantling clutch assembly, cleaning inspecting parts. (10 Hrs) 95. 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. (15 Hrs) 96. Perform Assembling of pressure plate adjusting the fingers checking run out of fly wheel and aligning clutch assembly with flywheel. (10 Hrs) 97. Perform Dismantling cleaning and assembling of gearshift mechanism changing oil in gear box. (15 Hrs) 98. 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. (15 Hrs)	**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/ center 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.

57-59	-do-	99. 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. (15 Hrs) 100. Practice on FWD Driveshaft Removal and Replacement. (15 Hrs) 101. Practice on overhauling & inspection of rear axle. (15 Hrs) 102. Practice on overhauling & inspection of differential assembly. (15 Hrs) 103. 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. (15 Hrs)	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.
60-61	-do-	104. Identify Automatic transmission components (5 Hrs) 105. Check automatic transmission fluid and replace transmission fluid & filter. (20 Hrs) 106. Practice on oil pressure control cable play adjustments, Inspection of shift lever switch, throttle position sensor, speed sensor and automatic transmission wiring harness coupler. (25 Hrs)	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 (1st & 2nd) 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.
62-64	Plan & perform maintenance, diagnosis and servicing of Vehicle Control System	Following practical to be Practiced On Light & Heavy Vehicle. 107. 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. (10 Hrs) 108. Practice on removing steering wheel, steering gearbox. (10 Hrs) 109. 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. (10 Hrs) 110. Check & top up power steering fluid, (5 Hrs) 111. Carryout Pressure testing a power steering system, Flushing a power steering system, (10 Hrs) 112. Carryout Inspecting & adjusting an engine drive belt, (5 Hrs)	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 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.

		113. Carryout Servicing a steering system, (10 Hrs) 114. Practice servicing wheel bearings. (10 Hrs) 115. Perform Troubleshooting-Causes and remedy for abnormal wear of tyre, wheel wobbling, poor self centring, hard steering, and vehicle pulling to one side. (5 Hrs)	
65-67	-do-	Following practical to be Practiced On Light & Heavy Vehicle 116. Practice on visual Inspection of chassis frame for crack, bent and twists. (15Hrs) 117. Carryout Overhauling and Inspection of shackle, leaf spring, front & rear suspension. (15 Hrs) 118. Practice on removing, inspection and assembling of shock absorber (15 Hrs) 119. Practice Lubricating a suspension system. (10 Hrs) 120. 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”. (20 Hrs)	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, Torsion bar suspension Rear suspension types & components- Rigid axle leaf spring suspension, Rigid axle coilspring suspension, Independent type suspension, Rigid non-drive suspension.
68-69	-do-	121. Practice on removing wheels from light & Heavy vehicle, dismantling tyres and tubes checking puncture. (10 Hrs)	Wheels & Tyres-Wheel types & sizes Wheels, Rim sizes & designations, Types of wheels Tyre types & characteristics- Tyres,

		122. Practice Assembling & inflating tyres to correct pressure. (10 Hrs) 123. Check & adjust tire pressure by use of air or by Nitrogen(10 Hrs) 124. Rotate the wheels in vehicle minor repairs to wheels and tyres, wheel balancing & alignment. (10 Hrs) 125. Check for tyre wear patterns. (10 Hrs)	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 vs atmospheric air in tyres
70-73	-do-	126. Practice on Adjusting brake pedal play, Overhauling and inspection of tandem master cylinder assembly. (5 Hrs) 127. Perform Overhauling and inspection of front and rear brake assembly, overhauling and inspection of wheel cylinder assembly. (5 Hrs) 128. Bleed hydraulic brakes & Disk brakes. (10 Hrs) 129. Carryout Overhauling and inspection of vacuum assisted brake assembly. (10 Hrs) 130. Perform Overhauling and inspection of disc brake. (10 Hrs) 131. 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. (15 Hrs) 132. 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.	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 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.

		(15 Hrs) 133. Carryout Trouble tracing in braking system of a heavy vehicle adjusting brakes and balancing all four wheel brakes, precautions to be observed while testing brakes points to be remember while preparing the vehicle for brake certificate. (15 Hrs) 134. Practice of maintaining of ABS system. (15 Hrs)	The construction and operation of heavy vehicle Anti-Slip Regulation / Traction Control (ASR) system. Introduction to Electromagnetic retarder brake (EMR) and Engine exhaust brake.
74-75	**Project Work/ Industrial Visit: -** **Broad Area:** a) Manual / Automatic Transmission b) Suspension system c) Steering system d) Wheels & tyres/ Braking system		
76-78	**Revision**		
79 - 80	Troubleshoot vehicle Engine components and ascertain repair	135. 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. (50 Hrs)	Licensing of drivers & conductors, Registration of vehicle, Traffic rules, Signals & controls, Accidents, Causes & analysis, Responsibility of driver, Offences, penalties & procedures, Different types of forms, Government administration structure, Personnel, Authorities & duties, Rules regarding construction of motor vehicles, Tax exemption & tax renewal, Insurance types & significance -Comprehensive Third party insurance, Duty of driver in case of accident
81-84	Testing of electronic control system and check functionally.	136. Carryout Identification of Electronic control Unit. (20 Hrs) 137. Perform Set up for testing, Testing of Electronic Control Circuit. (20 Hrs) 138. Perform Identification of various sensors installed in engine & it's mounting. (20 Hrs) 139. Check instruments & Gauges on dash board & replace defective gauges. (20 Hrs)	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

		140. Test Temperature sensor, Pressure senor, potentiometer, magnetic induction sensor, cam shaft sensor, crankshaft position sensor. (20 Hrs)	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.
85-86	Diagnose & rectify the defects in vehicle to ensure functionality of vehicle.	141. Carryout Diagnosis- Possible causes and remedy for Engine cranks, but will not or hard to start, Poor fuel economy or engine performance. (25 Hrs) 142. Practice Checking ignition timing, Checking & changing a spark plug, Identification and testing of Hall Effect sensor, Optical sensor. Tracing and testing of sensor circuits. (25Hrs)	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.
87- 88	Carryout overhauling of charging system.	143. Check charging system for the cause of undercharge, No charge, and over charge conditions. (10 Hrs) 144. 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. (10 Hrs) 145. Practice Inspecting & adjusting an engine drive belt, Replacing an engine drive belt / pulleys / Tensioner and their alignments. (10 Hrs) 146. Carryout Trouble shooting, possible causes and remedy for warning lamp does not glow	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.

		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. (20 Hrs)	
89 - 90	Carryout overhauling of starting system.	147. Remove starter motor from vehicle, and carryout Performance test for pull-in test, Hold-in test, pinion (plunger) return test, No-load performance test. (15 Hrs) 148. Check Solenoid and test for Hold in coil open circuit, Armature test – Ground test, Open circuit test, pull-in coil open circuit test, field coil test. Inspect brush length wear as per service manual. (15 Hrs) 149. 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. (15 Hrs) 150. Check a starting system, Jump-start a vehicle. (5 Hrs)	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.
91 -92	Troubleshoot electrical components of vehicle and ascertain repair	151. 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. (4 Hrs) 152. Perform Trouble shooting and remedy for Headlight - headlight do not light up, only one headlight does not light up, Only one beam ("Hi" or "Lo") does not light. (4 Hrs)	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

		153. 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. (4 Hrs) 154. Perform Trouble shooting and remedy for clearance, tail and license plate lights - All lights do not light up, some lights do not light up. (4 Hrs) 155. Perform Trouble shooting and remedy for Back-up light - Back-up lights do not light up. (4 Hrs) 156. Perform Trouble shooting and remedy for Brake lights -Brake lights do not light up, Brake light stay on. (4 Hrs) 157. Perform Trouble shooting and remedy for fuel meter and fuel gauge unit - Fuel meter shows no operation or incorrect operation. (4 Hrs) 158. Perform Trouble shooting and remedy for Engine coolant Temp (ECT) meter and ECT Sensor – Engine coolant temp meter shows no operation or incorrect operation. (4 Hrs) 159. 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. (4 Hrs) 160. 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. (4 Hrs) 161. Perform Trouble shooting and	

		remedy for interior light- Interior light do not light up. (5 Hrs) 162. Perform Trace the wiring circuit of traffic signal flashers light circuit-tracing defects in the flasher circuits, replacing fuse bulb. (5 Hrs)	
93 - 94	Overhaul, service and testing Vehicle Air Conditioning system, its parts and check functionality.	163. Identify Air conditioning components, Performance test on A/c unit, (5 Hrs) 164. Check Charged state of refrigerant, Inspecting & adjusting an engine drive belt, Replacing an engine drive belt. (10 Hrs) 165. Check heating system, Compressor rotation test, air Gap check, (5 Hrs) 166. 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, (20 Hrs) 167. Check abnormal noise from compressor, Magnetic clutch, condenser, evaporator, Blower motor. (5 Hrs) 168. Carryout Diagnosis test for High pressure gauge –pressure high and low, Low pressure gauge for pressure high and low. (5 Hrs)	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.
95 - 96	Troubleshoot electrical components of vehicle and ascertain repair	169. Perform Trouble shooting and remedy for Horn- No horn operation, poor sound quality, horn sounds continuously and to replace the horn if faulty. (5 Hrs) 170. Remove and install wiper motors and wiper switches. Checking & replacing wiper	Accessories: Horn circuit, wiper circuit, power window components and circuit. Power door lock circuit, automatic door lock circuit, remote keyless entry system circuit, antitheft system, immobilizer system. Navigation system, Car radio and cassette player, car videos. Description and function of Airbags, Seatbelt, Vehicle safety systems, Crash

		blades. (5 Hrs) 171. Perform Trouble shooting and remedy for windshield wiper and washer - no operation, intermittent operation, continuous operation, and wipers will not park. (5 Hrs) 172. Diagnose causes for improper operation of the windshield washer system and to replace the pump if faulty. (6 Hrs) 173. Diagnose the power window system for – all power window motors do not operate, some switches do not operate. (6 Hrs) 174. Diagnose the power door lock control for – All power door locks do not operate, only one power door lock not operate. (6 Hrs) 175. Diagnose for remote keyless entry and immobilizer system. (6 Hrs) 176. Familiarization of car radio wiring and speaker circuits. (5 Hrs) 177. Diagnose automatic seat belt systems, Diagnose air bag system and service warnings. (6 Hrs)	sensors, Seat belt pre-tensioners, Tire pressure monitoring systems Integrated communications, Proximity sensors, Reflective displays, Global positioning satellites, Triangulation/ trilateration, Telematics. Networking & multiplexing. Introduction to Hybrid & Electronic vehicle, Hydrogen fuel cell vehicle, Electrical & Electronic architecture.
97 - 99	Drive vehicle following Traffic Regulations and maintenance of good road conduct.	Driving Practice. 178. Practice in straight driving on wide roads. (15 Hrs) 179. Driving through lanes and curves. (15 Hrs) 180. Practice in reversing. (15 Hrs) 181. Practice overtaking another vehicle. (15 Hrs) 182. Practice in driving through sand and wet surfaces. Practice in parking and Diagonal parking. (15 Hrs)	Locating vehicle information, Obtaining & interpreting scan tool data, Using a repair manual, Using a shop manual, Using an owner's manual, Using a labour guide, Using a parts program, Using a service information program
100-101	**Project Work/ Industrial Visit: -** **Broad Area:** a) MPFI and CRDI		

	b) Engine scanning c) Starting system d) Lighting system e) HVAC f) Electrical accessories
102 - 103	**Revision**
104	**Examination**

Note:

1. *Some of the sample project works (indicative only) are given at the mid and end of each year.*
2. *Instructor may design their own project and also inputs from local industry may be taken for designing such new project.*
3. *The project should broadly covered maximum skills in the particular trade and must involve some problem solving skill. Emphasis should be on Teamwork: Knowing the power of synergy/ collaboration, Work to be assigned in a group (Group of at least 4 trainees). The group should demonstrate Planning, Execution, Contribution and application of Learning. They need to submit Project report.*
4. *If the instructor feels that for execution of specific project more time is required then he may plan accordingly in appropriate time during the execution of normal trade practical.*
5. *More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of both conventional & CNC turning operation, production of different components, turning of complex job, etc., may be shown to the trainees to give a feel of Industry and their future assignment.*