GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

MECHANIC MOTOR VEHICLE

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 5

SECTOR – AUTOMOBILE

MECHANICAL MOTOR VEHICLE

(Engineering Trade)

(Revised in 2018)

Version: 1.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 5

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
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List of Expert Members participated/ contributed for finalizing the course curriculum of Mechanic Motor Vehicle Trade at Chennai on 20.02.2018.			
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CONTENTS

1. COURSE INFORMATION

During the two years duration, a candidate is trained on subjects- Professional Skill, Professional Knowledge, Engineering Drawing, Workshop Calculation & Science and Employability Skills. In addition to this, a candidate is entrusted to make/do project work and Extra Curricular Activities to build up confidence. The practical skills are imparted in simple to complex manner & simultaneously theory subject is taught in the same fashion to apply cognitive knowledge while executing task. The broad components covered under Professional Skill subject are as below:

First Year: - This year will cover the safety aspect in general and specific to the trade, identification of tools & equipment, raw materials used. The trainee will perform Measuring & marking by using various Measuring & Marking tools. The trainee will be able to plan and perform basic fastening and fitting operations. Familiarize with basics of electricity, test and measure the electrical parameter. Skilling practice on maintenance of batteries being done. Practice making various welding joints by using Arc and gas welding. Trace and identify various hydraulics and pneumatics components and identify components in Air and Hydraulic Brake system. Identify various types of vehicle.

The candidate will be able to perform practice on dismantling Diesel Engine of LMV as per given standard procedures. Able to achieve skill on Overhauling of Cylinder Head , valve train , Piston, connecting rod assembly, crankshaft, flywheel and mounting flanges, spigot and bearings, camshaft etc. practice reassembling all parts of engine in correct sequence as per workshop manual. Perform testing on engine. Also the trainee practice on repair and maintenance of Cooling, lubrication, Intake & Exhaust system of Engine. Perform maintenance of diesel fuel system, FIP, Governor and monitor emission of vehicle. Practice on repair, maintenance and overhaul of Starter, alternator and perform Execute troubleshooting in engine of LMV/HMV.

Second Year: - In the second year, the trainee will learn to perform overhauling of light vehicle/Heavy Vehicle transmission units including Gear box, Single plate clutch assembly, Diaphragm clutch assembly , Constant mesh Gear box, synchromesh gear box, gear linkages, Propeller shaft, Universal Slip Joint, Rear axle assembly, Differential assembly. The trainee will perform overhauling of light vehicle Chassis units, adhering to the specifications and tolerances for the vehicle and the manufacturer's approved overhauling methods, Standard repair methods, health and safety requirements etc. the trainee will learn how to overhaul, repair and service Shackle, Leaf spring, Front axle, Front and rear suspension, Steering Gearbox- worm and roller type, Steering Gearbox- Reticulating ball type, Master cylinder, Tandem Master cylinder, Front and

rear brake, Wheel cylinder , Vacuum booster, Air servo unit, Air tank (reservoir) etc. The trainee will also learn to carry out wheel balancing and Wheel Alignment to within acceptable limits.

The trainee will troubleshoot vehicle Engine components and ascertain repair. Plan & service Electronic Control Unit and check functionality. Diagnose & rectify the defects in vehicle to ensure functionality of vehicle. The trainees will carry out overhauling of charging system. Also the trainee will perform overhauling of starting system. Troubleshoot electrical components of vehicle and ascertain repair. Overhaul, service and testing Vehicle Air Conditioning system, its parts and check functionality. The trainee will also learn to drive vehicle following Traffic Regulations and maintenance of good road conduct

2. TRAINING SYSTEM

2.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under the aegis of National Council of Vocational Training (NCVT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programmes of NCVT for propagating vocational training.

Mechanic Motor Vehicle Trade under CTS is one of the popular courses delivered nationwide through a network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. In the Domain area (Trade Theory & Practical) impart professional skills and knowledge, while Core area (Workshop Calculation and science, Engineering Drawing and Employability Skills) impart requisite core skill, knowledge and life skills. After passing out of the training programme, the trainee is awarded National Trade Certificate (NTC) by NCVT which is recognized worldwide.

Candidates broadly need to demonstrate that they are able to:

- Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional knowledge, core skills & employability skills while performing the job and machining work.
- Check the job/components as per drawing for functioning identify and rectify errors in job/components.
- Document the technical parameters related to the task undertaken.

2.2 CAREER PROGRESSION PATHWAYS:

- Can appear in 10+2 examination through National Institute of Open Schooling (NIOS) for acquiring higher secondary certificate and can go further for General/ Technical education.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).

- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.

2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two years:

S No.	Course Element	Notional Training Hours
1	Professional Skill (Trade Practical)	2158
2	Professional Knowledge (Trade Theory)	504
3	Workshop Calculation & Science	168
4	Engineering Drawing	252
5	Employability Skills	110
6	Library & Extracurricular Activities	168
7	Project Work	320
8	Revision & Examination	480
	Total	**4160**

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course and at the end of the training programme as notified by the Govt. of India from time to time. The employability skills will be tested in first year only.

a) The **Internal Assessment** during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the template (Annexure – II).

b) The final assessment will be in the form of summative assessment method. The All India Trade Test for awarding NTC will be conducted by NCVT as per the guideline of Govt of India. The pattern and marking structure is being notified by Govt. of India from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects 40%.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/wastage as per procedure, behavioral attitude, sensitivity to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.
Assessment will be evidence based, comprising the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work

Evidences of internal assessments are to be preserved until forthcoming examination for audit and verification by examination body. The following marking pattern to be adopted while assessing:

Performance Level	Evidence
(a) Weightage in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • Below 70% tolerance dimension achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and

	consistency in the finish. • Occasional support in completing the project/job.
(b) Weightage in the range of 75%-90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices.	• Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% tolerance dimension achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish. • Little support in completing the project/job.
(c) Weightage in the range of above 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment. • Above 80% tolerance dimension achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Brief description of Job roles:

Mechanic Motor Vehicle; repairs overhauls and services motor vehicles to keep them in good running condition.

Examines vehicle to ascertain nature and location of defects either by running engine or driving vehicle on road. Dismantles partially or completely defective unit or parts of vehicle such as engine, gear box, rear axle, front axle, steering assembly, radiator, etc. according to nature of repairs to be done, using hoist, jack, pullers, hand tools and other devices.

Measures essential parts like cylinder, bores piston, sizes crank pins etc. using gauges, micrometer and other precision tools and gets cylinders rebored, liners filled, valve seats refaced, bearings replaced etc. as necessary.

Repairs or overhauls and assembles engine such as replacing defective parts, scrapping bearings, setting timing, cleaning injectors, tuning carburetor, MPFI and CRDI Engines etc. according to maker's specification. Replaces or repairs defective parts of gear box, rear axle, steering mechanism etc. and sets them right ensuring correct alignment, clearance, meshing of gears, specified movements and operations. Relines and builds brakes, sets wheel alignment, adjust, steering, clutch, hand brakes etc fits new or repaired accessories and body parts, makes electrical connection, and performs other tasks to effect repairs.
Lubricates joints, tightens loose parts, tests performance of vehicle by driving on road and makes necessary adjustments to attain desired standard. Trouble shooting and rectification of engine, chassis, and auxiliary system. State the importance of Motor vehicle act and rules Plan and organize assigned work and detect & resolve issues during execution.

Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

Reference NCO-2015:

a) 7231.9900
b) 7231.0100
c) 7231.0101
d) 7231.0107
e) 7231.0400

4. GENERAL INFORMATION

Name of the Trade	**Mechanic Motor Vehicle**
NCO - 2015	7231.9900, 7231.0100, 7231.0101, 7231.0107, 7231.0400
NSQF Level	Level – 5
Duration of Craftsmen Training	Two years
Entry Qualification	Passed 10th Class with Science and Mathematics under 10+2 system of education or its equivalent
Unit Strength (No. Of Students)	12 (Max. supernumeraries seats: 4)
Space Norms	130 Sq. m
Power Norms	20 KW
Instructors Qualification for	
1. Mechanic Motor Vehicle Trade	Degree in Mechanical Engineering from recognized Engineering College/ university with one year experience in the relevant field. **OR** Diploma in Mechanical Engineering from recognized board of technical education with two-year experience in the relevant field. **OR** NTC/NAC passed in the Trade of "Mechanic Motor Vehicle" with three years post qualification experience in the relevant field. **Desirable:** Preference will be given to a candidate with CIC (Craft Instructor Certificate) in Mechanic Motor Vehicle trade. ***Note:*** ***Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications.***
2. Workshop Calculation & Science	Degree in Engineering with one year experience. **OR** Diploma in Engineering with two-year experience. **Desirable:** Craft Instructor Certificate in RoD&A course under NCVT.
3. Engineering Drawing	Degree in Engineering with one year experience. **OR** Diploma in Engineering with two-year experience. **OR**

	NCVT/ NAC in the Draughtsman (Mechanical) with three-year experience. **<u>Desirable</u>:** Craft Instructor Certificate in RoD&A course under NCVT.
4. Employability Skill	MBA OR BBA with two-year experience OR Graduate in Sociology/ Social Welfare/ Economics with two-year experience OR Graduate/ Diploma with two-year experience and trained in Employability Skills from DGT institutes. **AND** Must have studied English/ Communication Skills and Basic Computer at 12th/ Diploma level and above. **OR** **Existing Social Studies Instructors duly trained in Employability Skills from DGT institutes.**
List of Tools and Equipment	As per Annexure – I

Distribution of training on Hourly basis: (Indicative only)

Total Hours/Week	Trade Practical	Trade Theory	Work shop Cal. &Sc.	Engg. Drawing	Employability Skills	Extra-curricular Activity
40 Hours	25 Hours	6 Hours	2 Hours	3 Hours	2 Hours	2 Hours

5. NSQF LEVEL COMPLIANCE

NSQF level for **Mechanic Motor Vehicle** trade under CTS: **Level 5**

As per notification issued by Govt. of India dated- 27.12.2013 on National Skill Qualification Framework total 10 (Ten) Levels are defined.

Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

a. Process
b. Professional Knowledge
c. Professional Skill
d. Core Skill and
e. Responsibility

The broad learning outcome of **Mechanic Motor Vehicle** trade under CTS mostly matches with the Level descriptor at Level - 5.

The NSQF level-5 descriptor is given below:

Level	Process Required	Professional Knowledge	Professional Skill	Core Skill	Responsibility
Level 5	Job that requires well developed skill, with clear choice of procedures in familiar context.	Knowledge of facts, principles, processes and general concepts, in a field of work or study.	A range of cognitive and practical skills required to accomplish tasks and solve problem by selecting and applying basic methods, tools, materials and information.	Desired mathematical skill, understanding of social, political and some skill of collecting and organizing information, communication.	Responsibility for own work and learning and some responsibility for other's works and learning.

6. LEARNING/ ASSESSABLE OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

6.1. GENERIC LEARNING OUTCOME

1. Recognize & comply with safe working practices, environment regulation and housekeeping.

2. Understand and explain different mathematical calculation & science in the field of study including basic electrical. *[Different mathematical calculation & science-Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure]*

3. Interpret specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol]*

4. Select and ascertain measuring instrument and measure dimension of components and record data.

5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day-to-day work to improve productivity & quality.

6. Explain energy conservation, global warming and pollution and contribute in day-to-day work by optimally using available resources.

7. Explain personnel finance, entrepreneurship and manage/ organize related task in day-to-day work for personal & societal growth.

8. Plan and organize the work related to the occupation.

6.2. SPECIFIC LEARNING OUTCOME

First Year:

9. 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 guage)*

10. Plan & perform basic fastening & fitting operation by using correct hand tools, Machine tools & equipments.
11. Trace and Test all Electrical & Electronic components & circuits and assemble circuit to ensure functionality of system.
12. Join components by using Arc & Gas welding.
13. Check & Interpret Vehicle Specification data and VIN & Select & operate various Service Station Equipments.
14. Dismantle & assemble of Engine from vehicle (LMV/HMV) along with other accessories.
15. Overhaul Engine and check functionality.
16. Trace, Test & Repair Cooling and Lubrication System of engine.
17. Trace & Test Intake and Exhaust system of engine.
18. Service Fuel System and check proper functionality.
19. Test Engine Performance and set idling speed.
20. Monitor emission of vehicle and execute different operation to obtain optimum pollution as per emission norms.
21. Carryout overhauling of Alternator and Starter Motor.
22. Diagnose & rectify the defects in LMV/HMV to ensure functionality of vehicle.

Second Year:

23. Plan & perform maintenance, diagnosis and servicing of transmission system.
24. Plan & perform maintenance, diagnosis and servicing of Vehicle Control System
25. Troubleshoot vehicle Engine components and ascertain repair
26. Plan & service Electronic Control Unit and check functionality.
27. Diagnose & rectify the defects in vehicle to ensure functionality of vehicle.
28. Carryout overhauling of charging system.
29. Carryout overhauling of starting system.
30. Troubleshoot electrical components of vehicle and ascertain repair.
31. Overhaul, service and testing Vehicle Air Conditioning system, its parts and check functionality.
32. Drive vehicle following Traffic Regulations and maintenance of good road conduct

7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING OUTCOME	
Learning Outcome	**Assessment Criteria**
1. Recognize & comply with safe working practices, environment regulation and housekeeping.	1.1 Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
	1.2 Recognize and report all unsafe situations according to site policy.
	1.3 Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
	1.4 Identify, handle and store/ dispose of dangerous/unsalvageable goods and substances according to site policy and procedures following safety regulations and requirements.
	1.5 Identify and observe site policies and procedures in regard to illness or accident.
	1.6 Identify safety alarms accurately.
	1.7 Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to site accident/injury procedures.
	1.8 Identify and observe site evacuation procedures according to site policy.
	1.9 Identify Personal Productive Equipment (PPE) and use the same as per related working environment.
	1.10 Identify basic first aid and use them under different circumstances.
	1.11 Identify different fire extinguisher and use the same as per requirement.
	1.12 Identify environmental pollution & contribute to avoidance of same.
	1.13 Take opportunities to use energy and materials in an environmentally friendly manner.
	1.14 Avoid waste and dispose waste as per procedure.
	1.15 Recognize different components of 5S and apply the same in the working environment.

2. Understand, explain different mathematical calculation & science in the field of study including basic electrical and apply in day-to-day work.*[Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure]*	2.1 Explain concept of basic science related to the field such as Material science, Mass, weight, density, speed, velocity, heat & temperature, force, motion, pressure, heat treatment, centre of gravity, friction.
	2.2 Measure dimensions as per drawing.
	2.3 Use scale/ tapes to measure for fitting to specification.
	2.4 Comply given tolerance.
	2.5 Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.
	2.6 Ensure dimensional accuracy of assembly by using different instruments/gauges.
	2.7 Explain basic electricity, insulation & earthing.
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol]*	3.1 Read & interpret the information on drawings and apply in executing practical work.
	3.2 Read & analyse the specification to ascertain the material requirement, tools, and machining/ assembly/maintenance parameters.
	3.3 Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
4. Select and ascertain measuring instrument and measure dimension of components and record data.	4.1 Select appropriate measuring instruments such as micrometers, Vernier callipers, dial gauge, bevel protector and height gauge (as per tool list).
	4.2 Ascertain the functionality & correctness of the instrument.
	4.3 Measure dimension of the components & record data to analyse with the given drawing/measurement.

5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day-to-day work to improve productivity & quality.	5.1 Explain the concept of productivity and quality tools and apply during execution of job.
	5.2 Understand the basic concept of labour welfare legislation and adhere to responsibilities and remain sensitive towards such laws.
	5.3 Knows benefits guaranteed under various acts.
6. Explain energy conservation, global warming, pollution and contribute in day-to-day work by optimally using available resources.	6.1 Explain the concept of energy conservation, global warming, pollution and utilize the available resources optimally & remain sensitive to avoid environment pollution.
	6.2 Dispose waste following standard procedure.
7. Explain personnel finance, entrepreneurship and manage/ organize related task in day-to-day work for personal & societal growth.	7.1 Explain personnel finance and entrepreneurship.
	7.2 Explain role of various schemes and institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non-financing support agencies to familiarize with the policies/ programmes, procedure & the available scheme.
	7.3 Prepare Project report to become an entrepreneur for submission to financial institutions.
8. Plan and organize the work related to the occupation.	8.1 Use documents, drawings and recognize hazards in the work site.
	8.2 Plan workplace/ assembly location with due consideration to operational stipulation.
	8.3 Communicate effectively with others and plan project tasks.
	8.4 Assign roles and responsibilities of the co-trainees for execution of the task effectively and monitor the same.

SPECIFIC LEARNING OUTCOMES	
LEARNING OUTCOME	**ASSESSMENT CRITERIA**
FIRST YEAR	
9. Check & perform Measuring & marking by using various Measuring & Marking tools (Vernier Caliper, Micrometer, Telescope gauges, Dial bore gauges, Dial indicators, straightedge, feeler gauge, thread pitch gauge, vacuum gauge, tire pressure gauge.)	9. 1 Plan the working principles of measuring instruments and special tools required for auto workshop.
	9. 2 Select, care and use of measuring instrument.
	9. 3 Set up the measured value with workshop manual and quality concepts and proper safety.
	9. 4 Carry out decision on whether to replace or not.
10. Plan & perform basic fastening & fitting operation by using correct hand tools, Machine tools & equipments.	10.1 Describe the purpose, use of auto hand tools.
	10.2 List the safety rules for hand tools.
	10.3 Select the correct tool for the job.
	10.4 Set up the tacked pieces in specific position.
	10.5 Joint components by Brazing, Soldering, Riveting as per given drawing.
	10.6 Produce components by different operation (Drilling, Reaming, Taping, Dieting)
11. Trace and Test all Electrical & Electronic components & circuits and assemble circuit to ensure functionality of system. Charge and test batteries used in vehicle.	11.1 Plan and prepare as per procedure and safety methods of soldering the cable ends using an electric soldering iron.
	11.2 Use crimping tool to make a circuit joint.
	11.3 Explain the connection of an ammeter, voltmeter, and ohmmeter in a circuit trouble shooting.
	11.4 State open & short circuit, series and parallel circuits.
	11.5 Verify DC series & parallel circuits and its characteristics.
	11.6 Check out the open and short circuits in the lighting circuits.
	11.7 Verify ohm's law and measure resistance using rheostat.
	11.8 Check the voltage drop in the auto electrical system by using multimeter.
	11.9 Trace the auto electrical components by using vehicle wiring circuits.

	11.10 Check the condition of the solenoid switch in the starting system.
	11.11 Determine the forward to reverse resistance ratio of diodes and identify good / bad diodes.
	11.12 Perform battery charging
12. Join components by using Arc & Gas welding.	12.1. Determine the principles, process of different welding process applicable in automobile industry.
	12.2. Demonstrate the edge preparation for butt and fillets welds.
	12.3. Select the type and size of filler rod and flux/electrode, size of nozzle and gas pressure/welding current, preheating method and temperature as per requirement.
	12.4. Set and tack metals as per drawing.
	12.5. Deposit the weld maintaining appropriate technique and safety aspects.
	12.6. Cool the welded joint by observing appropriate cooling method. Use post heating, peening etc. as per requirement.
	12.7. Clean the joint and inspect the weld for its uniformity and different types of surface defects.
13. Check & Interpret Vehicle Specification data and VIN. Select & operate various Service Station Equipments	13. 1 Identify of different type of vehicle.
	13. 2 Identify the different vehicle specification data and information
	13. 3 Demonstrate the garage, service station different equipment
14. Dismantle & assemble of Engine from vehicle (LMV/HMV) along with other accessories	14.1 Demonstrate safe handling of lifting equipments.
	14.2 Identify the problems in the vehicle
	14.3 Perform the periodic testing of lifting equipments.
	14.4 Judge whether this Engine needs overhaul or not
	14.5 Perform dispose the used engine oil and safety measures in disposal.
	14.6 Perform on vehicle Engine Tests to analyze need of Overall
	14.7 Perform sequencing and identifying parts at the time of dismantle and assemble.
	14.8 Then Dismantle of Engine & Overhaul is ok, refer below attached screen shot for your reference

15. Overhaul Engine and check functionality	15. 1 Remove accessories fitted to the engine prior to engine removal.
	15. 2 Align the left hook of the crane with engine lifting bracket.
	15. 3 Remove the engine mountings
	15. 4 Remove the engine from vehicle.
	15. 5 Mount the engine on the vehicle.
	15. 6 Align and fit the gear box to the engine.
	15. 7 Refit the accessories to the engine.
	15. 8 Set the Timing of the Engine
	15. 9 Overhaul Valve Actuating Mechanism (Hydraulic latch actuator).
16. Trace, Test & Repair Cooling and Lubrication System of engine	16.1 Overhauling of Radiator/ Recovery tank water pump, oil pump, air cleaner
	16.2 Check the engine oil pressure at different r.p.ms.
	16.3 Overhaul the Oil Pump.
	16.4 Set Checking &Top up coolant, Draining & refilling coolant.
	16.5 Testing cooling system pressure & Thermostat
	16.6 Cleaning & reverse flushing. Overhauling water pump and refitting and repairs to oil flow pipe lines and unions if necessary.
	16.7 Check proper functioning of radiator fan (Mechanical/ Electrical / viscous / belt drive).
17. Trace & Test Intake and Exhaust system of engine	17.1 Overhauling of manifolds, silencer and tail pipe, air compressor, air exhauster and inspect parts of air exhauster, turbo charger from vehicle.
	17.2 Overhauling of air filter, clean & refit air cooler, fuel filter assembly and replace filter elements
	17.3 Remove and replace EGR valve, Use Smoke meter to test emission from engine.
18. Service Fuel System and check proper functionality	18.1 Overhauling fuel feed pump, fuel injector pump.
	18.2 Test injectors, check the injection timing by the spill cut off method
19. Test Engine Performance	19.1 Start engine, adjust idling speed.

and set idling speed	19.2 Overhaul the Governor (Mechanical & Pneumatic)
	19.3 Set the Engine Timing.
	19.4 Check performance of engine off load.
	19.5 Servicing of the cylinder and replace the defective parts.
20. Monitor emission of vehicle and execute different operation to obtain optimum pollution as per emission norms.	20.1 Check vacuum pump for its functioning.
	20.2 Perform troubleshooting of EVAP Canister.
	20.3 Inspect PCV hose, inspect PCV Valve and check for vacuum.
	20.4 Clean the PCV valve and replace if required.
	20.5 Inspect & clean EGR.
21. Carryout overhauling of Alternator and Starter Motor.	21.1 Trace the circuit from the alternator to the battery.
	21.2 Perform servicing of starter motor.
	21.3 Perform servicing of alternator and test its performance.
	21.4 Check belt condition and replace as per requirement.
22. Diagnose & rectify the defects in LMV/HMV to ensure functionality of vehicle.	22.1 Plan and diagnose the problem if engine not starting.
	22.2 Diagnose high fuel consumption and engine overheating.
	22.3 Diagnose for excessive oil consumption and low/high engine oil pressure.
	22.4 Diagnose for abnormal engine noise.
	22.5 Diagnose for engine's poor performance.
SECOND YEAR	
23. Plan & perform maintenance, diagnosis and servicing of transmission system	23.1 Select and wear suitable personal protective equipment and use vehicle coverings throughout all removal and replacement activities.
	23.2 Work in compliance with standard safety norms
	23.3 Carry out their removal and replacement activities by reviewing: • Vehicle technical data • Removal and replacement procedure • Legal requirements
	23.4 Use technical information to support the overhauling

		of light vehicle/Heavy Vehicle transmission units.
	23.5	Select tools and materials for the job and make this available for use in a timely manner.
	23.6	Use the tools and equipment in the way specified by manufacturers to overhaul light vehicle/Heavy vehicle transmission unit.
	23.7	Ascertain the assessment of the dismantled unit identifies accurately its condition and suitability for overhaul
	23.8	Conduct appropriate and target oriented discussions with higher authority and within the team, where an overhaul is uneconomic or unsatisfactory to perform
	23.9	Perform all overhauling of light vehicle transmission units, adhering to the specifications and tolerances for the vehicle and following: a. Manufacturer's approved overhauling methods b. Standard repair methods c. health and safety requirements. d. workplace procedures Range: a. Gear box b. Single plate clutch assembly c. Diaphragm clutch assembly d. Constant mesh Gear box e. synchromesh gear box f. Gear linkages g. Propeller shaft h. Universal Slip Joint i. Rear axle assembly j. Differential assembly
	23.10	Use testing methods that comply with the manufacturer's requirements.
	23.11	Adjust the unit's components correctly where necessary to ensure that they operate to meet the vehicle operating requirements.
24. Plan & perform maintenance, diagnosis	24.1	Select and wear suitable personal protective equipment and use vehicle coverings throughout all

and servicing of Vehicle Control System	removal and replacement activities. Work in compliance with standard safety norms.
	24.2 Work in compliance with standard safety norms.
	24.3 Use technical information to support the overhauling of light vehicle/Heavy Vehicle steering and suspension system
	24.4 Carryout their removal and replacement activities by reviewing: • Vehicle technical data • Removal and replacement procedures • Legal requirements
	24.5 Use the tools and equipment in the way specified by manufacturers to overhaul steering, suspension and braking system
	24.6 Ascertain the assessment of the dismantled unit identifies accurately its condition and suitability for overhaul
	24.7 Perform all overhauling of light vehicle Chassis units, adhering to the specifications and tolerances for the vehicle and following: a. The manufacturer's approved overhauling methods b. Standard repair methods c. health and safety requirements. d. workplace procedures Range: a) Shackle b) Leaf spring c) Front axle d) Front and rear suspension e) Steering Gearbox- worm and roller type f) Steering Gearbox- Reticulating ball type g) Master cylinder h) Tandem Master cylinder i) Front and rear brake j) Wheel cylinder k) Vacuum booster l) Air servo unit m) Air tank (reservoir)

	n) Brake valve o) Hand/parking brake p) Single brake chamber q) Slack adjuster r) Disc brake
	24.8 Carry out wheel balancing to within acceptable limits
	24.9 Carryout the recommended trouble shooting procedure as per Workshop manual for a) Abnormal wear b) Wheel wobbling c) Poor self centering d) Hard steering
	24.10 Rectify the defects following the vehicle manufacture standard procedure
	24.11 Use testing methods that comply with the manufacturer's requirements
	24.12 Adjust the unit's components correctly where necessary to ensure that they operate to meet the vehicle operating requirements.
	24.13 Ensure replaced driveline units and assemblies conform to the vehicle operating specification and any legal requirements
25. Troubleshoot vehicle Engine components and ascertain repair	31.25 Carryout the recommended trouble shooting procedure as per Workshop manual for a) Engine Not starting – Mechanical & Electrical causes, b) Engine Noise. c) High fuel consumption, d) Engine overheating, e) Low Power Generation, f) Excessive oil consumption, g) Low/High Engine Oil Pressure,
	31.26 Rectify the defects following the vehicle manufacture standard procedure.
26. Plan & service Electronic Control System and check functionality.	26.1 Identify the MPFI components by its name and Locate the MPFI Components in the given engine
	26.2 Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	26.3 Plan work in compliance with standard safety norms.

		26.4	Connect the scan tool to the Data link connector of given engine
		26.5	Read the Error code
		26.6	Test the reference voltage and continuity of the circuit as per vehicle wiring circuit
		26.7	Repair/Replace the defective part or wiring
		26.8	Erase the error memory
		26.9	Start and check the engine
27.	Diagnose & rectify the defects in vehicle to ensure functionality of vehicle	27.1	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
		27.2	Plan work in compliance with standard safety norms.
		27.3	Troubleshoot the Engine for Engine Crank but will not start
		27.4	Check Ignition Timing of Engine.
		27.5	Check the function of Mal Indication Lamp (MIL) ,Oil pressure warning light, charge indication light, Temperature warning light/gauge, Seat belt warning light, ABS warning light, Parking light, fuel level gauge
		27.6	Test the various sensors fitted on the given engine using multi meter/scan tool
28.	Carryout overhauling of charging system	28.1	Check Charging system for proper functioning as per manufacturer guidelines.
		28.2	Check alternator for proper functioning
		28.3	Remove alternator from the vehicle
		28.4	Overhaul and check alternator for proper function
		28.5	Refit Alternator to the vehicle and check for functioning
29.	Carryout overhauling of starting system	29.1	Check starting system for proper functioning as per manufacturer guidelines.
		29.2	Check starter for proper functioning
		29.3	Remove starter from the vehicle.
		29.4	Overhaul and check starter for proper function
		29.5	Refit starter to the vehicle and check for functioning
30.	Troubleshoot electrical components of vehicle and ascertain repair	30.1	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
		30.2	Plan work in compliance with standard safety norms
		30.3	Carryout the diagnostic procedure for the following troubles in the electrical accessories a) No horn, poor horn, continuous horn b) Wiper and washer no operation, continuous operation,

		Intermittent operation c) Power window no operation d) Power Door lock no operation e) Immobilizer system and keyless entry no operation f) Trouble(Error indication) in Automatic seat belt system g) g) Trouble(Error indication) in Air bag system
31.	Overhaul, service and testing Vehicle Air Conditioning system, its parts and check functionality	31.1 Ascertain and select tools and materials for the job and make this available for use in a timely manner.
		31.2 Plan work in compliance with standard safety norms.
		31.3 Carryout the diagnostic procedure for the following troubles a) No cooling b) Intermittent cooling c) Insufficient cooling d) Abnormal noise from compressor, magnetic clutch, condenser, evaporator and blower motor e) High pressure gauge-pressure High and low f) f) Low pressure gauge-pressure High and low
32.	Drive vehicle following Traffic Regulations and maintenance of good road conduct.	32.1 Follow the Road safety measures, Traffic rules and statutory regulations.
		32.2 Practice straight Driving
		32.3 Practice Driving through lanes and curves
		32.4 Practice Reverse Driving
		32.5 Practice Overtaking of another vehicle
		32.6 Practice Driving through sand and wet surface
		32.7 Practice Parking and Diagonal parking

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:

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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.*
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9.1 Workshop Calculation Science & Engineering Drawing:

First Year		
S No.	**Workshop Calculation and Science**	**Engineering Drawing**
1.	**Unit**: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units	Engineering Drawing: Introduction and its importance - Relationship to other technical drawing types - Conventions - Viewing of engineering drawing sheets - Method of Folding of printed Drawing Sheet as per BIS SP:46-2003
2.	**Fractions**: Fractions, Decimal fraction, L.C.M., H.C.F., Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems using Scientific Calculator.	Drawing Instruments: their Standard and uses - Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins/ Clips.
3.	**Square Root**: Square and Square Root, method of finding out square roots, Simple problem using calculator.	Lines: - Definition, types and applications in Drawing as per BIS SP:46-2003 - Classification of lines (Hidden, centre, construction, Extension, Dimension, Section) - Drawing lines of given length (Straight, curved) - Drawing of parallel lines, perpendicular line - Methods of Division of line segment
4.	**Ratio &Proportion**: Simple calculation on related problems.	Drawing of Geometrical Figures: Definition, nomenclature and practice of - Angle: Measurement and its types, method of bisecting. - Triangle-different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.

5.	**Percentage**: Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	Lettering and Numbering as per BIS SP46-2003: - Single Stroke, Double Stroke, inclined, Upper case and Lower case.
6.	**Material Science**: Properties- Physical & Mechanical, Types–Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys.	Dimensioning: - Definition, types and methods of dimensioning (functional, non-functional and auxiliary) - Types of arrowhead - Leader Line with text
7.	**Mass, Weight and Density**: Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals.	Free hand drawing of - Lines, polygons, ellipse, etc. - geometrical figures and blocks with dimension - Transferring measurement from the given object to the free hand sketches.
8.	**Speed and Velocity**: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation, equations of motions, simple related problems.	Sizes and Layout of Drawing Sheets - Basic principle of Sheet Size - Designation of sizes - Selection of sizes - Title Block, its position and content - Borders and Frames (Orientation marks and graduations) - Grid Reference - Item Reference on Drawing Sheet (Item List)
9.	**Work, Power and Energy**: work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.	Method of presentation of Engineering Drawing - Pictorial View - Orthogonal View - Isometric view
10.	-----	Symbolic Representation (as per BIS SP:46-2003) of: - Fastener (Rivets, Bolts and Nuts) - Bars and profile sections

		- Weld, brazed and soldered joints. - Electrical and electronics element - Piping joints and fittings
11.	**Algebra**: Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	Construction of Scales and diagonal scale
12.	**Mensuration:** Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi-circle. Volume of solids – cube, cuboids, cylinder and Sphere. Surface area of solids – cube, cuboids, cylinder and Sphere.	Practice of Lettering and Title Block
13.	**Trigonometry:** Trigonometrical ratios, measurement of angles. Trigonometric tables	Dimensioning practice: - Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003) - Symbols preceding the value of dimension and dimensional tolerance. - Text of dimension of repeated features, equidistance elements, circumferential objects.
14.	**Heat & Temperature**: Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation.	Construction of Geometrical Drawing Figures: - Different Polygons and their values of included angles. Inscribed and circumscribed polygons. - Conic Sections (Ellipse& Parabola)
15.	**Basic Electricity**: Introduction, use of electricity, how electricity is produced, Types of current_ AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Types of connections – series, parallel, electric power, Horse power, energy, unit of	Drawing of Solid figures (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions.

	electrical energy.	
16.	**<u>Levers and Simple Machines</u>:** Levers and its types. Simple Machines, Effort and Load, Mechanical Advantage, Velocity Ratio, Efficiency of machine, Relationship between Efficiency, velocity ratio and Mechanical Advantage.	Free Hand sketch of hand tools and measuring tools used in respective trades.
17.	---	Projections: - Concept of axes plane and quadrant. - Orthographic projections - Method of first angle and third angle projections (definition and difference) - Symbol of 1st angle and 3rd angle projection as per IS specification.
18.	--	Drawing of Orthographic projection from isometric/3D view of blocks
19.	--	Orthographic Drawing of simple fastener (Rivet, Bolts, Nuts & Screw)
20.	--	Drawing details of two simple mating blocks and assembled view.
Second Year		
1.	- Geometrical construction & theorem: division of line segment, parallel lines, similar angles, perpendicular lines, isosceles triangle and right angled triangle.	- Revision of first year topics.
2.	- Area of cut-out regular surfaces: circle and segment and sector of circle.	- Machined components; concept of fillet & chamfer; surface finish symbols.
3.	- Area of irregular surfaces. - Application related to shop problems.	- Screw thread, their standard forms as per BIS, external and internal thread, conventions on the features for drawing as per BIS.
4.	- Volume of cut-out solids: hollow cylinders, frustum of cone, block section. - Volume of simple machine blocks.	- Free hand Sketches for bolts, nuts, screws and other screwed members.

5.	- Material weight and cost problems related to trade.	- Standard rivet forms as per BIS (Six types).
6.	- Finding the value of unknown sides and angles of a triangle by trigonometrical method.	- Riveted joints-Butt & Lap (Drawing one for each type).
7.	- Finding height and distance by trigonometry.	- Orthogonal views of keys of different types
8.	- Application of trigonometry in shop problems. (viz. taper angle calculation).	- Free hand sketches for simple pipe, unions with simple pipe line drawings.
9.	- Forces definition. - Compressive, tensile, shear forces and simple problems. -Stress, strain, ultimate strength, factor of safety. -Basic study of stress-strain curve for MS.	- Concept of preparation of assembly drawing and detailing. Preparation of simple assemblies & their details of trade related tools/job/exercises with the dimensions from the given sample or models.
10.	- Temperature measuring instruments. Specific heats of solids & liquids.	-Free hand sketch of trade related components/ parts (viz., single tool post for the lathe, etc.)
11.	- Thermal Conductivity, Heat loss and heat gain.	- Study of assembled views of Vee-blocks with clamps.
12.	- Average Velocity, Acceleration & Retardation. - Related problems.	- Study of assembled views of shaft and pulley.
13.	- Circular Motion: Relation between circular motion and Linear motion, Centrifugal force, Centripetal force	- Study of assembled views of bush bearing.
14.	--	- Study of assembled views of a simple coupling.
15.	--	- Free hand sketching of different gear wheels and nomenclature.
16.	**Graph:** - Read images, graphs, diagrams -bar chart, pie chart. - Graphs: abscissa and ordinates, graphs of straight line, related to two sets of varying quantities.	- Free hand details and assembly of simple bench vice.
17.	Simple problem on Statistics: - Frequency distribution table - Calculation of Mean value. - Examples on mass scale productions. -Cumulative frequency -Arithmetic mean	- Reading of drawing. Simple exercises related to missing lines, dimensions. How to make queries.

18.	Acceptance of lot by sampling method (within specified limit size) with simple examples (not more than 20 samples).	- Simple exercises relating missing symbols. - Missing views
194.	- Friction- co-efficient of friction, application and effects of friction in Workshop practice. **Centre of gravity** and its practical application.	- Simple exercises related to missing section.
20.	- Magnetic substances- natural and artificial magnets. - Method of magnetization. Use of magnets.	-Free hand sketching of different types of bearings and its conventional representation.
21.	- Electrical insulating materials. - Basic concept of earthing.	- Solution of NCVT test. - Simple exercises related to trade related symbols. - Basic electrical and electronic symbols.
22.	- Transmission of power by belt, pulleys & gear drive. - Calculation of Transmission of power by belt pulley and gear drive.	- Study of drawing & estimation of materials.
23.	- Heat treatment and advantages.	- Solution of NCVT test papers.
24.	Concept of pressure – units of pressure, atmospheric pressure, absolute pressure, gauge pressure – gauges used for measuring pressure.	
25.	Introduction to pneumatics & hydraulics systems.	

9.2 EMPLOYABILITY SKILLS:

CORE SKILL – EMPLOYABILITY SKILL	
First Year	
1. English Literacy	**Duration : 20 hrs** **Marks : 09**
Pronunciation	Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)
Functional Grammar	Transformation of sentences, voice change, change of tense, spellings.
Reading	Reading and understanding simple sentences about self, work and environment
Writing	Construction of simple sentences writing simple English
Speaking/ Spoken English	Speaking with preparation on self, on family, on friends/ classmates, on known people, picture reading, gain confidence through role-playing and discussions on current happening, job description, asking about someone's job, habitual actions. Cardinal (fundamental) numbers ordinal numbers. Taking messages, passing on messages and filling in message forms, greeting and introductions, office hospitality, resumes or curriculum vitae essential parts, letters of application reference to previous communication.
2. IT Literacy	**Duration : 20 hrs** **Marks : 09**
Basics of Computer	Introduction, computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down computer.
Computer Operating System	Basics of Operating System, WINDOWS, User interface of Windows OS, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc., Use of common applications.
Word Processing and Worksheet	Basic operating of Word Processing, Creating, opening and closing documents, Use of shortcuts, Creating and Editing Text, Formatting the text, Insertion & creation of tables. Printing document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets.
Computer Networking and Internet	Basic of computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks), Meaning of World Wide Web (WWW), Web browser, Website, Web

	page and Search Engines. Accessing the Internet using web browser, Downloading and printing web pages, Opening an email account and use of email. Social media sites and its implication. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cybercrimes.
3. Communication Skills	**Duration : 15 hrs** **Marks : 07**
Introduction to Communication Skills	Communication and its importance Principles of effective communication Types of communication - verbal, non-verbal, written, email, talking on phone. Non-verbal communication- characteristics, components-Para-language Body language Barriers to communication and dealing with barriers. Handling nervousness/ discomfort.
Listening Skills	Listening-hearing and listening, effective listening, barriers to effective listening, guidelines for effective listening. Triple- A Listening - Attitude, Attention & Adjustment. Active listening skills.
Motivational Training	Characteristics essential to achieving success. The power of positive attitude. Self-awareness Importance of commitment Ethics and values Ways to motivate oneself. Personal goal setting and employability planning.
Facing Interviews	Manners, etiquettes, dress code for an interview. Do's & Don'ts for an interview.
Behavioral Skills	Problem solving, confidence building, attitude.
4. Entrepreneurship Skills	**Duration : 15 hrs** **Marks : 06**
Concept of Entrepreneurship	Entrepreneur - Entrepreneurship - Enterprises: Conceptual issue Entrepreneurship vs. management, Entrepreneurial motivation. Performance & Record, Role & Function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, and the process of setting up a business.

Project Preparation & Marketing Analysis	Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of PLC, Sales & distribution management. Difference between small scale & large scale business, Market survey, Method of marketing, Publicity and advertisement, Marketing mix.
Institution's Support	Preparation of project. Role of various schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non-financing support agencies to familiarize with the Policies/ Programmes & procedure & the available scheme.
Investment Procurement	Project formation, feasibility, Legal formalities i.e., Shop Act, Estimation & costing, Investment procedure - Loan procurement - Banking processes.
5. Productivity	**Duration : 10 hrs** **Marks : 05**
Benefits	Personal/ Workman - Incentive, Production linked Bonus, Improvement in living standard.
Affecting Factors	Skills, Working Aids, Automation, Environment, Motivation - How it improves or slows down productivity.
Comparison with Developed Countries	Comparative productivity in developed countries (viz. Germany, Japan and Australia) in selected industries e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages.
Personal Finance Management	Banking processes, Handling ATM, KYC registration, Safe cash handling, Personal risk and insurance.
6. Occupational Safety, Health and Environment Education	**Duration : 15 hrs** **Marks : 06**
Safety & Health	Introduction to occupational safety and health importance of safety and health at workplace.
Occupational Hazards	Basic Hazards, Chemical Hazards, Vibroacoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygiene, Occupational Diseases/ Disorders & its prevention.
Accident & Safety	Basic principles for protective equipment. Accident prevention techniques - control of accidents and safety measures.
First-Aid	Care of injured & sick at the workplaces, First-Aid & Transportation of sick person.
Basic Provisions	Idea of basic provision legislation of India.

	Safety, health, welfare under legislative of India.
Ecosystem	Introduction to Environment. Relationship between society and environment, Ecosystem and factors causing imbalance.
Pollution	Pollution and pollutants including liquid, gaseous, solid and hazardous waste.
Energy Conservation	Conservation of energy, re-use and recycle.
Global Warming	Global warming, climate change and Ozone layer depletion.
Ground Water	Hydrological cycle, Ground and surface water, Conservation and Harvesting of water.
Environment	Right attitude towards environment, Maintenance of in-house environment.
7. Labour Welfare Legislation	**Duration : 05 hrs** **Marks : 03**
Welfare Acts	Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's Compensation Act.
8. Quality Tools	**Duration : 10 hrs** **Marks : 05**
Quality Consciousness	Meaning of quality, Quality characteristic.
Quality Circles	Definition, Advantage of small group activity, Objectives of quality circle, Roles and function of quality circles in organization, Operation of quality circle. Approaches to starting quality circles, Steps for continuation quality circles.
Quality Management System	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.
House Keeping	Purpose of House-keeping, practice of good housekeeping.
Quality Tools	Basic quality tools with a few examples.

LIST OF TOOLS AND EQUIPMENT			
MECHANIC MOTOR VEHICLE (For Batch of 20 Candidates)			
S No.	**Name of the Tool & Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1.	Allen Key set of 12 pieces	2mm to 14mm	5+1 Nos.
2.	Calliper inside with spring	15 cm	6 Nos.
3.	Callipers outside with spring	15 cm	6 Nos.
4.	Center Punch.	10 mm. Dia. x 100 mm	6 Nos.
5.	Dividers with spring	15 cm	6 Nos.
6.	Electrician Screw Driver	250mm	6 Nos.
7.	Hammer ball peen with handle	0.5 kg	6 Nos.
8.	Hands file for Second cut flat	20 cm.	6 Nos.
9.	Philips Screw Driver set of 5 pieces	100 mm to 300 mm	6 Nos.
10.	Pliers combination	20 cm.	6 Nos.
11.	Screw driver Blade	20cm.X 9mm.	6 Nos.
12.	Screw driver Blade	30 cm. X 9 mm.	6 Nos.
13.	Scriber	15 cm	6 Nos.
14.	Spanner D.E. set of 12 pieces	6mm to 32mm	6 Nos.
15.	Spanner, ring set of 12	6 to 32 mm. (metric)	6 Nos.
16.	Spanners socket with speed handle, T-bar, ratchet and universal set of 28 pieces with box	up to 32 mm	6 Nos.
17.	Steel rule	30 cm inch and metric	6 Nos.
18.	Steel tool box with lock and key (folding type)	400x200x150 mm	6 Nos.
19.	Wire cutter and stripper		6 Nos.
B. INSTRUMENTS AND GENERAL SHOP OUTFIT			
20.	Adjustable spanner (pipe wrench)	350 mm	2 Nos.
21.	AC alternator slip ring puller	Variable	1 No.
22.	Air blow gun with standard accessories	Trigger operated with interchangeable nozzles	1 No.

23.	Allen Key set of 12 pieces	2mm to 14mm	2 Nos.
24.	Ammeter DC with external shunt	300A/ 60A	4 Nos.
25.	Air ratchet	with standard accessories	2 Nos.
26.	Air impact wrench	with standard accessories.	2 Nos.
27.	Anvil with Stand	50 Kgs	1 No.
28.	Auto Electrical test bench	For checking Dynamo, Alternator & Starter. With minimum2HP AC Motor, Digital Voltmeter & ammeter. Transformer minimum 150A.	1 No.
29.	Battery –charger	Capable to charge batteries from 5AH – 150AH.	2 Nos.
30.	Blow Lamp	1 litre	2 Nos.
31.	Belt Tensioner gauge		1 No.
32.	Car Jet washer with standard accessories	Minimum3 Phase 1HP 1400RPM Motor, 3 Reciprocating Plungers with pressure regulator & gauge. 8m Water hose with pressure adjustable brass nozzle.	1 No.
33.	Chain Pulley Block capacity with tripod stand	3 ton	1 No.
34.	Chisel flat	10 cm	4 Nos.
35.	Circlip pliers Expanding and contracting	15cm and 20cm	4 each
36.	Cleaning tray	45x30 cm.	4 Nos.
37.	Compression testing gauge	suitable for diesel Engine with standard accessories	2 Nos.
38.	Copper bit soldering iron	0.25 Kg	2 Nos.
39.	Cylinder bore gauge capacity	20 to 160 mm	1 No.
40.	Cylinder liner- Dry & wet liner, press fit &slidefit liner		1 each (consumable)
41.	Depth micrometer	0-25mm	1 No.

42.	Dial gauge type 1 Gr. A (complete with clamping devices and with magnetic stand)		1 No.
43.	Different type of Engine Bearing model	10 Different types on board	1 set
44.	Different type of piston model	5 Different Typeson board	1 set
45.	Drift Punch Copper	15 Cm	2 Nos.
46.	Drill twist (various sizes)	1.5 mm to 8 mm by 0.5mm	4 Nos.
47.	Electric Soldering Iron	230 V 60 watts 230 V 25 watts	2 each
48.	Electric testing screw driver		4 Nos.
49.	Engineer's square	Blade size 15 cm	4 Nos.
50.	Engineers stethoscope		1 No.
51.	Feeler gauge 20 blades (metric)		4 Nos.
52.	File flat , bastard	20 cm	4 Nos.
53.	File, half round ,second cut	20 cm	4 Nos.
54.	File, Square second cut	20 cm	4 Nos.
55.	File, Square round	30 cm	4 Nos.
56.	File, triangular , second cut	15 cm	4 Nos.
57.	Files assorted sizes and types including safe edge file (20 No's)		2each
58.	Flat File , second cut	25 cm	4 Nos.
59.	Flat File , bastard	35 cm	4 Nos.
60.	Fuel feed pump for Diesel	Hand operated Plunger Type	1 No.
61.	Fuel injection pump (Diesel) inline	4/6 cylinders RSV Mechanical Pneumatic Governor Type.	1 No.
62.	Fuel injection pump VE pump / Distributor fuel rotary pump (DPC) pumps / along with special tools and accessories		1 each
63.	Grease Gun		2 Nos.
64.	Grease Gun heavy duty trolley type	10 kg capacity	1 No.
65.	Growler		2 Nos.
66.	Hacksaw frame	adjustable 20-30 cm	10 Nos.
67.	Hammer Ball Peen	0.75 Kg	4 Nos.
68.	Hammer Chipping	0.25 Kg	5 Nos.
69.	Hammer copper with handle	1 Kg	4 Nos.
70.	Hammer Mallet		4 Nos.

71.	Hammer Plastic		4 Nos.
72.	Hand operated crimping tool/wire	(i) up to 4mm (ii) up to 10mm	2 each
73.	Hand vice	Up to 37 mm	2 Nos.
74.	Hollow Punch set of seven pieces	6mm to 15mm	2 set
75.	Injector – Multi hole type, Pintle type		4 each
76.	Injector testing set	(Hand tester)	1 No.
77.	Insulated Screw driver	20 cm x 9mm blade	4 Nos.
78.	Insulated Screw driver	30 cm x 9mm blade	4 Nos.
79.	Lifting jack screw	3 ton, 5ton & 20 Ton	1 each
80.	Magneto spanner set with 8 spanners		1 set
81.	Magnifying glass	75mm	2 Nos.
82.	Multimeter digital	LCD Display	5 Nos.
83.	Oil can	0.5/0.25 liter capacity	4 Nos.
84.	Automotive oil pump for dismantling and assembling.		2 Nos.
85.	Outside micrometer	0 to 25 mm	2 Nos.
86.	Outside micrometer	25 to 50 mm	2 Nos.
87.	Outside micrometer	50 to 75 mm	1 No.
88.	Outside micrometer	75 to 100 mm	1 No.
89.	Philips Screw Driver set of 5 pieces (pozidrivandtorx drive)	100 mm to 300 mm	2 Nos.
90.	Piston ring compressor		2 Nos.
91.	Piston Ring expander and remover.		2 Nos.
92.	Piston Ring groove cleaner.		1 No.
93.	Pliers flat nose	15 cm	2 Nos.
94.	Pliers round nose	15 cm	2 Nos.
95.	Pliers side cutting	15 cm	2 Nos.
96.	Portable electric drill Machine	Upto 10mm (heavy duty)	1 Nos.
97.	Prick Punch	15 cm	4 Nos.
98.	Punch Letter 4mm (Number)		2 sets
99.	Radiator cut section-cross flow	Radiator with sectioned side tanks, radiator core.	1 No.
100.	Radiator cut section-down flow	Radiator with sectioned upper & lower tanks, radiator core and cap.	1 No.
101.	Radiator pressure cap	LMV	2 Nos.

102.	Scraper Triangular	25 cm	2 Nos.
103.	Scriber	15 cm	2 Nos.
104.	Scriber with scribing black universal		2 Nos.
105.	Set of stock and dies -Metric		2sets
106.	Sheet Metal Gauge		2 Nos.
107.	Spanner T. flocks for screwing up and up-screwing inaccessible		2 Nos.
108.	Spanner, adjustable	15cm	2 Nos.
109.	Spark plug spanner 14mm x 18mm x Size	Long bit for Alto/800	2 Nos.
110.	Starter motor axial type, pre-engagement type & Co-axial type		1 each
111.	Steel measuring tape in a case	10 meter	2 Nos.
112.	Steel rule 15 cm inch and metric		4 Nos.
113.	Straight edge gauge 2 ft.		2 Nos.
114.	Stud extractor set of 3		2sets
115.	Stud remover with socket handle		1 No.
116.	Surface gauge with dial test indicator plunger type	0.01 mm	4 Nos.
117.	Tachometer (Counting type)		1 No.
118.	Tandem master cylinder with booster		4 Nos.
119.	Thermostat		2 Nos.
120.	Thread pitch gauge Metric		2 Nos.
121.	Timing lighter		2 Nos.
122.	Torque wrenches	5-35 Nm, 12-68 Nm & 50-225 Nm	1 each
123.	Turbocharger cut sectional view	Latest WGT type to show turbine, impeller and compressor wheels.	1 No.
124.	Tyre pressure gauge with holding nipple		2 Nos.
125.	Universal puller for removing pulleys, bearings		1 No.
126.	V' Block 75 x 38 mm pair with Clamps		2 Nos.
127.	Vacuum gauge	0 to 760 mm of Hg.	2 Nos.
128.	Valve Lifter		1 No.
129.	Valve spring compressor universal		1 No.
130.	Vernier calliper	0-300 mm with least count 0.02mm	4 Nos.

131.	Vice grip pliers		2 Nos.
132.	Automotive Water pump for dismantling and assembling		4 Nos.
133.	Wire Gauge (metric)		2 Nos.
134.	Work bench	250 x 120 x 60 cm with 4 vices 12cm Jaw	4 Nos.
135.	Working model of Air Brake Assembly	Two front drum sectioned to show the internal working. Front drum run by hand. Rear brake drum assembly (without drum) with brake shoe & liner, vehicular air compressor, air dryer, different valves, air pressure gauges, Spring break actuator, Stop light, Brake ChamberWith all accessories.	1 No.
136.	Alternator assembly used for LMV	Alternator (>50 Amp)	1 No.
137.	Carburetor – Solex, Mikuny for dismantling and assembling	Solex, Mikuny for dismantling and assembling	1 Each
138.	Chain Pulley Block-3 ton capacity with tripod stand	3 ton capacity with tripod Stand	1 No.
139.	Cut section Model of Mock layout of a motor car –electrical system working model	Wiring with parts and accessories of a car to be arranged according to the electrical circuit of a car. Working of Self-starter, Alternator, Wiper Motor, Horn, lighting system, sparks from plug to be shown with Distributor & battery. Should be mounted on suitable table	1 No.
140.	Cut section models of shock absorbers		1 No.
141.	Cut section of cross ply and radial tyres		1 No.

142.	Cut section working model of automatic transmission Gear box	Sectioned to show the internal mechanism of forward and reverse speeds.	1 No.
143.	Cut section working model of centrifugal clutch assembly.	Centrifugal Clutch sectioned to show the internal details	1 No.
144.	Cut section working model of Diaphragm clutch assembly.	Diaphragm Clutch sectioned to show the internal details	1 No.
145.	Cut section working model of Single plate clutch assembly	Single plate Clutch sectioned to show the internal details	1 No.
146.	Demonstration board of electronic Ignition system, ignition coil	With HT coil, HT wires, Spark Plugs, ignition switch, coil, distributor, battery, and wiring.	1 No.
147.	Demonstration board of MPFI system	With injectors, rail, inlet manifold, throttle body, distributor, ECU, purge valve, sensor, crank pulley, fuel tank module. By rotating the distributor, spark from plugs and spray from injectors with glowing LEDs/any other light can be demonstrated as per firing order of the engine.	1 No.
148.	Disk brake in working condition with caliper assembly with all parts	Exhibiting Brake disc, Caliper assembly, tandem master cylinder, brake hoses, oil bottle, pedal, etc.	1 No.
149.	Drum brake assembly in Working Condition	Brake drum, tandem master cylinder, oil container, brake hose, brake pedal.	1 No.

150.	Front axle (Rzeeppa Joint) with stand for Dismantling and assembly	Rzeppa joint of LMV.	1 No.
151.	Full floating axle and semi-floating axle assembly	Drum & axle casing should be with all components in working condition.	1 No.
152.	Functional/experiment model of different type of sensors.	With Different type of sensors like Throttle Position Sensor, Manifold Absolute Pressure Sensor, Engine Coolant Temperature Sensor, Vehicle Speed Sensor, Oxygen Sensor, Crankshaft Position Sensor, Camshaft Position Sensor, Intake Air Temperature Sensor, Mass Air Flow Sensor, Knock Sensor with ECU.	1 No.
153.	Steering assembly - 1.Rack & pinion, 2.Worm & roller 3. Recirculating ball, 4.Power steering, 5. Electric Assisted Power Steering	1. Rack & Pinion with steering wheel, column, tie rod end. 2. Worm & Roller steering assembly with drop arm. 3. Recirculating Ballsteering with pitman shaft and drop Arm. 4. Hydraulic working power steering with steering wheel, column, flow pipe, hydraulic pump, oil reservoir. 5. Electric Assisted Power Steering with Rack and pinion, Electric Motor and Motor Control Module	1 No.
154.	Synchronous Gear box with stand for Dismantling and assembly	Gearbox with 5 Forward & 1 Reverse Gear.	1 No.

155.	Tandem master cylinder with booster	Working model with TMC & Booster, alternator driven vacuum pump, brake oil reservoir, two brake drums, pedal, hoses.	1 No.
156.	Tubed tyre of car, trucks & motorcycle		1 No.
157.	Tubeless tyre of cars & trucks		1 No.
158.	Tyre& split rim wheel assembly	Commercial Vehicle	1 No.
159.	Working Model of power windows	Showing parts like door, glass with motor and its gear arrangement and operating switch.	1 No.
160.	Working model of torque converter	Model of LMV	1 No.
GENERAL SHOP OUTFIT			
161.	Air conditioned CRDI Vehicle in running condition -LMV	New vehicle with CRDI engine, 04 strokes, 04 cylinders, BS-IV, fitted with air condition.	1 No.
162.	Arbor press hand operated	2 ton capacity	1 No.
163.	Automotive exhaust 5 gas analyser (petrol & Diesel) and Diesel Smokemeter**(OPTIONAL)**	Exhaust 5 Gas Analyzer Petrol ARAI approved to check CO, CO_2, O_2, and HC& NO. Diesel Smoke Meter ARAI approved.	1 No.
164.	Diesel Engine – CRDI - 4 strokefor Dismantling and Assembling with Swiveling Stand.	Latest 4 Stroke 4 cylinder turbo charged CRDI Engine, 1100 -2200cc,with ECM, BCM and sensors, wiring, fuel feed, cooling system, instrument cluster.	1 No.
165.	Diesel engine (Running condition) Stationary type single cylinder	Single Cylinder, OH valves, fuel tank with handle, fuel feed, water cooling, oil	1 No.

		pump.	
166.	Hydraulic jack HI-LIFT type	3 ton capacity, and 5 Ton capacity	1 each
167.	Multi Scan Tool To scan Engine, ABS & EBD, AT, SRS, Body Control and immobilizer	Should perform automotive sensor simulation test specially designed to diagnose and simulate vehicle sensor faults for sensors like MAP sensor, Intake air temperature sensor, TP sensor etc.	1 No.
168.	Spring tension tester	Manually operated with analogue display.	1 No.
169.	Trolley type portable air compressor	Belt driven compressor along with accessories	1 No.
170.	Working Condition of Diesel Engine – CRDI - 4 stroke Engine, Assembly with fault simulation board	Latest 4 Stroke 4 cylinder turbo charged CRDI Engine,1100-2200cc with ECM, BCM and sensors, wiring, fuel feed, cooling system, instrument cluster with Fault setting bank for minimum 8 sensors and with diagnostic socket to read the faults. Engine management circuit diagram to be printed on the panel board.	1 No.
171.	Cut section of 4/6 cylinder diesel engine in moving condition to show movement of internal parts	6 cylinder diesel engine in working condition to show movement of internal parts and glowing LED's/any other light as per firing order with spray from the fuel nozzles.	1 No.
172.	Diesel Engine six Cylinder in running condition	Latest Diesel Engine CRDI 4 Stroke 6 Cylinders, Turbocharged Engine in	1 No.

		running condition. 4500 - 6000 cc.All sensors, wiring, fuel feed, cooling system & instrument cluster	
173.	Air bag simulator	Driver & Co Driver Air Bags, Seat belts with front seats, crash sensors, air bag ECU, Wiring Harness	1 No.
174.	Air conditioning service Unit (Car)	Suitable for R134A. Recovery with vacuum pump, automatic drain & stop after recovery.	1 No.
175.	Four stroke petrol engine with CNG setup-working condition	Latest 4 Stroke 3/4 cylinder MPFI in running condition,1000-1600cc with ECM, BCM and all sensors, wiring, fuel feed system, cooling system, instrument cluster & with CNG/ Petrol selection switch on Panel.Latest CNG kit.	1 No.
176.	Heavy Commercial vehicle	Fitted with Latest 06 cylinder CRDI diesel engine with all parts and accessories. (Without body on frame). Engine Capacity: 4500 - 6000 cm3. Nos. of Cylinders: 6 Inline.	1 No.
177.	MPFI petrol engine with swiveling stand along with special tools for dismantling and assembling	Latest 4 Stroke 3/4 cylinder MPFI in running condition,1000-1600cc with ECM, BCM and all sensors, wiring, fuel feed system, cooling system, instrument cluster	1 No.

178.	Petrol Engine(2-stroke) Motor Cycle/Scooter along with special tools and accessories (Optional) * If not available in market video demonstration may be used to explain working.	Cut Section of 2 Stroke 2 W Engine Single Cylinder	1 No.
179.	Transfer case with stand for Dismantling and assembly.	To show the gear mechanism of forward and reverse speeds.	1 No.
180.	Tube/ tyre vulcanizing machine	220 V , Heater Capacity 400W x 2 With different types of Die &Mould	1 No.
181.	Two post car lift – capacity 4000 kg	Hydraulic Type with Mechanical Arms Locking.	1 No.
182.	Tyre Changer Machine	Motorized Pneumatic Type, Rim clamping facility, and bead breaking facility with air inflating device.	1 No.
183.	Ultrasonic Injection cleaning equipment	Flow analysis & spray pattern test, leak test, auto programming mode, ultrasonic test with timer, Min 1000 ML Lit, SS Tank with Lid, SS Stand.	1 No.
184.	Wheel alignment Machine –computerized 3D (Optional)	Latest machine for four wheel alignment. With connected camera , IR Lighting Source min. 8mm, Reflector metal based, should work in sunlight	1 No.
185.	Wheel balancing machine	For wheel balancing of LMV. Motor 0.5 HP Shaft Diameter min 38mm. Hardened flange assy. Balancing catch nut of metal.	1 No.

186.	Working Condition of Petrol MPFI Engine Assembly with fault simulation board	Latest 4 Stroke 3/4 cylinder MPFI in running condition,1000-1600cc with ECM, BCM and all sensors, wiring, fuel feed system, cooling system, instrument cluster& with Fault setting bank for minimum 6 sensors with diagnostic socket.	1 No.
C. CONSUMABLE			
187.	Battery		As required
188.	Brake fluids		As required
189.	Chalk, Prussian blue		As required
190.	Chemical compound for fasteners		As required
191.	Diesel		As required
192.	Different type gasket material		As required
193.	Different type of oil seal		As required
194.	Drill Twist (assorted)		As required
195.	Emery paper - 36–60 grit , 80–120		As required
196.	Engine oil & Engine coolant		As required
197.	Gear oils		As required
198.	Hacksaw blade (consumable)		As required
199.	Holders, lamp teakwood boards, plug sockets,		As required
200.	Hydrometer		8 Nos.
201.	Lapping abrasives		As required
202.	Petrol		As required
203.	Power steering oil		As required
204.	Radiator Coolants		As required
205.	Safety glasses		As required
206.	Steel wire Brush 50mmx150mm		5 Nos.
D. CLASS ROOM FURNITURE FOR TRADE THEORY			
207.	Instructor's table and Chair (Steel)		1 set
208.	Students chairs with writing pads		20 Nos.
209.	White board size 1200mm X 900 mm		1 No.
210.	Instructors lap top with latest(vista &		1 No.

	above) configuration pre-loaded with operating system. and MS Office package.		
211.	LCD projector with screen.		1 No.
212.	Trainees locker	6½ ‘ x 3’ x 1½’	1 set each (optional)
E. TOOLS & EQUIPMENTS FOR ENGINEERING DRAWING HALL			
213.	Drawing board	(700mm x500 mm) IS: 1444	20+1
214.	Mini drafter		20+1
215.	Set square	celluloid 45^{o} (250 X 1.5 mm)	20+1
216.	Stool for trainees		20+1
217.	Cupboard (big)		1 No.
218.	White Board	8ft. x 4ft.	1 No.
219.	Trainer’s Table		1 No.
220.	Trainer’s Chair		1 No.
221.	Draughtsman drawing instrument box		20+1 Nos.
222.	Draughtsman table		20 Nos.

TOOLS & EQUIPMENT FOR EMPLOYABILITY SKILLS		
S No.	**Name of the Equipment**	**Quantity**
1.	Computer (PC) with latest configurations and Internet connection with standard operating system and standard word processor and worksheet software	10 nos.
2.	UPS - 500VA	10 nos.
3.	Scanner cum Printer	1 no.
4.	Computer Tables	10 nos.
5.	Computer Chairs	20 nos.
6.	LCD Projector	1 no.
7.	White Board 1200mm x 900mm	1 no.
Note: Above Tools & Equipment not required, if Computer LAB is available in the institute.		

ANNEXURE-II

FORMAT FOR INTERNAL ASSESSMENT

Name & Address of the Assessor:		**Year of Enrollment:**
Name & Address of ITI (Govt./Pvt.):		**Date of Assessment:**
Name & Address of the Industry:		**Assessment location: Industry / ITI**
Trade Name:	**Examination:**	**Duration of the Trade/course:**
Learning Outcome:		

S No.	**Candidate Name**	**Father's/Mother's Name**	Safety Consciousness	Workplace Hygiene	Attendance/ Punctuality	Ability to follow Manuals/ Written Instructions	Application of Knowledge	Skills to Handle Tools & Equipment	Economical use of Materials	Speed in Doing Work	Quality in Workmanship	VIVA	**Total Internal Assessment Marks**	**Result (Y/N)**
Maximum Marks (Total 100 Marks)			**15**	**5**	**10**	**5**	**10**	**10**	**5**	**10**	**15**	**15**		
1														
2														