MECHANIC REPAIR & MAINTENANCE OF HEAVY VEHICLES

COMPETENCY BASED CURRICULUM
(Duration: 2 Yrs.)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL- 5

SECTOR – Automobile

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

MECHANIC REPAIR & MAINTENANCE OF HEAVY VEHICLES

(Revised in 2018)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL - 5

Developed By

Ministry of Skill Development and Entrepreneurship
Directorate General of Training
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Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

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1. BACKGROUND

1.1 Apprenticeship Training Scheme under Apprentice Act 1961

The Apprentices Act, 1961 was enacted with the objective of regulating the programme of training of apprentices in the industry by utilizing the facilities available therein for imparting on-the-job training. The Act makes it obligatory for employers in specified industries to engage apprentices in designated trades to impart Apprenticeship Training on the job in industry to school leavers and person having National Trade Certificate (ITI pass-outs) issued by National Council for Vocational Training (NCVT) to develop skilled manpower for the industry**.** There are four categories of apprentices namely**; trade apprentice, graduate, technician and technician (vocational) apprentices.**

Qualifications and period of apprenticeship training of **trade apprentices** vary from trade to trade. The apprenticeship training for trade apprentices consists of basic training followed by practical training. At the end of the training, the apprentices are required to appear in a trade test conducted by NCVT and those successful in the trade tests are awarded the National Apprenticeship Certificate.

The period of apprenticeship training for graduate (engineers), technician (diploma holders and technician (vocational) apprentices is one year. Certificates are awarded on completion of training by the Department of Education, Ministry of Human Resource Development.

1.2 Changes in Industrial Scenario

Recently we have seen huge changes in the Indian industry. The Indian Industry registered an impressive growth during the last decade and half. The number of industries in India have increased manifold in the last fifteen years especially in services and manufacturing sectors. It has been realized that India would become a prosperous and a modern state by raising skill levels, including by engaging a larger proportion of apprentices, will be critical to success; as will stronger collaboration between industry and the trainees to ensure the supply of skilled workforce and drive development through employment. Various initiatives to build up an adequate infrastructure for rapid industrialization and improve the industrial scenario in India have been taken.

1.3 Reformation

The Apprentices Act, 1961 has been amended and brought into effect from 22nd December, 2014 to make it more responsive to industry and youth. Key amendments are as given below:

- Prescription of number of apprentices to be engaged at establishment level instead of trade-wise.
- Establishment can also engage apprentices in optional trades which are not designated, with the discretion of entry level qualification and syllabus.
- Scope has been extended also to non-engineering occupations.
- Establishments have been permitted to outsource basic training in an institute of their choice.
- The burden of compliance on industry has been reduced significantly.

2. TRAINING SYSTEM

2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under 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.

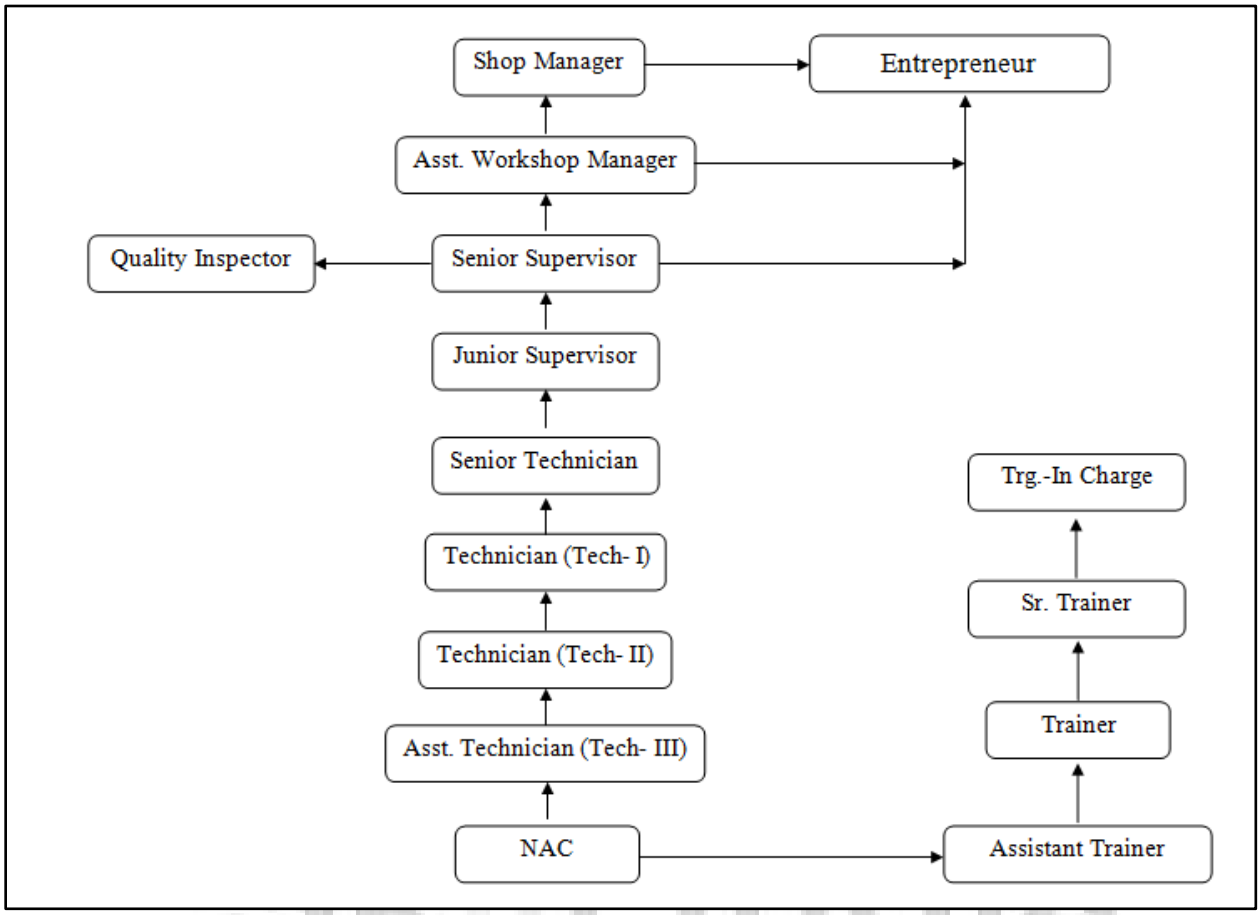
Mechanic Repair & Maintenance of Heavy Vehicles trade under ATS is one of the most popular courses delivered nationwide through different industries. The course is of two years (02 Blocks) duration. It mainly consists of Domain area and Core area. In the Domain area Trade Theory & Practical impart professional - skills and knowledge, while Core area - Workshop Calculation and science, Engineering Drawing and Employability Skills imparts requisite core skills & knowledge and life skills. After passing out the training programme, the trainee is being awarded National Apprenticeship Certificate (NAC) by NCVT having worldwide recognition.

Broadly candidates need to demonstrate that they are able to:

- Read & interpret technical parameters/document, 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 skill, knowledge, core skills & employability skills while performing jobs and solve problem during execution.
- Check the job/assembly as per drawing for functioning, identify and rectify errors in job/assembly.
- Document the technical parameters related to the task undertaken.

2.2 CAREER PROGRESSION PATHWAYS:

- Indicative pathways for vertical mobility.



2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two years (*Basic Training and On-Job Training*) : -

Total training duration details: -

Time (in months)	**1-3**	**4-12**	**13-15**	**16-24**
Basic Training	**Block– I**	**-----**	**Block – II**	**------**
Practical Training (On - job training)	**----**	**Block – I**	**------**	**Block – II**

MECHANIC REPAIR & MAINTENANCE OF HEAVY VEHICLES

A. Basic Training

For 02 yrs. Course (Engg) :-(**Total 06 months:** 03 months in 1st yr. + 03 months in 2nd yr.)
For 01 yr. course (Engg) :-(**Total 03 months:** 03 months in 1st yr.)

S No.	Course Element	Total Notional Training Hours	
		For 02 Yrs. course	**For 01 Yr. course**
1.	Professional Skill (Trade Practical)	550	275
2.	Professional Knowledge (Trade Theory)	240	120
3.	Workshop Calculation & Science	40	20
4.	Engineering Drawing	60	30
5.	Employability Skills	110	55
	Total (Including internal assessment)	**1000**	**500**

B. On-Job Training:-

For 02 yrs. Course (Engg) :-(**Total 18 months:** 09 months in 1st yr. + 09 months in 2nd yr.)

Notional Training Hours for On-Job Training: 3120 Hrs.

For 01 yr. course (Engg) :-(**Total 12 months**)

Notional Training Hours for On-Job Training: 2080 Hrs.

C. Total training hours:-

Duration	**Basic Training**	**On-Job Training**	**Total**
For 02 yrs. course (Engg)	1000 hrs.	3120 hrs.	4120 hrs.
For 01 yr. course (Engg)	500 hrs.	2080 hrs.	2580 hrs.

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 Govt of India from time to time. The Employability skills will be tested in first two semesters 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 NAC will be conducted by NCVT on completion of course as per 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

The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects 40%. The candidate pass in each subject conducted under all India trade test.

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 team work, avoidance/reduction of scrap/wastage and disposal of scarp/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 semester 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 with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • Below 70% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b) Weightage in the range of above75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • 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/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • 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, Automobile 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 re-bored, liners filled, valve seats refaced, bearings re-metalled etc. as necessary. Repairs or overhauls and assembles engine by performing tasks similar to those of Mechanic Petrol or Diesel Engine such as replacing defective parts, scrapping bearings, grinding valves, setting timing, cleaning injectors, tuning carburettor 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. May assemble complete vehicle from finished components.

Reference NCO:

7231.0100 Mechanic, Automobile

4. NSQF LEVEL COMPLIANCE

NSQF level for Mechanic Repair & Maintenance of Heavy Vehicles trade under ATS: **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 Repair & Maintenance of Heavy Vehicles trade under ATS 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.

5. GENERAL INFORMATION

Name of the Trade	MECHANIC REPAIR & MAINTENANCE OF HEAVY VEHICLES
NCO - 2015	7231.0100 Mechanic, Automobile
NSQF Level	Level – 5
Duration of Apprenticeship Training (Basic Training + On-Job Training)	Two years (02 Blocks each of one year duration).
Duration of Basic Training	a) Block –I : 3 months b) Block – II : 3 months **Total duration of Basic Training: 6 months**
Duration of On-Job Training	a) Block– I: 9 months b) Block–II : 9 months **Total duration of Practical Training: 18 months**
Entry Qualification	Passed 10th class examination under 10+2 system of education or its equivalent.
Selection of Apprenticeship	The apprentices will be selected as per Apprenticeship Act amended time to time.
Instructors Qualification for Basic Training	As per ITI instructors qualifications as amended time to time for the specific trade.
Infrastructure for Basic Training	As per related Trade of ITI
Examination	The internal examination/ assessment will be held on completion of each block. Final examination for all subjects will be held at the end of course and same will be conducted by NCVT.
Rebate to Ex-ITI Trainees	01year
CTS trades eligible for Mechanic Repair & Maintenance of Heavy Vehicles Apprenticeship	Mechanic Repair & Maintenance of Heavy Vehicles

Note:

- *Industry may impart training as per above time schedule for different block, however this is not fixed. The industry may adjust the duration of training considering the fact that all the components under the syllabus must be covered. However the flexibility should be given keeping in view that no safety aspects is compromised.*
- *For imparting Basic Training the industry to tie-up with ITIs having such specific trade and affiliated to NCVT.*

6. LEARNING OUTCOME

6.1 GENERIC LEARNING OUTCOME

The following are minimum broad Common Occupational Skills/Generic Learning Outcome after completion of the Mechanic Repair & Maintenance of Heavy Vehicles course of 02 years duration under ATS.

Block I & II:-

1. Recognize & comply 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

Block – I

1. Repair wiper motors.
2. Trace trouble in the wiper motor circuit and rectify them.
3. Trouble trace in electrical circuits using AVO meter.
4. Overhaul a synchromesh gear box.
5. Overhaul transfer case assembly.
6. Replace universal joint cups and cross in propeller shaft assembly.
7. Identify noise and rectify transmission system.
8. Repair jacks (Mechanical and Hydraulic type).
9. Care and maintenance of air compressor and hydraulic hoist.
10. Care and maintenance of valve refacer, injector tester, spark plug tester and car washer.
11. Care and maintenance of exhaust gas analyzer/smoke tester.
12. Practice use special tools.
13. Use, care and maintenance of vacuum/pressure gauges in diagnosis engine troubles.
14. Preventive maintenance.

Block – II

15. Remove engine from vehicle and observe all safety precautions.
16. Dismantle cylinder head and decarburize.
17. Re-condition valves and valve seats.
18. Remove piston and connecting rod assembly.
19. Dismantle Gudgeon Pins and bushes, Piston rings, cleaning, checking and refitting them. Check main bearing and crank shaft.
20. Overhaul oil pump.
21. Check alignment of connecting rods for twist and bend.
22. Re-assemble piston and connect rod assembly in engine block.
23. Overhaul water pump. Replace hose pipes and check leaks.
24. Maintain lead-acid battery. Charge a battery from a battery charger.
25. Troubleshoot engine.
26. Troubleshoot cooling system, lubrication system and fuel feed system.
27. Practice starting and stopping a diesel engine.
28. Troubleshoot diesel Engine.

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

7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING OUTCOME	
LEARNING OUTCOMES	**ASSESSMENT CRITERIA**
1. Recognize & comply 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 off 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*	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.

calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure]	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.
	3. 4. Read & interpret the signs and symbols for electrical components and AC/DC systems.
	3. 5. Encounter drawings with electrical circuit diagrams and layout diagrams.
4. Select and ascertain measuring instrument and measure dimension of components and record data.	4.1 Select appropriate measuring instruments such as Ammeter, voltmeter, meggar, earth tester etc. (as per tool list).
	4.2 Ascertain the functionality & correctness of the instrument.
	4.3 Measure dimension of the components & record data to analyse the with 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 and 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 recourses 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 familiarizes 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 OUTCOME	
Block-I & II (Section:10 in the competency based curriculum)	
*Assessment Criteria i.e. the standard of performance, for each specific learning outcome mentioned under **block – I & block – II** (section: 10) must ensure that the trainee achieves well developed skill with clear choice of procedure in familiar context. Assessment criteria should broadly cover the aspect of **Planning** (Identify, ascertain, estimate etc.); **Execution** (perform, illustration, demonstration etc. by applying 1) a range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information 2) Knowledge of facts, principles, processes, and general concepts, in a field of work or study 3)Desired Mathematical Skills and some skill of collecting and organizing information, communication) and **Checking / Testing** to ensure functionality during the assessment of each outcome. The assessments parameters must also ascertain that the candidate is responsible for own work and learning and some responsibility for other's work and learning.*	

8. SYLLABUS

BASIC TRAINING (Block – I)

Duration: (03) Three Months

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1	Familiarization with institute, Importance of the trade-Machinery used in Trade. Types of work done by the students in the Institute-shop floor of the Institute. Identify safety equipment their use safety rules to be observed in an Automobiles repair shop. Accident & their causes-up keep of fire extinguishers. Familiarization of the tools and machinery available in the shop. Their use and upkeep, importance of cleanliness of workshop, tools, jacks, trays and horses. Perform general servicing of vehicles washing, cleaning, oiling, greasing and lubrication of vehicle.	Introduction to Central Outer Vehicle Acts & Rules. General introduction to the course-duration of the course & course content. Study of the Syllabus General Rules pertaining to the Institute Facilities available hostel recreation and medical facilities library working hours-time table. Importance of safety & general precautions to be observed in the shop, fire extinguishers used for different types of fire storing & handling of inflammable materials elementary first aid. Different types of Fire Extinguishes used for different types of fires and their location. Fire training & different types of Fire General description of motor vehicles-major assemblies-description location and function of each locking methods and devices used in vehicles hydraulic and screw jacks hydraulic hoist & air compressor- their description & uses.
2	Perform Inspection of under carriage of vehicle. Tightening all loose bolts & nuts, use of hydraulic jacks hoist and horses used in the shop, selecting materials for packings - cutting packings and gaskets, practice in use of locking devices such as lock nuts, cotter and split pins-keys, circlips, lock rings, lock washers, locking using wire and location where they are used. Practice removing wheels from vehicle, dismantling tyres and tubes checking puncture assembling inflating to correct pressure. Rotating the wheels in vehicle minor repairs to wheels and tyres, wheel balancing & alignment.	Description of wheels and tyres-types selection of tyres, ply rating, inflation pressure and carrying capacity, storage of tyres.

	Inspect the frame checking alignment of frame servicing of spring replacing new bushes in shackle pins changing hushes in shock absorbers-cleaning & lubrication of wheel bearings, adjusting wheel bearings.	Frames-description and function common troubles conventional suspension system. Types of leaf springs used different types of shock absorbers. Their description, operation & maintenance.
3-4	Remove king pins and bushes replacing new bushes & plus after removing bushes & rings, lubrication of king pin bushes in the front, independent suspension system. Inspect and overhaul front & rear suspension rear springs, coil spring torsion bars, check up main axle for alignment. Inspect and adjust steering linkages, after replacement of worn parts alignment of steering wheels with respect to front wheel, check and correct toe-in.	Description of different types of independent suspension system, special features in each system maintenance and lubrication of front suspension system. The front axle, description & functions types of steering knuckle arrangement of steering knuckle joint general layout of steering linkages. Description of different types of steering boxes (latest type of steering boxes), special features of each adjustments repair and maintenance of steering and boxes power steering description and its advantages.
5	Inspect and overhaul steering boxes adjusting steering gear backlash, and end play check and adjust toe-in, camber angles checking kingpin angle & caster angle with special gauges. Repairing and Maintenance of Hydraulic Power steering.	Description of Ackerman's angle, caster, camber toe-in and toe-out on turns, purpose and effects of these angles.
6-7	Adjust brake pedal play dismantling wheel break assembly cleaning and inspecting adjusting brake shoes for proper clearances, bleeding hydraulic brakes & Disk brakes. Remove master cylinder, dismantling cleaning and inspection of parts-assembling and testing bleeding the braking system after cleaning the pipelines. Perform dismantling wheel brake assembly removing old lining & fitting new lining on the brake shoe removing, cleaning of brake drums inspecting wheel cylinders & brake drums-fitting new cups and brake hosepipes, re-assembling adjusting wheel bearing ad testing adjusting all 4 wheel brakes.	Arrangement of brakes in cars and trucks-description of hand brakes, its purposes layout of mechanical and hydraulic breaking system in cars. Master cylinders including the tandem master cylinder, special features of each function-common troubles & remedy. Brake lining types of uses relining the brake shoes precautions to be observed wheel cylinders description function and types brake fluids. Description and use types of fluids used.
8	Practice bleeding of vacuum assisted hydraulic brakes removing & refitting of vacuum boosters-repairs to pipelines-adjusting the brakes in vacuum assisted hydraulic brakes.	Description and advantages of vacuum assisted hydraulic brakes - special features - common troubles in vacuum assisted hydraulic brakes.

	Adjust Air brake s-repair to tank unit, air compressor, wheel brake adjuster-locating air leaks in the brake lines and rectifying - general maintenance and care. Practice 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.	Description of air brake system. Major components in Air brake system. Description and purpose of each part - their care and maintenance - troubles in Air brake assembly and their remedy. Brake testing efficiency of brakes braking distance, weight transference during braking a vehicle common trouble in brakes & their remedies. Study about fail-safe brakes.
9	Practice adjusting clutch pedal play-removing gearbox and clutch assembly from Heavy Vehicle. Dismantling clutch assembly, cleaning inspecting parts. Perform removal & 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. Assemble pressure plate adjusting the fingers checking run out of fly wheel and aligning clutch assembly with flywheel.	Lay out of transmission system-description of single plate clutch-different types of clutches used in Vehicles-their description, special features and advantages. Clutch linings types materials used bonded & riveted lining clutch plate constructions, purpose of damper spring precautions while relining a clutch plate. Fluid coupling description operation & advantage of using fluid coupling common troubles and remedy.
10	Perform dismantling cleaning and assembling of gearshift mechanism changing oil in gear box studying gear ratios in the gear box. 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.	Lubrication of gearbox constant mesh gearbox description and advantages. Synchromesh gear box advantages description, operation in different gear positions common trouble and remedy types of synchromesh gearboxes their special features.
11-12	Carryout removing open type propeller shaft from vehicle, removing universal joints cleaning replacing worn out parts, reassembling & refitting to vehicle-special precautions while removing torque tube drive shaft. Practice removing rear brake drums and adjusting the wheel bearings in full floating rear axles & semi floating axles, replacing oil seals in rear axles.	Universal joints and propeller shaft-open and closed type propellers shaft types of universal joints, care and maintenance-constant velocity joints special and advantages. Description and purpose of different types of rear axles special features and advantages in each type lubrication of rear axles-reasons for oil in brake drum.
13	**Assessment/Examination 03days**	

NOTE: -

More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of related industry operations may be shown to the trainees to give a feel of Industry and their future assignment.

MECHANIC REPAIR & MAINTENANCE OF HEAVY VEHICLES

BASIC TRAINING (Block – II)

Duration: (03) Three Months

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1	Remove rear axle assembly from vehicle, dismantling, cleaning, inspecting parts for wear and damage, cutting, packings /gaskets-removing tail pinion and bearings cleaning and inspection of oil-seals and bearings.	Description & functions of final drive assembly-crown wheel and tail pinion hypoid gear, Bevel type and worm & worm wheel and its lubrication descriptions of differential and its principle of operation.
2	Check tooth contact in crown land pinion and adjusting back-lash- assembling the rear axle assembly on vehicles and testing. Troubleshooting in the transmission system of vehicle, detecting noises from clutch, gear box, universal joints and rear axle Assembly.	Description and function of differential gears types tooth contact and backlash, preloading adjustment. Common troubles and their remedy in rear axle assembly.
3	Dismantle unserviceable engine of heavy vehicle-cleaning studying the parts in the engine and reassembling the engine- practice in the use of correct tools and right procedure. Dismantle an unserviceable engine, cleaning of parts in the engine, measuring of cylinder bore-crank pins main journals pistons studying valve-operating mechanism.	Description of internal and external combustion engineers, different types of I.C. engines. Important working parts in the engine, the 4-stroke cycle of operation. Description of valve operating mechanism & valve timing description and function of valve spring guide tappets, valve seals and locks.
4	Practice checking compression pressure & vacuum in a running engine of heavy vehicle dismantling the cylinder - head from the engine, decarbonising the cylinder head, removing the valves, cleaning, and reassembling and adjusting tappets.	Description & function of cylinder block-cylinder head cylinder liners reconditioning of cylinder heads.

5-6	Carryout removing pistons and connecting rods from engine, dismantling, cleaning, inspecting, checking clearances installing rings and pistons pins. Practice removing connecting rod assembly, cleaning & checking bearing clearances, replacing bearing shells, setting correct clearances. Measuring wear in crank pins and main journals in crankshaft. Assemble crankshaft, main bearings, connecting rods and piston assembly in the engine, fitting cylinder head and starting the engine and tuning up engine for smooth slow speed running with the help of using torque wrench, at proper torque & sequence.	Description & functions of different types of pistons & connecting rod attachment, piston rings and piston pins common troubles and remedy. Description & functions of connecting rod. Materials used for connecting rods-big end and main bearings shells piston pins and locking methods of piston-pins crank shaft description function & types common trouble & remedy. Firing order of the different types engine and crankshaft balancing description of the flywheel and its function crankcase and oil sump.
7-8	Check cooling system for overheating cleaning radiators, dismantling, cleaning, assembling and testing water pump, reverse flushing the system and adjusting the fan belt tension. Study the lubrication oil flow system in engine, overhauling oil filters; oil pump and setting the pressure release valve for correct oil pressure maintenance and repairs in the lubrication system in engine. Practice joining wires and soldering forming simple electrical circuits measuring of current, voltage & resistance cleaning and topping up of a lead acid battery testing battery with hydrometer-cell tester, connecting battery to charger. Study different electrical circuits in a heavy vehicle-checking loose open and short circuits.	Engine cooling methods air & water-cooling& coolants radiators, pump, thermostats and fan, their description, function care and maintenance reasons for engine overheating. Need for lubrication of engine parts-friction lubrication oil and its properties, lubrication system types full flow and by pass flow system, components in lubrication system oil filters and pumps, types their special features and uses. Simple electrical circuit, series & parallel, circuits identification of alternating current and direct/current meters insulators conductors types of resistance- ohm's law and its application common electrical terms and symbols primary and secondary cells lead acid battery description construction common troubles and remedy. Description of different electrical circuits in a heavy vehicle.

9-10	Practice removing dynamo alternators from vehicle, dismantling cleaning, checking for defects, assembling and testing for motoring action of dynamo & fitting to vehicles. Study electrical circuit in the engine assembly. Check loose open and short circuits cleaning and testing spark plugs overhauling of distributor assembly checking and setting ignition timing. Remove starter motor from vehicle and overhaul the starter motor testing of starter motor. Carryout practice on unserviceable diesel engine- removing jammed nuts, broken studs and reconditioning damaged threaded holes-removing cylinder head connecting rods, and pistons cleaning, inspecting and refitting them Practice starting & stopping of vehicle engines, general maintenance of engines-checking oil, fuel, water levels and accessories of diesel engines. Working of each components used in CNG engine.	Description of charging circuit operation of dynamo alternatives 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. History & Development of compression ignition engines classification of C.I. Engine Advantages and disadvantages over petrol engines, constructional details of single and multi-cylinder engines. The four stroke and two stroke diesels-Engine-unit-flow and loop scavenging constant volume cycles the diesel cycle, indicator-diagrams. Study about various components used in conversion of Diesel Engine to CNG Engine.

11-12	Bleed fuel lines for air locks repairing fuel leaks in the pipelines and unions cleaning of oil and air filters in diesel engines. Clean and service primary fuel filters and pressure stage filters, removing feed pump dismantling cleaning, reassembling, refitting and testing the feed pump. Dismantle an unserviceable fuel injection pump, cleaning inspecting, studying parts and reassembling. Removing F.I. pumps from running engine changing oil and fitting back to engine, testing the governor & setting injection timing. Start and adjust the slow speed of the engine. Test injectors for missing on the vehicle removing dismantling, cleaning, inspecting replacing defective parts reassembling the injectors and testing them. Demonste retrofitting of vehicles CNG & LPG system Euro II, III, IV,	Fuel used in diesel engines, specification of diesel fuels, and importance of clean fuel, Air fuel ratio, and general layout of the fuel feed system in diesel engines. Types of CRDI system fuel injection systems air injection & airless injection fuel feed pumps description, operation-common troubles and remedy. Fuel injection pumps description & operation types adjustments in the pumps phasing and calibration of pumps checking and fixing injection-timing governors types their description and operation starting and adjusting slow speed. Injector nozzles types description, operation testing of injector's special features of pintle nozzles. Emission standard, Catalytic converter, noise pollution, Battery operated vehicle, Hybrid vehicle
13	**Assessment/Examination 03 days**	

NOTE: -

- *More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of related industry operations may be shown to the trainees to give a feel of Industry and their future assignment.*

9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERING DRAWING

Block – I		
Sl. No.	**Workshop Calculation and Science (Duration: - 20 hrs.)**	**Engineering Drawing (Duration : - 30 hrs.)**
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** - Viewing of engineering drawing sheets. - Method of Folding of printed Drawing Sheet as per BIS SP:46-2003
2.	**Fractions**: Common fractions, additions, substation multiplication & Divisions. Applied Workshop problems involving fractions & vulgar fractions.	**Drawing Instruments : their 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.	**Properties of Material** : 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 Alloys.	**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.	**Average :** Problems of Average. **Ratio &Proportion** : Simple calculation on related problems.	**Drawing of Geometrical Figures:** Drawing practice on: - Angle: Measurement and its types, method of bisecting. - Triangle -different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.
5.	**Mass, Weight and Density**: Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of	**Dimensioning:** - Definition, types and methods of dimensioning (functional, non-functional

	density.	and auxiliary) - Types of arrowhead Leader Line with text
6.	**Percentage**: Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	**Free hand drawing of** - Free hand sketching of nuts bolts studs with dimensions from samples. - Free hand sketching of solids and hollow bodies such as square rectangular, cylinder, rings and cones.
7.	- Forces definition. - Definition and example of compressive, tensile, shear forces, axial and tangential forces. Stress, strain, ultimate strength, factor of safety for MS. **Speed and Velocity**: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation.	**Method of presentation of Engineering Drawing** - Pictorial View - Orthogonal View - Isometric view
8.	**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. - Area of cut-out regular surfaces: circle and segment and sector of circle. - Volume of cut-out solids: hollow cylinders, frustum of cone, block section. - Volume of simple solid blocks	**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
9.	**Algebra** : Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables). - Circular Motion: Relation between circular motion and Linear motion, Centrifugal force, Centripetal force.	**Dimensioning practice:** - Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003) - Symbols preceding the value of dimension and dimensional tolerance.
10.	**Work, Power and Energy**: work, unit of work, power, unit of power, Horse power, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.	**Construction of Geometrical Drawing Figures:** - Polygons and their values of included angles. Conic Sections (Ellipse)

11.		**Projections:** - Concept of axes plane and quadrant. - Orthographic projections - Method of first angle and third angle projections (definition and difference) - Explanation of simple orthographic projection 1st angle. Free hand sketching of types and wheels. - Explanation of 3rd angle projection. Free hand sketching of front axle assembly.

Block – II		
Sl. No.	**Workshop Calculation and Science (Duration: - 20 hrs.)**	**Engineering Drawing (Duration : - 30 hrs.)**
1.	Meaning of tenacity, elasticity brittleness, hardness, compressibility and ductility examples of each. Effect of alloying elements and properties of cast iron and steel alloys.	- Views of simple hallow and solids bodies with dimensions sketching of steering linkages. - Free hand sketching of different types of steering boxes
2.	**Friction** and its application in Workshop practice. Meaning of friction examples of useful and wasteful friction in vehicles co efficient of friction-simple problems on friction.	- Free hand sketching of caster, camber, king-pin angle. Ackerman's angle toe-in & toe-out. Free hand sketching of brake wheel cylinders cam adjuster, brake shoe assembly and anchor pins.
3.	**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.	- Reading & interpretation of assembly drawing and detailing. - Free hand sketching of break linings wheel brake assembly sectioned views of master cylinder.
4.	**Basic Electricity**: Introduction, use of electricity, 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 electrical energy. Concept of earthing.	- Reading of drawing. Simple exercises related to missing lines, dimensions and views. How to make queries. - Freehand sketching - the lay out of vacuum assisted. Hydraulic brake system. - Freehand sketching of the lay out of Air brake system and sketching of slacken adjuster.
5.	**Heat treatment** – Necessity, different common types of Heat treatment. Applied problems in force, work-done, energy & power. Applied problems in horsepower calculation of speed ratios in 4-speed gearbox & 5-speed gearbox. Explanation of horse power and indicated horse power electrical equivalent of H P.	- Isometric drawing of simple objects such as squire and rectangular blocks with grooves-keyways. - Isometric view of clutch pedal-clutch release bearing-fork and clutch plate-free hand sketching of clutch assembly. - Free hand sketching of shifter mechanism and hear shift lever. - Free hand sketching of the arrangement of gears inside the sliding mesh gear box in different gear positions. - Simple exercises related to trade related symbols. - Solution of NCVT test papers.
6.	**Graph:**	

	- Read images, graphs, diagrams – bar chart, pie chart. - Graphs: abscissa and ordinates, graphs of straight line, related to two sets of varying quantities.	
7.	**Transmission of power:** By belt, pulleys & gear drive.	
8.	**Concept of pressure** – units of pressure, atmospheric pressure, gauge pressure – gauges used for measuring pressure**.** **Introduction to pneumatics & hydraulics systems.** Solution of NCVT test papers	

9.2 EMPLOYABILITY SKILLS

(DURATION: - 110 HRS.)

Block – I (Duration – 55 hrs.)	
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 know, 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 messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.
2. I.T. Literacy Duration : 20 Hrs.	Marks : 09
Basics of Computer	Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.
Computer Operating System	Basics of Operating System, WINDOWS, The 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 of 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, Web Site, 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 cyber crimes.
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
Block – II **Duration – 55 hrs.**	
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, 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. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.
Institutions 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 familiarizes 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 improves or slows down.
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 hygienic, 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.

10. DETAILS OF COMPETENCIES (ON-JOB TRAINING)

The **competencies/ specific outcomes** on completion of On-Job Training are detailed below: -

Block – I

1. Repair wiper motors.
2. Trace trouble in the wiper motor circuit and rectify them.
3. Trouble trace in electrical circuits using AVO meter.
4. Overhaul a synchromesh gear box.
5. Overhaul transfer case assembly.
6. Replace universal joint cups and cross in propeller shaft assembly.
7. Identify noise and rectify transmission system.
8. Repair jacks (Mechanical and Hydraulic type).
9. Care and maintenance of air compressor and hydraulic hoist.
10. Care and maintenance of valve refacer, injector tester, spark plug tester and car washer.
11. Care and maintenance of exhaust gas analyzer/smoke tester.
12. Practice use special tools.
13. Use, care and maintenance of vacuum/pressure gauges in diagnosis engine troubles.
14. Preventive maintenance.

Block – II

15. Remove engine from vehicle and observe all safety precautions.
16. Dismantle cylinder head and decarburize.
17. Re-condition valves and valve seats.
18. Remove piston and connecting rod assembly.
19. Dismantle Gudgeon Pins and bushes, Piston rings, cleaning, checking and refitting them. Check main bearing and crank shaft.
20. Overhaul oil pump.
21. Check alignment of connecting rods for twist and bend.
22. Re-assemble piston and connect rod assembly in engine block.
23. Overhaul water pump. Replace hose pipes and check leaks.
24. Maintain lead-acid battery. Charge a battery from a battery charger.
25. Troubleshoot engine.
26. Troubleshoot cooling system, lubrication system and fuel feed system.
27. Practice starting and stopping a diesel engine.
28. Troubleshoot diesel Engine.

Note:

1. Industry must ensure that above mentioned competencies are achieved by the trainees during their on job training.

2. In addition to above competencies/ outcomes industry may impart additional training relevant to the specific industry.

ANNEXURE – I

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

MECHANIC REPAIR & MAINTENANCE OF HEAVY VEHICLES			
LIST OF TOOLS AND EQUIPMENT for Basic Training (For 20 Apprentices)			
A. TRAINEES TOOL KIT			
Sl. no.	**Name of the Tool &Equipments**	**Specification**	**Quantity**
1	Rule Steel	30 cm	21 nos.
2	Divider Spring	15 cm	21 nos.
3	Prick Punch	15 cm	21 nos.
4	Chisel cross cut	3X8 cm	21 nos.
5	Hammer Ball Peen	0.5 kg	21 nos.
6	Hammer copper	1 kg with handle	21 nos.
7	Engineering square	15 cm blade	21 nos.
8	Scriber	15 cm	21 nos.
B : INSTRUMENTS & GENERAL SHOP OUTFIT			
9.	Rule Steel	60 cm	1
10.	Rule Steel	100 cm	1
11.	Scriber block Universal		2
12.	Surface Plate	500X500X10 mm	2
13.	Surface Plate high quality steel hardened and tempered	60X60 cm	1
14.	Hacksaw frame adjustable	20X30 cm blade	2
15.	'V Block pair with clamps (for inspection of crankshaft)	75 X 38 mm	2
16.	Punch Hollow	(6, 7, 8, 9, 10.5 and 12 mm set)	2
17.	Punch figure set	3 mm	1
18.	Punch letters set	3 mm	1

19.	Hand vice	37 mm	2
20.	File, flat	35 cm bastard	1
21.	File, flat	25 cm second cut	1
22.	File, flat	20 cm smooth	1
23.	File, flat safe edge	25 cm smooth	1
24.	File, triangular	15 cm second cut	1
25.	File, half round	20 cm second cut	1
26.	File, round	30 cm 2 nd. cut	1
27.	File, square	20 cm second cut	1
28.	Twist Drill,	metric 3 mm to 12 mm (1 mm step)	1
29.	Tape and dies complete set in box B.A., B.S.W., B.S.F & metric with handles		1
30.	Hand reamer, adjustable	10.5 mm to 11.25 mm, 11.25 to 12.75 mm, 12.75 mm to 14.25 mm, and 14.25 mm to 15.75 mm	1
31.	Scraper flat	25 cm	1
32.	Scraper triangular	25 cm	1
33.	Scraper half round	25 cm	1
34.	Sets of Morse socket	MT 0-1, 1-2, and 2-3	1
35.	Set of Garage tools	Piston ring spanner-60 mm to 125 mm double bend, set of pliers, spanners screw drivers, bush removing kit, plug spanners, tapped spanner set, box spanner set, tap and die set-6 to 24 mm, piston ring expander 50 mm to 125 mm, kit for electrician fitter, tool kit for scooter car, steel Punch set, body repair tool kit, circlip pliers, wheel spanner set etc.	1 set
36.	Micrometer outside	25 - 50 mm	1
37.	Micrometer outside	0-25 mm	1
38.	Micrometer outside	50-57 mm	1

39.	Micrometer outside	75 - 100 mm	1
40.	Micrometer inside	50 to 75 mm and 150 mm and 25 mm to 50 mm	1
41.	Vernier Caliper set	250 or 200 mm inside, outside and depth	1
42.	Vernier Height Gauge	stainless steel with fixed based carbide scriber, accuracy 0.02 mm, Ranges - 150 mm with base size 45 X 45 mm and 300 mm with base size 85 X 125 mm	1
43.	Feeler gauge	set of three - 0.01 to 1.00 mm with 10 blades 0.03 to 1.5 mm With 10 blades and 0,5 to 2.5 mm with 10 blades	1
44.	Set of Dial gauge	reading 0.01 mm with range 10 mm, graduation 0-100 mm, Reading 0.01 mm with range 1 mm graduation 0-100 mm as with stock proof Arrangements and tolerance indicators -IS: 2002-1985	1
45.	Dial bore gauge	with dial reading 0.01 mm size 50-160 mm number anvils-11 number of space pins -4 L.C. = 0.001 mm contact point carbide Tip	1
46.	Safety goggles- clear glass (pair)		1
47.	Hammer, planishing		1
48.	Setting hammer		1
49.	Mallet (Wooden)		1
50.	Trammel	30 cm	1
51.	Blow Lamp	0.5 litre	1
52.	Soldering iron	12 watts	1
53.	Soldering iron Copper	125 cm (fire heated)	1
54.	Pliers nose (round and straight)	150 mm and 200 mm each	1
55.	Snip straight straight and bend	250 mm each	1
56.	Mallet		1

57.	Poker		1
58.	Spanners double ended	set of 12 metric sizes 6 to 32 mm	1
59.	Spanner offset double ended	set of 7 WAV 3 mm to 13.5 mm	1
60.	Double open-ended ignition spanner set	of BA-OXlto 8X9 set of file	1
61.	Spanner Clyburn	15 cm	1
62.	Spanners adjustable	20 cm	1
63.	Spanner Ring off	set of 6 (SAE)	1
64.	Spanner for spark plug	14 mm	1
65.	Magneto spanner	set of 8 spanners	1
66.	Turbo charger or Super changer		2
67.	Spanner socket set (complete set)	6-32 mm sockets	2
68.	Spanner T. Flocks for screwing up and unscrewing in inaccessible position		1
69.	Double open ended Tappet spanner set.	10.5 mm X 12 mm tol0.5 mm to 18 mm set of four	1
70.	Drift copper	10 mm dia. X 150 mm	1
71.	Paraffin pressure gun		1
72.	Grease Pressure Gun		1
73.	Chain Pulley Block	1 ton capacity	1
74.	Tray cleaning	45 X 30 cm	1
75.	Drilling machine (bench)	12 mm dia	1
76.	Oil can	0.5 litre	1
77.	Lifter, Valve spring		1
78.	Tool, Valve grinding, suction type (consumable tool)		1
79.	Valve seat cutting tools complete with Guides and Pilot bar (all angles) in Box		1
80.	Extractor, Stud EZY out type		1
81.	Compression gauge	17.6 kg/Sq cm	1

82.	Stone, Carborandum	15 X 5 X 3.75 cm rough and smooth	1
83.	Cylinder Dial Gauge		1
84.	Ring expander and remover		1
85.	Torque wrench	0-67.5 kg/sq. cm	1
86.	Work bench	240 X 120 X75 cm with 4 vices 12.5	1
87.	Lockers with 8 drawers (standard size)		2
88.	Metal rack	180 X 150 X 45 cm	2
89.	Fuel feed pump		2
90.	Fuel infector pumps		2
91.	Carburetor (two different types) each		2
92.	Water Pump and Oil Pump each		1
93.	Filing jig for adjusting the piston ring gap		1
94.	Steel almirah	180 X 90 X 50 cm	1
95.	Black Board		1
96.	Desk or table	90 X 60 cm(for Instructor)	2
97.	Fire Extinguisher		2
98.	Fire buckets with stand		4
99.	Clutches of different types such as cone type, disc type		1
100.	Stator motor axial type, pre-engagement type Co-axial type		1
101.	Infector different types each		2
102.	Battery each	12 Volt (lead acid and alkaline)	2
103.	Chair		1
104.	Distributor assembly		2
105.	Pulley set universal for bearing and buses		1
106.	Hydraulic jack trolley type	5 ton capacity	1
107.	Hydraulic car lift	3 ton capacity X 175 cm lift	1
108.	Hydraulic mobile crane	l ton capacity, above ground level 4 mm, outreach 3.5 mm, IS ; 4573/1982	1

109.	Pulley puller		2
110.	Bearing pulley set (100 to 300 mm, for extracting both outer and inner races, it should be supplied with a box containing, (i) 8 internal extractors, (ii) 2-counter stays, (iii) pulley chuck of capacity, (iv) 2 arm coolers, and (v) slide hammer)	5 to 32 mm capacity 80 to 160 mm	1 1 1 2 set
111.	Piston ring compressor		2
112.	Valve key inserter		1
113.	Connecting rod alignment fixture		1
114.	Valve refacer		1
115.	High rate discharger set and operated		1
116.	A.V.O. meter / Digital Multimeter		1
117.	Injector cleaning kit set		2
118.	Glow plug set		1
119.	Nozzle holder jigs set		1
120.	P.T injector		1
121.	Alternator		1
122.	Cir clip pliers		1
123.	Piston groove cleaner		1
124.	Thread pitch gauge		1
125.	Fillet radius gauge		1
126.	Stud remover		1
127.	Starter test benches		1
128.	High pressure hose pipe	with plain nozzle 2X10 mts.,15 NB size 7 kg/cm. Sq.	1
129.	Spring tension tester		1
130.	Spark plug scope (to check the spark plug in running engine)		1
131.	4- cylinder 4 - stroke diesel engine (in running condition) it should include transmission and clutch assembly		2

132.	Drilling Machine	bench to drill up to 12 mm	1
133.	Dynamo and voltage regulator		1
134.	Growler		1
135.	Battery Charger		1
136.	Timing light		1
137.	Hydrometer		1
138.	Continuity meter		1
139.	Tyre Changer		1
140.	Sound Meter		1
141.	Gas Analyzer		1
142.	Smoke Meter - with Engine r.p.m. & Temp. Sensor		1
143.	4 - gas analyser with temp. & Engine r.p.m. Sensors.		1
C : GENERAL MACHINERY INSTALLATIONS			
144.	Air compressor Pressure gauge (1.5 cfm two stage, compressor, working, pressure 12 kg/cm sq. receiver 250 Its. Motor 5 HP. Complete with switch safety valve, pressure gauge non return valve, air cooled, after cools, inter cooled & air delivering valve & others slandered accessories - motor starter etc.)		1
145.	Gas cutter with acetylene & oxygen gas cylinder		1
146.	Valve grinding & refacing Machine		1
147.	Arbor press & operated	2 ton capacity	1
148.	Morse test apparatus or Diesel Engine (engine with dynamometer & tachometer)		1
149.	Morse test apparatus or Petrol Engine (engine with dynamometer & tachometer)		1
150.	Spark plug cleaner & testing machine with air compressor (bench type with build in dry abrasive air blast to remove conductive deposits a & compression chamber with pressure gauge		1
151.	Operating pressure 8(bar power I phase 50 w) . Armature testing bench (glower) (for teaching armatures of generators, starters motor heated with ammeter).		1
152.	Commentator Checking bench lighting circuit		1
153.	Regulator cutout checking circuit		1

154.	Thermostat Test bench		1
155.	Water pump test bench		1
156.	Radiator pressure test bench		1
157.	Exhaust gas analyzer for petrol engine	(for CO range 0-10% resolution 0.1%. For HC Range 0-10,000 ppm, Resolution 10 ppm)	1
158.	Exhaust gas analyzer	(for diesel engine for CO. Range 0-10% Resolution 0.1%, for HC Range 0-10,000 ppm, Resolution 10 ppm	1
159.	Clutch assembly of any used engine (petrol/ diesel)		1
160.	G-clam or valve spring compressor		
161.	Stock absorber testing bench		1
162.	Air pressure gauge (for checking air pressure in the tyre)		1
163.	Tyre remover/opener (manual type)		1
164.	Tyre remover/opener (pneumatic / hydraulic type)		1
165.	Diesel fuel pump calibrating and phasing machine		1
166.	Brake testing equipment (to test efficiency of vehicle where motion after braking is plotted)		1
167.	Engine compressor gauge (Petrol engine)		2
168.	Engine compressor gauge (Diesel engine)		2
169.	6 - Cylinder 4 -Stroke Diesel Engine		1

MECHANIC REPAIR & MAINTENANCE OF HEAVY VEHICLES

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: MECHANIC REPAIR & MAINTENANCE OF HEAVY VEHICLES

LIST OF TOOLS& EQUIPMENTS FOR -20APPRENTICES

1) **Space Norms** : 45 Sq. m.(For Engineering Drawing)

2) Infrastructure:

A : TRAINEES TOOL KIT:-			
Sl. No.	**Name of the items**	**Specification**	**Quantity**
1.	Four Stroke petrol engine model on polished wooden base		1 no
2.	Model of fuel supply system of diesel engine		1 no
3.	Model of fuel supply system of petrol engine		1 no
4.	Various types of horns		1 each
5.	Demonstration kit for Retrofitting CNG		no
B : Furniture Required			
Sl. No.	**Name of the items**	**Specification**	**Quantity**
1	Discussion Table		1 No.
2	Tool Cabinet		2 Nos.
3	Trainees locker		As per requirement
4	Book shelf (glass panel)		1 No.
5	Storage Rack		2 Nos
6	Storage shelf		2 Nos
7	Computer table		1 No
8	Computer chair		2 Nos
9	Printer table		1 No

10	Online UPS 2KVA		1 No

TOOLS & EQUIPMENTS FOR EMPLOYABILITY SKILLS		
Sl. 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 & Equipments 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 :	**Semester:**		**Duration of the Trade/course:**
Learning Outcome:			

Sl. No	**Maximum Marks (Total 100 Marks)**		**15** Safety consciousness	**5** Workplace hygiene	**10** Attendance/ Punctuality	**5** Ability to follow Manuals/ Written instructions	**10** Application of Knowledge	**10** Skills to handle tools & equipment	**5** Economical use of materials	**10** Speed in doing work	**15** Quality in workmanship	**15** VIVA	**Total internal assessment Marks**	**Result (Y/N)**
	Candidate Name	**Father's/Mother's Name**												
1														
2														