

**SYLLABUS FOR THE TRADE**

**OF**

**MECHANIC REPAIR & MAINTENANCE OF HEAVY VEHICLES  
[Semester Pattern]**

**UNDER  
CRAFTSMAN TRAINING SCHEME (CTS)**

*Designed in– 2013*

*By*

Government of India

**CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE**

Directorate General of Employment & Training

Ministry of Labour & Employment

EN-81, Sector-V, Salt Lake City

Kolkata-700 091

**LIST OF MEMBERS ATTENDED TRADE COMMITTEE MEETING**

| <b>Sl. No.</b> | <b>Name</b>  | <b>Office</b>                       |                 |
|----------------|--|-------------------------------------|-----------------|
| 1              | Sri M.S. Lingaiah, Director                                    | CSTARI, Salt Lake, Kol.             | <b>Chairman</b> |
| 2              | Sri P. K. Roy, Sr. Envr. Engineer                              | W.B.Pollution Control Board         | Member          |
| 3              | Sri T.S. Ramanathan, Dy. Manager<br>(HRD)                      | CSC Ltd. Kolkata                    | Member          |
| 4              | Kashi Nath Karmakar, Sr. Faculty<br><br>Automobile Engineering | G.T.T.I. Sealdah Branch             | Member          |
| 5              | Maj.(Retd) D.K.Ghosh, G.M.                                     | Dewar's Garage Kolkata              | Member          |
| 6              | Mr. Debabrata Halder, Works Manager                            | Rolta Motor (Bajaj Auto)<br>Kolkata | Member          |
| 7              | Sri R. Senthil Kumar, JDT                                      | CSTARS, Salt Lake, Kol.             | Member          |
| 8              | Sri T. Mukhopadhyay, DDT                                       | CSTARS, Salt Lake, Kol.             | Member          |
| 9              | Sri A. Chakraborty, ADT  | -DO-                                | Member          |
| 10             | Sri P.K. Koley, T.O.   | -DO-                                | Member          |
| 11             | Sri A.B. Dhara. T.O.   | -DO-                                | Member          |
| 12             | Sri S.B. Sarder, T.O.  | -DO-                                | Member          |

**List of members attended the Workshop to finalize the syllabus of “MECHANIC REPAIR & MAINTENANCE OF HEAVY VEHICLES” under CTS into held from 6<sup>th</sup> to 10<sup>th</sup> May’2013 at CSTARI, Kolkata.**

| <b>Sl. No.</b> | <b>Name &amp; Designation</b>                             | <b>Organisation</b>                            | <b>Remarks</b> |
|----------------|---|--|----------------|
| 1.             | R.N. Bandyopadhyaya, Director                             | CSTARI, Kolkata-91                             | Chairman       |
| 2.             | K. L. Kuli, Joint Director of Training                    | CSTARI, Kolkata-91                             | Member         |
| 3.             | K. Srinivasa Rao,<br>Joint Director of Training           | CSTARI, Kolkata-91                             | Member         |
| 4.             | L.K. Mukherjee,<br>Deputy Director of Training            | CSTARI, Kolkata-91                             | Member         |
| 5.             | Ashoke Rarhi,<br>Deputy Director of Training              | ATI-EPI, Dehradun                              | Member         |
| 6.             | N. Nath,<br>Assistant Director of Training                | CSTARI, Kolkata-91                             | Member         |
| 7.             | S. Srinivasu,<br>Assistant Director of Training           | ATI-EPI, Hyderabad-13                          | Member         |
| 8.             | Sharanappa,<br>Assistant Director of Training             | ATI-EPI, Hyderabad-13                          | Member         |
| 9.             | Ramakrishne Gowda,<br>Assistant Director of Training      | FTI, Bangalore                                 | Member         |
| 10.            | Goutam Das Modak,<br>Assistant Director of Trg./Principal | RVTI, Kolkata-91                               | Member         |
| 11.            | Venketesh. Ch. , Principal                                | Govt. ITI, Dollygunj, Andaman & Nicobar Island | Member         |
| 12.            | A.K. Ghate, Training Officer                              | ATI, Mumbai                                    | Member         |
| 13.            | V.B. Zumbre, Training Officer                             | ATI, Mumbai                                    | Member         |
| 14.            | P.M. Radhakrishna pillai,<br>Training Officer             | CTI, Chennai-32                                | Member         |
| 15.            | A.Jayaraman, Training officer                             | CTI Chennai-32,                                | Member         |
| 16.            | S. Bandyopadhyay, Training Officer                        | ATI, Kanpur                                    | Member         |
| 17.            | Suriya Kumari .K , Training Officer                       | RVTI, Kolkata-91                               | Member         |
| 18.            | R.K. Bhattacharyya, Training Officer                      | RVTI, Trivandrum                               | Member         |
| 19.            | Vijay Kumar, Training Officer                             | ATI, Ludhiana                                  | Member         |
| 20.            | Anil Kumar, Training Officer                              | ATI, Ludhiana                                  | Member         |
| 21.            | Sunil M.K. Training Officer                               | ATI, Kolkata                                   | Member         |
| 22.            | Devender, Training Officer                                | ATI, Kolkata                                   | Member         |
| 23.            | R. N. Manna, Training Officer                             | CSTARI, Kolkata-91                             | Member         |
| 24.            | Mrs. S. Das, Training Officer                             | CSTARI, Kolkata-91                             | Member         |
| 25.            | Jyoti Balwani, Training Officer                           | RVTI, Kolkata-91                               | Member         |
| 26.            | Pragna H. Ravat, Training Officer                         | RVTI, Kolkata-91                               | Member         |
| 27.            | Sarbojit Neogi, Vocational Instructor                     | RVTI, Kolkata-91                               | Member         |
| 28.            | Nilotpall Saha, Vocational Instructor                     | I.T.I., Berhampore, Murshidabad, (W.B.)        | Member         |
| 29.            | Vijay Kumar, Data Entry Operator                          | RVTI, Kolkata-91                               | Member         |

### GENERAL INFORMATION

1. Name of the Trade : **MECHANIC REPAIR & MAINTENANCE OF HEAVY VEHICLES**
2. N.C.O. Code No. :
3. Duration of Craftsmen Training : 1 year (Two Semester)
4. Power Norms : 6 KW
5. Space Norms : 504 sq. mtr.  
(Vehicle parking in common garage)
6. Entry Qualification : Passed in 10<sup>th</sup> Class Examination & Minimum 18 years of age
7. Unit strength : 16 (No. of Trainees)
8. Instructors Qualification : a) Diploma in Mechanical/Automobile Engg From recognized board of technical education with two years experience in the relevant field with HMV Driving license  
OR  
10<sup>th</sup> Passed + NTC/NAC in the Trade of “ MECHANIC (Heavy Motor Vehicle)” with 3 Years post qualification experience in the relevant field with HMV Driving license  
  
b) Preference will be given to a candidate with Crafts Instructor Certificate (CIC)

\* **Note:** At least one Instructor must have Degree/Diploma in Mechanical/Automobile Engg. when applied for 02 units.

**TRADE: MECHANIC REPAIR & MAINTENANCE OF HEAVY VEHICLES**

**FIRST SEMESTER**

**Semester Code:- MHV;SEM-I**

| <b>Weeks</b> | <b>Trade Practical</b>   | <b>Trade Theory</b>  | <b>Engineering Drawing</b>  | <b>Workshop calculation and Science</b>  |
|--------------|--|--|---|--|
| 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.  | 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.                                  |   |  |
| 2.           | Description of 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. | 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 Extinguishers used for different types of fires and their location. Fire training & different types of Fire | Introduction to Engineering Drawing & Blue print reading. Free hand sketching of straight lines, rectangles, squares and circles. | Common fractions, additions, subtraction multiplication & Divisions. Applied workshop problems involving fractions & vulgar fractions. |
| 3.           | General servicing of vehicles washing, cleaning, oiling, greasing and lubrication of vehicle.  | 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.  | Free hand sketching of nuts bolts studs with dimensions from samples.   | Properties of ferrous & non-ferrous metals and their uses.   |
| 4.           | Inspection of under carriage of vehicle. Tightening all loose  | -do-   | Free hand sketching of solids and hollow  | Brief description of manufacturing   |

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|    | 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. |  | bodies such as square rectangular, cylinder, rings and cones.   | process of steel, copper & aluminum.   |
| 5. | 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.  | Explanation of simple orthographic projection 1 <sup>st</sup> angle. Free hand sketching of tyres and wheels. | Metric system, met weight & measurement units used, conversion from FPS to Metric system & vice versa. |
| 6. | Inspection the frame checking alignment of frame servicing of spring replacing new bushes in shackle pins changing bushes 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. | Exercise in simple orthographic projection.   | Exercise involving metric and FPS units.   |
| 7. | Removing king pins and bushes replacing new bushes & plus after removing bushes & rings, lubrication of king pin bushes in the front, independent suspension system.  | Description of different types of independent suspension system, special features in each system maintenance and lubrication of front suspension system.                                   | Explanation of 3 <sup>rd</sup> angle projection. Free hand sketching of front axle assembly.                  | Shop problems in metric system.  |

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| 8.  | Inspection and overhaul front & rear suspension rear springs, coil spring torsion bars, check up main axle for alignment.   | The front axle, description & functions types of steering knuckle arrangement of steering knuckle joint general layout of steering linkages.  | Views of simple hallow and solids bodies with dimensions sketching of steering linkages.      | Meaning of tenacity, elasticity brittleness, hardness, compressibility and ductility examples of each. |
| 9.  | 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 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. | Free hand sketching of different types of steering boxes                                      | Effect of alloying elements and properties of cast iron and steel alloys.                              |
| 10. | 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.   | Free hand sketching of caster, camber, king-pin angle. Ackerman's angle toe-in & toe-out.     | Problems in steering geometry- calculation of caster, camber.  |
| 11. | Adjusting brake pedal play dismantling wheel break assembly cleaning and inspecting adjusting brake shoes for proper clearances, bleeding hydraulic brakes & Disk brakes.   | Arrangement of brakes in cars and trucks-description of hand brakes, its purposes layout of mechanical and hydraulic breaking system in cars.   | Free hand sketching of break linings wheel brake assembly sectioned views of master cylinder. | Square root of perfect square, square root of whole numbers and decimals relating to braking distance. |
| 12. | Removing master cylinder, dismantling cleaning and inspection of parts- assembling and testing bleeding the   | Master cylinders including the tandem master cylinder, special features of each function- common troubles & remedy.   | -do-  | Simple levers, problems related to as applied to motor vehicles.                                       |

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|     | braking system after cleaning the pipelines.  |   |   |  |
| 13. | 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. | 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.       | Free hand sketching of brake wheel cylinders cam adjuster, brake shoe assembly and anchor pins. | Meaning of friction examples of useful and wasteful friction in vehicles co efficient of friction-simple problems on friction. |
| 14. | 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.   | Freehand sketching - the lay out of vacuum assisted. Hydraulic brake system                     | Properties of matter molecules and atoms-atomic symbols and atomic number, simple chemical formula.                            |
| 15. | Adjusting 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.  | 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. | Freehand sketching of the lay out of Air brake system and sketching of slacken adjuster.        | Definition of mass, unit of force-weight of a body- energy and power.  |
| 16. | 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  | Brake testing efficiency of brakes braking distance, weight transference during braking a vehicle common trouble in brakes & their remedies. Study about fail-safe brakes.                  | Freehand sketching of the lay out of Air brake system and sketching of slacken adjuster.        | Applied problems in force, work done energy and power.   |



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|     | preparing the vehicle for brake certificate.  |   |   |  |
| 17. | -do-  | -do-  | -do-  | -do-   |
| 18. | Adjusting clutch pedal play-removing gearbox and clutch assembly from Heavy Vehicle. Dismantling clutch assembly, cleaning inspecting parts.  | Lay out of transmission system-description of single plate clutch-different types of clutches used in Vehicles-their description, special features and advantages.  | Isometric drawing of simple objects such as squire and rectangular blocks with grooves-keyways.                     | Applied problems in force, work-done, energy & power.  |
| 19. | 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.       | Clutch linings types materials used bonded & riveted lining clutch plate constructions, purpose of damper spring precautions while relining a clutch plate.         | Isometric view of clutch pedal-clutch release bearing-fork and clutch plate-free hand sketching of clutch assembly. | Applied problems in force, work-done, energy & power.  |
| 20. | Assembling of pressure plate adjusting the fingers checking run out of fly wheel and aligning clutch assembly with flywheel.  | Fluid coupling description operation & advantage of using fluid coupling common troubles and remedy.  | - do -  | Applied problems in force, work-done, energy & power.  |
| 21. | Dismantling cleaning and assembling of gearshift mechanism changing oil in gear box studying gear ratios in the gear box.   | Lubrication of gearbox constant mesh gearbox description and advantages.  | Free hand sketching of shifter mechanism and hear shift lever.  | Applied problems in horsepower calculation of speed ratios in 4-speed gearbox & 5-speed gearbox. |
| 22. | 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. | Synchromesh gear box advantages description, operation in different gear positions common trouble and remedy types of synchromesh gearboxes their special features. | Free hand sketching of the arrangement of gears inside the sliding mesh gear box in different gear positions.       | Explanation of horse power and indicated horse power electrical equivalent of H.P.               |

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| 23. | Removing open type propeller shaft from vehicle, removing universal joints cleaning replacing worn out parts, re-assembling & refitting to vehicle-special precautions while removing torque tube drive shaft. | Universal joints and propeller shaft-open and closed type propellers shaft types of universal joints, care and maintenance-constant velocity joints special and advantages. | Use of drawing instruments T-square and drawing boards-construction of simple figures.            | Ratios and proportions, simple problems gear ratios in gearbox & rear axles. |
| 24. | Removing rear brake drums and adjusting the wheel bearings in full floating rear axles & semi floating axles, replacing oil seals in rear axles.   | 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.              | Construction of simple solid figures with dimensions and titles use of different types of scales. | -do-   |
| 25. | <b>Project works / Industrial Visit(Optional)</b>  |   |   |  |
| 26. | <b>Examination</b>   |   |   |  |

**TRADE: MECHANIC REPAIR & MAINTENANCE OF HEAVY VEHICLES**  
**SECOND SEMESTER**  
**Semester Code:- MHV;SEM-II**

| Week No. | Practical  | Trade Theory   | Engineering Drawing   | Workshop calculation and science   |
|----------|--|--|---|--|
| 1        | Removing 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. | Free hand sketching of different types of rear axles.                           | Calculations of areas of square, rectangular, triangles, circles & regular polygons. |
| 2        | Checking tooth contact in crown land pinion and adjusting back-lash-assembling the rear axle assembly on vehicles and testing.   | Description and function of differential gears types tooth contact and back lash, preloading adjustment. Common troubles and their remedy in rear axle assembly.   | Free hand sketching of universal joints, silencer brackets and spring shackles. | Calculations of areas of square, rectangular, triangles, circles & regular polygons. |
| 3        | Trouble shooting 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 back lash, preloading adjustment. Common troubles and their remedy in rear axle assembly.   | Free hand sketching of universal joints, silencer brackets and spring shackles. | -do-   |
| 4        | Dismantling of 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.                                | Description of internal and external combustion engines, different types of I.C. engines. Important working parts in the engine, the 4-stroke cycle of operation.  | Free hand sketching of 4 stroke cycles.   | Calculation of volumes and weight of cubes, hexagonal prisms- shop problems.         |
| 5        | Dismantling an unserviceable engine, cleaning of parts in the engine, measuring of cylinder bore-crank pins main journals  | Description of valve operating mechanism & valve timing description and function of valve spring guide tappets, valve seals and locks.   | Free hand sketching of 4 stroke cycles.   | Calculation of volumes and weight of cubes, hexagonal prisms shop problems.          |

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|   | pistons studying valve-operating mechanism.  |   |   |   |
| 6 | Checking compression pressure & vacuum in a running engine of heavy vehicle dismantling the cylinder - head from the engine, dearbonising 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.  | Drawing of 3 views of stepped, taper & Cylinder blocks in 3 <sup>rd</sup> angle projection. | Calculations of cylinder wear - ovality- taper and compression ratios problems on compression ratios.   |
| 7 | Removing pistons and connecting rods from engine, dismantling, cleaning, inspecting, checking clearances installing rings and pistons pins.  | Description & functions of different types of pistons & connecting rod attachment, piston rings and piston pins common troubles and remedy.   | Drawing of 3 views of stepped, taper & Cylinder blocks in 3 <sup>rd</sup> angle projection. | Center of gravity Examples problems involving center of gravity in vehicles.  |
| 8 | Removing connecting rod assembly, cleaning & checking bearing clearances, replacing bearing shells, setting correct clearances. Measuring wear in crank pins and main journals in crankshaft.  | 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. | Drawing of plan, elevation and side views of tapered hollow objects.                        | Heat and temperature thermometers centigrade & Fahrenheit scales their conversion. Use of temperature measuring instruments their description & uses. |
| 9 | Assembling 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. | Firing order of the different types engine and crankshaft balancing description of the flywheel and its function crankcase and oil sump.  | Drawing of plan, elevation and side views of tapered hollow objects.                        | Heat and temperature thermometers centigrade & Fahrenheit scales their conversion. Use of temperature measuring instruments their description & uses. |

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| 10 | Checking cooling system for overheating cleaning radiators, dismantling, cleaning, assembling and testing water pump, reverse flushing the system and adjusting the fan belt tension.  | Engine cooling methods air & water-cooling& coolants radiators, pump, thermostats and fan, their description, function care and maintenance reasons for engine overheating.  | Drawing the 3 views in 3 <sup>rd</sup> angle projection of curved objects.          | Geometrical Properties of angles, triangles, circles   |
| 11 | Studying 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.                               | 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.   | Free hand sketching of oil filters oil flow circuits oil pumps                      | Geometrical Properties of angles, triangles, circles   |
| 12 | Practice in 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. | 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. | Free hand sketching of electrical symbols and drawing of simple electrical circuits | Electricity and its effects static & dynamic electricity - AC & DC differences.                              |
| 13 | Studying different electrical circuits in a heavy vehicle-checking loose open and short circuits.  | Description of different electrical circuits in a heavy vehicle.   | Free hand sketching of different circuits of a vehicle-sketching the circuits.      | Magnets natural and artificial types poles of magnets Magnetic fields.                                       |
| 14 | Removing dynamo alternators from vehicle, dismantling cleaning, checking for defects, assembling and testing for motoring action of dynamo & fitting to  | Description of charging circuit operation of dynamo alternatives regulator unit ignition warning lamp troubles and remedy in charging system.  | Free hand sketching of charging system.   | Definition of ampere, volt and ohm-units current potential different resistors, ampere, volt ohm, ohm's law. |

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|    | vehicles. Study of wiring harness of 1 or 2 E.C.M. system (Euro - II vehicle), Octane No. & Ucten No. Studying electrical circuit in the engine assembly checking loose open and short circuits cleaning and testing spark plugs overhauling of distributor assembly checking and setting ignition timing. |   |   |   |
| 15 | Removing starter motor from vehicle and overhauling the starter motor testing of starter motor.  | Description of starter motor circuit constructional details of starter motor solenoid switches, common troubles and remedy in starter circuit.  | Sketching starter motor circuit and solenoid switch circuit.            | Calculations based on Ohm's Law.  |
| 16 | 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   | 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.                          | Free hand sketching of combustion chambers of different types.          | Lubricants types special purpose viscosity effects of temperature on viscosity high detergent oil and its applications. |
| 17 | -do-   | -do-  | -do-  | -do-  |
| 18 | Practice in 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.  | 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. | Free hand sketching of four stroke cycles and two stroke cycle engines. | Lubricants types, viscosity and effects of temperature on viscosity high detergent oils and their application.          |

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| 19 | Bleeding fuel lines for air locks repairing fuel leaks in the pipelines and unions cleaning of oil and air filters in diesel engines.   | 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.  | Free hand sketching of diesel fuel feed system and fuel filters. | Gears & belt drives, problems on gear and belt drive.  |
| 20 | Cleaning and servicing of primary fuel filters and pressure stage filters, removing feed pump dismantling cleaning, re-assembling, re-fitting and testing the feed pump.  | Types of CRDI system fuel injection systems air injection & airless injection fuel feed pumps description, operation-common troubles and remedy.   | Free hand sketching of diesel fuel feed system and fuel filters. | Gears and belt drives, problems on gear and belt torque definition its relation to forces on engine mounting, steering gear box and torque wrench. |
| 21 | Dismantling 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 | 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. | Free hand sketching of components from assembly's fuel pumps.    | Inclined plane its uses examples and applied problems.   |
| 22 | do  | do   | do   | do   |
| 23 | Testing injectors for missing on the vehicle removing dismantling, cleaning, inspecting replacing defective parts reassembling the injectors and testing them.  | Injector nozzles types description, operation testing of injector's special features of pintle nozzles.  | Free hand sketching of fuel injectors of different types.        | Screws and screw jacks problems on screw jacks.  |

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| 24 | Demonstrating retrofitting of vehicles CNG & LPG system Euro II, III, IV, | Emission standard, Catalytine converter, noise pollution, Battery operated vehicle, Hy-bride vehicle | Revision | Revision |
| 25 | Revision  |  |          |          |
| 26 | Examination   |  |          |          |

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**TRADE: "MECHANIC HEAVY VEHICLE"****LIST OF TOOLS & EQUIPMNT****A. TRAINEES TOOL KIT FOR 16 TRAINEES +1 INSTRUCTOR**

| Sl. No. | Name of the items              | Qty.    |
|---------|--------------------------------|---------|
| 1       | Rule Steel 30 cm               | 17 nos. |
| 2       | Divider Spring 15 cm           | 17 nos. |
| 3       | Prick Punch 15 cm              | 17 nos. |
| 4       | Chisel cross cut 3X8 cm        | 17 nos. |
| 5.      | Hammer Ball Peen 0.5 kg        | 17 nos. |
| 6.      | Hammer copper 1 kg with handle | 17 nos. |
| 7.      | Engineering square 15 cm blade | 17 nos. |
| 8.      | Scriber 15 cm                  | 17 nos. |

**B. GENERAL MACHINERY SHOP OUT FIT**

|     |  |        |
|-----|--|--------|
| 1.  | Rule Steel 60 cm   | 1no.   |
| 2.  | Rule Steel 100 cm  | 1no.   |
| 3.  | Scriber block Universal  | 2 nos. |
| 4.  | Surface Plate 500X500X10 mm  | 2 nos. |
| 5.  | Surface Plate high quality steel hardened and tempered 60X60 cm  | 1no.   |
| 6.  | Hacksaw frame adjustable 20X30 cm blade  | 2 nos. |
| 7.  | 'V' Block 75 X 38 mm pair with clamps (for inspection of crankshaft)   | 2 nos. |
| 8.  | Punch Hollow (6, 7, 8, 9, 10.5 and 12 mm set)  | 2 nos. |
| 9.  | Punch figure set 3 mm  | 1no.   |
| 10. | Punch letters set 3 mm   | 1no.   |
| 11. | Hand vice 37 mm  | 2 nos. |
| 12. | File, flat 35 cm bastard   | 1no.   |
| 13. | File, flat 25 cm second cut  | 1no.   |
| 14. | File, flat 20 cm smooth  | 1no.   |
| 15. | File, flat safe edge 25 cm smooth  | 1no.   |
| 16. | File, triangular 15 cm second cut  | 1no.   |
| 17. | File, half round 20 cm second cut  | 1no.   |
| 18. | File, round 30 cm 2 nd. cut  | 1no.   |
| 9.  | File, square 20 cm second cut  | 1no.   |
| 10. | Twist Drill, metric 3 mm to 12 mm (1 mm step)  | 1no.   |
| 11. | Tape and dies complete set in box B.A., B.S.W., B.S.F & metric with handles  | 1no.   |
| 28. | 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   | 1no.   |
| 29. | Scraper flat 25 cm   | 1no.   |
| 30. | Scraper triangular 25 cm   | 1no.   |
| 31. | Scraper half round 25 cm   | 1no.   |
| 32. | Sets of Morse socket MT 0-1, 1-2, and 2-3  | 1no.   |
| 33. | Set of Garage tools (Piston ring spanner-60 mm to125 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<br>- 50 mm to 125 mm, kit for electrician fitter, tool kit for scooter car, steel<br>- Punch set, body repair tool kit, circlip pliers, wheel spanner set etc. | 1 set  |

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| 34. | Micrometer outside 25 - 50 mm   | 1no.   |
| 35. | Micrometer outside 0 - 25 mm  | 1no.   |
| 36. | Micrometer outside 50-57 mm   | 1no.   |
| 37. | Micrometer outside 75 - 100 mm  | 1no.   |
| 38. | Micrometer inside 50 to 75 mm and 150 mm and 25 mm to 50 mm   | 1no.   |
| 39. | Vernier Caliper set 250 or 200 mm inside, outside and depth   | 1no.   |
| 40. | 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 no   |
| 41. | 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 no   |
| 42. | 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) | 1no    |
| 43. | 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 no   |
| 44. | Safety goggles- clear glass (pair)  | 1 no   |
| 45. | Hammer, planishing  | 1 no   |
| 46. | Setting hammer  | 1 no   |
| 47. | Mallet (Wooden)   | 1 no   |
| 48. | Trammel 30 cm   | 1 no   |
| 49. | Blow Lamp 0.5 litre   | 1 no   |
| 50. | Soldering iron 12 watts   | 1 no   |
| 51. | Soldering iron Copper 125 cm (fire heated)  | 1 no   |
| 52. | Pliers nose (round and straight) 150 mm and 200 mm each   | 1 no   |
| 53. | Snip straight straight and bend 250 mm each   | 1 no   |
| 54. | Mallet pot  | 1 no   |
| 55. | Poker 1 no  |        |
| 56. | Spanners double ended set of 12 metric sizes 6 to 32 mm   | 1 set  |
| 57. | Spanner offset double ended set of 7 W/W (3 mm to 13.5 mm)  | 1 set  |
| 58. | Double open-ended ignition spanner set (of BA-0X1 to 8X9 set of file)   | 1 set  |
| 59. | Spanner Clyburn 15 cm   | 1 no   |
| 60. | Spanners adjustable 20 cm   | 1no.   |
| 61. | Spanner Ring off-set of 6 (SAE)   | 1no.   |
| 62. | Spanner for sparking plug 14 mm   | 1no.   |
| 63. | Magneto spanner set of 8 spanners   | 1no.   |
| 64. | Turbo changer or Super changer  | 2 nos. |
| 65. | Spanner socket set 6-32 mm sockets (complete set)   | 2 sets |
| 66. | Spanner T.Flocks for screwing up and unscrewing in inaccessible position  | 1      |
| 67. | Double open ended Tappet spanner set(10.5 mm X 12 mm to 10.5 mm to 18 mm set of four).  | 1 set  |
| 68. | Drift copper 10 mm dia. X 150 mm  | 1 no   |
| 69. | Paraffin pressure gun   | 1 no   |
| 70. | Grease Pressure Gun   | 1 no   |
| 71. | Chain Pulley Block - 1 ton capacity   | 1 no   |

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| 72.  | Tray cleaning 45 X 30 cm   | 1 no     |
| 73.  | Drilling machine (bench) 12 mm dia   | 1 no     |
| 74.  | Oil can 0.5 litre  | 1 no     |
| 75.  | Lifter, Valve spring   | 1 no     |
| 76.  | Tool, Valve grinding, suction type (consumable tool)   | 1 no     |
| 77.  | Valve seat cutting tools complete with Guides and Pilot<br>bar (all angles) in Box   | 1 no     |
| 78.  | Extractor, Stud EZY out type   | 1 no     |
| 79.  | Compression gauge to read 17.6 kg/Sq cm  | 1 no     |
| 80.  | Stone, Carborandum 15 X 5 X 3.75 cm rough and smooth   | 1 no     |
| 81.  | Cylinder Dial Gauge  | 1 no     |
| 82.  | Ring expander and remover  | 1 no     |
| 83.  | Torque wrench (0-67.5 kg/sq. cm)   | 1 no     |
| 84.  | Work bench 240 X 120 X75 cm with 4 vices 12.5  | 1 no     |
| 85.  | Lockers with 8 drawers (standard size)   | 2 nos.   |
| 86.  | Metal rack 180 X 150 X 45 cm   | 2 nos.   |
| 87.  | Fuel feet pump   | 2 nos.   |
| 88.  | Fuel infector pumps  | 2 nos.   |
| 89.  | Carburetor (two different types)<br>each   | 2 nos.   |
| 90.  | Water Pump and Oil Pump each   | 1 no     |
| 91.  | Filing jig for adjusting the piston ring gap   | 1 no     |
| 92.  | Steel almirah 180 X 90 X 50 cm   | 1 no     |
| 93.  | Black Board with easel   | 2 nos.   |
| 94.  | Desk or table 90 X 60 cm (for Instructor)  | 1 no     |
| 95.  | Fire Extinguisher  | 1 no     |
| 96.  | Fire buckets with stand  | 4 nos.   |
| 97.  | Clutches of different types such as cone type, disc type   | 1no each |
| 98.  | Stator motor axial type, pre-engagement type Co-axial type   | 1no each |
| 99.  | Infector different types<br>each   | 2 nos.   |
| 100. | Battery 12 Volt (lead acid and alkaline)<br>each   | 2 nos.   |
| 101. | Chair 1 no   |          |
| 102. | Distributor assembly   | 2 nos.   |
| 103. | Pulley set universal for bearing and buses   | 1 no     |
| 104. | Hydraulic jack (trolley type 5 ton capacity)   | 1 no     |
| 105. | Hydraulic car lift (3 ton capacity X 175 cm lift)  | 1 no     |
| 106. | Hydraulic mobile crane (1ton capacity, above ground level 4 mm,<br>out reach 3.5 mm, IS ; 4573/1982  | 1 no     |
| 107. | Pulley puller  | 2 nos.   |
| 108. | Bearing pulley set (100 to 300 mm, for extracting both outer and inner races,<br>it should be supplied with a box containing,(i) 8 internal extractors,<br>(ii) 2-counter stays, (iii) pulley chuck of capacity 5 to 32 mm,<br>(iv) 2 arm coolers, capacity 80 to 160 mm and (v) slide hammer) | 2 set    |
| 109. | Piston ring compressor   | 2 nos.   |
| 110. | Valve key inserter   | 1 no     |
| 111. | Connecting rod alignment fixture   | 1 no     |
| 112. | Valve refacer  | 1 no     |
| 113. | High rate discharger set and operated  | 1 no     |

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| 114. | A.V.O. meter / Digital Multimeter   | 1 no   |
| 115. | Injector cleaning kit set   | 2 nos. |
| 116. | Glow plug set   | 1 no   |
| 117. | Nozzle holder jigs set  | 1 no   |
| 118. | P.T injector  | 1 no   |
| 119. | Alternator  | 1 no   |
| 120. | Cir clip pliers   | 1 no   |
| 121. | Piston groove cleaner   | 1 no   |
| 122. | Thread pitch gauge  | 1 no   |
| 123. | Fillet radius gauge   | 1 no   |
| 124. | stud remover  | 1 no   |
| 125. | Starter test benches  | 1 no   |
| 126. | High pressure hose pipe (with plain nozzle 2X10 mts.,15 NB size 7 kg/cm. Sq.)                                     | 1 no   |
| 127. | Spring tension tester   | 1 no   |
| 128. | Spark plug scope ( to check the spark plug in running engine)   | 1 no   |
| 129. | 4- cylinder 4 – stroke diesel engine<br>(in running condition) it should include transmission and clutch assembly | 2 nos. |
| 130. | Drilling Machine bench to drill up to12 mm  | 1 no   |
| 131. | Dynamo and voltage regulator  | 1 no   |
| 132. | Growler   | 1no    |
| 133. | Battery Charger   | 1 no   |
| 134. | Timing light  | 1 no   |
| 135. | Hydrometer  | 1 no   |
| 136. | Continuity meter  | 1 no   |
| 137. | Tyre Changer  | 1 no   |
| 138. | Sound Meter   | 1 no   |
| 139. | Gas Analyzer  | 1 no   |
| 140. | Smoke Meter – with Engine r.p.m. & Temp. Sensor   | 1 no   |
| 141. | 4 - gas analysis with temp. & Engine r.p.m. Sensors.  | 1 no   |

### C. GENERAL MACHINERY

| Sl.No | ITEMS  | QUANTITY |
|-------|--|----------|
| 1     | Air compressor Pressure gauge (1.5 cfm two stage, compressor, working, pressure 12 kg/cm sq. receiver 250 lts. 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 no     |
| 2.    | Gas cutter with acetylene & oxygen gas cylinder  | 1 no     |
| 3.    | Valve grinding & refacing Machine  | 1 no     |
| 4.    | Arbor press & operated 2 ton capacity  | 1 no     |
| 5.    | Morse test apparatus or Diesel Engine (engine with dynamometer & tachometer)   | 1 no     |
| 6.    | Morse test apparatus or Petrol Engine (engine with dynamometer & tachometer)   | 1 no     |
| 7.    | 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 no     |

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| 8.  | Operating pressure 8( bar power I phase 50 w) . Armature testing bench (glower) (for teaching armatures of generators, starters motor heated with ammeter). | 1 no   |
| 9.  | Commentator Checking bench lighting circuit   | 1 no   |
| 10. | Regulator cutout checking circuit   | 1no    |
| 11. | Thermostat Test bench   | 1 no   |
| 12. | Water pump test bench   | 1 no   |
| 13. | Radiator pressure test bench  | 1 no   |
| 14. | 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 no   |
| 15. | 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 no   |
| 16. | Clutch assembly of any used engine (petrol/ diesel)   | 1 no   |
| 17. | G-clam or valve spring compressor   | 1 no   |
| 18. | Stock absorber testing bench  | 1 no   |
| 19. | Air pressure gauge (for checking air pressure in the tyre)  | 1 no   |
| 20. | Tyre remover/opener (manual type)   | 1 no   |
| 21. | Tyre remover/opener (pneumatic / hydraulic type)  | 1 no   |
| 22. | Diesel fuel pump calibrating and phasing machine  | 1 no   |
| 23. | Brake testing equipment (to test efficiency of vehicle where motion after braking is plotted)   | 1 no   |
| 24. | Engine compressor gauge (Petrol engine)   | 2 nos. |
| 25. | Engine compressor gauge (Diesel engine)   | 2 nos. |
| 26. | 6 - Cylinder 4 -Stroke Diesel Engine  | 1 no   |

#### D. TEACHING AIDS

|    |   |        |
|----|---|--------|
| 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                  | 1 no   |

#### E. WORKSHOP FURNITURE

| Sl. No. | Description              | Quantity                           |
|---------|--------------------------|------------------------------------|
| 1       | Discussion Table         | 1 No.                              |
| 2       | Tool Cabinet             | 2 Nos.                             |
| 3       | Trainees locker          | Required to accommodate 16 lockers |
| 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                               |

**NB. :- The syllabus for the subject of Social Studies is common for all trades.**