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

COMPETENCY BASED CURRICULUM

MECHANIC ELECTRIC VEHICLE

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

SECTOR – AUTOMOTIVE

Directorate General of Training

MECHANIC ELECTRIC VEHICLE

(Engineering Trade)

(Revised in 2024)

Version: 3.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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1. COURSE INFORMATION

During the two-year duration, a candidate is trained on subjects- Professional Skill, Professional Knowledge, and Employability Skills related to job role. In addition to this, a candidate is entrusted to make/do project work and Extra Curricular Activities to build up confidence. The practical skills are imparted in simple to complex manner & simultaneously theory subject is taught in the same fashion to apply cognitive knowledge while executing task.

The content broadly covers various systems and sub systems of vehicle. Repair and Maintenance of various components such as Motors, Motor controller, Battery Pack, Battery Management System, Charging System, Regenerative Braking. The broad components covered under Professional Skill subject are as below:

FIRST YEAR: In this year, the contents cover from safety aspect related to trade, basic fitting operation viz. assembly and disassembly of major components, their understanding of functions related to operation of EV. It covers various systems and sub-systems such as power train, chassis, body engineering systems, Safety System etc and operates garage equipment. It also covers repair, and maintenance of automobile electrical components and general vehicle systems and sub systems. Troubleshoot of electrical components of vehicle and ascertain repair.

The practical training starts with understanding basic instruments, gauges, components of EV. It also covers various systems and sub systems of vehicle, electrical system, tools, motor calculations, electric transmission and propulsion system along with testing, replacing and diagnosing the components related to EV.

SECOND YEAR: In this year, Electric Vehicle components, such as Motor, Motor Controller, Battery Pack, Battery Management System, Charging System, regenerative braking etc. In addition to above comparison of performance of EV and IC engine vehicles is included.

The practical on electric, electronic and EV systems is covered. DC/DC convertor, regenerative braking, HVAC/FATC etc. In addition, EV symbols, switches, control units and communication protocols are covered. Disassemble and assemble various components of EV along with understanding different fasteners and hand tools. And finally, fault finding & breakdown maintenance of related components and systems is done. Then practical's on total repair, testing and diagnosing the systems and related circuits are done. Followed by preventive and breakdown maintenance of associated components.

2. TRAINING SYSTEM

2.1 GENERAL

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

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

Candidates broadly need to demonstrate that they are able to:

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

2.2 PROGRESSION PATHWAYS:

- Can join industry as EV Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can appear in 10+2 examination through National Institute of Open Schooling (NIOS) for acquiring higher secondary certificate and can go further for General/ Technical education.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in

ITIs.

- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE:

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

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
	Total	**1200**	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) of industry opportunity not available the group project is mandatory.

On the Job Training (OJT)/ Group Project	150	150
Optional Courses (10th/ 12th class certificate along with ITI certification or add on short term courses)	240	240

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The Continuous Assessment (Internal) 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 formative assessment template provided on www.bharatskills.gov.in

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

assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

2.4.2 ASSESSMENT GUIDELINE

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

Assessment will be evidence based, comprising some of 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
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examination body. The following marking pattern to be adopted for formative assessment:

Performance Level	Evidence
(a) Mark in the range of 60 -75% to be allotted during assessment	

For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish. • Occasional support in completing the project/job.
(b) Mark in the range of 75%-90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices.	• Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracyachieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish. • Little support in completing the project/job.
(c) Mark 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% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Mechanic Electric Vehicle; repairs overhauls and services motor vehicles to keep them in good running condition. Examines vehicle to ascertain nature and location of defects either by running engine or driving vehicle on road. Dismantles partially or completely defective unit or parts of vehicle such as DC/DC converters, 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. Replaces or repairs defective parts of gear box, rear axle, steering mechanism, Configures BMS with software application, SoC mapping for charging and discharging, Inspecting & testing a battery after charging, safe storage, handle, and dispose of high voltage battery systems, Diagnose, repair, and test high voltage battery systems. Diagnose, repair, and testing of EV battery controls 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.

Maintenance Technician-Service Workshop; maintains and manages tools and equipment used in the workshop.

AC Specialist is responsible for installing, servicing and repairing an air conditioning system of a vehicle. The individual also performs routine maintenance of the various components associated with the air-conditioning system of the vehicle.

Fitter Automobile; attends to minor repairs to motor vehicles under guidance of Mechanic Automobile. Receives instructions from Mechanic, Automobile about tasks to attend. Jacks up vehicle to required height for repair in convenient position where necessary. Removes nuts and bolts to dismantle parts such as water pump assembly, fuel pumps assembly, distributor, generator, steering, brakes, transmission and suspension systems, etc. Decarbonizes battery under guidance of mechanic. Tightens loose parts, lubricates joints, does minor repairs, replacements and adjustments and performs simple fitting operations such as filing, chipping, grinding etc. May work in workshops or garage. May drive vehicle on road. May be designated as Service Mechanic if engaged in cleaning, polishing, oiling and greasing vehicles and do minor routine adjustments as included in servicing.

Auto Service Technician - Mechanic is responsible for the repair and routine servicing and maintenance (including electrical and mechanical aggregates) of vehicles.

Reference NCO-2015:

a) 7231.0100 – Mechanic, Automobile
b) 7231.0101 – Maintenance Technician – Service Workshop
c) 7231.0102 – AC Specialist
d) 7231.0400 – Fitter Automobile
e) 7231.0107 – Auto Service Technician – Mechanic

Reference NOS:

a) ASC/N9412
b) ASC/N9476
c) ASC/N9477
d) ASC/N9478
e) ASC/N9479
f) ASC/N9480
g) ASC/N9481
h) ASC/N9482
i) ASC/N9483
j) ASC/N9484
k) CSC/N9401
l) CSC/N9402
m) ASC/N9485
n) ASC/N9486
o) ASC/N9487
p) ASC/N9488
q) ASC/N9489
r) ASC/N9490
s) ASC/N9491
t) ASC/N9492

4. GENERAL INFORMATION

Name of the Trade	**Mechanic Electric Vehicle**
NCO - 2015	7231.0100, 7231.0101, 7231.0102, 7231.0400, 7231.0107
NOS Covered	ASC/N9412, ASC/N9476, ASC/N9477, ASC/N9478, ASC/N9479, ASC/N9480, ASC/N9481, ASC/N9482, ASC/N9483, ASC/N9484, CSC/N9401, CSC/N9402, ASC/N9485, ASC/N9486, ASC/N9487, ASC/N9488, ASC/N9489, ASC/N9490, ASC/N9491, ASC/N9492
NSQF Level	Level – 4
Duration of Craftsmen Training	Two years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, CP, LC, DW, AA, BLIND, LV, DEAF, HH, AUTISM, ID, SLD
Unit Strength (No. Of Students)	24 (There is no separate provision of supernumerary seats)
Space Norms	192 Sq. m
Power Norms	5 KW
Instructors Qualification for	
1. Mechanic Electric Vehicle Trade	B.Voc/ Degree in Automobile/ Mechanical Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. OR 03 years Diploma in Automobile/ Mechanical Engineering from AICTE recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. OR NTC/NAC passed in the trade of "Mechanic Electric Vehicle" with three years' experience in the relevant field. **Essential Qualification:** Relevant National Craft Instructor Certificate (NCIC) in any of the variants under DGT. Must Possess valid LMV driving License. ***NOTE: -*** *Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.*

2. Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in relevant trade OR NCIC in RoDA or any of its variants under DGT
3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering/ Draughtsman group of trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade OR Regular/RPL variants NCIC in RoDA or any of its variants under DGT
4. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills from DGT institutes. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) OR Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills from DGT institutes.
5. Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

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

5.1 LEARNING OUTCOMES:

FIRST YEAR:

1. Identify and handle different types of tools and workshop equipment in the Auto workshop following safety precautions. (NOS: ASC/N9412)
2. Check, identify and interpret different types of vehicles and their specifications. (NOS: ASC/N9476)
3. Identify the electrical circuits and test their parameters by using electrical measuring instruments, and the basic electronic circuits and analyse their circuit functioning. (NOS: ASC/N9477)
4. Identify and study of Electric vehicle components and Performance comparison of EV and IC engine vehicles. (Components of Electric Vehicle such as Motor, Motor Controller, Battery Pack, Battery Management System, Charging System etc.) (NOS: ASC/N9478)
5. Checking by using workshop tools, instruments and operate garage equipments. (NOS: ASC/N9479)
6. Check the automobile systems and sub-systems such as power train, chassis, transmission system, different suspension systems, tyres & wheels (Functions, tyre marking, tyre Designs), body engineering systems, safety system etc. (NOS: ASC/N9480)
7. Trace and Test all Electrical, Electronic components & circuits and assemble circuit to ensure functionality of system. (NOS: ASC/N9481)
8. Diagnose, repair and perform maintenance of automobile electrical components & general vehicle architecture. (NOS: ASC/N9482)
9. Perform checking and troubleshooting of wiring circuits – HV and LV and the electrical components in the electric vehicle. (NOS: ASC/N9483)
10. Dismantle, diagnose& rectify the defects in vehicle and assemble the vehicle components to ensure functionality of vehicle. (NOS: ASC/N9484)
11. Read and apply engineering drawing for different application in the field of work. (NOS: CSC/N9401)
12. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: CSC/N9402)

SECOND YEAR:

13. Apply the knowledge of power transmission system in electric vehicle, its basic components and functions; electric vehicle motor, its speed control technique and motor controller. (NOS: ASC/N9485)
14. Identify and develop Battery Pack Components, monitor and check performance of

high voltage rechargeable energy storage system and Battery Management System. (NOS: ASC/N9486)

15. Perform battery testing, charging and cycling operations. (NOS: ASC/N9487)
16. Test and troubleshoot Accessory and Auxiliary Components -Power Steering, Braking and HVAC Comfort System. (NOS: ASC/N9488)
17. Selecting, operating and troubleshooting of Electric Vehicle Charging Ecosystem. (NOS: ASC/N9489)
18. Drive an Electric Vehicle following the safety rules for driving. (NOS: ASC/N9490)
19. Diagnose, repair and testing of EV vehicles and subsystems and EV components. (NOS: ASC/N9491)
20. Regulatory requirements and new trends in electric vehicle. (NOS: ASC/N9492)
21. Read and apply engineering drawing for different application in the field of work (NOS: CSC/N9401)
22. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: CSC/N9402)

6. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENT CRITERIA
FIRST YEAR	
1. Identify and handle different types of tools and workshop equipment in the Auto workshop following safety precautions. (NOS: ASC/N9412)	Carry out First aid and Fire safety.
	Follow safe handling of batteries & equipment and Periodic testing of the same.
	Describe the purpose, use of auto hand tools.
	Learning Usage of tools & Machinery in this trade.
	Occupational Safety & Health guidelines. List the safety rules for tools.
2. Check, identify and interpret different types of vehicles and their specifications. (NOS: ASC/N9476)	Identify various types of vehicles (Classification).
	Identify the different vehicle specification data and information.
3. Identify the electrical circuits and test their parameters by using electrical measuring instruments, and the basic electronic circuits and analyse their circuit functioning. (NOS: ASC/N9477)	Carry out soldering operation.
	Carry out testing of components in electric circuits.
	Carry out Crimping of wires.
	Carry out diagnosis of various electric circuits.
	Plan work in compliance with standard safety norms.
	Identify and test different types of basic electronic components.
	Plan to construct and test various Logic Gates.
4. Identify and study of Electricvehicle components and Performance comparison of EV and IC engine vehicles. *(Components of Electric Vehicle such as Motor, Motor Controller, Battery Pack, Battery Management System, Charging System etc.)* (NOS: ASC/N9478)	Interpret Indian Market Data.
	Identify different types of Electric Vehicle Technology (BEV, HEV, PHEV and FCEV), Architecture of Electric Vehicle.
	Identify main components of electric vehicle and their function Verify component specification sheet.
	Trace the High Voltage wiring on the vehicle.
	Compare performance of EV and IC engine vehicles.
5. Checking by using workshop tools, instruments and operate garage equipments. (NOS:	Identify and select General workshop tools & power tools.
	Perform loosening and tightening of various screws, nuts and bolts in EV vehicle using tools.
	Check the parameters of EV Vehicle using measuring instruments.

ASC/N9479)	
6. Check the automobile systems and sub-systems such as powertrain, chassis, transmission system, different suspension systems, tyres & wheels (Functions, tyre marking, Tyre Designs), body engineering systems, Safety System etc. and operate garage equipment. (NOS: ASC/N9480)	Identify main systems and sub systems of Automobile and specify their function (transmission and driveline systems).
	Sketch General vehicle Architecture system.
	Draw typical layouts and Identify nomenclature of auto electrical systems, chassis and Monocoque body, Steering Systems, Suspension system, Brakes, wheels & tyres.
7. Trace and Test all Electrical, Electronic components & circuits and assemble circuit to ensure functionality of system. (NOS: ASC/N9481)	Explain various terms such as +ve cycle, -ve cycle, Frequency, Time period, RMS, Peak, Instantaneous value. Single phase and Three phase supply.
	Identify type of electrical cables and their Specifications. Types of wires & cables, standard wire gauge (SWG).
	Identify Fuses & circuit breakers, Ballast resistor, Stripping wire insulation, cable color codes and sizes.
8. Diagnose, repair and perform maintenance of automobile electrical components & general vehicle architecture. (NOS: ASC/N9482)	Identify and interpretation of automobile electrical architecture & power supply systems.
	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Plan work in compliance with standard safety norms.
	Carryout the diagnostic procedure for the following troubles in the electrical accessories: - No horn, poor horn, continuous horn. - Wiper and washer no operation, continuous operation, Intermittent operation. - Power window no operation. - Power Door lock no operation. - Immobilizer system and keyless entry no operation. - Trouble (Error indication) in Automatic seat belt system. – Trouble (Error indication) in Air bag system.
9. Perform checking and troubleshooting of wiring circuits - HV and LV and the electrical components in the electric vehicle. (NOS: ASC/N9483)	Select appropriate electric raw materials as per the requirement.
	Diagnose and carry out remedial action as per the OEM Manual - Horns, Wiper Motor, Power Windows.
	Follow personal and shop safety procedures and use appropriate attire and protective equipment.
	Plan work in compliance with standard safety norms.
	Operate equipment according to safety protocols and identify tools, tests equipment and service procedures used in the servicing of EV and HEV's.

	Identify components and their locations indicated on the wiring diagram.
	Diagnose, repair, and test DC/DC converters.
	Perform diagnosis of Electric Vehicle.
10. Dismantle, diagnose & rectify the defects in vehicle and assemble the vehicle components to ensure functionality of vehicle. (NOS: ASC/N9484)	Demonstrate safe handling of lifting equipment.
	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Plan work in compliance with standard safety norms.
	Test the various sensors fitted on the vehicle.
	Identify the problems in the vehicle.
	Repair the fault. Replace the faulty components (if necessary).
	Perform sequencing and identifying parts at the time of dismantle and assemble.
	Carryout assembly and disassembly of simple automobile system (such as front Mirror).
11. Read and apply engineering drawing for different application in the field of work. (NOS: CSC/N9401)	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
12. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: CSC/N9402)	Solve different mathematical problems
	Explain concept of basic science related to the field of study
SECOND YEAR	
13. Apply the knowledge of power transmission system in electric vehicle, its basic components and functions; electric vehicle motor, its speed control technique and motor controller. (NOS: ASC/N9485)	Identify types of motors.
	Working Principle of Motor (Study-state, volts, Hertz control, electronic control).
	Speed control technique. Power transmission system in electric vehicle and its basic components and its functions.
	Motor cooling system and working component.
	Motor controller working principle and basic components.
14. Identify and develop Battery Pack Components, monitor and check performance of	Identify different cell chemistries.
	Identify different cell geometries.
	Identification of various sensors installed - Battery Temperature

high voltage rechargeable energy storage system and Battery Management System. (NOS: ASC/N9486)	Mapping.
	Plan work in compliance with standard safety norms.
	Perform Verification of cell performance against supplier data sheet
	Perform Interfacing of BMS with Battery Pack configuration of BMS with software application.
	Carry out Voltage, Current and Temperature Measurement with BMS.
	Verify SoC mapping for charging and discharging.
	Perform mapping of battery SoH using data to map Battery SoH.
	Plan work in compliance with standard safety norms.
15. Perform battery testing, charging and cycling operations. (NOS: ASC/N9487)	Perform safe storage, handle, and dispose of high voltage battery systems.
	Diagnose, repair, and test high voltage battery systems.
	Plan work in compliance with standard safety norms.
	Perform Replacement of defective Battery Module of 48V Module Systems.
	Diagnose, repair, and testing of EV battery controls.
16. Test and troubleshoot Accessory and Auxiliary Components - Power Steering, Braking and HVAC Comfort System. (NOS: ASC/N9488)	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Prepare the job for sawing, filling, bending.
	Plan work in compliance with standard safety norms.
	Produce component by observing standard procedure.
	Check for dimensional accuracy as per standard procedure.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
	Ensure the workshop cleanliness.
17. Selecting, operating and troubleshooting of Electric Vehicle Charging Ecosystem. (NOS: ASC/N9489)	Identify Type of Charger and Voltage Levels Operate Standard Chargers.
	Determine Charging Time and charging inputs under various conditions.
	Diagnosis and remedy for Charger not responding, Charger not delivering expected current.
	Plan work in compliance with standard safety norms.
	Ensure the workshop cleanliness.
18. Drive an Electric Vehicle following the safety rules for driving. (NOS: ASC/N9490)	Carry out Drive by Wire Architecture.
	Troubleshoot and Repair Accelerator Pedal.
	Troubleshoot and Repair - Brake not working.
	Drive an Electric Vehicle.
	Plan work in compliance with standard safety norms.

19. Diagnose, repair, and testing of EV vehicles and subsystems and EV components. (NOS: ASC/N9491)	Diagnose, repair, and test vehicle charging interface/infrastructure.
	Diagnose, repair, and test regenerative braking.
	Diagnose, repair, and test thermal systems management and control.
	Diagnose and repair Braking system.
	Diagnose and repair e-Compressor.
	Diagnose, repair, and test high voltage electric distribution systems
	Diagnose, repair, and test power electronic circuitry for electric drive systems.
	Check DTCs and erase them as per manufacturer's guidelines.
	Carry out test and diagnose EV components.
	Select appropriate Tools required for testing.
	Plan work in compliance with standard safety norms.
	Ensure workshop cleanliness.
20. Regulatory requirements and new trends in electricvehicle. (NOS: ASC/N9492)	Electric vehicle regulations.
	Electric vehicle recycling and reuse.
	Government policies for E vehicles.
	Autonomous vehicle system architecture.
	Autonomous vehicle LIDAR system.
	Autonomous vehicle object detection and AI cameras system.
	Autonomous vehicle ADAS system
	Autonomous vehicle collision detection system.
21. Read and apply engineering drawing for different application in the field of work. (NOS: CSC/N9401)	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
22. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: CSC/N9402)	Solve different mathematical problems
	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS FOR MECHANIC ELECTRIC VEHICLE TRADE			
FIRSTYEAR			
Duration	**Reference Learning Outcomes**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.;	Identify and handle different types of tools and workshop equipment in the Auto workshop following safety precautions.	1. Importance of trade training, List of tools &Machinery used in the trade. 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). 3. First Aid Method and basic training. 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. 5. Hazard identification and avoidance. 6. Safety signs for Danger, Warning, caution & personal safety message. 7. Preventive measures for electrical accidents &steps to be taken in such accidents. 8. Use of Fire extinguishers. 9. Practice and understand precautions to be followed while working in fitting jobs. 10. Safe use of tools and equipment used in the trade.	All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. Soft Skills, its importance and Job area after completion of training. Importance of safety and general precautions observed in the in the industry/ shopfloor. Introduction of First aid. Operation of electrical mains and electrical safety. Introduction of PPEs. Response to emergencies e.g.; power failure, fire, and system failure. Importance of housekeeping & good shopfloor practices. Introduction to 5S concept & its application. Occupational Safety & Health: Health, Safety and Environment guidelines, legislations & regulations as applicable. Basic understanding on Hot work, confined space work and material handling equipment.

Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	Check, identify and interpret different types of vehicles and their specifications.	11. Demonstrate the Comparison among commercial and passenger vehicle such as decision making in finding the driving wheels in both cases. 12. Demonstration and Classification of vehicles based on various categories such as Body Type, Load, Fuel used, Power source used, no. of wheels, transmission used, Placement &position of engine, transmission & Steering system, no. of axles, braking system used, differential & final reduction etc. 13. Demonstration on identifying the car body styles and the reason behind. 14. Demonstration of vehicle specification. Identification of vehicle information Number. 15. Study two different vehicles and prepare are port to show differences between these two vehicles.	Study of automobiles, History of Automobile, Evolution and growth of the Industry, Key Automobile Companies and their Products. Brief description of components and their locations. Study the Classification of Automobiles based on various aspects and determining the reason (Commercial, Passenger), Product Segments (Criteria for Vehicle Types, Variants and Versions, Markets: India, EU and US). Introduction and uses of Vehicle hoists – brief introduction Two post and four post hoist, Engine hoists, mechanical Jacks, Hydraulic jacks, Stands etc.
Professional Skill 75 Hrs.; Professional Knowledge 15 Hrs.	Identify the electrical circuits and test their parameters by using electrical measuring instruments, and the basic electronic circuits and analyse their circuit functioning.	16. Practice in joining wires using soldering Iron, Construction of Simple electrical circuits, Crimping of connectors. 17. Measuring of current, voltage and resistance using digital multi-meter, practice in electric circuit. 18. Continuity test for fuses, jumper wires, fusible links, circuit breakers.	Basic electricity: Electricity principles, Ground connections, Ohm's law, Voltage, Current, Resistance, Power, Energy. Voltmeter, ammeter, Ohmmeter Mulitmeter, Conductors & insulators, Wires, Shielding, Length vs resistance, Resistor ratings. Capacitors and Coils Fuses & circuit breakers,

		19. Identify and Diagnose series, parallel, series-parallel circuits using Ohm's law, Check electrical 20. Testing of relay and solenoids and its circuit. 23. Identify and test power and signal connectors for continuity. 24. Identify and test different type of Diodes. (04 hrs) 25. Identify and test NPN & PNP Transistors for its functionality. 26. Identify and test MOSFET and IGBT. 27. Construct and test simple logic circuits OR, AND &NOT and Logic gates using switches. 28. Construct circuit to read temperature and pressure sensor. 29. Construct PWM generator.	Ballast resistor, Stripping wire insulation, cable colour codes and sizes, Resistors in Series circuits, Parallel circuits and Series-parallel circuits, Electro static effects, Capacitors and its applications, Capacitors in series and parallel Cells in series and parallel Magnetic effects, Heating effects, Thermo-electric energy, Thermistors, Thermo couples, Electrochemical energy, Photovoltaic energy, Piezo electric energy, Electromagnetic induction, Relays, Solenoids, Primary & Secondary windings, Transformers, stator and rotor coils. Basic electronics: Electrical and Electronic Components: - Switches Description of Normally open, Normally closed, single pole single throw switch (SPST), ganged, and mercury switches used in Automobile circuit. Description of Relay, ISO Relays, Solenoids, Buzzers. Resistors- Description of different type of resistors and their colour codes.- Fixed, stepped, and variable resistors Rheostat, Potentiometer. Description of Diodes, Diode identification and ratings, Zener diodes, Avalanche diodes, Light emitting diodes, photo diodes and clamping diodes. Transistors- Description of

			NPN, PNP, field-effect, transistor (FET), IGBT, phototransistors. Description of Integrated circuits. Circuit protection Devices-Description off uses, different type of fuses-glass or ceramic, blade and bullet or cartridge fuses. Fusible links, maxi fuses, circuit breaker, Positive Temperature coefficient (PTC) resistor device Logic gates-OR, AND & NOT and Logic gates using switches. Input and Output Interfacing. PWM Generation.
Professional Skill 95 Hrs.; Professional Knowledge 25 Hrs.	Identify and study of Electric vehicle components and Performance comparison of EV and IC engine vehicles. *(Components of Electric Vehicle such as Motor, Motor Controller, Battery Pack, Battery Management System, Charging System etc.)*	30. Practice using digital meters such as AC DC clamp meters. 31. Identify and study performance of Electric vehicles, in comparison to IC engine vehicles. 32. Identification and locate the basic components of EV 33. Identify various gauges/instrument on dashboard of an electric vehicle and identify differences in instrumentation panel with IC engine vehicle. 37. Trace out electrical power flow/ electrical layout. 38. Check the proper voltage, various practical work related to chopper circuit. 39. Testing of motor controller output at different conditions.	Introduction to Electric Vehicle Technology, EV Terminology Comparison of Electric Vehicle with IC engine vehicle based on emissions, range, fuel type. Types of electric vehicle, BEV, HEV, PHEV and FCEV. Application of Lux meters. Architecture of Electric Vehicle, working principle of fully electric vehicle, Major component, performance parameter, Basics of Motors, Selection, sizing and characteristic of Motor, calculation for motor effort, electric transmission. Principle, working and operation of propulsion system, DC Motor - Drives Armature Voltage, chopper circuit, step up, Step down chopper, control strategy, chopper amplifier.

			Brushless DC Motor – principle working, features, speed control system of brushless DC motor, efficiency, calculation.
Professional skills 40 Hrs. Professional Knowledge 20 hrs.	Checking by using workshop tools, instruments and operate garage equipments.	40. Practice on General workshop tools & power tools. 41. Practice on loosening and tightening of various screws, nuts and bolts in EV vehicle using tools 42. Check the parameters of EV Vehicle using measuring instruments	Marking scheme, Marking material-chalk, Prussian blue. Cleaning tools-Scraper, wire brush, Emery paper, Description, care and use of Surface plates, steel rule, measuring tape, try square vacuum gauge, tire pressure gauge. Details of various types of marking and cutting tools-punch, scriber, hammer and mallets, hacksaw frame and blade, chisels Threads-thread categorization- types of threads-types of screwed joints- types of nuts-property classes of bolts-screw locking arrangements-types and description of screwing tools. garage equipments and power tools
Professional Skill 150 Hrs.; Professional Knowledge 30 Hrs.	Check the automobile systems and sub-systems such as power train, chassis, transmission system, different suspension systems, tyres & wheels (Functions, tyre marking, tyre Designs), body engineering systems, safety system etc.	43. Demonstration on Identification of Various Automobile systems and subsystems. 44. Comparative analysis on body over chassis &Monocoque body. 45. Practical to identify the External and Internal Body Components and their Functions. 46. Draw suitable sketches to show functions of various components. 47. Demonstration on Identification of powertrain & its type.	Functional Introduction to various automotive systems and subsystems. Power Train: Introduction to engines and its types, transmission and driveline systems. Chassis System: Chassis and Monocoque body, Steering Systems, Suspension System(Its functions &different components, different types like Double Wishbone, trailing twist axle suspension, MacPhersons rut suspension, multi-link

		48. Demonstration on Identification of transmission & drive line components. 49. Overhauling of Automatic Transmission system (single speed reduction gear) 50. Demonstration on identification of Steering systems. 51. Demonstration on Identification of suspension systems. 52. Practice to measure awheel base of a vehicle with measuring tape. 53. Practice to remove wheel lug nuts with use of an air impact wrench. 54. Practice to check the air pressure inside the vehicle tires are maintained at the recommended setting.	etc), Functions of Tyres and Wheels, Introduction to JATMA/ATMA/ETRTO standards, Tyres and Wheels markings. Tyre selection considerations for automobile, Tyre Designs- Diagonal vs Radial Ply, Tubed vs Tubeless, Wheel Alignment. Working and construction of Automatic Transmission system (single speed reduction gear) Body Engineering: Styling, Exterior, Interior, trims etc. Vehicle Integration: DMU, Ergonomics, Layout and Packaging studies.
Professional Skill 100 Hrs.; Professional Knowledge 20 Hrs.	Trace and Test all Electrical, Electronic components & circuits and assemble circuit to ensure functionality of system.	55. Identify the Phase, Neutral and Earth on power socket, use at ester to monitor AC power. 56. Construct a test lamp and use it to check the health of mains. 57. Measure the voltage between phase and ground and rectify earthing on earth. 58. Measure the gauge of the wire using SWG and outside micrometer. 59. Crimp the lugs to wire end.	Basics of AC & DC. Various terms such as +ve cycle, -ve cycle, Frequency, Time period, RMS, Peak, Instantaneous value. Single phase and Three phase supply. Terms like Line and Phase voltage/ currents. Insulators, conductors and semiconductor properties. Different type of electrical cables and their Specifications. Types of wires & cables, standard wire gauge (SWG). Classification of cables according to gauge (core size), number of conductors, material, insulation strength, flexibility etc. Basics of electricity,

			Electricity principles, Ground connections, Ohm's law, Voltage, Current, Resistance, Power, Energy. Voltmeter, ammeter, Ohmmeter, Multimeter, Conductors & insulators, Wires, Shielding, Length vs resistance, Resistor ratings. Fuses & circuit breakers, Ballast resistor, Stripping wire insulation, cable color Codes and sizes, Resistors in Series circuits, Parallel circuits and Series-parallel circuits, Electro static effects, Capacitors and its applications, Capacitors in series and parallel.
Professional Skill 130 Hrs.; Professional Knowledge 20 Hrs.	Diagnose, repair and perform maintenance of automobile electrical components & general vehicle architecture.	70. Carry out study about new types of battery and suggest improvements to the main limiting factors to batteries, battery fault, battery testing. 71. Hands on removing and fitting basic mechanical, electrical and trim components. 72. Perform fault diagnosis on electrical wiring harness. 73. Practice on application of different electrical switches in EV such as Switches, Steering lock cum ignition switch. 74. Combi Switch, Fascia switches, Head lamp levelling switch, mirror adjustment switches, Front & Rear fog lamp switches. 75. Hazard switch, Window winding switch, Heated rear window switch,	Introduction to automobile electrical architecture &power supply systems, Nomenclature of auto electrical systems, Typical layouts. General vehicle Architecture System Understand basic circuit diagrams and symbols Instrument Cluster: Different types, Tell-Tales. Electrical Distribution System: Wire, Fuse, Relay etc. selection process, Voltage, Drop Analysis, Grounding and Splicing Strategy Wiring Harness Design: Harness Topology. Familiarization and Types & Classification of Switches. Diagnostics, fault finding and Root cause analysis for electrical system.

		HVAC Control panel switches, Steering wheel switches. 76. Remove and install power door lock and tracing the circuit.	
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	Perform checking and troubleshooting of wiring circuits – HV and LV and the electrical components in the electric vehicle.	77. Identify different fuses in EV. Select Fuse for circuit protection. 78. Diagnose and carry out remedial action as per the OEM Manual -Horns, Wiper Motor, Power Windows.	Wiring and circuit diagrams Automotive Wiring- difference between primary wiring and secondary wiring. Comparison between solid and stranded primary wire. Description of wire size- Metric and American wire gauge (AWG), Importance of ground straps used in automotive wiring. Description of different type of terminals and connectors Molded, multiple-wire hard shell, bulkhead, weather-pack, metri-pack, heat-shrink covered butt connectors. Importance of printed circuit boards, wiring harnesses, wiring diagrams and color codes and circuit numbering. Study of common electrical and electronic symbols used in wiring diagrams Accessories: Horn circuit, wiper circuit, power window components and circuit. Power door lock circuit, automatic door lock circuit, remote keyless entry system circuit, antitheft system, immobilizer system. Navigation system, Car infotainment system, car videos.
		79. Explain vehicle safety systems' including	Description and function of Airbags, Seatbelt, Vehicle

		disconnects; interlock loops etc. 80. Diagnose, repair, and test DC/DC converters. 81. Check Inverter Assembly. 82. Diagnostic tools for EV. Use Scan Tool.	safety systems, Crash sensors, Seat belt pre-tensioners, Tire pressure monitoring systems, Integrated communications, Proximity sensors, Reflective displays, Global positioning satellites, Triangulation/ trilateration, Telematics. Application of Automotive bus system- currently used in cars: CAN (Control Area Network), LIN (Local Interconnect Network), FlexRay™ and MOST (Media Oriented Systems Transport)., Importance of E/E Architecture. High Voltage Elements - PDU, Voltage Converters, Switching Devices, HV – Diagnostics and Troubleshooting, HV Cabling - Repair, Safety Certification, HVIL, Isolation Testing Power Electronics – Inverter and Voltage Converters, Introduction to Scan Tool and reading vehicle diagnostics.
Professional Skill 100 Hrs.; Professional Knowledge 20 Hrs.	Dismantle, diagnose& rectify the defects in vehicle and assemble the vehicle components to ensure functionality of vehicle.	83. Hand on assemble and disassembly of electric vehicle components asper vehicle manual. 84. Identify and interpret electrical system concern. 85. Practice on testing and relays.	Understanding Assembly and disassembly processes from vehicle manual. Thread categorization-types of threads- types of screwed joints- types of nuts- property classes of bolts- screw locking arrangements- types and description of screwing tools. General principles of electrical engineering- structure of atoms- voltage-

			current- fuses- electrical conduction- current direction- types of current- voltage drop-resistance- PTC and NTC resistors- types of resistors- ohm's law- resistor circuits-electro magnetism-electro magnetic induction solenoids - description of multi-meter- function and types of relays- semiconductors.
ENGINEERING DRAWING			
Professional Knowledge ED- 30 Hrs.	Read and apply engineering drawing for different application in the field of work.	Introduction to Engineering Drawing and Drawing Instruments – Conventions Sizes and layout of drawing sheets Title Block, its position and content Drawing Instrument Lines- Types and applications in drawing Free hand drawing of – Geometrical figures and blocks with dimension Transferring measurement from the given object to the free hand sketches. Free hand drawing of hand tools and measuring tools. Drawing of Geometrical figures: Angle, Triangle, Circle, Rectangle, Square, Parallelogram. Lettering & Numbering – Single Stroke. Dimensioning Types of arrowhead Leader line with text Position of dimensioning (Unidirectional, Aligned) Symbolic representation – Different symbols used in the related trades. Concept and reading of Drawing in Concept of axes plane and quadrant Concept of Orthographic and Isometric projections Method of first angle and third angle projections (definition and difference) Reading of Job drawing of related trades.	
WORKSHOP CALCULATION & SCIENCE			
Professional Knowledge WCS- 30 Hrs.	Demonstrate basic mathematical concept and principles to perform practical	**Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion	

	operations. Understand and explain basic science in the field of study.	Factors, HCF, LCM and problems Fractions - Addition, subtraction, multiplication & division Decimal fractions - Addition, subtraction, multiplication & division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and square root Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non-ferrous metals Introduction of iron and cast iron **Mass, Weight, Volume and Density** Mass, volume, density, weight Related problems for mass, volume, density, weight and specific gravity **Speed and Velocity, Work, Power and Energy** Work, power, energy, HP, IHP, BHP and efficiency Potential energy, kinetic energy and related problems with assignment **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Scales of temperature, Celsius, Fahrenheit, kelvin and conversion between scales of temperature Heat &Temperature - Temperature measuring instruments, types of thermometers, pyrometer and transmission of heat - Conduction, convection and radiation **Basic Electricity** Introduction and uses of electricity, electric current AC, DC their comparison, voltage, resistance and their units Conductor, insulator, types of connections - series and parallel Ohm's law, relation between V.I.R & related problems Electrical power, energy and their units, calculation with assignments Magnetic induction, self and mutual inductance and EMF generation Electrical power, HP, energy and units of electrical energy **Mensuration** Area and perimeter of square, rectangle and parallelogram

		Area and perimeter of Triangles Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder **Trigonometry** Measurement of angles Trigonometrical ratios
Project Work/ Industrial Visit: -Broad Area: a) Assembly and disassembly of major chassis system. b) Fault finding in wiring harness. c) Calculation of powertrain.		

SYLLABUS FOR MECHANIC ELECTRIC VEHICLE TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill 75 Hrs.; Professional Knowledge 15 Hrs.	Apply the knowledge of power transmission system in electric vehicle, its basic components and functions; electric vehicle motor, its speed control technique and motor controller.	86. Study Motor Controller working. Remove and install rotor from stator and diagnose motor rotor position sensor.	Induction motor - drive, working principle, Study-state, volts, Hertz control, electronic control, electric Motor to wheel transmission system components & its working principles, speed control technique, Voltage inverter, Switched Reluctance motor–working Principle, Different component, control system, motor circuit. Permanente magnet synchronous motor (PMSM) construction and working Advantages and disadvantages of various motors.
		87. Diagnose drive/traction motor-generator assembly for improper operation (such as an inoperative condition, noise, shudder, overheating.	Motor controller working principle and basic components. Motor cooling system and working component, Theoretical torque calculation, reason for heating, noise and failure of motor.
Professional Skill 75 Hrs.; Professional Knowledge 15 Hrs.	Identify and develop Battery Pack Components, monitor and check performance of high voltage rechargeable energy storage system and Battery Management System.	88. Develop Battery Pack with Series Parallel Configuration. 89. Identify different cell chemistries. 90. Identify different cell geometries. 91. Identification of various sensors installed - Battery Temperature Mapping. 92. Verify cell performance against supplier data sheet.	Cells - Cell Types Lead Acid/Lithium-ion polymer/liquid cooled lithium-ion heating system/Li-ion/NiMH, NiCad etc., Chemistries and Geometries, Cell Selection and sizing, Handling Cells, Understanding Cell Charging and Discharging Curves, Understand Temperature impact on cell, Internal resistance, Cell Construction

		93. Conduct Voltage, Current and Temperature Measurement with BMS. 94. Configuration of BMS with software application. 95. Balance cells with external circuits. 96. Verify SoC mapping for charging and discharging Use Data to map Battery SoH.	and Manufacturing, Life cycle of various types of batteries Battery Module and Pack Development - Battery Pack Configuration, Pack and Module Construction, Configurations, Types and Energy Concepts, Voltage, and Temperature Measurement, Current Measurement, Thermal Management, Pack Sealing Sensors used in BMS Battery capacity and rating Battery charging and discharging calculation. Battery Management System (BMS)/Energy Management System (EMS) - Need of BMS, Voltage, Current and Temperature Monitoring, Cell Balancing - Types, Active, Passive, SoC Determination, SoC Algorithms, Battery cooling System.
Professional Skill 75 Hrs.; Professional Knowledge 30 Hrs.	Perform battery testing, charging and cycling operations.	97. Connecting battery to a charger for battery charging, Inspecting & testing a battery after charging. 98. Perform safe storage, handle, and dispose of high voltage battery systems. 99. Replace defective Battery Module of 48V Module Systems. 100. Check battery assembly sensors for proper functioning.	Understanding charge and discharge cycles, Understanding State of Charge and State of Health, Battery Life, Cycles of Operation, SoH, Concept of State of Energy (SoE) and State of Power (SoP) Battery handling at swapping Stations

		101. Diagnose, repair, and test high voltage battery systems. 102. Diagnose, repair, and testing of EV battery controls. 103. Measure and Diagnose the cause(s) of excessive Key-off battery drain (parasitic draw) and do corrective action.	Using second life batteries-selection, redeployment, refurbishment Battery Disposal, Storing Batteries.
Professional Skill 150 Hrs.; Professional Knowledge 45 Hrs.	Test and troubleshoot Accessory and Auxiliary Components -Power Steering, Braking and HVAC Comfort System.	104. Check Cooling Requirement for EV Components. 105. Check battery cooling fan for proper functioning. 106. Check cooling system optimal performance for Inverter assembly. 107. Inspection of power steering control module circuit. 108. Checking & adjusting power steering fluid, Pressure testing a power steering system, Flushing a power steering system. 109. Identification of various sensors installed. 110. Trouble shooting and remedy for steering wheel feels heavy at low speed, poor recovery from turns, Vehicle pulls to one side during straight driving. 111. Identify and locate the components of Car AC system in a given vehicle. 112. Check a heating system, Compressor rotation test, air Gap check, Refrigerant recovery -evacuating -charging of	EV Thermal Management - Cooling of Battery Pack, Motor and Inverter, Active and Passive Cooling, Fluid Based Cooling, Ethylene Glycol, Forced Air Cooling, Cabin Air Based Cooling Description of Electric power assisted steering, Basic electric power steering operation. Electronic adjustable-rate shock absorbers, Brakes – types of brake systems such as Mechanical, Hydraulics & Air brake construction and working. Drum wheel btake, disc wheel brake system construction and working etc. Electric brakes, Electro hydraulic braking (EHB), ABS brake system, Antilock braking system operation, Principles of ABS braking, ABS master cylinder, Hydraulic control unit, Wheel speed sensors, ABS with Electronic Brake force Distribution (EBD)control unit. Heating Ventilation Air Conditioning (HVAC)legislation, Vehicle

		A/c system.) 113. Check charge state of refrigerant. Check AC system and its components for proper functioning. 114. Check e-Compressor, Carry out the diagnostic procedure for the following trouble - No cooling. 115. Intermittent cooling, insufficient cooling, abnormal noise from compressor, magnetic clutch, condenser, evaporator, and blower. High pressure gauge— Pressure high and low. Low pressure gauge Pressure high and low. 116. Demonstration on Identification of disc and drum brakes, warning & safety devices. 117. Overhauling of Disc wheel and drum wheel assembly hydraulic braking system 118. Identification of ABS components, checking of ABS warning lamp, Electronic Brake Distribution (EBD).	heating, ventilation & cooling systems, Basic air-conditioning principles, Air-conditioning capacity, Air-conditioning refrigerant, Humidity. Description and function of Fixed orifice, Control devices, Thermostatic expansion valve, Thermal expansion valves, Air-conditioning compressors, Condensers & evaporators, Receiver drier, Lines & hoses, TXvalve construction, Temperature. monitoring thermostat, Refrigerants, Pressure switches, Heating elements. Air-conditioning ECU, Ambient air temperature sensor, Servomotors, Electric servomotors, Automatic climate control sensors, Evaporator temperature sensor, Blower speed control, Ventilation systems Electric Inverter Compressor: Principle of working, types and advantages over conventional compressor. HVAC system and Compressor.
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	Selecting, operating and troubleshooting of Electric Vehicle Charging Ecosystem.	119. Identify Type of Charger and Voltage Levels. 120. Operate Standard Chargers Determine Charging Time under various conditions. 121. Requirement of charging inputs for different types of chargers. 122. Diagnosis and remedy for Charger not responding, Charger not	Charging system- The purpose of Charging system, charging system components, charging system circuit, AC Charger, DC Charger, Solar Integrated (MPPT based) Charger High voltage charging systems, Charger cooling. Constant Current (CC) & Constant Voltage (CV) Charging Standard -Chademo, GB/T,

		delivering expected current.	DC001, CCS -Protocols, Connectors Electric Vehicles charging station - Type of Charging station, Selection and Sizing of charging station, Components of charging station, Single line diagram of charging station. Terms associated with EV Charging Station Charging Station Indicators, Charging Station Installation, Charging Station for swappable battery packs DC/DC converter, working principle, Type, Calculation. Relay, operation, types and application. Rule based and optimization-based control, Software based control, Thermal management system, Cell load distribution, SOC and SOH determination. Repair and maintenance of Electric Vehicle system. Chopper circuit of DC motor.
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	Drive an Electric Vehicle following the safety rules for driving.	123. Carry out Drive by Wire Architecture Learn. 124. Riding Modes - Accelerator Pedal to Torque.	Drive by Wire System - Accelerator Pedal Acceleration and Braking in EV Functional Safety Understanding driving pattern, accessories usage (HVAC) and drive cycle and driver dependency. Electronic Controlled
Professional Skill 300 Hrs.; Professional Knowledge 90 Hrs.	Diagnose, repair and testing of EV vehicles and subsystems and EV components.	125. Troubleshoot and Repair - Brake not working.	Brake: Principle of Regenerative Braking., Regenerative Brake cooperative control operation. Riding Modes - Sport and Comfort, Driver Behavior, Economy mode.

		126. Trace the light circuit - test bulbs, align head lamps, Aiming headlights. 127. Changing a headlight bulb, checking of a head light switch and to replace if faulty. 128. Trace the wiring circuit of lighting system. 129. Remove and install wiper motors and wiper switches. 130. Hands-on and practice to Identify different location of various ECUs in vehicle. Identify antitheft system. 131. Remove and install new horn. 132. Practice on Identifying Proximity sensor, Parking sensor, crash sensor, Rain and Light Sensor. 133. Remove and install power door lock and tracing the circuit. 134. Identification of Air conditioning components. 135. Hands on adjustment of A/C inside the cabin.	Lighting system, Lamps/light bulbs (Halogen, Xenon and LED), Lamp/light bulb information, LED lighting. Headlight & dimmer circuits, Park & taillight circuits, Brake light circuits, turn signal circuit, Cornering lights, Fog lights circuit, interior lights-courtesy, reading and instrument panel lights, Smart lighting, Reverse lights Temperature monitoring thermo stat. Air-conditioning ECU, Blower speed control, Ventilation systems. Accessories: Horn circuit, wiper circuit, power window components and circuit Power door lock circuit, automatic door lock circuit. Antitheft system, immobilizer.
		136. Do the preventive maintenance of FATC/ HVAC machine. 137. Automatic transmission Identification of Automatic transmission components and related sensors. 138. Perform RCA and tracing of wiring circuit in auto transmission. 139. Perform Electronic Power Steering	ECU Communications-Communication between different ECUs. LIN Bus, MOST Bus, CAN Bus.

		Identification of EPS components and related sensors.	
		140. Hands-on for RCA and Tracing wiring circuit in EPS. 141. Tracing wiring circuit of parking sensor, co-passenger sensor and seat belt.	Electronic control transmission Continuously variable transmission (C.V.T.) -Description of Electric power assisted steering, Basic electric power steering operation.
		142. Practice of safety precautions and procedures to be observed while working with EV Kit and related tools.	Automatic Transmissions- Torque converters, Torque converter principles, drive plate, Converter operation, Torque multiplication, Fluid flow, Heat exchanger, Lock-up converters, clutches. Planetary gearing.
Professional Skill 65 Hrs.; Professional Knowledge 25 Hrs.	Regulatory requirements and new trends in electric vehicle.	143. To list out various requirements for electric vehicle. 144. Understanding recycling and reuse vehicle. 145. Understanding latest development. 146. Understanding autonomous vehicle system. 147. Understanding of autonomous vehicle system components like LIDAR, object detection, AI cameras, ADAS, collision detection sensor.	Study of electric vehicle regulations. Study of electric vehicle recycling and reuse. Study of advancement of electric vehicle. Study of autonomous vehicle system architecture.
ENGINEERING DRAWING			
Professional Knowledge ED- 30 Hrs.	Read and apply engineering drawing for different application in the field of work.	Reading of Electrical, Electronic & Mechanical Sign and Symbols used in Automobile. Sketches of Electrical, Electronic & Mechanical components used in Automobile. Reading of Electrical wiring diagram and Layout diagram used in Automobile. Drawing of Electrical circuit diagram used in Automobile. Drawing of Block diagram of Instruments & equipment of trades	

WORKSHOP CALCULATION & SCIENCE		
Professional Knowledge WCS- 30 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**Friction** Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction Friction - Lubrication Friction - Co- efficient of friction, application and effects of friction in workshop practice **Centre of Gravity** Centre of gravity - Centre of gravity and its practical application **Algebra** Algebra - Addition, subtraction, multiplication & division Algebra - Theory of indices, algebraic formula, related problems **Elasticity** Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade Estimation and costing - Problems on estimation and costing
Project Work/ Industrial Visit: - **Broad Area:** a) Design and soldering of required output battery bank. b) System balancing of electric two wheelers. c) Visit to electric vehicle manufacturing plant. HVAC		

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs. + 60 Hrs.)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in

ANNEXURE-I

LISTOFTOOLSANDEQUIPMENT			
MECHANIC ELECTRIC VEHICLE (for Batch of 24 Candidates)			
S No.	**Name of the Tools & Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1.	Steel rule	30 cm & 60 cm graduated both in English & Metric units	24 Nos.
2.	Hand Gloves	_	24 Nos.
3.	Safety Shoes	_	24 Nos.
4.	Helmet	_	24 Nos.
B. TOOLS, INSTRUMENTS AND GENERAL SHOP OUTFIT			
5.	“V” block	V-Block pair 7cm with clamps	10 Nos.
6.	“V” block	V-Block15cm with clamps	10 Nos.
7.	Micrometer Outside	0–50 mm outside	05 Nos.
8.	Vernier Caliper	0-15cm	05 Nos.
9.	Micrometer Inside	Up to 20m 006D	05 Nos.
10.	Spirit Level	15 cm metal	10 Nos.
11.	File warding	15 cm smooth	10 Nos.
12.	File flat	30 cm second cut.	10 Nos.
13.	File flat	20 cm bastard	10 Nos.
14.	File Swiss type	Needle set of 12.	10 Nos.
15.	Card file.	-----	02 Nos.
16.	Oil Stone	15 cmx 5cmx 2.5cm	02 Nos.
17.	Pliers combination	15 cm	10 Nos.
18.	Blow Lamp	0.50liters.	10 Nos.
19.	Spanner	D.E. 6-26 mm set of 10 pcs.	10 Nos.
20.	Spanner adjustable	15 cm	10 Nos.
21.	Box spanner	Set 6-25 mm set of 8 with Tommy bar.	10 Nos.
22.	Glass magnifying	7 cm	10 Nos.
23.	Clamp “C”	5 cm	05 Nos.
24.	Clamp “C”	10 cm	05 Nos.
25.	Scraper flat	15 cm.	05 Nos.
26.	Scraper triangular	15 cm	05 Nos.
27.	Scraper half round	15cm	05 Nos.
28.	Chisel	cold 9mm cross cut 9 mm diamond.	10 Nos.
29.	Chisel	cold 19 mm flat	10 Nos.
30.	Chisel	cold 9mmroundnose.	10 Nos.
31.	Motorized+ Tennon Saw	----	01 No.
32.	Hand hammer	1 kg. with handle Ball Peen	10 Nos.
33.	Hacksaw	Frame fixed 30cm.	10 Nos.
34.	Mallets Wooden	----	10 Nos.

35.	V-Block, Files, mallets, screw drivers, chisels, etc.	----	10 Nos.
36.	Hand Drilling Machine	Rated input power: 600W, Power output: 301W, Rated torque: 1.8 Nm	01 No.
37.	Professional Air Blower	Power consumption: 820 W, No-loadspeed:16000rpm, Flowrate:0-4.5, m3/s	01 No.
38.	Hammer Drill Wired	Drill type: hammer, optimum power Transfer	01 No.
39.	Digital Dial Torque Wrench	Range: 20 to 280 Nm	02 Nos.
40.	Lifting Tackle/Sling	1Ton×2mtr	04 Nos.
41.	Impact Wrench	1/2 inchdrive	02 Nos.
42.	Laser Light Pen	---	02 Nos.
43.	Surface Plate with stand	Cast iron	01 No.
44.	Palm Scale	Capacity-500 gms, Least Count-0.1g	01 No.
45.	Allen Screw driver Wrench Tool	6PcsT Handle Ball Ended Hex Key	01 No.
46.	Universal Quick Adjustable Multi-function Wrench Spanner	Range:6-32mm	01 No.
47.	Double Ended Wrench Hex Socket Spanner	8 In1, Range: 6-32mm	01 No.
C. GENERAL MACHINERY/SOFTWARE INSTALLATIONS (AUTOMOBILE BOM)			
48.	Car lift-4Ton	HydraulicLiftModelwithLiftingCapacity4 Ton	1 No.
49.	2WheelerBikeorScooter Assembly Set EV		1 No.
50.	Transmission/Gearbox Demo Kit	Transmission system for EV	1 No.
51.	HVAC Demo Kit		1 No.
52.	Instruction Kit for Charging System		1 No.
53.	Lighting and Wiring System mock layout		1 No.
54.	Electric Vehicle	4 wheeler	1 No.
55.	Electric Vehicle KIT Chassis	i) 3 Wheel Passenger full vehicle for assembly &disassembly ii) 4-WheelerBuggy iii) Electrical vehicle component checker/Diagnostic iv) Solar Based Charging v) Safety Tool Kit	1set
56.	Demonstration Kit of Electrical Vehicle		1 No.
57.	Battery Management System		1 No.

58.	Multimeter Digital		05 Nos.
59.	Ammeter able to read up to 300 A		02 Nos.
60.	Continuity Tester		05 Nos.
61.	Tyre pressure gauge		01 No.
62.	Measuring Tape		01 No.
63.	Electrical soldering iron		05 Nos.
64.	Soldering cum desoldering set	600 watt	05 Nos.
65.	Degital cum analog IC Testing Trainer		05 Nos.
66.	Pressure and temperature testing Kit		05 Nos.
67.	Lux Meter		05 Nos.
68.	Line Tester (Electrician)		05 Nos.
69.	Wire Stripper		10 Nos.
70.	Crimping Tools		10 Nos.
71.	Lithium Battery pack tester		02 Nos.
72.	Steering wheel puller		05 Nos.
73.	Diagnostic tool for EV		01 Nos.
74.	Puller for EV Motor		05 Nos.
75.	Dismantling and assembling of BMS Trainer Kit		02 Nos.
76.	BLDC Motor		10 Nos.
77.	Led Acid Battery	12 V 150AH	As required
78.	Led Acid Battery Charger		1 No.
79.	Lithium-Ion battery	2KW	2 No.
80.	EV motion position sensor test kit		1 set

ANNEXURE -II

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts, trainers of ITIs, NSTIs, faculties from universities and all others who contributed in revising the curriculum. Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

List of Expert Members participated/ contributed for finalizing the course curriculum of Mechanic Electric Vehicle Trade at NSTI Chennai.

S No.	Name & Designation Sh./Mr./Ms.	Organization	Remarks
1.	Shri. A.S. Bhagat, Joint Director	NSTI, Chennai	Chairman
2.	M.J. Vijaya Raju, Assistant Director	CSTARI, Kolkata	Co-ordinator
3.	G. Rajan, Managing Director	Cuuro Motors	Expert
4.	KVS Narayana, Training Officer	CSTARI, Kolkata	Co-ordinator
5.	Satheeshkumar N, Assistant Director	Govt. ITI, Bodi	Expert
6.	W. Jamson, JTO	Govt. ITI, Dindigul	Expert
7.	M. Raja, ATO	Govt. ITI, Sivagangai	Expert
8.	V. Muthusamy	Govt. ITI, Nagercoil	Expert
9.	D. Viswanathan, Sr. Mgr.	Lanson Toyota	Expert
10.	Pradeep S, Sr. Engineer	TATA Technologies	Expert
11.	M. Veeran, Head of Sales	Power Lab Instruments	Expert
12.	Shanmugam, Head TA	Power Lab Instruments	Expert
13.	P. Monoharan, CEO	Micro Wech Instruments	Expert
14.	C Venkata krishnan, PRL/AD	Govt. ITI Gundalam	Expert
15.	Dr. Ishtiaq Khan, Program Director	TATA Technologies	Expert
16.	Prashant Handigund, Program Director	TATA Technologies	Expert
17.	R. Rajesh Kanna, TO	NSTI, Chennai	Expert
18.	N. Ramesh Kumar, Assistant Director	NSTI, Chennai	Expert

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्