

བཟོ་རིག་སློབ་སྟོན་སྒྲུང་བཤར་དང་ཐབས་རིག་ལྟེ་བ།
རིག་ཕྱུ་ལ་གོང་འཕེལ་དང་ལས་མི་འཆར་གཞི་ལས་ཁུངས།
ཤེས་རིག་དང་རིག་ཕྱུ་ལ་གོང་འཕེལ་ལྷན་ཁག།



Technical Trainers Training and
Resource Center
Department of Workforce Planning and
Skills Development
Ministry of Education and Skills
Development



སྒྲིག་སྐྱོང་གཞི་བཞག་གི་ཙུ་གཞུང་།
སྒྲིག་འཁོར་འཕུལ་རིག།
ལག་ཁྱེར་3 པ།

COMPETENCY BASED CURRICULUM
ELECTRIC VEHICLE TECHNOLOGY
CERTIFICATE 3



སློབ་སྦྱོང་གི་ལོ་རྒྱུས་ལྟར་
སློབ་འཁོར་འཕུལ་རིག་
ལག་ཁྱེར་ ༣ པ།

Competency Based Curriculum
Electric Vehicle Technology
Certificate 3

Technical Trainers Training and Resource Center
Department of Workforce Planning and Skills Development
Ministry of Education and Skills Development
Thimphu

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FOREWORD

Bhutan has seen a gradual increase in the requirement of skilled workers in recent years due to growth of industries. However, supply of skilled workforce that are responsive to the needs of the industry has not been able to keep in pace with the industry demand. Since the skilled workers are crucial ingredient for socio-economic development of the country, it is important to have adequate number of trained and certified workers. With growing industries, the “Electric Vehicle Service Technician” is not only the most significant occupation but also have high demand in the labour market. In an effort to meet the skilled human resources requirement in the area of power sector, it is imperative to deliver training based on Competency Based Training system in Electric Vehicle Technology BQF Certificate-3 to ensure quality and adequate number of work force in this sector.

To this end, the Department of Workforce Planning and Skills Development (DWPSD) is pleased to present revised Competency Based Curriculum for Electric Vehicle Technology Certificate-3 course developed based on national competency standard. Since it is an outcome of a more participatory process of curriculum development, it is expected to provide training delivery with reformed approaches having its content being directly related to labour market needs, focusing on imparting of skills and assessment based on industry work standards. We believe that the Competency Based Curriculum will help in bridging the skill gap between industry’s needs and training institutes thereby enhance the employability of the technical graduates.

The Department acknowledges the valuable contributions made by institutes, officials, and experts from relevant industries who were involved in the design and development of this curriculum. As it is a dynamic document which may require revision based on the needs of the changing labour market, the Department look forward to receiving valuable feedbacks from the institutes and the industries to further improve and refine the curriculum

The Department hope that this document will help advance Competency Based Learning in most of the TVET Institutions.



(Sangay Dorji)

Officiating Director

Department of Workforce Planning and Skills Development

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COMPETENCY PROFILE

Trade: Electric Vehicle Technology Certificate Level-3

Competency Area	Sub- Competency Area	Competencies/Tasks			
A: Carrying out preparatory work for EV servicing	A1: Apply safety practices at workplace	A1.01 Use PPE	A1.02 Use fire extinguisher	A1.03 Apply basic first aid	A1.04 Implement emergency measures
	A2: Use tools and equipment	A2.01 Use two pole testers	A2.02 Use mega ohm meter	A2.03 Use battery pack leak tester	A2.04 Use coolant refilling and drain kit
		A2.05 Use battery module balancer	A2.06 Use two post car lift	A2.07 Use scissor lift	
	A3: Prepare to service EV components	A3.01 Set up work area	A3.02 Prepare tools and equipment	A3.03 Perform High Voltage (HV) shutdown	A3.04 Check residual voltage
B: Carrying out servicing of EV drive battery, EV control module and EV traction motor system	B1: Service EV drive battery	B1.01 Dismount EV drive battery	B1.02 Replace battery cell	B1.03 Replace power relay assembly	B1.04 Replace Battery management system
		B1.05 Replace cell monitoring units	B1.06 Replace temperature sensors	B1.07 Replace water level sensor	B1.08 Replace wire harness and terminals
		B1.09 Replace coolant hose	B1.10 Replace battery case	B1.11 Perform battery pack leak test	B1.12 Mount EV drive battery
		B1.13 Diagnose EV drive battery fault	B1.14 Replace auxiliary battery		

	B2: Service EV control module	B2.01 Replace Power Delivery Module assembly	B2.02 Replace Inverter	B2.03 Replace electric water pump	B2.04 Replace electronic parking brake
		B2.05 Replace electronic control brake unit	B2.06 Inspect interlock circuit	B2.07 Diagnose EV control module	
	B3: Service EV traction motor system	B3.01 Calibrate resolver offset	B3.02 Deactivate Park lock actuator	B3.03 Replace Park lock actuator	B3.04 Service reduction gearbox
		B3.05 Replace traction motor	B3.06 Diagnose traction motor system		
	C: Carry out servicing of EV AC system and EV charging system	C1: Perform refrigerant recovery and recharging	C1.01 Recover refrigerant	C1.02 Perform flushing	C1.03 Perform evacuation
		C2: Service EV AC electrical system	C2.01 Replace electric AC compressor	C2.02 Replace PTC heater	C2.03 Diagnose EV AC system
		C3: Service EV charging system	C3.01 Replace on-board charger	C3.02 Update software	C3.03 Diagnose EV charging system

COURSE INFORMATION

COURSE TITLE	Electric Vehicle Technology
LEVEL	Certificate Level 3
COURSE OBJECTIVE	Upon completion of this training program, the trainees will be able to: • Carry out preparatory work for EV servicing • Carry out servicing of EV drive battery, EV control module and EV traction motor system • Carry out servicing of EV AC system and EV charging system
COURSE DESCRIPTION	This course is designed to provide trainees with the knowledge, skills and attitudes required to be competent Electric Vehicle Service Technician. This course will prepare the trainees to exhibit professionalism, teamwork, adaptability, and safety practices as per the requirement of workplace. To obtain certification of this course, all learning outcomes prescribed must be achieved.
COURSE DURATION	922 Hours
TRAINER AND TRAINEE RATIO	1:12 (Practical) 1:20 (Theory)
ENTRY REQUIREMENT	Completed Auto Electrical/Automobile Technician Certificate-2
TVET TRAINER REQUIREMENTS	• Must have a minimum qualification of Diploma in relevant field with three years of working experience; • Must have undergone Training of Trainers-Technical Instruction and Pedagogy; • Must¹ have at least 5 years job/industry experience

¹ Applicable only if institutes hire instructor or guest lecturer from industry

COURSE OUTLINE

Sl. No	Subject /Module	Duration (Hours)	Content Competencies (Mapped)
1.	Core modules	378	CC
2.	OJT	280 (2months)	CC
Total hours for Core Competencies (CC)		658	
1.	Applied Dzongkha	42	SS
2.	ICT	48	SS
3.	Applied Mathematics	53	SS
4.	Technical English	51	SS
Total hours for Soft Skills (SS)		194	
1.	Assessment	70	
Entire Course Duration		922	

Note: (*) This curriculum contains core modules which cover main competencies of Electric Vehicle Technology Certificate level-3 and OJT component. There are separate curricula for subjects/modules for delivery of soft skills, professional development & values and environmental concern & safety. In order to achieve the qualification of Electric Vehicle Technology Certificate level-3, the subjects and modules listed must be accomplished as per the credit hours provided.

Content Competencies:

CC-Core Competencies

SS-Soft Skills

PD-Professional Development and Values

ES-Environmental concern and Safety

COURSE STRUCTURE FOR CORE COMPETENCIES

Training Modality	Module Title	Learning outcomes	Nominal Duration (Hour)
1. Institute Training	A. Carrying out preparatory work for EV servicing	A1. Apply safety practices at workplace A2. Use tools and equipment A3. Prepare to service EV components	56
	B. Carrying out servicing of EV drive battery, EV control module and EV traction motor system	B1. Service EV drive battery B2. Service EV control module B3. Service EV traction motor	241
	C. Carrying out servicing of EV AC system and EV charging system	C1. Perform refrigerant recovery and charging C2. Service AC electrical system C3. Service EV charging system	81
2. On the Job Training	A. Carrying out preparatory work for EV servicing	A1. Apply safety practices at workplace A2. Use tools and equipment A3. Prepare to service EV components	280 (2 months)
	B. Carrying out servicing of EV drive battery, EV control module and EV traction motor system	B1. Service EV drive battery B2. Service EV control module B3. Service EV traction motor	
	C. Carrying out servicing of EV AC system and EV charging system	C1. Perform refrigerant recovery and charging C2. Service AC electrical system C3. Service EV charging system	
Total CC Duration:			658

ASSESSMENT AND CERTIFICATION SYSTEM

ASSESSMENT	Diagnostic assessment of each skill will be conducted to identify areas where trainees may require additional support or intervention. This assessment will also evaluate their existing knowledge, skills, and understanding prior to a specific learning experience or unit of study. Methods such as pre-tests, concept mapping, KWL charts, and observations of student work will be utilized. Formative assessment for every module and learning outcome will be conducted through assignments, project works, continuous assessment, demonstration of practical skills/observations, oral questioning and written test. Summative assessment after completion of each national certificate level will be conducted by TVET Quality Council, Bhutan Qualifications and professional certification authority, MoESD as per the National Competency Standards and Guidelines for National Assessment and Certification System, provided the course is accredited with TVET Quality Council, Bhutan Qualifications and professional certification authority, MoESD.
CERTIFICATION	On successful completion of every module, the institute will award a certificate of achievement to the trainees. The TVET Quality Council, Bhutan Qualifications and professional certification authority, MoESD will award a National Certificate to the trainees upon the successful completion of NC level assessment.
COURSE DELIVERY	1. Modular 2. Demonstration 3. Lecture 4. Industrial training/attachment 5. Project work 6. Problem-based learning 7. Project-based learning
RESOURCES	Materials • Pen, paper, cleaning rag, first aid kit, EV drive battery, inverter, motor, battery pack, compressed air, safety barrier, safety signs, service plug, power relay assembly, BMS, Cell Monitoring unit, temperature sensor, water level sensor, wire harness, connectors, wire terminals, coolant hose, battery case, bubble spray, coolant, PDM assembly, gasket, inverter, electric water pump, electronic parking brake caliper, brake pad, shim, brake fluid, electronic control brake unit, interlock relay, 12V battery, interlock assembly, wire harness, electronic control module, fuse, park lock actuator, lubricant, fluid, EV traction motor, undercover, reduction gearbox, power distribution module, AC compressor, refrigerant, compressor oil, 3-phase HV cable, reducer oil, coolant, MAC/AC hose, soap, refrigerant, compressor oil, compressor assembly, O-ring, PTC heater, on-board charger and charging cable (EVSE) Tools • Stretcher, dummy, vinyl sheet, scissors, rescue hook, auto-mechanic hand tool set, insulated socket wrench, insulated DE spanner set, insulated ring spanner

	set, insulated screw driver set, coolant refilling & drain kit, pallet, torque wrench, fastening belt, brake fluid bleeding tool, manual oil gun, refrigerant leak detector and UV torch Instruments • Two pole tester, mega ohm meter, HV multimeter, battery pack leak tester, weighing scale and manifold gauge Equipment • Fire extinguisher, battery pack leak tester, coolant refill & drain kit, battery module balancer, Air compressor, scissor lift/EV battery lift, heat gun, crane with attachment, diagnostic scan tool, recovery cylinder, refrigerant recovery machine, vacuum pump, refrigerant charging station, diagnostic scan tool with wifi connection and charging station PPE • High Voltage insulation glove, electrical shock proof safety boot, face shield, helmet, electrical insulation work dress and rubber mat Learning Materials • Competency Based Learning Materials (CBLM) • Reference books • Hand-outs • Audio visuals Infrastructure and training facilities • <i>Theory classroom size:</i> Minimum of 1 m² per trainee; • <i>Practical Workshop size:</i> Minimum of 2.25 m² per trainee. Variables must be considered depending upon type of skills being taught and the number of trainees participating at a time.
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MODULE 1: CARRYING OUT PREPARATORY WORK FOR EV SERVICING

MODULE INFORMATION

Occupation	Electric Vehicle Service Technician
Competency Area	Carry out preparatory work for EV servicing
Module Title	Carrying out preparatory work for EV servicing
Module Code	7412-L3-M1
Module Description	This module is structured to provide learners with the knowledge, skills and right attitude required to apply safety practices at workshop, use tools & equipment and prepare to service EV components
Nominal Duration	56 Hours
Certificate Level	Certificate Level 3
Pre-requisite	Auto-Electrical/ Automobile Technician Certificate Level 2
Learning Outcome	1. Apply safety practices at workplace 2. Use tools and equipment 3. Prepare to service EV components

Module Title	Carrying out preparatory work for EV servicing		
Module Code	7412- L3-M1		
Learning Outcome 1	Apply safety practices at workplace		
Duration	Theory: 10 hours	Practical:9 hours	Total: 19 hours
Assessment Criteria	• PPE is used as per the job requirement following standard procedure • Fire extinguisher is used as per the job requirement following standard procedure • Basic first aid is applied as per the job requirement following standard procedure • Emergency measures are implemented as per the job requirement following standard procedure		
Content	A1.00 Introductory knowledge • Introduction to EV technology • Climate change mitigation methods • Comparison between ICE and EV • Automobile life cycle assessment • Statistics of EV in Bhutan • Trends and scope of EV service technician A1.01 Using PPE Knowledge • Introduction to PPE • Types of PPE and their uses • Different standards of PPE • Importance of selecting correct PPE • Importance of wearing PPE at site Skills • Using EV insulation gloves • Observation skills • Planning skills • Teamwork skills • Communication skills • Problem-solving skills • Interpersonal relationship skills • Creativity skills • Time management skills • Innovation skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity		

	• Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation A1.02 Using fire extinguisher Knowledge • Principle of fire • Classification of fire • Definition of fire extinguisher • Purpose of using fire extinguisher • Types of fire extinguishers and its application • Methods of combating fire • Importance of periodic inspection of fire extinguishers Skills • Observation skills • Planning skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation • Ensuring to maintain safe distance between the fire extinguisher and the fire A1.03 Applying basic first aid Knowledge • Introduction to first aid • Importance of first aid • Types of first aid • Introduction to CPR • Purpose of CPR • Dos and Don'ts of CPR Skills • Performing CPR
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	• Using first aid kits • Observation skills • Planning skills <i>Attitude, safety, and environmental concern</i> • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation A1.04 Implementing emergency measures <i>Knowledge</i> • Introduction to emergency measures • Precautions while taking emergency response • Reaction of the human body when electrocuted • Effects on the human body in the event of electric shock <i>Skills</i> • Using a first aid kit • Observation skills • Communication skills • Problem-solving skill <i>Attitude, safety, and environmental concern</i> • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation
Learning Conditions	Learning Materials • Competency-Based Learning Materials (CBLM) • Hand-outs • Audio Visuals

	• Reference books • Manuals • LMS Learning facilities and infrastructure • Classroom with adequate facilities • Information Technology (IT) lab • Library • Workshop Materials • Pen, paper, marking cloths, and first aid kit Tools • Stretcher, dummy, vinyl sheet, scissors and rescue hook Equipment • Fire extinguisher and oxygen cylinder PPE • High Voltage insulation gloves, electrical shockproof, safety boot, face shield, helmet, electrical insulation work dress and rubber mat
Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: • Lecture • Interactive discussion • Demonstration • Industrial visit/training • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Oral/viva-voce • Written test • Assignment • Project work

Module Title	Carrying out preparatory work for EV servicing		
Module Code	7412- L3-M1		
Learning Outcome 2	Use tools and equipment		
Duration	Theory: 5.5 hours	Practical: 16 hours	Total: 21.5 hours
Assessment Criteria	- Two pole tester is used as per the job requirement following standard procedure - Mega Ohm meter is used as per the job requirement following standard procedure - Battery pack leak tester is used per the job requirement following standard procedure - Coolant refilling and drain kit is used per the job requirement following standard procedure - Coolant refilling and drain kit is used per the job requirement following standard procedure - Battery module balancer is used per the job requirement following standard procedure - Two post car lift is used as per the job requirement following standard procedure - Scissors lift is used as per the job requirement following standard procedure		
Content	A2.01 Using two pole testers Knowledge - Purpose and characteristics of two-pole tester - Types of two-pole tester and their uses - Different standards of two-pole tester Skills - Analytical skills - Communication skills - Observation skills - Planning skills Attitude, safety and environmental concern - Effective time management - Being team player - Being efficient in using resources - Being vigilant and patient - Having work ethics and integrity - Proper handling of tools, materials and equipment - Having sense of ownership and accountability - Ensuring correct use of PPE - Ensuring proper disposal of waste - Ensuring to follow environmental rules and regulations - Ensuring to follow OHS rules and regulation		

	A2.02 Using mega ohm meter Knowledge • Purpose of Mega-ohm meter • Characteristics of mega-ohm meter • Types of Mega-ohm meter and their application Skills • Analytical skills • Communication skills • Observation skills • Planning skills Attitude, safety and environmental concern • Effective time management • Being team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials and equipment • Having sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation A2.03 Using battery pack leak tester Knowledge • Purpose and characteristics of battery pack leak tester • Purpose of testing air tightness in the battery pack Skills • Observation skills • Planning skills Attitude, safety and environmental concern • Effective time management • Being team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials and equipment • Having sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation A2.04 Using coolant refill and drain kit
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	Knowledge • Purpose of coolant refill and drain kit • Characteristics of using coolant refill and drain kit Skills • Observation skills • Planning skills Attitude, safety and environmental concern • Effective time management • Being team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials and equipment • Having sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation A2.05 Using battery module balancer Knowledge • Introduction to battery module balancer • Purpose of battery module balancer Skills • Observation skills • Planning skills Attitude, safety and environmental concern • Effective time management • Being team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials and equipment • Having sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation A2.06 Using two-post car lift Knowledge • Types of two post-car lift • Function of two post-car lift • Operation of two post-car lift
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	• Periodic maintenance of two post-car lift Skills • Reading the manufacturer's manual • Observation skills • Planning skills • Communication skills Attitude, safety and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation A2.07 Using scissor lift Knowledge • Types of scissors lift • Function of scissors lift • Operation of scissors lift • Periodic maintenance of scissors lift Skills • Reading the manufacturer's manual • Observation skills • Planning skills • Communication skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation
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Learning Conditions	Learning Materials • CBLM • Hand-outs • Audio Visuals • Reference books • Manuals • LMS Learning Facilities and infrastructure • Classroom with adequate facilities • Information Technology (IT) lab • Library • Workshop Materials • Pen, paper, EV drive battery, inverter, motor, battery pack, hydraulic fluid and compressed air Tools • Two pole testers and a mega-ohm meter Equipment • Scissors lift, battery pack leak tester, coolant refill & drain kit, Two post-car lift, and battery module balancer PPE • High Voltage insulation gloves, electrical shockproof safety boot, electrical insulation work dress, and rubber mat
Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: • Lecture • Interactive discussion • Demonstration • Industrial visit/training • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Oral/viva-voce • Written test • Assignment • Project work

Module Title	Carrying out preparatory work for EV servicing		
Module Code	7412- L3-M1		
Learning Outcome 3	Prepare to service EV components		
Duration	Theory: 7.5 hours	Practical:8 hours	Total: 15.5 hours
Assessment Criteria	• Work area is set up as per the job requirement following standard procedure • Tools and materials are prepared as per the job requirement following standard procedure • High Voltage shutdown is performed as per the job requirement following standard procedure • Residual voltage is checked as per the job requirement following standard procedure		
Content	A3.01 Setting up work area Knowledge • Importance of setting up work area • Principle of 5S • Types of HV cautionary signage Skills • Observation skills • Planning skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials and equipment • Having sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation A3.02 Preparing tools and equipment Knowledge • Importance of preparing tools and equipment • Consequences of using defective tools and equipment Skills • Observation skills • Planning skills Attitude, safety and environmental concern • Effective time management • Being a team player		

	• Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation A3.03 Performing high voltage shutdown <i>Knowledge</i> • Introduction to Electric Vehicle (EV) • Construction of EV system • Components of EV system and their functions • Introduction to High Voltage shutdown • Purpose of high voltage shutdown • Risks and Hazards related to high voltage <i>Skills</i> • Analytical skills • Communication skills • Observation skills • Planning skills <i>Attitude, safety and environmental concern</i> • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation A3.04 Checking residual voltage <i>Knowledge</i> • Types of battery • Classification of battery • Introduction to residual voltage • Purpose of checking residual voltage <i>Skills</i> • Using two pole testers
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	- Analytical skills - Communication skills - Observation skills - Planning skills Attitude, safety and environmental concern - Effective time management - Being team player - Being efficient in using resources - Being vigilant and patient - Having work ethics and integrity - Proper handling of tools, materials and equipment - Having sense of ownership and accountability - Ensuring correct use of PPE - Ensuring proper disposal of waste - Ensuring to follow environmental rules and regulations - Ensuring to follow OHS rules and regulation
Learning Conditions	Learning Materials - CBLM - Hand-outs - Audio Visuals - Reference books - Manuals - LMS Learning Facilities and infrastructure - Classroom with adequate facilities - Information Technology (IT) lab - Library - Workshop Materials - Pen, paper, safety barrier, safety signs, service plug and EV battery Tools - Auto mechanic hand tools set, EV technician hand tool set Instrument - Two pole tester PPE - High Voltage insulation gloves, electrical shockproof safety boot, and electrical insulation work dress

Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: • Lecture • Interactive discussion • Demonstration • Industrial visit/training • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Oral/viva-voce • Written test • Assignment • Project work

MODULE 2: CARRYING OUT SERVICING OF EV DRIVE BATTERY, EV CONTROL MODULE, AND EV TRACTION MOTOR SYSTEM

MODULE INFORMATION

Occupation	Electric Vehicle Service Technician
Competency Area	Carry out servicing of EV drive battery, EV control module and EV traction motor system
Module Title	Carrying out servicing of EV drive battery, EV control module and EV traction motor system
Module Code	7412- L3-M2
Module Description	This module is structured to provide the learners with knowledge, skills and right attitude to service EV drive battery, EV control module and EV traction motor
Nominal Duration	241 Hours
Qualification Level	Certificate Level 3
Pre-requisite	Completed Module: 7412-L3-M1
Learning Outcome	1. Service EV drive battery 2. Service EV control module 3. Service EV traction motor system

Module Title	Carrying out servicing of EV drive battery, EV control module and EV traction motor system		
Module Code	7412- L3-M2		
Learning Outcome 1	Service EV drive battery		
Duration	Theory: 24.5 hours	Practical: 78.5 hours	Total: 103 hours
Assessment Criteria	• EV drive battery is dismantled as per the job requirement following standard procedure • Battery cell is replaced as per the job requirement following standard procedure • Power relay assembly is replaced as per the job requirement following standard procedure • Battery Management system is replaced as per the job requirement following standard procedure • Cell monitoring unit is replaced as per the job requirement following standard procedure • Temperature sensors are replaced as per the job requirement following standard procedure • Water level sensor is replaced as per the job requirement following standard procedure • Wire harness and terminals are replaced as per the job requirement following standard procedure • Coolant hose is replaced as per the job requirement following standard procedure • Battery case is replaced as per the job requirement following standard procedure • Battery pack leak test is performed as per the job requirement following standard procedure • EV Battery pack is mount as per the job requirement following standard procedure • EV drive battery fault is diagnosed as per the job requirement following standard procedure • Auxiliary battery is replaced as per the job requirement following standard procedure		
Content	B1.01 Dismounting EV drive battery Knowledge • Introduction to lithium-ion battery • Types of lithium-ion battery • Construction of EV battery pack • Components of EV battery pack and their functions • Working of EV battery • Specification of EV battery • Safety precautions while handling EV battery • Importance of implementing logout/tagout procedure Skills		

	• Operating scissor lift • Using two post car lift • Using two pole tester • Analytical skills • Communication skills • Observation skills • Planning skills <i>Attitude, safety, and environmental concern</i> • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B1.02 Replacing battery cell <i>Knowledge</i> • Function of EV battery cell • Types of lithium-ion battery cell • Composition of Lithium-ion battery cell • Chemical reaction of lithium-ion Battery • Process of EV battery disposal • Calculations related to EV battery sizing and energy consumption • Causes, symptoms, and remedies of battery cell failure <i>Skills</i> • Using two pole tester • Using battery module hanger • Using multimeter • Observation skills • Planning skills • Numeracy skills <i>Attitude, safety, and environmental concern</i> • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations
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	- Ensuring to follow OHS rules and regulation B1.03 Replacing power relay assembly Knowledge - Definition of Power relay assembly - Function of power relay assembly - Construction of power relay - Symptoms, causes, and remedies of defective power relay assembly Skills - Using multimeter - Observation skills - Planning skills Attitude, safety and environmental concern - Effective time management - Being a team player - Being efficient in using resources - Being vigilant and patient - Having work ethics and integrity - Proper handling of tools, materials, and equipment - Having a sense of ownership and accountability - Ensuring correct use of PPE - Ensuring proper disposal of waste - Ensuring to follow environmental rules and regulations - Ensuring to follow OHS rules and regulation B1.04 Replacing Battery Management System Knowledge - Introduction to Battery Management System (BMS) - Function of BMS - Construction of BMS - Working of regenerative braking system - Causes, symptoms, and remedies of BMS failure Skills - Observation skills - Planning skills Attitude, safety, and environmental concern - Effective time management - Being a team player - Being efficient in using resources - Being vigilant and patient - Having work ethics and integrity - Proper handling of tools, materials, and equipment - Having a sense of ownership and accountability - Ensuring correct use of PPE - Ensuring proper disposal of waste - Ensuring to follow environmental rules and regulations
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	- Ensuring to follow OHS rules and regulation B1.05 Replacing Cell Monitoring Unit Knowledge - Introduction to Cell Monitoring Unit (CMU) - Function of CMU - Causes, symptoms, and remedies of CMU failure Skills - Analytical skills - Communication skills - Observation skills - Planning skills Attitude, safety, and environmental concern - Effective time management - Being a team player - Being efficient in using resources - Being vigilant and patient - Having work ethics and integrity - Proper handling of tools, materials, and equipment - Having a sense of ownership and accountability - Ensuring correct use of PPE - Ensuring proper disposal of waste - Ensuring to follow environmental rules and regulations - Ensuring to follow OHS rules and regulation B1.06 Replacing temperature sensor Knowledge - Introduction to temperature sensor - Function of temperature sensor - Construction of temperature sensor - Working principle of temperature sensor - Causes, symptoms, and remedies of temperature sensor failure Skills - Using multimeter - Observation skills - Planning skills Attitude, safety, and environmental concern - Effective time management - Being a team player - Being efficient in using resources - Being vigilant and patient - Having work ethics and integrity - Proper handling of tools, materials, and equipment - Having a sense of ownership and accountability - Ensuring correct use of PPE - Ensuring proper disposal of waste
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	• Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B1.07 Replacing water level sensor Knowledge • Introduction to water level sensor • Function of water level sensor • Construction of water level sensor • Working principle of water level sensor • Causes, symptoms, and remedies of water level sensor failure Skills • Using multimeter • Observation skills • Planning skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials and equipment • Having sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B1.08 Replacing wire harness and terminals Knowledge • Introduction to wire harness • Determining sizes of wire • Safety precautions while handling wire harness • Symptoms, causes, and remedies of wire harness and terminals faults Skills • Using multimeter • Interpreting wiring diagram • Observation skills • Planning skills • Numeracy skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment
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	• Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B1.09 Replacing coolant hose <i>Knowledge</i> • Purpose of EV battery cooling system • Components of EV battery cooling system • Working of EV battery Cooling system • Symptoms, causes, and remedies of faulty EV battery cooling system <i>Skills</i> • Observation skills • Planning skills <i>Attitude, safety, and environmental concern</i> • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B1.10 Replacing battery case <i>Knowledge</i> • Purpose of battery case • Causes, symptoms, and remedies of battery case failure <i>Skills</i> • Observation skills • Planning skills <i>Attitude, safety, and environmental concern</i> • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste
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	• Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B1.11 Performing battery pack leak test Knowledge • Importance of battery pack leak test • Consequences of air leakage in battery pack • Causes of battery pack leakage Skills • Using battery air leak tester • Observation skills • Planning skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B1.12 Mounting EV battery Knowledge • Safety precautions for lifting EV battery • Purpose of checking IR on battery and vehicle body after mounting Skills • Using a scissor lift • Using mega ohm tester • Using Diagnostic Scan tool • Using two post car lift • Observation skills • Planning skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE
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	• Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B1.13 Diagnosing EV drive battery <i>Knowledge</i> • Causes, symptoms, and remedies of EV drive battery fault <i>Skills</i> • Using diagnostic scan tool • Observation skills • Planning skills <i>Attitude, safety, and environmental concern</i> • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B1.14 Replace auxiliary battery <i>Knowledge</i> • Function of auxiliary battery • Definition of key fob • Purpose of Waiting for 5–10 minutes for ECU power down • Purpose of replacing auxiliary battery within one hour • Reason for battery registration via OBD-II <i>Skills</i> • Using diagnostic scan tool • Observation skills • Planning skills <i>Attitude, safety, and environmental concern</i> • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste and auxiliary battery
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	- Ensuring to follow environmental rules and regulations - Ensuring to follow OHS rules and regulation
Learning Conditions	Learning Materials - CBLM - Hand-outs - Audio Visuals - Reference books - Manuals - LMS Learning Facilities and Infrastructure - Classroom with adequate facilities - Information Technology (IT) lab - Library - Workshop Materials - Pen, paper, EV battery, power relay assembly, BMS, Cell Monitoring unit, temperature sensor, water level sensor, wire harness, connectors, wire terminals, coolant hose, battery case, bubble spray, lead acid battery, battery pack, petroleum jelly and coolant Tools - Auto mechanic hand tool set, insulated socket wrench set, insulated DE spanner set, insulated ring spanner set, insulated screwdriver set, coolant refill & drain kit, pallet, torque wrench and fastening belt Instrument - Two pole tester, HV multimeter, battery pack leak tester, and mega ohm meter Equipment - Air compressor, scissor lift, two post car lift, heat gun, crane with attachment, and diagnostic scan tool PPE - High Voltage insulation glove, electrical shockproof safety boot, face shield, helmet, electrical insulation work dress, and rubber mat
Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: - Lecture - Interactive discussion - Demonstration - Industrial visit/training - Guided practice - Group practice with project-based learning - Individual practice with problem-based learning

Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Oral/viva-voce • Written test • Assignment • Project work
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Module Title	Carrying out servicing of EV drive battery, EV control module, and EV traction motor system		
Module Code	7412- L3-M2		
Learning Outcome 2	Service EV control module		
Duration	Theory: 14 hours	Practical: 53 hours	Total: 67 hours
Assessment Criteria	• PDM assembly is replaced as per job requirement following standard procedure • Inverter is replaced as per job requirement following standard procedure • Electric water pump is replaced as per job requirement following standard procedure • Electronic parking system is replaced as per job requirement following standard procedure • Electronic control brake unit is replaced as per job requirement following standard procedure • Interlock circuit is inspected as per job requirement following standard procedure • EV control module is diagnosed as per job requirement following standard procedure		
Contents	B2.01 Replacing PDM assembly Knowledge • Introduction to EV control module • Function of EV control module • Function of Power Delivery Module and DC/DC converter • Construction of PDM assembly • Working principle of PDM assembly • Causes, symptoms, and remedies of PDM assembly failure Skills • Using diagnostic scan tool • Analytical skills • Observation skills • Planning skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials and equipment • Having sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B2.02 Replacing inverter		

	Knowledge • Function of inverter • Construction of inverter • Working principle of inverter • Causes, symptoms, and remedies of inverter failure Skills • Using diagnostic scan tool • Analytical skills • Observation skills • Planning skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B2.03 Replacing electric water pump Knowledge • Introduction to EV motor and power electronics cooling system • Construction of EV motor and power electronics cooling system • Working principle of EV motor and power electronics cooling system • Construction of electric water pump • Operation of electric water pump • Causes, symptoms, and remedies of cooling system failure Skills • Using diagnostic scan tools • Analytical skills • Observation skills • Planning skills Attitude, safety and environmental concern • Effective time management • Being team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE
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	• Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B2.04 Replacing electronic parking brake Knowledge • Introduction to electronic parking brake system • Construction of an electronic parking brake system • Working principle of electronic parking brake system • Causes, symptoms, and remedies of electronic parking brake failure Skills • Using diagnostic scan tool • Analytical skills • Communication skills • Observation skills • Planning skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B2.05 Replacing electronic control brake unit Knowledge • Introduction to electronic control brake unit • Purpose of electronic control brake unit • Construction of electronic control brake unit • Causes, symptoms, and remedies of electronic control brake unit failure Skills • Using diagnostic scan tool • Analytical skills • Communication skills • Observation skills • Planning skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient
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	• Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B2.06 Inspecting interlock circuit Knowledge • Introduction to interlock circuit • Types of interlock • Function of interlock Skills • Using diagnostic scan tool • Using multimeter • Analytical skills • Communication skills • Observation skills • Planning skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B2.07 Diagnosing EV control module Knowledge • Introduction to EV control module • Function of EV control module • Causes, symptoms, and remedies of EV Control Module Failure Skills • Use diagnostic scan tool • Using multimeter • Using oscilloscope • Analytical skills • Communication skills • Observation skills
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	• Planning skills Attitude, safety and environmental concern • Effective time management • Being team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials and equipment • Having sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation
Learning Conditions	Learning Materials • CBLM • Hand outs • Audio-visuals • Reference books • Manuals • LMS Learning Facilities and Infrastructure • Classroom with adequate facilities • Library • IT lab • Workshop Materials • Pen, paper, PDM assembly, gasket, inverter, coolant, electric water pump, electronic parking brake caliper, brake pad, shim, brake fluid, electronic control brake unit, interlock relay, 12V battery, interlock assembly, wire harness, and electronic control module Tools • Auto mechanic hand tool set, torque wrench, flare nut wrench, and brake fluid bleeding tool Instrument • Multimeter Equipment • Diagnostic scan tool PPE • High Voltage insulation glove, face mask, electrical shockproof safety boot, and electrical insulation work dress
Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: • Lecture

	• Interactive discussion • Demonstration • Industrial visit/training • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Oral/viva-voce • Written test • Assignment • Project work • Rubrics

Module Title	Carrying out servicing of EV drive battery, EV control module and EV traction motor system		
Module Code	7412- L3-M2		
Learning Outcome 3	Service EV traction motor system		
Duration	Theory: 17 hours	Practical: 54 hours	Total: 71 hours
Assessment Criteria	• Resolver offset is calibrated as per job requirement following standard procedure • Park lock actuator is deactivated as per job requirement following standard procedure • Park lock actuator is replaced as per job requirement following standard procedure • Reduction gearbox is serviced as per job requirement following standard procedure • Traction motor is replaced as per job requirement following standard procedure • Traction motor system is diagnosed as per job requirement following standard procedure		
Contents	B3.01 Calibrating resolver offset Knowledge • Introduction to Motor Control unit • Function of the resolver in motor control • Purpose of calibrating resolver offset Skills • Using diagnostic scan tools • Analytical skills • Observation skills • Planning skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B3.02 Deactivating Park lock actuator Knowledge • Introduction to electronic shift selector • Shift selection positions and their functions • Function of electronic shift control module		

	• Purpose of deactivating park lock actuator Skills • Communication skills • Observation skills • Planning skills Attitude, safety, and environmental concern • Effective time management • Being team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B3.03 Replacing Park lock actuator Knowledge • Function of Park lock actuator • Construction of Park lock actuator • Working of Park lock actuator • Symptoms, causes and remedies of Park lock actuator failure Skills • Using diagnostic scan tool • Observation skills • Planning skills Attitude, safety, and environmental concern • Effective time management • Being team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B3.04 Servicing reduction gearbox Knowledge • Introduction to reduction gearbox • Component of reduction gearbox and its function
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	• Working principle of reduction gearbox • Purpose of Automatic Transmission Fluid (ATF) • Properties of ATF • Function of earth brush • Symptoms, causes, and remedies of reduction gearbox failure Skills • Using two post car lift • Observation skills • Planning skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B3.05 Replacing traction motor Knowledge • Introduction to motor • Types of motor • Purpose of traction motor • Specification of motor • Construction of motor • Flemings left hand and right-hand rule • Working principle of motor • Symptoms, causes, and remedies of traction motor failure Skills • Using diagnostic scan tool • Communication skills • Observation skills • Planning skills Attitude, safety, and environmental concern • Effective time management • Being team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability
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	• Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation B3.06 Diagnosing traction motor system Knowledge • Methods of diagnosing traction motor failure • Symptoms, causes, and remedies of traction motor system failure Skills • Using diagnostic scan tool • Observation skills • Planning skills Attitude, safety and environmental concern • Effective time management • Being team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation
Learning Conditions	Learning Materials • CBLM • Handouts • Audio-visuals • Reference books • Manuals • LMS Learning Facilities and Infrastructure • Classroom with adequate facilities • Library • IT lab • Workshop Materials • Pen, paper, fuse, park lock actuator, lubricant, ATF, EV traction motor, undercover, reduction gearbox, power distribution module, 3-phase HV

	cable, reducer oil, refrigerant R134a, compressor oil, nitrogen gas, and coolant Tools • Auto Mechanic hand tool set and manual oil gun Equipment • Diagnostic scan tool, two post car lift, and scissor lift PPE • High Voltage insulation glove, electrical shock proof safety boot, electrical insulation work dress and rubber mat
Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: • Lecture • Interactive discussion • Demonstration • Industrial visit/training • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Oral/viva-voce • Written test • Assignment • Project work

MODULE 3: CARRYING OUT SERVICING OF EV AC SYSTEM AND EV CHARGING SYSTEM

MODULE INFORMATION

Occupation	Electric Vehicle service Technician
Competency Area	Carry out servicing of EV AC electrical system and EV charging system
Module Title	Carrying out servicing of EV AC electrical system and EV charging system
Module Code	7412- L3-M3
Module Description	This module is structured to provide the learners with knowledge, skills and right attitude required service EV AC system and EV charging system
Nominal Duration	81 Hours
Qualification Level	Certificate Level 3
Pre-requisite	Completed Module 7412-L3-M2
Learning Outcome	1. Perform refrigerant recovery and charging 2. Service EV AC electrical system 3. Service EV charging system

Module Title	Carrying out servicing of EV AC electrical system and EV charging system		
Module Code	7412- L3-M3		
Learning Outcome 1	Perform refrigerant recovery and charging		
Duration	Theory: 10.5 hours	Practical:20 hours	Total: 30.5 hours
Assessment Criteria	- Refrigerant is recovered as per the job requirement following standard procedure - Flushing is performed as per the job requirement following standard procedure - Evacuation is performed as per the job requirement following standard procedure - Refrigerant is charged as per the job requirement following standard procedure		
Content	C1.01 Recovering refrigerant Knowledge - Introduction to MAC system - Purpose of MAC system - Construction of MAC system - Working principle of MAC system - Purpose of refrigerant recovery Skills - Using recovery machine - Using manifold gauge - Using weighing scale - Numeracy skills - Analytical skills - Communication skills Attitude, safety and environmental concern - Effective time management - Being team player - Being efficient in using resources - Being vigilant and patient - Having work ethics and integrity - Proper handling of tools, materials, and equipment - Having a sense of ownership and accountability - Ensuring correct use of PPE - Ensuring proper disposal of waste - Ensuring to follow environmental rules and regulations - Ensuring to follow OHS rules and regulation C1.02 Perform flushing Knowledge - Purpose of flushing - Purpose of flushing with dry nitrogen - Type of flushing agent		

	Skills • Using nitrogen cylinder • Numeracy skills • Analytical skills • Communication skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation C1.03 Performing evacuation Knowledge • Purpose of evacuation/vacuuming • Purpose of deep vacuuming and maintaining 500 microns Skills • Using manifold gauge • Using vacuum pump • Observation skills • Communication skills • Analytical skills Attitude, safety and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation C1.04 Charging refrigerant Knowledge • Introduction to refrigerant • Classification of refrigerant
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	• Properties of refrigerant • Effect of refrigerant to the environment Skills • Using manifold gauge • Using a vacuum pump • Using a refrigerant charging station • Observation skills • Communication skills • Analytical skills Attitude, safety, and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation
Learning Conditions	Learning Materials • CBLM • Hand-outs • Audio Visuals • Reference books • Manuals • LMS Learning Facilities and infrastructure • Classroom with adequate facilities • Information Technology (IT) lab • Library • Workshop Materials • Pen, paper, markin cloth, MAC/AC hose, soap, notrogen and refrigerant Tools • Auto mechanic hand tool set, and one-way valve Instrument • Weighing scale and manifold gauge Equipment • Recovery cylinder, refrigerant recovery machine, nitrogen cylinder, vacuum pump, and refrigerant charging station

	PPE • High Voltage insulation glove, electrical shockproof safety boot, and electrical insulation work dress
Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: • Lecture • Interactive discussion • Demonstration • Industrial visit/training • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Oral/viva-voce • Written test • Assignment • Project work

Module Title	Carrying out servicing of EV AC electrical system and EV charging system		
Module Code	7112- L3-M3		
Learning Outcome 2	Service EV AC electrical system		
Duration	Theory: 8 hours	Practical: 17 hours	Total: 25 hours
Assessment Criteria	- Electric compressor is replaced as per the job requirement following standard procedure - PTC heater is replaced as per the job requirement following standard procedure - EV AC electrical system is diagnosed as per the job requirement following standard procedure		
Contents	C2.01 Replacing electric AC compressor Knowledge - Introduction EV AC system - Components of EV AC system and their functions - Construction of AC compressor - Working of electric AC compressor - Function of electric AC compressor inverter Skills - Using vacuum pump - Operating refrigerant charging station - Observation skills - Planning skills Attitude, safety and environmental concern - Effective time management - Being a team player - Being efficient in using resources - Being vigilant and patient - Having work ethics and integrity - Proper handling of tools, materials, and equipment - Having a sense of ownership and accountability - Ensuring correct use of PPE - Ensuring proper disposal of waste - Ensuring to follow environmental rules and regulations - Ensuring to follow OHS rules and regulation C2.02 Replacing Positive Temperature Coefficient (PTC) heater Knowledge - Introduction to PTC heater - Function of PTC heater - Construction of PTC heater - Working of PTC heater - Symptoms, causes and remedies of PTC failure Skills - Observation skills - Analytical skills		

	• Planning skills <i>Attitude, safety and environmental concern</i> • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation C2.03 Diagnosing EV AC electrical system <i>Knowledge</i> • Symptoms, causes, and remedies of EV AC electrical system failure <i>Skills</i> • Using diagnostic scan tool • Using vacuum pump • Operating refrigerant charging station • Using manifold gauge • Observation skills • Planning skills <i>Attitude, safety and environmental concern</i> • Effective time management • Being team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials and equipment • Having sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation
Learning Conditions	Learning Materials • CBLM • Hand-outs • Audio-visuals • Reference books • Manuals • LMS Learning Facilities and Infrastructure

	• Classroom with adequate facilities • Library • IT lab • Workshop Materials • Pen, paper, refrigerant, compressor oil, compressor assembly, O-ring and PTC heater Tools • Auto mechanic hand tool set, refrigerant leak detector and UV torch Instrument • Manifold gauge Equipment • Refrigerant charging station, vacuum pump, refrigerant recovery machine, and diagnostic scan tool PPE • High Voltage insulation glove, electrical shockproof safety boot, and electrical insulation work dress
Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: • Lecture • Interactive discussion • Demonstration • Industrial visit/training • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Oral/viva-voce • Written test • Assignment • Project work • Rubrics

Module Title	Carrying out servicing of EV AC electrical system and EV charging system		
Module Code	7112- L3-M3		
Learning Outcome 3	Service EV charging system		
Duration	Theory: 5.5 hours	Practical: 20 hours	Total: 25.5 hours
Assessment Criteria	- On-Board Charger is replaced as per job requirement following standard procedure - Software is updated as per job requirement following standard procedure - Charging system is diagnosed as per job requirement following standard procedure		
Contents	C3.01 Replacing On-Board Charger Knowledge - Introduction to EV charging system - Function of EV charging system - Components of EV charging system and their function - Operation of EV charging system - Types of charging system - Types of charging port - Symptoms, causes, , and remedies of on-board charger failure Skills - Operating charging station - Using diagnostic scan tool - Using multimeter - Analytical skills - Observation skills - Planning skill - Communication skill Attitude, safety and environmental concern - Effective time management - Being a team player - Being efficient in using resources - Being vigilant and patient - Having work ethics and integrity - Proper handling of tools, materials, and equipment - Having a sense of ownership and accountability - Ensuring correct use of PPE - Ensuring proper disposal of waste - Ensuring to follow environmental rules and regulations - Ensuring to follow OHS rules and regulation C3.02 Updating software Knowledge - Introduction to vehicle system software - Importance of updating software		

	Skills • Using diagnostic scan tool • Analytical skills • Observation skill Attitude, safety and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation C3.03 Diagnosing charging system Knowledge • Terminals of charging port and their functions • Symptoms, causes, and remedies of charging system failure Skills • Using diagnostic scan tool • Using multimeter • Analytical skills • Observation skills • Planning skills Attitude, safety and environmental concern • Effective time management • Being a team player • Being efficient in using resources • Being vigilant and patient • Having work ethics and integrity • Proper handling of tools, materials, and equipment • Having a sense of ownership and accountability • Ensuring correct use of PPE • Ensuring proper disposal of waste • Ensuring to follow environmental rules and regulations • Ensuring to follow OHS rules and regulation
Learning Conditions	Learning Materials • CBLM • Hand-outs • Audio-visuals • Reference books

	• Manuals Learning Facilities and Infrastructure • Classroom with adequate facilities • Library • IT lab • Workshop Materials • Pen, paper, On-Board Charger, and charging cable (EVSE) Tools • Auto mechanic hand tool set and torque wrench Instrument • Multimeter Equipment • Diagnostic scan tool (with/without wifi connection) and charging station PPE • High Voltage insulation glove, electrical shockproof safety boot, and electrical insulation work dress
Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: • Lecture • Interactive discussion • Demonstration • Industrial visit/training • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Oral/viva-voce • Written test • Assignment • Project work • Rubrics

ANNEXURE

Annex I: Time Distribution

Time Distribution (Regular course)					
Electric Vehicle Technology Certificate 3					
Module Title	Learning outcomes	Tasks	Theory (Hours)	Practical (Hours)	Total (hours)
A: Carrying out preparatory work for EV servicing	A1: Apply safety practices at workplace	A1.00 Introductory knowledge	4	0	4
		A1.01 Use PPE	2	1	3
		A1.02 Use fire extinguisher	1	2	3
		A1.03 Apply basic first aid	1	2	3
		A1.04 Implement emergency measures	2	4	6
	Sub Total		10	9	19
	A2: Use tools and equipment	A2.01 Use two pole testers	1	2	3
		A2.02 Use mega ohm meter	1	2	3
		A2.03 Use battery pack leak tester	0.5	2	2.5
		A2.04 Use coolant refill and drain kit	0.5	3	3.5
		A2.05 Use battery module balancer	0.5	3	3.5
		A2.06 Use two-post car lift	1	2	3
		A2.07 Use scissors lift	1	2	3
	Sub Total		5.5	16	21.5
	A3: Prepare to service EV components	A3.01 Set up work area	1	2	3
		A3.02 Prepare tools and equipment	1	2	3
		A3.03 Perform High Voltage (HV) shutdown	4	2	6
		A3.04 Check residual voltage	1.5	2	3.5
	Sub Total		7.5	8	15.5
	Total Duration (A)		23	33	56
B: Carrying out servicing of EV drive battery, EV control module and EV traction motor system	B1: Service EV drive battery	B1.01 Dismount EV drive battery	5	13	18
		B1.02 Replace battery cell	4	8	12
		B1.03 Replace power relay assembly	1	4	5
		B1.04 Replace Battery management system	1	3	4
		B1.05 Replace cell monitoring units	1	3	4
		B1.06 Replace temperature sensors	1.5	3	4.5
		B1.07 Replace water level sensor	2	3	5
		B1.08 Replace wire harness and terminals	1	5	6
		B1.09 Replace coolant hose	2	4	6
		B1.10 Replace battery case	1	10	11
		B1.11 Perform battery pack leak test	1	4	5
		B1.12 Mount EV drive battery	0.5	10	10.5
		B1.13 Diagnose EV drive battery fault	0.5	5.5	6
		B1.14 Replace auxiliary battery	3	3	6
	Sub Total		24.5	78.5	103

	B2: Service EV control module	B2.01 Replace Power Delivery Module assembly	3	9	12
		B2.02 Replace Inverter	2	16	18
		B2.03 Replace electric water pump	3	9	12
		B2.04 Replace electronic parking brake	2	6	8
		B2.05 Replace electronic control brake unit	2	4	6
		B2.06 Inspect interlock circuit	1	4	5
		B2.07 Diagnose EV control module	1	5	6
	Sub Total		14	53	67
	B3: Service EV traction motor system	B3.01 Calibrate resolver offset	1	5	6
		B3.02 Deactivate Park lock actuator	2	3	5
		B3.03 Replace Park lock actuator	2	4	6
		B3.04 Service reduction gearbox	5	13	18
		B3.05 Replace traction motor	6	24	30
		B3.06 Diagnose traction motor system	1	5	6
Sub Total		17	54	71	
Total Duration (B)		55.5	185.5	241	
C: Carry out servicing of EV AC system and EV charging system	C1: Perform refrigerant recovery and recharging	C1.01 Recover refrigerant	6	6	12
		C1.02 Perform flushing	1	2	3
		C1.03 Perform evacuation	0.5	6	6.5
		C1.04 Charge refrigerant	3	6	9
	Sub Total		10.5	20	30.5
	C2: Service EV AC electrical system	C2.01 Replace electric compressor	5	6	11
		C2.02 Replace PTC heater	2	6	8
		C2.03 Diagnose EV AC system	1	5	6
	Sub Total		8	17	25
	C3: Service EV charging system	C3.01 Replace on-board charger	4	12	16
		C3.02 Update software	0.5	3	3.5
		C3.03 Diagnose EV charging system	1	5	6
	Sub Total		5.5	20	25.5
	Total Duration (C)		24	57	81
Total Duration			102.5	275.5	378

Annex II: Assessment Sample

Unit of competency	Drive Light Vehicle
Unit Code	8322-U4-L2
Module Title	Driving Light Vehicle
Module Code	8322-U4-L2-M1
Time Duration	45 min *
Problem or Project: Drive Light Vehicle	
Introduction: Perform pre-operating procedures before starting the vehicle. Drive light vehicle under different environment conditions following standard traffic rules and defensive driving techniques. Perform post operating procedures after parking the vehicle.	
Observation: (How will you be assessed as Competent?) Your performance will be assessed based on the following criteria: • Performance of pre and post operating procedures as per standard practices; • Application of standard procedures while starting the LMV; • Demonstrating the driving skills in different road condition using the system of vehicle control (SOVC); • Demonstrating your adherence to RSTA Rules, Defensive Driving; • The final outcome of your driving skills	
Note: For Assessor/Institute for preparation for assessment. Materials and Equipment for 1 candidate • LMV in good running condition with all necessary vehicle documents Roles and responsibilities of assessors (before/during and after assessment) • Identify in advance the different road environment (rough road, town, simulated night and poor light condition, highway) • During assessment let the candidate demonstrate moving off, reversing, overtaking, and parking.	

Assessor/ Observation Check List

Unit of competency	Drive Light Vehicle		
Unit Code	8322-U4-L2		
Module Title	Driving Light Vehicle		
Module Code	8322-U4-L2-M1		
Problem/Project: Drive Light Vehicle	Psychomotor (Practical) domain level: P2		
Candidate's Name:			
Place of Assessment:		Date of Assessment:	
A. During the demonstration of skills did the candidate do following:	Marks allocated	Marks received	Remarks
1. Check mirror settings, fluid level, tire pressure and required documents.	4		
2. Start LMV according to the procedure of standard starting procedure (Cockpit Drill)	2		
3. Move off and steer LMV wearing seat belts and without stalling the engine*	3		
4. Reverse LMV safely without stalling the engine*	3		
5. Park LMV safely in the centre of given parking area following standard parking procedure	2		
6. Drive LMV on the highway according to the road conditions following the road safety signs.	2		
7. Drive LMV in towns according to the traffic signs and signals.	2		
8. Drive LMV on 4WD safely (if necessary and available)	1		
9. Giving pass and overtake the vehicle safely according to the road and weather condition *	3		
10. Stop LMV safely in a given area according to standard stopping procedure	1		
B. Is the job outcome correct in the following areas?			
Caused no accidents and damages to the vehicle.*	5		
Total marks obtained	28		
The Candidate's performance	Satisfactory:		
	Not Satisfactory:		

Note: The questions marked with * are the critical questions which the trainees must be able to answer. Otherwise, they will be rated unsuccessful even if they perform well in the practical exam. The mark P is for the psychomotor domain level (P1- Simple Routine Assignment; P2- Questions related to Simple Routine Assignment and P3- Questions not related to Simple Routine Assignment)

Oral Questions checklist:

Unit of competency		Drive Light Vehicle		
Unit Code		8322-U4-L2		
Module Title		Driving Light Vehicle		
Module Code		8322-U4-L2-M1		
Problem/Project: Drive Light Vehicle				
Candidate's Name:				
Place of Assessment:		Date of Assessment:		
Questions (and its domain level) to be answered by the trainee / candidate:	Key Answer	Marks allocated	Marks obtained	Remarks
Why do you keep the vehicle in start mode for a few minutes before moving? (Verifying observations) (C1)				
In case of accidents who will you contact first? (contingency questions) (C2)				
While entering intersection, before how many seconds do you have to give signal? (verifying observations) (C3)				
Total Marks Obtained				
The candidate's performance was:		Satisfactory:		
		Not Satisfactory:		
Assessor's Name:		Signature:		

Note: The questions marked with C describes the cognitive level of the questions. C1- Remembering; C2- Functional Understanding and C3- Problem Solving.

Written questions checklist:

Unit of competency		Drive Light Vehicle	
Unit Code		8322-U4-L2	
Module Title		Driving Light Vehicle	
Module Code		8322-U4-L2-M1	
Problem/Project: Drive Light Vehicle			
Candidate's Name:			
Place of Assessment:		Date of Assessment:	
Questions (and its domain level) to be answered by the trainee/ candidate:	Key Answer	Marks Allocated	Marks Obtained
1. List down three types of parking. (Short Answer Question) (C1)	Angle, Straight and	1	

Annex III: Module Recognition

This is to verify that

Mr/Ms.....

has completed module on

.....

Covering following learning outcomes:

1.
2.
3.

Instructor:

Head of the Department:

.....

.....

Signature:

Signature:

Date: / / (dd/mm/yyyy)
.....(dd/mm/yyyy)

Date: / /

Head of the Institute:

Trained Assessor (Institute)/Exam OC:

.....

.....

Signature:

Signature:

Date: / ... / (dd/mm/yyyy)

Date: / /(dd/mm/yyyy)

Annex IV: Lesson Plan

Lesson Plan

Course Title:		NC Level:		
Module Code:		Duration:		
Module Title:				
Learning Outcome:				
Skill/Task/Topic:				
Terminal Performance Objective:				
(Note: Write narrative statement extracted from TPO of Task Sheet)				
Enabling Objectives (Related knowledge):				
By the end of the lesson learners will be able to:				
i) ii) iii)				
What (Content/Activity)	Who (T/L)	How (Methods/ Media)	Duration (Min.)	Questions
Introduction: Main body Conclusion				
Projects/Problems:				

Instructional Resources Plan				
Skills/Task/Topic:				
No. of Trainees:				
Sl. No.:	Instructional materials/resources	Specifications	Qty.	Remarks
Prepared by :		Signature	Date:	
Revised by:		Signature	Date:	
Approved by:		Signature	Date:	

Task sheet

TS-1/4: Practical Plan

TS-1/4: Practical Plan			
Course Title:		N C Level:	
Module code:		Duration:	
Module Title			
Learning outcome			
Skills/Task Title:		Task no:	
Terminal Performance Objective: <i>Given:</i> <i>Cue:</i> <i>Who:</i> <i>What:</i> <i>Within:</i> <i>How well:</i> - - -			
Enabling Objectives (Related Skills): <i>By the end of a lesson, the learners will be able to:</i> i) ii) iii) iv)			
Activities	Who (T/L)	How (methods/ media)	Duration
Project/Assignment:			

TS-2/4: Tool and Equipment required:							
<i>Sl no.</i>	<i>Particulars</i>	<i>Specifications</i>	<i>Qty.</i>	<i>Remarks</i>			
Training Materials required:							
<i>Sl no.</i>	<i>Particulars</i>	<i>Specifications</i>	<i>Qty.</i>	<i>Rate</i>	<i>Amount</i>	<i>Remarks</i>	
TS-3/4: Performance Guide							
Skill/Task:					Date:		
Directions: Use the following performances criteria to rate the learner. Check YES/NO to indicate whether the learner performed each step as indicated or not?							
Sl. No:	Steps					Yes	No
Note: Critical steps: All * marked steps should be carried out very carefully. For a quality performance guide, all items should be checked "YES"							

TS-4/4: Instruction and Drawing***General Instructions for Trainees***

- i)
- ii)
- iii)
- iv)

Drawing (if any)**Safety Precaution**

- i)
- ii)
- iii)

Prepared by:**Signature****Date:****Revised By:****Signature****Date:****Approved by:****Signature****Date:**

Annex V: Course Plan
Institutes letter head and Logo

(Trade)YEAR PLAN- _____ Semester_____ (Year)

Trade: NC Level:			Schedule																																								Total Hours																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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Prepared by:

Verified & Approved by:

Date:

Monthly/Weekly Plan

Month: Trade: Trainer:

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Week 01							
Week 02							
Week 03							
Week 04							
Week 05							

Developed by: Approved by:

Date



For more information please contact:

Technical Trainers Training and Resource Center (TTTRC), DWPSD

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