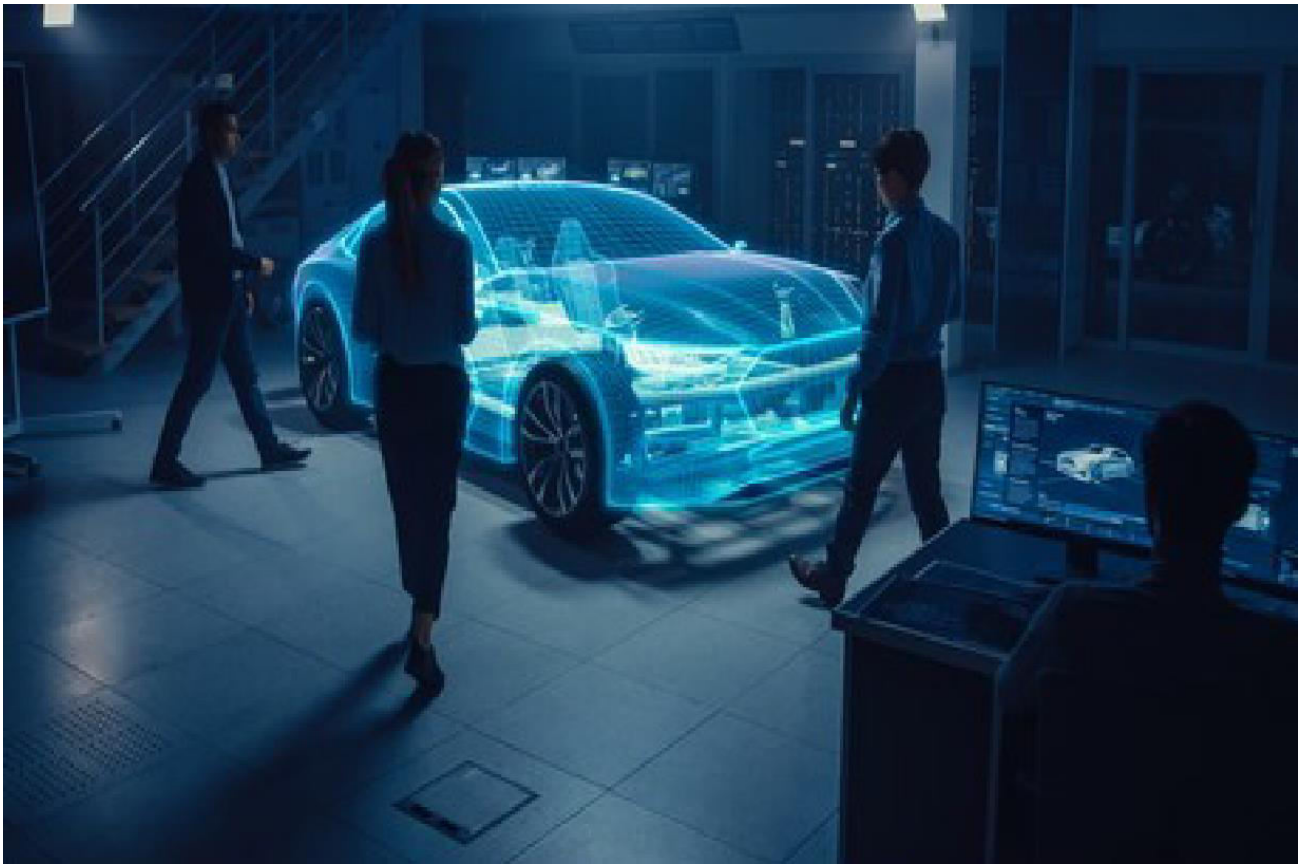

Model Curriculum

NOS Name: Fundamentals of Electric Vehicle Battery Pack Design

NOS Code: ASC/N8118

NOS Version: 1.0

NSQF Level: 5.5

Model Curriculum Version: 1.0

Table of Contents

Training Parameters

Sector	Automotive
Sub-Sector	Research & Development
Occupation	Automotive Product Designing
Country	India
NSQF Level	5.5
Aligned to NCO/ISCO/ISIC Code	NCO-2015/7231.0201
Minimum Educational Qualification and Experience	UG Diploma in relevant field with 1.5 Years of Relevant experience OR 3rd year of UG Degree in relevant field OR Diploma after 10th in relevant field with 3 Years of Relevant experience
Pre-Requisite License or Training	
Minimum Job Entry Age	18 years
Last Reviewed On	15/03/2024
Next Review Date	15/03/2027
NSQC Approval Date	15/03/2024
QP Version	1.0
Model Curriculum Creation Date	15/03/2024
Model Curriculum Valid Up to Date	15/03/2027
Model Curriculum Version	1.0
Minimum Duration of the Course	60 Hours 00 Minutes
Maximum Duration of the Course	60 Hours 00 Minutes

Program Overview

This section summarizes the end objectives of the program along with its duration.

Training Outcomes

At the end of the program, the learner should have acquired the listed knowledge and skills.

- Development of battery pack suiting EV requirements and charging infrastructure suiting the market conditions
- Designing of components of the battery pack and charging system as well as skills on mobility engineering
- Maintenance of battery pack for optimum functioning and recycling of its constituents for compliance with sustainability guidelines.

Compulsory Modules

The table lists the modules and their duration corresponding to the Compulsory NOS of the QP.

NOS and Module Details	Theory Duration	Practical Duration	On-the-Job Training Duration (Mandatory)	On-the-Job Training Duration (Recommended)	Total Duration
ASC/N8118 –Fundamentals of Electric Vehicle Battery Pack Design– 1.0 NSQF Level – 5.5	**15:00**	**45:00**			**60:00**
Module 1: Prepare on electric mobility engineering and battery pack options for EV	04:00	11:00			15:00
Module 2: Designing of EV battery pack and analysis of its operation under diverse vehicle working modes	8:00	23:00			31:00
Module 3: Design validation and battery pack maintenance under operations in its lifecycle	03:00	11:00			14:00
Total Duration	**15:00**	**45:00**			**60:00**

Module Details

Module 1: Prepare on electric mobility engineering and battery pack options for EV

Mapped to ASC/N8118, v1.0

Terminal Outcomes:

- Describe the operational impact of battery pack in the perspective of eMobility and Sustainability
- Illustrate the energy flow in the EV system and the charging infrastructure

Duration: *<04:00>*	**Duration**: *<11:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Identify the factors leading to accelerated transition to zero-emission propulsion. • Discuss the sustainability quotient of EV battery types with same high throughput. • Explain the variety of configurations of energising the electric motor to propel EV. • Detail the types of charging the battery pack in EV and supporting infrastructure. • Describe the EV supply equipment (EVSV) for various vehicle applications in market. • Illustrate the current (DC/AC) flow in traction battery and auxiliary battery lines of EV.	• Illustrate the schematic of discharging / recharging cycle of EV traction battery. • Model using Matlab software the flow of energy from power source to traction motor through all components in between.
Classroom Aids:	
Whiteboard, marker pen, projector, Internet	
Tools, Equipment and Other Requirements	
Matlab, MS-PowerPoint	

Module 2: Designing of EV battery pack and analysis of its operation under diverse vehicle working modes

Mapped to ASC/N8118, v1.0

Terminal Outcomes:

- Perform design and development of parts and systems of battery pack for best battery management and thermal management parameters
- Analyse the cycles of discharging and recharging battery pack as per diverse usage profiles of the EV

Duration: *<08:00>*	**Duration**: *<23:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Explain the battery cells-modules-pack arrangement, battery tray designs, charging port & EVSV designs. • Prepare the flow chart of the V-model for designing parts-hardware-software as per SAE standards in the most effective way. • Discuss the development of SiC power electronics, high-voltage battery, rapid charging systems and emerging trends. • Calculate the battery pack design parameters (voltage, current, power, capacity, losses, etc) affecting EV performance (mass, acceleration, torque, range, traction effort, etc).	• Illustrate the arrangement of battery pack elements, battery tray, charging system in a mid-size car model. • Design the battery pack for a mini car as per battery management stipulations using Matlab software. • Design the battery pack of a 3-wheeled electric PV for apt thermal management using CAD-CAE software. • Depict the layout of the battery-pack, traction-motor, power-electronics for high-voltage rapid-charging system of an off-road CV. • Detail the schematic of auxiliary battery circuit of a luxury car conforming to electrical, fire, safety and sustainability standards. • Program using Python the code for switching EV to high performance mode.
Classroom Aids:	
Whiteboard, marker pen, projector, Internet	
Tools, Equipment and Other Requirements	
• Broadband for Cloud based FOSS, Matlab, Python, MS-PowerPoint • Technical reference books, Case-study documents	

Module 3: Design validation and battery pack maintenance under operations in its lifecycle

Mapped to ASC/N8118, v1.0

Terminal Outcomes:

- Perform tests for validation of battery pack design to confirm conformance to industry & government standards & regulations on eMobility
- Prepare maintenance scheme for optimum performance of battery pack all along the duty cycle of EV and at end-of-life complying with reuse/recycle stipulations

Duration: *<03:00>*	**Duration**: *<11:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Analyse the thermal management aspects using mechanical CAE software for battery mass distribution, insulation, temperature gradient, coolant flow rate, heat dissipation rate, etc. • Examine the test results against the varying parameters to determine design criticality under company-industry-country specific standards (UN38.3, ISO 26262, UL 2580, etc.) • Study battery pack design validation procedures for hardware functioning test, system verification test, EV sub-system validation test, Homologation test, Quality compliance test. • Follow the stipulations to check for health of battery and disposal (reuse/recycle) of battery pack components.	• Perform battery management simulation for charging/discharging cycles, high/low voltage, current, power density, series & parallel configuration, cell balancing in electric car. • Illustrate using Matlab software the test results varying with battery management parameters in a 3-wheeled EV designed as per Indian standards. • Prepare the maintenance plan for battery pack, charging accessories and infrastructure for steady output of performance parameters of a cargo van.
Classroom Aids:	
Whiteboard, marker pen, projector, Internet	
Tools, Equipment and Other Requirements	
Matlab, Python, MS-PowerPoint, MS-Excel LMS licence, Technical reference books, Case-study documents	

Annexure

Trainer Requirements

Trainer Prerequisites						
Minimum Educational Qualification	**Specialization**	**Relevant Industry Experience**		**Training Experience**		**Remarks**
		Years	***Specialization***	***Years***	***Specialization***	
B.E/B.Tech	Electrical/Electronics/Mechanical	3	Electronics/ Automobile	1	Electronics/ Automobile	NA
B.E/B.Tech	Electrical/Electronics/Mechanical	4	Designing EV assemblies	0	Assessment	NA
Diploma	Electrical/Electronics/Mechanical	5	Battery parts development	3	Coaching / Assessment	NA
Diploma	Electrical/Electronics/Mechanical	6	Validation testing	2	Assessment	NA

Trainer Certification	
Domain Certification	**Platform Certification**
“Fundamentals of Electric Vehicle Battery Pack Design, ASC/N8118, version 1.0”. Minimum accepted score is 80%.	"Recommended that the trainer is certified for the job role “Trainer (VET and Skills)”, Mapped to Qualification Pack: MEP/Q2601, V2.0” Minimum accepted score is 80%."

Assessor Requirements

Assessor Prerequisites						
Minimum Educational Qualification	**Specialization**	**Relevant Industry Experience**		**Training Experience**		**Remarks**
		Years	***Specialization***	***Years***	***Specialization***	
B.E/B.Tech	Electrical/Electronics/Mechanical	4	Electronics/ Electrical/ Automobile	1	Electronics/ Electrical/ Automobile	NA
B.E/B.Tech	Electrical/Electronics/Mechanical	5	Designing EV components	1	Assessment	NA
Diploma	Electrical/Electronics/Mechanical	6	Battery parts development	3	Coaching / Assessment	NA
Diploma	Electrical/Electronics/Mechanical	7	Validation testing	2	Assessment	NA

Assessor Certification	
Domain Certification	**Platform Certification**
"Fundamentals of Electric Vehicle Battery Pack Design", ASC/N8118, version 1.0". Minimum accepted score is 80%.	Recommended that the Accessor is certified for the job role "Assessor (VET and Skills)", Mapped to Qualification Pack: MEP/Q2701, V2.0" Minimum accepted score is 80%.

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Assessment Strategy

1. Assessment System Overview:

- Batches assigned to the assessment agencies for conducting the assessment on SDMS/SIP or email
- Assessment agencies send the assessment confirmation to VTP/TC looping SSC
- Assessment agency deploys the ToA certified Assessor for executing the assessment
- SSC monitors the assessment process & records

2. Testing Environment:

- Confirm that the centre is available at the same address as mentioned on SDMS or SIP
- Check the duration of the training.
- Check the Assessment Start and End time to be as 10 a.m. and 5 p.m.
- If the batch size is more than 30, then there should be 2 Assessors.
- Check that the allotted time to the candidates to complete Theory & Practical Assessment is correct.
- Check the mode of assessment—Online (TAB/Computer) or Offline (OMR/PP).
- Confirm the number of TABs on the ground are correct to execute the Assessment smoothly.
- Check the availability of the Lab Equipment for the particular Job Role.

3. Assessment Quality Assurance levels / Framework:

- Question papers created by the Subject Matter Experts (SME)
- Question papers created by the SME verified by the other subject Matter Experts
- Questions are mapped with NOS and PC
- Question papers are prepared considering that level 1 to 3 are for the unskilled & semi-skilled individuals, and level 4 and above are for the skilled, supervisor & higher management
- Assessor must be ToA certified & trainer must be ToT Certified
- Assessment agency must follow the assessment guidelines to conduct the assessment

4. Types of evidence or evidence-gathering protocol:

- Time-stamped & geo-tagged reporting of the assessor from assessment location
- Centre photographs with signboards and scheme specific branding
- Biometric or manual attendance sheet (stamped by TP) of the trainees during the training period
- Time-stamped & geo-tagged assessment (Theory + Viva + Practical) photographs & videos

5. Method of verification or validation:

- Surprise visit to the assessment location
- Random audit of the batch
- Random audit of any candidate

6. Method for assessment documentation, archiving, and access

- Hard copies of the documents are stored
- Soft copies of the documents & photographs of the assessment are uploaded / accessed from Cloud Storage
- Soft copies of the documents & photographs of the assessment are stored in the Hard Drives

References

Glossary

Term	Description
Declarative Knowledge	Declarative knowledge refers to facts, concepts and principles that need to be known and/or understood in order to accomplish a task or to solve a problem.
Key Learning Outcome	Key learning outcome is the statement of what a learner needs to know, understand and be able to do in order to achieve the terminal outcomes. A set of key learning outcomes will make up the training outcomes. Training outcome is specified in terms of knowledge, understanding (theory) and skills (practical application).
OJT (M)	On-the-job training (Mandatory); trainees are mandated to complete specified hours of training on site
OJT (R)	On-the-job training (Recommended); trainees are recommended the specified hours of training on site
Procedural Knowledge	Procedural knowledge addresses how to do something, or how to perform a task. It is the ability to work, or produce a tangible work output by applying cognitive, affective or psychomotor skills.
Training Outcome	Training outcome is a statement of what a learner will know, understand and be able to do upon the completion of the training.
Terminal Outcome	Terminal outcome is a statement of what a learner will know, understand and be able to do upon the completion of a module. A set of terminal outcomes help to achieve the training outcome.

Acronyms and Abbreviations

NOS	National Occupational Standard(s)
NSQF	National Skills Qualifications Framework
QP	Qualifications Pack
TVET	Technical and Vocational Education and Training
SOP	Standard Operating Procedure
WI	Work Instructions
PPE	Personal Protective equipment

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