



# Fundamentals of Electric Vehicle Battery Pack Design

Unit Code: ASC/N8118

Version: 1.0

NSQF Level: 5.5

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## Description

This NOS unit is about preparing for the most discussed field of electric vehicles and the emerging trends in battery usage. This NOS unit is about designing EV battery pack in sustainable-optimal-durable-economical manner. Its as well about skilling on designing, analyzing, validating, maintaining and disposing battery pack and associated systems like charging station, on-board charging and on-the-go charging mechanisms

## Scope

The scope covers the following :

- Prepare on electric mobility engineering and battery pack options for EV
- Designing of EV battery pack and analysis of its operation under diverse vehicle working modes
- Design validation and battery pack maintenance under operations in its lifecycle

## Elements and Performance Criteria

### *Prepare on electric mobility engineering and battery pack options for EV*

To be competent, the user/individual on the job must be able to:

- PC1.** Examine the factors for migration from fossil fuel to zero-emission propulsion
- PC2.** Analyse electric motor propulsion options and various types of electric power sources
- PC3.** Study the historical market trends and sustainability schemes of on-board charging and battery swapping units
- PC4.** Review the primary (dry/alkali) and secondary (rechargeable Li-ion/NiHM & solid-state) battery types for various applications of vehicles
- PC5.** Learn about EV Supply Equipment (EVSE) and battery charging infrastructure
- PC6.** Understand the methods of battery charging for traction & auxiliary batteries and charging modes & trends

### *Designing of EV battery pack and analysis of its operation under diverse vehicle working modes*

To be competent, the user/individual on the job must be able to:

- PC7.** PC1. Study the battery cells-modules-pack arrangement, battery tray designs, charging port & EVSV designs
- PC8.** Review the V-model for designing parts-hardware-software as per IEEE standards in the most effective way
- PC9.** PC1. Design the battery pack as per battery management and thermal management stipulations
- PC10.** Learn development of SiC power electronics, high-voltage battery, rapid charging systems
- PC11.** PC1. Analyse traction battery and auxiliary battery for compliance with chemical, electrical, fire, safety, capacity, and sustainability standards
- PC12.** Calculate the battery pack design parameters (voltage, current, power, capacity, losses, etc) affecting EV performance (mass, acceleration, torque, range, traction effort, etc)

### *Design validation and battery pack maintenance under operations in its lifecycle*

To be competent, the user/individual on the job must be able to:

- PC13.** Analyse the thermal management aspects using mechanical CAE software for battery mass distribution, insulation, temperature gradient, coolant flow rate, heat dissipation rate, etc.

- PC14.** Simulate the battery management aspects for charging/discharging cycles, high/low voltage, current, power density, series & parallel configuration, cell balancing, etc.
- PC15.** Study battery pack design validation procedures for hardware functioning test, system verification test, EV sub-system validation test, Homologation test, Quality compliance test
- PC16.** 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.)
- PC17.** Prepare the maintenance plan for battery pack, charging accessories and infrastructure for steady output of performance parameters
- PC18.** Follow the stipulations to check for health of battery and disposal (reuse/recycle) of battery pack components

## **Knowledge and Understanding (KU)**

The individual on the job needs to know and understand:

- KU1.** Automobile propulsion methods and prime mover energy sources
- KU2.** Comparison of fossil fuel and alternative fuels including zero-emission propulsion
- KU3.** Electric battery elements and the constituents of vehicle battery pack
- KU4.** EV battery charging process & accessories and supporting infrastructure
- KU5.** Energy conversion and storage process in EV battery pack
- KU6.** V-model development method for sub-unit design and validation
- KU7.** Functional elements of EV battery management (V, A, KWhr, Ohm, losses)
- KU8.** Power electronics, charging & discharging cycles
- KU9.** Thermal management aspects in EV
- KU10.** Statutory compliance factors for EV battery pack usage and disposal
- KU11.** Duty cycles of battery pack operations in the EV lifecycle
- KU12.** Battery maintenance and recycling procedures as well as industry/country guidelines/standards

## **Generic Skills (GS)**

User/individual on the job needs to know how to:

- GS1.** read and interpret notes, designs and instructions shared by various teams internal/external
- GS2.** follow instructions, guidelines, procedures, rules, and service level agreements/contracts
- GS3.** listen & comprehend accurately and communicate smoothly with the supervisor/team-mates
- GS4.** follow rule-based decision-making process and make judgments for positive business impact
- GS5.** imbibe the work culture, recognise workplace problems correctly and take suitable actions
- GS6.** analyse aptly all information gathered from observation, experience, explanation, literature
- GS7.** plan and organise the work to achieve targets and meet deadlines
- GS8.** apply problem-solving approaches to different situations appropriately
- GS9.** act with attention-to-detail, being first-time-right, for on-time-delivery
- GS10.** exchange technical information clearly using proper language and manage data per protocol

## Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Prepare on electric mobility engineering and battery pack options for EV</i>	<b>5</b>	<b>10</b>	-	<b>10</b>
<b>PC1.</b> Examine the factors for migration from fossil fuel to zero-emission propulsion	-	-	-	1
<b>PC2.</b> Analyse electric motor propulsion options and various types of electric power sources	1	-	-	1
<b>PC3.</b> Study the historical market trends and sustainability schemes of on-board charging and battery swapping units	1	-	-	2
<b>PC4.</b> Review the primary (dry/alkali) and secondary (rechargeable Li-ion/NiHM & solid-state) battery types for various applications of vehicles	1	3	-	2
<b>PC5.</b> Learn about EV Supply Equipment (EVSE) and battery charging infrastructure	1	3	-	2
<b>PC6.</b> Understand the methods of battery charging for traction & auxiliary batteries and charging modes & trends	1	4	-	2
<i>Designing of EV battery pack and analysis of its operation under diverse vehicle working modes</i>	<b>15</b>	<b>35</b>	-	<b>10</b>
<b>PC7. PC1.</b> Study the battery cells-modules-pack arrangement, battery tray designs, charging port & EVSV designs	3	5	-	2
<b>PC8.</b> Review the V-model for designing parts-hardware-software as per IEEE standards in the most effective way	2	2	-	1
<b>PC9. PC1.</b> Design the battery pack as per battery management and thermal management stipulations	3	8	-	2
<b>PC10.</b> Learn development of SiC power electronics, high-voltage battery, rapid charging systems	2	5	-	1
<b>PC11. PC1.</b> Analyse traction battery and auxiliary battery for compliance with chemical, electrical, fire, safety, capacity, and sustainability standards	2	7	-	2

<b>Assessment Criteria for Outcomes</b>	<b>Theory Marks</b>	<b>Practical Marks</b>	<b>Project Marks</b>	<b>Viva Marks</b>
<b>PC12.</b> Calculate the battery pack design parameters (voltage, current, power, capacity, losses, etc) affecting EV performance (mass, acceleration, torque, range, traction effort, etc)	3	8	-	2
<i>Design validation and battery pack maintenance under operations in its lifecycle</i>	<b>5</b>	<b>5</b>	-	<b>5</b>
<b>PC13.</b> Analyse the thermal management aspects using mechanical CAE software for battery mass distribution, insulation, temperature gradient, coolant flow rate, heat dissipation rate, etc.	1	1	-	1
<b>PC14.</b> Simulate the battery management aspects for charging/discharging cycles, high/low voltage, current, power density, series & parallel configuration, cell balancing, etc.	1	-	-	1
<b>PC15.</b> Study battery pack design validation procedures for hardware functioning test, system verification test, EV sub-system validation test, Homologation test, Quality compliance test	1	2	-	1
<b>PC16.</b> 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.)	1	-	-	-
<b>PC17.</b> Prepare the maintenance plan for battery pack, charging accessories and infrastructure for steady output of performance parameters	-	2	-	1
<b>PC18.</b> Follow the stipulations to check for health of battery and disposal (reuse/recycle) of battery pack components	1	-	-	1
<b>NOS Total</b>	<b>25</b>	<b>50</b>	-	<b>25</b>

**National Occupational Standards (NOS) Parameters**

<b>NOS Code</b>	ASC/N8118
<b>NOS Name</b>	Fundamentals of Electric Vehicle Battery Pack Design
<b>Sector</b>	Automotive
<b>Sub-Sector</b>	Research & Development
<b>Occupation</b>	Automotive Product Designing
<b>NSQF Level</b>	5.5
<b>Credits</b>	2
<b>Minimum Educational Qualification &amp; Experience</b>	Completed 2nd year of UG (UG Diploma) (In trades: Manufacturing/Mechanical/Automobile/Electrical/Electronics or relevant ) with 1-2 Years of experience OR Pursuing 3rd year of UG (In trades: Manufacturing/Mechanical/Automobile/Electrical/Electronics or relevant )
<b>Version</b>	1.0
<b>Last Reviewed Date</b>	NA
<b>Next Review Date</b>	NA
<b>CCN Category</b>	1