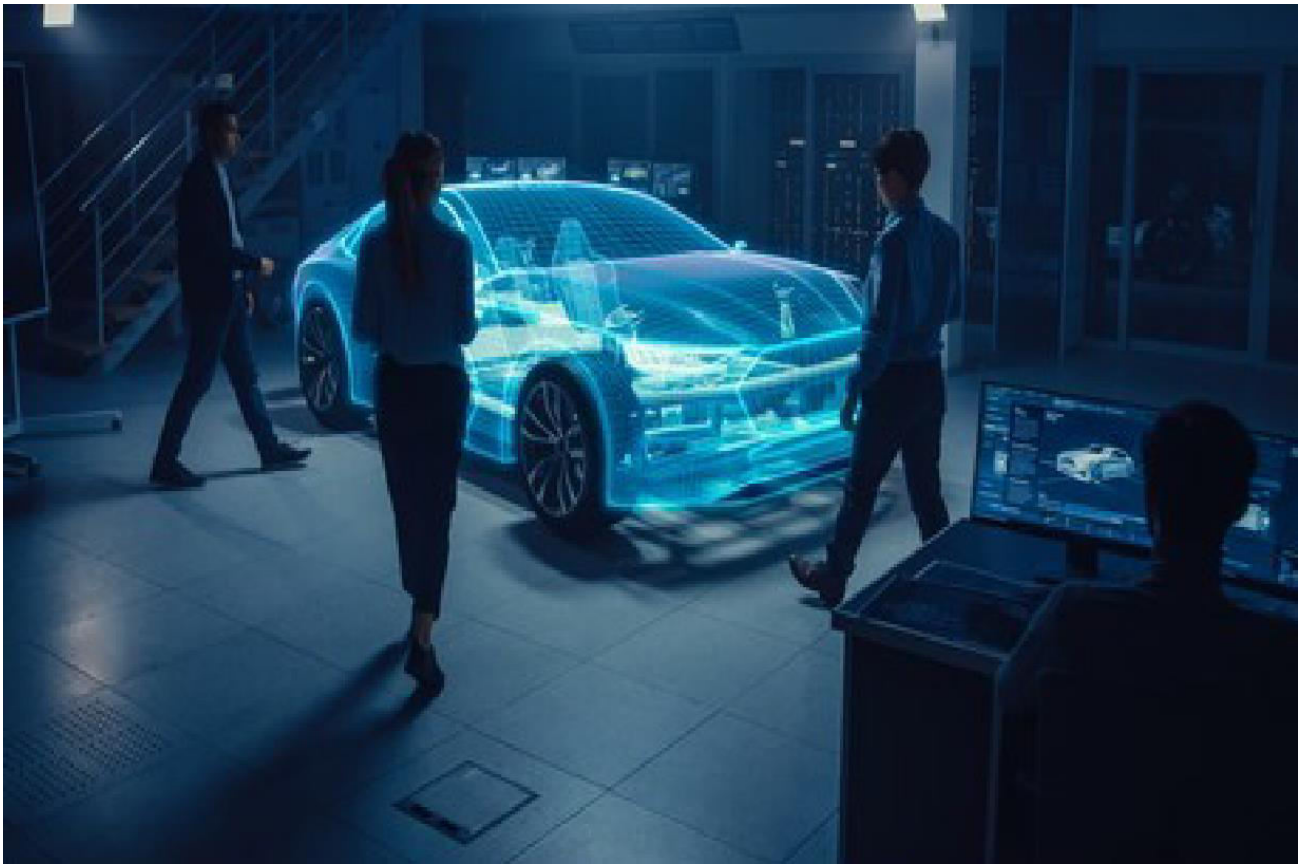

Model Curriculum

NOS Name: Fundamentals of Electric Vehicle Powertrain Design

NOS Code: ASC/N8119

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.

- Designing EV powertrain's mechanical and electromechanical components in a frugal-optimal-reliable manner
- Analysis of Electric Drive Unit (EDU) parts and sub-units for strength-durability-endurance-kinematics
- Validation of EDU at system level and vehicle level for performance, reliability and quality.

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/N8119 – Fundamentals of Electric Vehicle Powertrain Design– 1.0 NSQF Level – 5.5	**15:00**	**45:00**			**60:00**
Module 1: Prepare on power distribution modes in EV and Alternative Energy Mobility (AEM)	03:00	12:00			15:00
Module 2: Designing of Electric Drive Unit (EDU) for optimal balance of power consumption and EV performance	9:00	21:00			30:00
Module 3: EDU design validation at system level and vehicle level for performance, reliability and quality	03:00	12:00			15:00
Total Duration	**15:00**	**45:00**			**60:00**

Module Details

Module 1: Prepare on power distribution modes in EV and Alternative Energy Mobility (AEM)

Mapped to ASC/N8119, v1.0

Terminal Outcomes:

- Describe the strategic role of electric drive unit (EDU) in the future of eMobility for automobiles
- Illustrate the diverse options of power flow in the EDU system from the energy source to the wheels

Duration: *<03:00>*	**Duration**: *<12:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Enlist the methods of electrical energy generation and mechanical power transfer mechanisms to propel vehicle wheels. • Explore the powertrain assemblies in EV and the major components in the train of power from inverter upto traction motor. • Explain the functionalities of mechanical parts and electronic hardware in EV powertrain. • Understand the range of powertrain ECU parameters for best output of frequency, current and power density. • Examine the DC<>AC conversion efficiency for traction motor energy consumption optimally.	• Illustrate the EDU parameters (torque, power, etc) varying along the flow of power from source to wheel of 3-wheeler. • Model using Matlab software the energy flow characteristics in the train of power from inverter upto traction motor of a 4-wheeler.
Classroom Aids:	
Whiteboard, marker pen, projector, Internet	
Tools, Equipment and Other Requirements	
Matlab, MS-PowerPoint	

Module 2: Designing of Electric Drive Unit (EDU) for optimal balance of power consumption and EV performance

Mapped to ASC/N8119, v1.0

Terminal Outcomes:

- Perform design and development of parts and systems of powertrain of EV for utmost optimal performance
- Analyse the throughput of EDU sub-units undergoing moderate and harsh duty cycles of EV

Duration: *<9:00>*	**Duration**: *<21:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Explain the EDU parts' mass optimization options for maximum efficiency. • Prepare the analysis of powertrain for regenerative EV and on-board charging with minimal electromagnetic losses. • Discuss the development of the power density module (PDM) with SiC enabled power electronics. • Examine the powertrain output parameters for single speed and multi-speed transmission.	• Illustrate the arrangement of powertrain components in a mid-size electric car model. • Analyse using Matlab tool the powertrain parameters for regenerative EV. • Depict the EDU design of an electric SUV with output parameters varying for single speed & multi-speed transmission and single-motor & dual-motor configurations. • Analyse performance of EDU's mechanical & electronic components by simulating using FOSS tool the diverse drive cycles. • Program using Python the code for the ECU of powertrain of an all-terrain vehicle.
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: EDU design validation at system level and vehicle level for performance, reliability and quality

Mapped to ASC/N8119, v1.0

Terminal Outcomes:

- Perform tests for validation of powertrain for conformity with manufacturer's quality standards
- Prepare report on the variations in EDU's performance and reliability under NEDC & WLTC duty cycles

Duration: *<03:00>*	**Duration**: *<12:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Study the testing scheme for system level verification of eAxle, traction motor, inverter, charger and reduction drive. • Follow power boost and high voltage (400V/800V) conditions for hardware (HiL) and software (SiL) testing and for design validation of components on test-rig/bench. • Review EV test plan for industry & market specific proto-vehicle validation & homologation.	• Enlist Indian auto R&D authority's test procedures for design validation of powertrain assemblies undergoing tests on chassis dynamometer. • Illustrate using MS-Excel the test plan for sub-compact car prototype's validation as well as costing for the DV test equipments. • Prepare the plan for product validation of powertrain (mechanical & electronic) for vibration, water-ingress, fatigue, wear & tear and electromagnetic characteristics. • Demonstrate using Matalb software the variations in output of EDU under New European Drive Cycle (NEDC) and World harmonized Light-duty vehicle Test Cycle (WLTC) for performance tests.
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 powertrain	0	Assessment	NA
Diploma	Electrical/Electronics/Mechanical	5	EDU 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 Powertrain Design, ASC/N8119, 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/ Automobile	1	Electronics/ Electrical/ Automobile	NA
B.E/B.Tech	Electrical/Electronics/Mechanical	5	Designing EV powertrain	1	Assessment	NA
Diploma	Electrical/Electronics/Mechanical	6	EDU 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 Powertrain Design, ASC/N8119, 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%.

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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