



Fundamentals of Electric Vehicle Powertrain Design

Unit Code: ASC/N8119

Version: 1.0

NSQF Level: 5.5

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Description

This NOS unit is about preparing for the fast evolving field of electric vehicle powertrain and its universal design for alternative fuel mobility. This NOS unit is about designing EV powertrains mechanical and electromechanical components in a frugal-optimal-reliable manner. Its as well about skilling on designing, simulating and validating powertrain parts and sub-units

Scope

The scope covers the following :

- Prepare on power distribution modes in EV and Alternative Energy Mobility (AEM)
- Designing of Electric Drive Unit (EDU) for optimal balance of power consumption and EV performance
- EDU design validation at system level and vehicle level for performance, reliability and quality

Elements and Performance Criteria

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

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

- PC1.** Examine popular and evolving options of alternative energy mobility
- PC2.** Study the electrical energy generation methods and mechanical power transfer mechanisms to propel wheels
- PC3.** Explore the powertrain assemblies in EV and the major components in the train of power from inverter upto traction motor
- PC4.** Learn about the functionalities of mechanical parts and electronic hardware in powertrain
- PC5.** Review powertrain ECU parameters for best output of frequency, current and power density
- PC6.** Examine the DC<>AC conversion efficiency against traction motor energy consumption

Designing of Electric Drive Unit for optimal balance of power consumption and EV performance

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

- PC7.** Explore EDU parts' mass optimization options for maximum efficiency
- PC8.** Analyse powertrain for regenerative EV and on-board charging with minimal electromagnetic losses
- PC9.** Design the power density module (PDM) with SiC enabled power electronics
- PC10.** Examine the powertrain output parameters for single & multi-speed transmission and single-motor & dual-motor configurations
- PC11.** Adopt V-model development for virtual verification and validation of hardware and components in EDU
- PC12.** Analyse performance of mechanical & electronic components by simulating under diverse drive cycles

EDU design validation at system level and vehicle level for performance, reliability and quality

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

- PC13.** Prepare testing scheme for system level verification of eAxle, traction motor, inverter, charger and reduction drive
- PC14.** 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

- PC15.** Study standard test procedures for product validation of powertrain assemblies under vehicle testing on dynamometer and test beds
- PC16.** Review EV test plan for industry & market specific proto-vehicle validation & homologation
- PC17.** Plan testing of powertrain components (mechanical & E/E) for vibration, water-ingress, fatigue, wear & tear and electromagnetic characteristics
- PC18.** Study the variations in output of EDU under New European Drive Cycle (NEDC) and World harmonized Light-duty vehicle Test Cycle (WLTC) for performance-reliability-quality

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1.** Automobile propulsion methods and driveline characteristics
- KU2.** Alternative energy sources and universality of electric motor powered wheels
- KU3.** Electric Drive Unit (EDU) elements and torque characteristics
- KU4.** Rotary part balancing and EDU robustness under harshness
- KU5.** V-model development method for sub-unit design and validation
- KU6.** Functional elements of EDU (strength, stiffness, durability, endurance, kinematics)
- KU7.** Simulation principles for static-dynamic-transient states of EDU
- KU8.** Testing methodologies in lab, test-tracks and on/off-road mode
- KU9.** Statutory compliance factors for EV battery pack usage and disposal

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 power distribution modes in EV and Alternative Energy Mobility (AEM)</i>	5	10	-	5
PC1. Examine popular and evolving options of alternative energy mobility	-	-	-	1
PC2. Study the electrical energy generation methods and mechanical power transfer mechanisms to propel wheels	1	-	-	1
PC3. Explore the powertrain assemblies in EV and the major components in the train of power from inverter upto traction motor	1	-	-	1
PC4. Learn about the functionalities of mechanical parts and electronic hardware in powertrain	1	3	-	-
PC5. Review powertrain ECU parameters for best output of frequency, current and power density	1	4	-	1
PC6. Examine the DC<>AC conversion efficiency against traction motor energy consumption	1	3	-	1
<i>Designing of Electric Drive Unit for optimal balance of power consumption and EV performance</i>	15	30	-	10
PC7. Explore EDU parts' mass optimization options for maximum efficiency	1	5	-	2
PC8. Analyse powertrain for regenerative EV and on-board charging with minimal electromagnetic losses	2	3	-	1
PC9. Design the power density module (PDM) with SiC enabled power electronics	2	3	-	1
PC10. Examine the powertrain output parameters for single & multi-speed transmission and single-motor & dual-motor configurations	3	5	-	2
PC11. Adopt V-model development for virtual verification and validation of hardware and components in EDU	3	6	-	2
PC12. Analyse performance of mechanical & electronic components by simulating under diverse drive cycles	4	8	-	2

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>EDU design validation at system level and vehicle level for performance, reliability and quality</i>	5	10	-	10
PC13. Prepare testing scheme for system level verification of eAxle, traction motor, inverter, charger and reduction drive	1	2	-	2
PC14. 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	1	-	-	1
PC15. Study standard test procedures for product validation of powertrain assemblies under vehicle testing on dynamometer and test beds	1	2	-	2
PC16. Review EV test plan for industry & market specific proto-vehicle validation & homologation	-	2	-	2
PC17. Plan testing of powertrain components (mechanical & E/E) for vibration, water-ingress, fatigue, wear & tear and electromagnetic characteristics	1	2	-	2
PC18. Study the variations in output of EDU under New European Drive Cycle (NEDC) and World harmonized Light-duty vehicle Test Cycle (WLTC) for performance-reliability-quality	1	2	-	1
NOS Total	25	50	-	25

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N8119
NOS Name	Fundamentals of Electric Vehicle Powertrain Design
Sector	Automotive
Sub-Sector	Research & Development
Occupation	Automotive Product Designing
NSQF Level	5.5
Credits	2
Minimum Educational Qualification & Experience	Pursuing 3rd year of UG (In trades: Manufacturing/Mechanical/Automobile/Electrical/Electronics or relevant) OR Completed 2nd year of UG (UG Diploma) (In trades: Manufacturing/Mechanical/Automobile/Electrical/Electronics or relevant) with 1-2 Years of experience
Version	1.0
Last Reviewed Date	NA
Next Review Date	NA
CCN Category	1