



Foundation course in Flex Fuel Engine Design

Unit Code: ASC/N8120

Version: 1.0

NSQF Level: 5.5

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Description

This NOS unit is about preparing for the fast evolving technology and market of alternative fuel propulsion in automobiles and understanding the statutory compliance factors associated with the vehicle configuration of Flex Fuel Engine (FFE). This NOS unit is about determining the right configuration of auto parts/assemblies for the given flex fuel blend as well as skilling to design hardware & software systems and components necessary for developing FFVs frugally & optimally. It aids in career-boosting by acquiring skills in lab/field testing and CAD-CAE simulations of FFV operations

Scope

The scope covers the following :

- Prepare on Flex Fuel Vehicle (FFV) systems and Alternative Fuel Propulsion (AFP) markets
- Designing of FFV systems and FF Engine (FFE) Management systems
- Analysis of the effects of Ethanol blend ratios by simulating and testing

Elements and Performance Criteria

Prepare on Flex Fuel Vehicle (FFV) systems and Alternative Fuel Propulsion (AFP) markets

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

- PC1.** Identify the differences between gasoline and flex fuels
- PC2.** Specify the changes in configuration between ICE & FFE and as well in the fuel sources and refueling infrastructure
- PC3.** Understand all regulations for environmental protection from traditional petroleum fuels
- PC4.** Specify the features in India and world's major automobile markets for sourcing and dispensing Ethanol as propulsion fuel
- PC5.** Detail the changes on parts of vehicle sub-systems adapting to FFV configuration
- PC6.** Model using CAD the layout of mass and energy flow in FFV

Designing of FFV systems and FF Engine (FFE) Management systems

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

- PC7.** Describe the functioning of mechanical part assemblies controlled by electronic systems
- PC8.** Detail the design specifications of mechanical parts in FFV
- PC9.** Determine the design quality of FFE parts for meeting targets on fuel efficiency, DFSS, durability and reliability
- PC10.** Design and develop ECU, sensor, solenoid, etc in the E/E sub-system following the Model Based Engineering (MBE) approach
- PC11.** Perform material selection and geometry design (corrosion-free, light-weight, low-cost) for achieving optimal Factor of Safety
- PC12.** Demonstrate the design of mechanical parts of FFE via 2D drawing views, 3D-CAD, 2D production drawing

Analysis of the effects of Ethanol blend ratios by simulating and testing

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

- PC13.** Analyse E5, E10, E15, E20, E25, E50, E75 & E85 blend ratios for calorific value & octane rating, engine power & torque, fuel economy, pollution effects and NVH performance
- PC14.** Determine FFE performance characteristics for each blend ratio applicable to diverse ambient conditions, fuel quality and FFV driving circuits/cycles

- PC15.** Test the electronic systems as per MBE 'V' model for design verification and product validation; calibrate the FFE ECUs for spark timing, fuel injection timing & air-fuel ratio and develop calibration maps for various blend ratios
- PC16.** Test the mechanical parts associated with FFE for Validation (DV-PV-PPV : Design - Product - Pre-production) and Type-Approval (Homologation & production compliance) on engine test rig, chassis dynamometer, proving ground and user-trial field
- PC17.** Define the design robustness through calculations on Factor of Safety (FoS), Fatigue-Life, Frequency-response & Thermal characteristics and finalise design as per CAE & test results
- PC18.** Perform Finite Element (FE) meshing & modeling of part CAD models with materials, select boundary-conditions (BC), varied load-cases and do FE Analysis (FEA) results post-processing

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1.** Composition of flex fuel and comparison with petroleum fuels
- KU2.** Sources of flex fuel, processing, distribution and storing systems around the world
- KU3.** Typical configuration of regular IC engine and its performance parameters with gasoline
- KU4.** Flex fuel engine structure and the electro-mechanical systems in the inlet & outlet sides
- KU5.** National policies, statutory compliance regulations, pollution laws, automotive standards
- KU6.** FFV sub-systems, sub-assemblies within, parts thereof and electronic hardware & software
- KU7.** Mass & energy flow characteristics of FFV and the systems to mitigate risk & manage crisis
- KU8.** Automobile functionalities and the supporting systems in manufacturing-logistics-servicing
- KU9.** Key functions of Product Development (R&D), Planning & Programs Management, Marketing
- KU10.** Detailed information of intra-R&D teams - Vehicle architecture, Design, PE, ME, Proto-shop
- KU11.** In-depth understanding of Product Engineering teams - SMT, VI, CAE, Testing, Homologation
- KU12.** Working knowledge of product development (APQP) & part sourcing (PPAP) processes, Q-R-D
- KU13.** Conventions followed in industry for engineering drawings (2D),3D-models and documentation
- KU14.** Limits & Fits, GD&T etc on mechanical assembly and Circuit integrity & soldering on electronics
- KU15.** Engine functions, troubleshooting, assembling, overhauling, performance checking, test-driving
- KU16.** Standard Ethanol blend ratios in major FFV markets and chemical composition of fuel & exhaust
- KU17.** Various methods of designing and associated softwares - CAD (Creo, UG, etc), CAE, EPD (Matlab)
- KU18.** Various testing procedures - indoor (lab, bench) & outdoor (field, proving grounds)
- KU19.** Diverse terrains and driving patterns for the FFV operations by consumers
- KU20.** Knowledge based engineering (KBE) methodology
- KU21.** Engineering design calculations
- KU22.** CAD-CAE software specialties
- KU23.** Practical FEA techniques

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 Flex Fuel Vehicle (FFV) systems and Alternative Fuel Propulsion (AFP) markets</i>	6	8	-	6
PC1. Identify the differences between gasoline and flex fuels	1	-	-	1
PC2. Specify the changes in configuration between ICE & FFE and as well in the fuel sources and refueling infrastructure	1	-	-	1
PC3. Understand all regulations for environmental protection from traditional petroleum fuels	1	-	-	1
PC4. Specify the features in India and world's major automobile markets for sourcing and dispensing Ethanol as propulsion fuel	1	-	-	1
PC5. Detail the changes on parts of vehicle sub-systems adapting to FFV configuration	1	2	-	1
PC6. Model using CAD the layout of mass and energy flow in FFV	1	6	-	1
<i>Designing of FFV systems and FF Engine (FFE) Management systems</i>	10	24	-	11
PC7. Describe the functioning of mechanical part assemblies controlled by electronic systems	2	-	-	1
PC8. Detail the design specifications of mechanical parts in FFV	2	-	-	2
PC9. Determine the design quality of FFE parts for meeting targets on fuel efficiency, DFSS, durability and reliability	2	-	-	2
PC10. Design and develop ECU, sensor, solenoid, etc in the E/E sub-system following the Model Based Engineering (MBE) approach	2	8	-	2
PC11. Perform material selection and geometry design (corrosion-free, light-weight, low-cost) for achieving optimal Factor of Safety	1	8	-	2
PC12. Demonstrate the design of mechanical parts of FFE via 2D drawing views, 3D-CAD, 2D production drawing	1	8	-	2

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Analysis of the effects of Ethanol blend ratios by simulating and testing</i>	9	18	-	8
PC13. Analyse E5, E10, E15, E20, E25, E50, E75 & E85 blend ratios for calorific value & octane rating, engine power & torque, fuel economy, pollution effects and NVH performance	1	-	-	1
PC14. Determine FFE performance characteristics for each blend ratio applicable to diverse ambient conditions, fuel quality and FFV driving circuits/cycles	1	-	-	1
PC15. Test the electronic systems as per MBE 'V' model for design verification and product validation; calibrate the FFE ECUs for spark timing, fuel injection timing & air-fuel ratio and develop calibration maps for various blend ratios	2	4	-	2
PC16. Test the mechanical parts associated with FFE for Validation (DV-PV-PPV : Design - Product - Pre-production) and Type-Approval (Homologation & production compliance) on engine test rig, chassis dynamometer, proving ground and user-trial field	2	-	-	1
PC17. Define the design robustness through calculations on Factor of Safety (FoS), Fatigue-Life, Frequency-response & Thermal characteristics and finalise design as per CAE & test results	2	8	-	2
PC18. Perform Finite Element (FE) meshing & modeling of part CAD models with materials, select boundary-conditions (BC), varied load-cases and do FE Analysis (FEA) results post-processing	1	6	-	1
NOS Total	25	50	-	25

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N8120
NOS Name	Foundation course in Flex Fuel Engine Design
Sector	Automotive
Sub-Sector	Research & Development
Occupation	Automotive Product Designing
NSQF Level	5.5
Credits	2
Minimum Educational Qualification & Experience	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)
Version	1.0
Last Reviewed Date	NA
Next Review Date	NA
CCN Category	1