Model Curriculum

NOS Name: Product Reverse Engineering

NOS Code: ASC/N8115

NOS Version: 1.0

NSQF Level: 5.5

Model Curriculum Version: 1.0

Automotive Skills Development Council | 153, Gr Floor, Okhla Industrial Area, Phase – III, Leela Building, New Delhi – 110020

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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-2015/3118.0301
Minimum Educational Qualification and Experience	Certificate-NSQF in Computer Aided Product Design, level 5.5
Pre-Requisite License or Training	
Minimum Job Entry Age	18 years
Last Reviewed On	29/09/2023
Next Review Date	29/09/2026
NSQC Approval Date	29/09/2023
QP Version	1.0
Model Curriculum Creation Date	29/09/2023
Model Curriculum Valid Up to Date	29/09/2023
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.

- Carry out 3D scanning of product on 3D scanner.
- Apply various reverse engineering techniques to study the given component.
- Carry out 3D printing of product on 3D printer.

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/N8115 – Product Reverse Engineering – 1.0 NSQF Level – 5.5	**15:00**	**45:00**			**60:00**
Module 1: Introduction to CAD modelling software	01:00	01:00			02:00
Module 2: Carry out object scanning, reverse engineering and designing modified component	7:00	22:00			29:00
Module 3: Develop product prototype by 3D printing	7:00	22:00			29:00
Total Duration	**15:00**	**45:00**			**60:00**

Module Details

Module 1: Introduction to CAD modelling software

Mapped to ASC/N8115, v1.0

Duration: *<01:00>*	**Duration**: *<01:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• List various CAD modelling software like CATIA, AutoCAD, Unigraphics etc. used in industry. • Discuss the CAD modelling standards and procedures involved in industry. • Elaborate product modelling standards and techniques followed in industry.	• Show comparison between various CAD modelling software. • Demonstrate the use of CAD modelling software.
Classroom Aids:	
Whiteboard, marker pen, projector	
Tools, Equipment and Other Requirements	
CAD modelling software	

Module 2: Carry out object scanning, reverse engineering and designing of modified component

Mapped to ASC/N8115, v1.0

Terminal Outcomes:

- Identify requirements and specifications for the product reverse engineering products.
- Perform scanning, reverse engineering and designing of modified component.

Duration: *<07:00>*	**Duration**: *<22:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Proficiency in preparing objects for scanning by applying a temporary matte powder to enhance scan accuracy. • utilizing high-accuracy 3D scanners to capture crucial sections of a part. • Competence in performing object scanning and creating mesh files in 3D scanning equipment following established Standard Operating Procedures (SOP). • Ability to import mesh files or scanned data into CAD software equipped with reverse engineering tools. • Proficiency in extracting the shape of the scan to generate an editable solid model using CAD tools, including semi-automatic surfacing, automatic surfacing, and manual redrawing techniques. • Competence in identifying flaws in scanned models, addressing issues, and generating blueprints using reverse engineering tools within CAD software. • Proficiency in using scanned data or object models as references in CAD software for the reverse engineering process. • Ability to create rectified 3D models of products using CAD software. • Proficiency in preparing layouts and various views of drawings to illustrate the relationship between components and assemblies. • Competence in submitting drawings to the supervisor and design team for review and feedback. • Ability to tag and store drawings with the correct numbers and codes in accordance with organizational guidelines. • Proficiency in converting object models into STL or AMF file formats as required by 3D printers.	• Proficiency in the precise application of temporary matte powder to objects to enhance scan accuracy, minimizing errors in the scanning process. • Skill in effectively operating high-accuracy 3D scanners, including positioning, calibration, and scanning techniques, to accurately capture crucial sections of complex parts. • Competence in performing object scanning meticulously, following established Standard Operating Procedures (SOP) for equipment setup, scanning procedures, and mesh file creation. • Ability to seamlessly import mesh files or scanned data into CAD software equipped with reverse engineering tools, ensuring data integrity and compatibility. • Proficiency in utilizing CAD tools, including semi-automatic surfacing, automatic surfacing, and manual redrawing techniques, to extract the shape of the scan accurately and create editable solid models. • Competence in identifying flaws or imperfections in scanned models, effectively addressing issues using reverse engineering tools within CAD software, and generating precise blueprints for further design and analysis. • Proficiency in using scanned data or object models as references within CAD software, enhancing the accuracy and efficiency of the reverse engineering process. • Ability to produce high-quality rectified 3D models of products using CAD software, ensuring accuracy and adherence to design specifications.

• Competence in transferring verified object model STL/AMF files to portable storage devices or directly to 3D printers following Standard Operating Procedures (SOP) or Work Instructions (WI).	• Competence in preparing comprehensive layouts and various views of drawings using CAD software, effectively illustrating the relationship between components and assemblies for clear communication within the design team.
Classroom Aids:	
Whiteboard, marker pen, projector	
Tools, Equipment and Other Requirements	
• 3D Scanner, Drafting tools, MS office, designing software like CATIA, Auto-CAD, Unigraphics • Handbook, job orders and Technical Reference Books.	

Module 3: Develop product prototype by 3D printing

Mapped to ASC/N8115, v1.0

Terminal Outcomes:

- Perform the steps to operate and set up the machine for printing the automotive components.
- Demonstrate post-processing activities like quality check, segregation, storage etc.

Duration: *<7:00>*	**Duration**: *<22:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Explain various 3D Printing technologies such as Fused Deposition Modelling, StereoLithography etc. • Describe functionality of the 3D printing machine. • Explain the selection criteria of 3D printing machine as per the product specifications. • Recall various specifications of machine such as build speed, extrusion speed, nozzle temperature etc. • List machine operating parameters such as room temperature range, air cleanliness. • Explain standard tessellation language (.stl) code file and its selection criteria for machine operation. • List steps for preparing 3D printing machine for operation. • List the steps to be performed for operating the 3D printing machine. • List the steps to be performed for uploading and removing new code files in the machine memory. • Describe post-processing techniques such as removing and cleaning printed parts, inspection, segregation etc. of parts. • Discuss ways for removing the fabricated part from machine and support structures from the part. • Explain methods of inspecting the quality and non-conformities of the part. • List maintenance activities for a 3D printing machine. • Summarise the documents, records and information to be maintained related to the maintenance and repairing done.	• Demonstrate how to convert a standard design model into standard tessellation language (.stl) file format. • Use appropriate resources to obtain information about part orientation, support structure requirement, machine specifications, machine operating parameters etc. as per the work requirement. • Show how to set the 3D printing machine and its parameters as per SOP/WI. • Demonstrate organizational specified procedure of starting and operating the 3D printing machine for printing of automotive components. • Show how to select the optimum orientation of part. • Apply appropriate ways to identify and rectify errors in machine during the machine operation. • Prepare a sample report about the errors identified and rectified in the machine. • Demonstrate how to remove the printed part and support structures from the machine carefully. • Apply appropriate ways to clean the part for getting required surface finish. • Apply appropriate inspection methods for checking the quality and non-conformities of the part. • Apply appropriate ways to identify measurement errors between 3D printed files and drafted files provided. • Apply appropriate methods to remove the errors in product design and rectify the difference. • Apply appropriate ways to ensure the smooth running and appropriate working of the repaired 3D printing machine.

Classroom Aids:
Whiteboard, marker pen, projector
Tools, Equipment and Other Requirements
3D Printing machines- Fixed Deposition Modelling Machine, Stereo-Lithography Machine, Metal Sintering Machine & any other type of 3D printing machine with the all the consumables required, Flash Drive (With pre-stored program)

Annexure

Trainer Requirements

Trainer Prerequisites						
Minimum Educational Qualification	**Specialization**	**Relevant Industry Experience**		**Training Experience**		**Remarks**
		Years	***Specialization***	***Years***	***Specialization***	
B.E/B.Tech	Mechanical/Automobile	3	Mechanical/ Automobile	1	Mechanical/ Automobile	NA
B.E/B.Tech	Mechanical/Automobile	4	Designing	0	Assessment	NA
Diploma	Mechanical/Automobile	5	Designing	1	Assessment	NA
Diploma	Mechanical/Automobile	6	Designing	0	Assessment	NA

Trainer Certification	
Domain Certification	**Platform Certification**
"Product Reverse Engineering, ASC/N8115, 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	Mechanical/Electrical/Automobile	4	Mechanical/ Electrical/ Automobile	1	Mechanical/ Electrical/ Automobile	NA
B.E/B.Tech	Mechanical/Electrical/Automobile	5	Designing	0	Assessment	NA
Diploma	Mechanical/Electrical/Automobile	6	Designing	1	Assessment	NA
Diploma	Mechanical/Electrical/Automobile	7	Designing	0	Assessment	NA

Assessor Certification	
Domain Certification	**Platform Certification**
"Product Reverse Engineering, ASC/N8115, 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 & geotagged 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 & geotagged 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