Qualification Pack

Automotive Additive Manufacturing Engineer

QP Code: ASC/Q6414

Version: 1.0

NSQF Level: 6

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

Contents

ASC/Q6414: Automotive Additive Manufacturing Engineer

Brief Job Description

The individual at this job is responsible for finalizing product specifications, designing of automotive component, jigs & fixtures and development of product prototype as per the requirements fixed by R&D team.

Personal Attributes

The person should be result oriented with good technical and analytical skills, should have Excellent Interpersonal Skills, communication and presentation skills and a good team player. They should have ability to manage projects, prioritizing of work and mentoring the budding engineers.

Applicable National Occupational Standards (NOS)

Compulsory NOS:

1. ASC/N9810: Manage work and resources (Manufacturing)
2. ASC/N9812: Interact effectively with team, customers and others
3. ASC/N6435: Prepare for product designing
4. ASC/N6436: Design automotive component, jigs & fixtures using CAD Software
5. ASC/N6437: Develop product prototype by 3D printing

Qualification Pack (QP) Parameters

Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Production Engineering
Country	India
NSQF Level	6
Aligned to NCO/ISCO/ISIC Code	NCO-2015/NIL
Minimum Educational Qualification & Experience	M.E./M.Tech in the relevant field OR B.E/ B. Tech in the relevant field with 1 Year of relevant experience OR 3 years Diploma (Automobile/ Mechanical/Electrical/Electronics) from a recognized

	body (after class 12th) with 3 years of relevant experience OR Certificate NSQF (Automotive Prototype Manufacturing Lead Technician Level 5) with 3 Years of relevant experience
Minimum Level of Education for Training in School	
Pre-Requisite License or Training	NA
Minimum Job Entry Age	22 Years
Last Reviewed On	
Next Review Date	28th July, 2022
Deactivation Date	28th July, 2025
NSQC Approval Date	28th July, 2022
Version	1.0

ASC/N9810: Manage work and resources (Manufacturing)

Description

This NOS unit is about implementing safety, planning work, adopting sustainable practices for optimising the use of resources.

Scope

The scope covers the following :

- Maintain safe and secure working environment
- Maintain Health and Hygiene
- Effective waste management practices
- Material/energy conservation practices

Elements and Performance Criteria

Maintain safe and secure working environment

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

PC1. identify hazardous activities and the possible causes of risks or accidents in the workplace

PC2. implement safe working practices for dealing with hazards to ensure safety of self and others

PC3. conduct regular checks of the machines with support of the maintenance team to identify potential hazards

PC4. ensure that all the tools/equipment/fasteners/spare parts are arranged as per specifications/utility into proper trays, cabinets, lockers as mentioned in the 5S guidelines/work instructions

PC5. organise safety drills or training sessions to create awareness amongst others on the identified risks and safety practices

PC6. fill daily check sheet to report improvements done and risks identified

PC7. ensure that relevant safety boards/signs are placed on the shop floor for the safety of self and others

PC8. report any identified breaches in health, safety and security policies and procedures to the designated person

Maintain Health and Hygiene

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

PC9. ensure workplace, equipment, restrooms etc. are sanitized regularly

PC10. ensure team is aware about hygiene and sanitation regulations and following them on the shop floor

PC11. ensure availability of running water, hand wash and alcohol-based sanitizers at the workplace

PC12. report advanced hygiene and sanitation issues to appropriate authority

PC13. follow stress and anxiety management techniques and support employees to cope with stress, anxiety etc

PC14. wear and dispose PPEs regularly and appropriately

Effective waste management practices

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

PC15. ensure recyclable, non-recyclable and hazardous wastes are segregated as per SOP

PC16. ensure proper mechanism is followed while collecting and disposing of non-recyclable, recyclable and reusable waste

Material/energy conservation practices

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

PC17. ensure malfunctioning (fumes/sparks/emission/vibration/noise) and lapse in maintenance of equipment are resolved effectively

PC18. prepare and analyze material and energy audit reports to decipher excessive consumption of material and water

PC19. identify possibilities of using renewable energy and environment friendly fuels

PC20. identify processes where material and energy/electricity utilization can be optimized

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. organisation procedures for health, safety and security, individual role and responsibilities in this context

KU2. the organisation's emergency procedures for different emergency situations and the importance of following the same

KU3. evacuation procedures for workers and visitors

KU4. how and when to report hazards as well as the limits of responsibility for dealing with hazards

KU5. potential hazards, risks and threats based on the nature of work

KU6. various types of fire extinguisher

KU7. various types of safety signs and their meaning

KU8. appropriate first aid treatment relevant to different condition e.g. bleeding, minor burns, eye injuries etc.

KU9. relevant standards, procedures and policies related to 5S followed in the company

KU10. the various materials used and their storage norms

KU11. importance of efficient utilisation of material and water

KU12. basics of electricity and prevalent energy efficient devices

KU13. common practices of conserving electricity

KU14. common sources and ways to minimize pollution

KU15. categorisation of waste into dry, wet, recyclable, non-recyclable and items of single-use plastics

KU16. waste management techniques

KU17. significance of greening

Generic Skills (GS)

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

GS1. read safety instructions/guidelines
GS2. modify work practices to improve them
GS3. work with supervisors/team members to carry out work related tasks
GS4. complete tasks efficiently and accurately within stipulated time
GS5. inform/report to concerned person in case of any problem
GS6. make timely decisions for efficient utilization of resources
GS7. write reports such as accident report, in at least English/regional language

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Maintain safe and secure working environment	20	13	-	8
PC1. identify hazardous activities and the possible causes of risks or accidents in the workplace	4	2	-	2
PC2. implement safe working practices for dealing with hazards to ensure safety of self and others	3	1	-	2
PC3. conduct regular checks of the machines with support of the maintenance team to identify potential hazards	2	2	-	1
PC4. ensure that all the tools/equipment/fasteners/spare parts are arranged as per specifications/utility into proper trays, cabinets, lockers as mentioned in the 5S guidelines/work instructions	3	2	-	1
PC5. organise safety drills or training sessions to create awareness amongst others on the identified risks and safety practices	2	-	-	-
PC6. fill daily check sheet to report improvements done and risks identified	2	2	-	-
PC7. ensure that relevant safety boards/signs are placed on the shop floor for the safety of self and others	2	2	-	1
PC8. report any identified breaches in health, safety and security policies and procedures to the designated person	2	2	-	1
Maintain Health and Hygiene	13	7	-	5
PC9. ensure workplace, equipment, restrooms etc. are sanitized regularly	3	2	-	1
PC10. ensure team is aware about hygiene and sanitation regulations and following them on the shop floor	2	1	-	-
PC11. ensure availability of running water, hand wash and alcohol-based sanitizers at the workplace	2	2	-	1
PC12. report advanced hygiene and sanitation issues to appropriate authority	1	1	-	1

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC13. follow stress and anxiety management techniques and support employees to cope with stress, anxiety etc	2	1	-	1
PC14. wear and dispose PPEs regularly and appropriately	3	-	-	1
Effective waste management practices	6	4	-	1
PC15. ensure recyclable, non-recyclable and hazardous wastes are segregated as per SOP	3	2	-	-
PC16. ensure proper mechanism is followed while collecting and disposing of non-recyclable, recyclable and reusable waste	3	2	-	1
Material/energy conservation practices	11	6	-	6
PC17. ensure malfunctioning (fumes/sparks/emission/vibration/noise) and lapse in maintenance of equipment are resolved effectively	2	2	-	1
PC18. prepare and analyze material and energy audit reports to decipher excessive consumption of material and water	3	2	-	1
PC19. identify possibilities of using renewable energy and environment friendly fuels	3	1	-	2
PC20. identify processes where material and energy/electricity utilization can be optimized	3	1	-	2
NOS Total	**50**	**30**	**-**	**20**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N9810
NOS Name	Manage work and resources (Manufacturing)
Sector	Automotive
Sub-Sector	Generic
Occupation	Generic
NSQF Level	6
Credits	TBD
Version	1.0
Last Reviewed Date	28th July, 2022
Next Review Date	28th July, 2025
NSQC Clearance Date	28th July, 2022

ASC/N9812: Interact effectively with team, customers and others

Description

This unit is about communicating with team members, superior and others.

Scope

The scope covers the following :

- Communicate effectively with team members
- Interact with superiors
- Respect gender and ability differences

Elements and Performance Criteria

Communicate effectively with team members

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

PC1. implement ways to share information with team members in line with organisational requirements

PC2. ensure that work requirements are clearly communicated to the team members through all means including face-to-face, telephonic and written

PC3. manage and co-ordinate with team members to integrate work as per requirements

PC4. work in a way that show respect for all team members and customers

PC5. carry out commitments made to team members and let them know in good time if there is any discrepancy with reasons

PC6. resolve conflicts within the team members at work to achieve smooth workflow

PC7. guide the team members to follow the organisation's policies and procedures

PC8. ensure team goals are given preference over individual goals

PC9. respect personal space of colleagues and customers

Interact with superiors

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

PC10. report progress on job allocated and team performance to the superiors

PC11. escalate problems to superiors that cannot be handled

PC12. train the team members to report completed work and receive feedback on work done

PC13. encourage team members to rectify errors as per feedback and minimize mistakes in future

Respect gender and ability differences

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

PC14. ensure team shows sensitivity towards all genders and PwD

PC15. adjust communication styles to reflect gender sensitivity and sensitivity towards person with disability

PC16. help PwD team members to overcome the challenges, if asked

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. the importance of effective communication and establishing good working relationships with team members and superiors
KU2. different methods of communication as per the circumstances
KU3. gender based concepts, issues and legislation
KU4. organisation standards and guidelines to be followed for PwD
KU5. rights and duties at workplace with respect to PwD
KU6. organisation policies and procedures pertaining to written and verbal communication

Generic Skills (GS)

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

GS1. read safety instructions/guidelines
GS2. modify work practices to improve them
GS3. work with supervisors/team members to carry out work related tasks
GS4. complete tasks efficiently and accurately within stipulated time
GS5. make timely decisions for efficient utilization of resources
GS6. read instructions/guidelines/procedures
GS7. write in English/any one language

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Communicate effectively with team members	20	14	-	8
PC1. implement ways to share information with team members in line with organisational requirements	2	2	-	-
PC2. ensure that work requirements are clearly communicated to the team members through all means including face-to-face, telephonic and written	2	2	-	2
PC3. manage and co-ordinate with team members to integrate work as per requirements	2	1	-	2
PC4. work in a way that show respect for all team members and customers	3	1	-	2
PC5. carry out commitments made to team members and let them know in good time if there is any discrepancy with reasons	2	2	-	-
PC6. resolve conflicts within the team members at work to achieve smooth workflow	3	2	-	-
PC7. guide the team members to follow the organisation's policies and procedures	2	1	-	-
PC8. ensure team goals are given preference over individual goals	2	1	-	-
PC9. respect personal space of colleagues and customers	2	2	-	2
Interact with superiors	18	10	-	7
PC10. report progress on job allocated and team performance to the superiors	4	3	-	2
PC11. escalate problems to superiors that cannot be handled	4	2	-	1
PC12. train the team members to report completed work and receive feedback on work done	5	2	-	2
PC13. encourage team members to rectify errors as per feedback and minimize mistakes in future	5	3	-	2

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Respect gender and ability differences	12	6	-	5
PC14. ensure team shows sensitivity towards all genders and PwD	4	2	-	2
PC15. adjust communication styles to reflect gender sensitivity and sensitivity towards person with disability	4	2	-	2
PC16. help PwD team members to overcome the challenges, if asked	4	2	-	1
NOS Total	**50**	**30**	**-**	**20**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N9812
NOS Name	Interact effectively with team, customers and others
Sector	Automotive
Sub-Sector	Generic
Occupation	Generic
NSQF Level	6
Credits	TBD
Version	1.0
Last Reviewed Date	28th July, 2022
Next Review Date	28th July, 2025
NSQC Clearance Date	28th July, 2022

ASC/N6435: Prepare for product designing

Description

This NOS unit is about identifying and analysing the design requirements received from R&D team, creating the product design based on that and assisting the manager in finalizing the design specifications.

Scope

The scope covers the following :

- Identify product requirements
- Create basic product design
- Support in finalization of design specification
- Ensure reliability and validity of the product design

Elements and Performance Criteria

Identify and analyse product requirements

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

PC1. obtain product requirements from the R & D Team like basic customer preferences, benchmarking data, technology parameters etc. and analyse them for creating the product design

PC2. analyse the type of material (including new material), technology and technique to be used in the design of the product

PC3. define the shape/ size/ environmental impact of the design

PC4. discuss the product requirements with team and supervisor and create a picture/image of the design

Create basic product design

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

PC5. create a freehand sketch/silhouette of product on the basis of image of the product design

PC6. ensure that all aspects of aesthetic appeal, ergonomics etc. are considered while creating the product design

PC7. select the procedure that displays design hierarchy

PC8. use mechanical CAD (Computer Aided Design) system to generate design geometry

PC9. generate the drafting sheets of the product (Jigs & Fixtures, Automotive components) with its technical and structural constituents on the basis of the initial sketches

Support in finalization of design specifications

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

PC10. support the manager in creation of design input and requirements for each of the aggregates, 3D model of the product, etc.

PC11. support the manager in defining elements related to color design (interior and exterior) through analysis of a range of data including what colors are in vogue in the fields of fashion and interior design around the world

PC12. support in achieving the required specification of the product and ensure conformance between design output and design input

PC13. support in deciding the means for providing design input and demonstration of product to ensure each requirement has been met

PC14. support in creating a mechanism for capturing design output

PC15. develop a Quality Cost Delivery analysis for all decision metrics related to the development of product prototype and cost involved with the support of manager

Ensure reliability and validity of the product design

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

PC16. define reliability requirements on the basis of benchmarks, competitive analysis, cost, safety, etc. in coordination with the manager

PC17. identify key reliability risk items and corresponding risk reduction strategy with the help of the product design manager

PC18. estimate the products design reliability and analyse it by using simulation models, prior warranty and tests data from similar models

PC19. analyse failure risks and and mechanics of the product design

PC20. use the design of experiments methodology to identify factors significant to the life of the vehicle

PC21. use Life Data Analysis (LDA) techniques to statistically estimate the reliability of the product design and calculate various reliability-related metrics

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant standards and procedures followed in the company

KU2. company manufacturing processes & the equipment in use

KU3. sequence of operations for each process

KU4. procedure that displays design hierarchy

KU5. type of automotive systems being used for the process

KU6. latest technologies and regulations in auto industry

KU7. QMS requirements

KU8. various specifications and parameters required to be finalized for design of the product

KU9. various requirements in terms of design and utility of the component

KU10. process flow of designing the vehicle and its components

KU11. use of simulation tools such as CAD, CAM etc.

KU12. Draughting Standards & Techniques- e.g. ANSI series IS/ ISO

KU13. how to conduct the failure analysis

KU14. impact of each cause of failure on vehicle

KU15. Draughting Standards & Techniques- e.g. ANSI series IS/ ISO

KU16. documents and records need to be maintained

KU17. different parameters used to evaluate the performance of the design

KU18. how to check reliability and validity of the product design

Generic Skills (GS)

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

GS1. follow instructions, guidelines, procedures, rules, and service level agreements
GS2. listen effectively and communicate information accurately
GS3. follow rule-based decision-making processes
GS4. make decisions on suitable courses
GS5. plan and organize the work to achieve targets and meet deadlines
GS6. apply problem-solving approaches to different situations
GS7. analyse the business impact and disseminate relevant information to others
GS8. apply balanced judgments to different situations
GS9. check the work is complete and free from errors

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Identify and analyse product requirements	**9**	**10**		**4**
PC1. obtain product requirements from the R & D Team like basic customer preferences, benchmarking data, technology parameters etc. and analyse them for creating the product design	3	3		1
PC2. analyse the type of material (including new material), technology and technique to be used in the design of the product	2	3		1
PC3. define the shape/ size/ environmental impact of the design	2	2		1
PC4. discuss the product requirements with team and supervisor and create a picture/image of the design	2	2		1
Create basic product design	**11**	**11**		**5**
PC5. create a freehand sketch/silhouette of product on the basis of image of the product design	2	2		1
PC6. ensure that all aspects of aesthetic appeal, ergonomics etc. are considered while creating the product design	2	3		1
PC7. select the procedure that displays design hierarchy	2	2		1
PC8. use mechanical CAD (Computer Aided Design) system to generate design geometry	3	2		1
PC9. generate the drafting sheets of the product (Jigs & Fixtures, Automotive components) with its technical and structural constituents on the basis of the initial sketches	2	2		1
Support in finalization of design specifications	**9**	**10**		**5**
PC10. support the manager in creation of design input and requirements for each of the aggregates, 3D model of the product, etc.	1	2		1
PC11. support the manager in defining elements related to color design (interior and exterior) through analysis of a range of data including what colors are in vogue in the fields of fashion and interior design around the world	2	1		1

PC12. support in achieving the required specification of the product and ensure conformance between design output and design input	1	1		
PC13. support in deciding the means for providing design input and demonstration of product to ensure each requirement has been met	2	2		1
PC14. support in creating a mechanism for capturing design output	1	2		1
PC15. develop a Quality Cost Delivery analysis for all decision metrics related to the development of product prototype and cost involved with the support of manager	2	2		1
Ensure reliability and validity of the product design	**11**	**9**		**6**
PC16. define reliability requirements on the basis of benchmarks, competitive analysis, cost, safety, etc. in coordination with the manager	2	2		1
PC17. identify key reliability risk items and corresponding risk reduction strategy with the help of the product design manager	2	1		1
PC18. estimate the products design reliability and analyse it by using simulation models, prior warranty and tests data from similar models	2	2		1
PC19. analyse failure risks and and mechanics of the product design	3	2		1
PC20. use the design of experiments methodology to identify factors significant to the life of the vehicle	1	1		1
PC21. use Life Data Analysis (LDA) techniques to statistically estimate the reliability of the product design and calculate various reliability-related metrics	1	1		1
NOS Total	**40**	**40**	**-**	**20**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N6435
NOS Name	Prepare for product designing
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Production Engineering
NSQF Level	6
Credits	TBD
Version	1.0
Last Reviewed Date	28th July, 2022
Next Review Date	28th July, 2025
NSQC Clearance Date	28th July, 2022

ASC/N6436: Design automotive component, jigs & fixtures using CAD Software

Description

This NOS unit is about designing of automotive components, jigs & fixtures of product by using 2D and 3D design software tools and converting the design into Stereolithography format.

Scope

The scope covers the following :

- Prepare for product designing
- Design the object model using CAD Software
- Convert the design into 3D printer supporting format(Stereolithography)

Elements and Performance Criteria

Prepare for product designing

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

PC1. identify the customer requirements and work to be done by interpreting the work order, process manuals and instructions from internal design team and supervisor

PC2. identify and select most suitable Computer Aided Design Software like catia, NX , Fusion 360 etc. for creating the designs and models as per design requirement

PC3. identify the type of 3D scanner and scanned files

PC4. interpret the product design and collate the design requirements in terms of material used for making the component, packaging and other requirements to decide the dimensions, measurements and tolerances of the aggregate/component

PC5. refer any issues related to design concept clarity, dimensions and practicality to competent internal specialist or supervisor if they cannot be resolved by own

Design the object model using CAD Software

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

PC6. create an object model as per drawing/dimension by using selected CAD software

PC7. identify and optimize the Scanned files with using 3D modelling software

PC8. develop and design specifications of the component by using the Geometric and Trigonometric rules/ formula provided by the supervisor

PC9. set the required unit and dimension parameters and insert sketches, scanned images, diagrams, signs or symbols, etc. of required product design in the software

PC10. create a 3D model of product by using CAD techniques as per the information received from the customer

PC11. use the software features like tools modeling, sculpting, generative design, simulation, assemblies, collaboration, tool validation and design options like free form, solid, and mesh modeling for creating the object model as per the information received

PC12. verify the object model by comparing it with the information and specifications mentioned in the product modelling document

Convert the design into 3D Printer supporting format

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

PC13. convert the object model into STL or AMF file format as per the 3D printer requirement

PC14. check object model files for common errors such as holes, self-intersections, manifold errors, faces etc. and rectify the same by following organizational recommended procedures

PC15. transfer the verified object model STL / AMF file into portable storage device or directly to 3D printer as per SOP/WI

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant manufacturing standards and procedures followed in the company

KU2. organization methodology/procedures used for automotive product design

KU3. how to read and interpret sketches and engineering drawings

KU4. different types of designing processes and associated software like CATIA, AutoCAD, Unigraphics etc.

KU5. draughting standards & techniques- e.g. ANSI series IS/ISO

KU6. technical drawing practices as per the company standards

KU7. drawings and modelling techniques like 2D and 3D

KU8. methods of using instruments like Vernier callipers, Micrometres, rulers and other inspection tools

KU9. use of advance measuring instrument like CMM , RMM etc.

KU10. function of different Computer aided design Software tools

KU11. algebra and trigonometric rules and applications

KU12. how to identify and correct errors in the object model file

Generic Skills (GS)

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

GS1. follow instructions, guidelines, procedures, rules, and service level agreements

GS2. listen effectively and communicate information accurately

GS3. follow rule-based decision-making processes

GS4. make decisions on suitable courses

GS5. plan and organize the work to achieve targets and meet deadlines

GS6. apply problem-solving approaches to different situations

GS7. analyse the business impact and disseminate relevant information to others

GS8. apply balanced judgments to different situations

GS9. check the work is complete and free from errors

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Prepare for product designing	**14**	**12**		**7**
PC1. identify the customer requirements and work to be done by interpreting the work order, process manuals and instructions from internal design team and supervisor	3	3		2
PC2. identify and select most suitable Computer Aided Design Software like catia, NX , Fusion 360 etc. for creating the designs and models as per design requirement	3	2		1
PC3. identify the type of 3D scanner and scanned files	2	3		1
PC4. interpret the product design and collate the design requirements in terms of material used for making the component, packaging and other requirements to decide the dimensions, measurements and tolerances of the aggregate/component	3	2		1
PC5. refer any issues related to design concept clarity, dimensions and practicality to competent internal specialist or supervisor if they cannot be resolved by own	3	2		2
Design the object model using CAD Software	**19**	**19**		**8**
PC6. create an object model as per drawing/dimension by using selected CAD software	3	3		2
PC7. identify and optimize the Scanned files with using 3D modelling software	2	3		1
PC8. develop and design specifications of the component by using the Geometric and Trigonometric rules/ formula provided by the supervisor	2	3		1
PC9. set the required unit and dimension parameters and insert sketches, scanned images, diagrams, signs or symbols, etc. of required product design in the software	3	3		1
PC10. create a 3D model of product by using CAD techniques as per the information received from the customer	3	2		1

PC11. use the software features like tools modeling, sculpting, generative design, simulation, assemblies, collaboration, tool validation and design options like free form, solid, and mesh modeling for creating the object model as per the information received	3	2		1
PC12. verify the object model by comparing it with the information and specifications mentioned in the product modelling document	3	3		1
Convert the design into 3D Printer supporting format	**7**	**9**		**5**
PC13. convert the object model into STL or AMF file format as per the 3D printer requirement	2	3		1
PC14. check object model files for common errors such as holes, self-intersections, manifold errors, faces etc. and rectify the same by following organizational recommended procedures	3	3		2
PC15. transfer the verified object model STL / AMF file into portable storage device or directly to 3D printer as per SOP/WI	2	3		2
NOS Total	**40**	**40**	**-**	**20**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N6436
NOS Name	Design automotive component, jigs & fixtures using CAD Software
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Production Engineering
NSQF Level	6
Credits	TBD
Version	1.0
Last Reviewed Date	28th July, 2022
Next Review Date	28th July, 2025
NSQC Clearance Date	28th July, 2022

ASC/N6437: Develop product prototype by 3D printing

Description

This unit is about developing a prototype of product by using 3D printing machines and performing the post process of the fabricated product as per standards drafting sheets of the organization.

Scope

The scope covers the following :

- Prepare 3D printable file from design & modeling software packages
- Generate 3D printable file from design & modeling software packages
- Monitor post-printing activities
- Support in maintenance of 3D printing and allied machinery

Elements and Performance Criteria

Prepare 3D printable file from design & modeling software packages

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

PC1. convert a standard design model into standard tessellation language (.stl) file format

PC2. select encoding format for the 3D printing program file

PC3. rectify any errors which are generated in the file creation process

Generate 3D printable file from design & modeling software packages

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

PC4. select the standard tesselation language (.stl) code file needed for machine operation

PC5. connect the data storage devices with the machine

PC6. select the optimum orientation for the part

PC7. set the part orientation, printing time & the amount of material used on the machine

PC8. set the slicing layer thickness & its dependencies on surface finish & machining time

PC9. support the 3D printing machine operator during 3D printing operation and monitor the 3D printing process

PC10. coordinate with designer to rectify any errors which are generated during the file uploading process or errors observed during the 3D printing process

Monitor post-printing activities

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

PC11. ensure that operator is removing the printed part from machine safely and without any damage to its structure

PC12. ensure that operator is removing the support structures present in the fabricated part

PC13. check that printed part is cleaned after printing process for improving the surface finish as per SOP

PC14. ensure that all the tools, equipment and auxiliaries are cleaned and stored after completion of work as per the guidelines

PC15. inspect that part is as per the drawing and required quality and if non-conforming, take action as per organizational guidelines

PC16. find out the measurement errors between 3D printed files and drafted files provided

PC17. carryout the optimization process of the product to rectify the difference

PC18. store & preserve the automotive parts manufactured as per organizational guidelines and procedures

Support in maintenance of 3D printing and allied machinery

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

PC19. prepare the maintenance plan and checklist as per machinery requirement

PC20. support the operators in performing minor repairs, adjustments and alignment of loose bolts, belts, drive slacks, guards and covers of the machine

PC21. ensure that repaired 3D printing machine is working properly and running smoothly

PC22. maintain records of maintenance activities done on machine as per organizational procedure

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant manufacturing standards and procedures followed in the company

KU2. organization methodology/procedures used for product design

KU3. all the symbols and notifications being displayed by the 3D Printing machine and their corresponding meaning

KU4. technology 3D Printing such as Fused Deposition Modelling, Stereo Lithography, Metal Laser Sintering

KU5. types of files such as .stl, code file, etc generated in the various steps of the process

KU6. techniques of fabricating a component with 3D Printing

KU7. how to upload and remove code files from the machine memory

KU8. types of 3D Printing techniques

KU9. types of materials available for fabrication in various 3D printing technique

KU10. post-processing techniques

KU11. how to detect and rectify error at various stages of part generation

KU12. various inspection methods for inspecting the quality of product such as CMM, RMM and 3D Measurement machine.

Generic Skills (GS)

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

GS1. follow instructions, guidelines, procedures, rules, and service level agreements

GS2. listen effectively and communicate information accurately

GS3. follow rule-based decision-making processes

GS4. make decisions on suitable courses

GS5. plan and organize the work to achieve targets and meet deadlines

GS6. apply problem-solving approaches to different situations

GS7. analyse the business impact and disseminate relevant information to others

GS8. apply balanced judgments to different situations

GS9. check the work is complete and free from errors

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Prepare 3D printable file from design & modeling software packages	**6**	**7**		**4**
PC1. convert a standard design model into standard tessellation language (.stl) file format	2	2		1
PC2. select encoding format for the 3D printing program file	2	2		2
PC3. rectify any errors which are generated in the file creation process	2	3		1
Generate 3D printable file from design & modeling software packages	**12**	**12**		**6**
PC4. select the standard tesselation language (.stl) code file needed for machine operation	2	2		1
PC5. connect the data storage devices with the machine	1	1		
PC6. select the optimum orientation for the part	1	1		1
PC7. set the part orientation, printing time & the amount of material used on the machine	2	2		1
PC8. set the slicing layer thickness & its dependencies on surface finish & machining time	2	2		1
PC9. support the 3D printing machine operator during 3D printing operation and monitor the 3D printing process	2	2		1
PC10. coordinate with designer to rectify any errors which are generated during the file uploading process or errors observed during the 3D printing process	2	2		1
Monitor post-printing activities	**14**	**14**		**6**
PC11. ensure that operator is removing the printed part from machine safely and without any damage to its structure	2	2		1
PC12. ensure that operator is removing the support structures present in the fabricated part	2	2		1
PC13. check that printed part is cleaned after printing process for improving the surface finish as per SOP	2	2		1

PC14. ensure that all the tools, equipment and auxiliaries are cleaned and stored after completion of work as per the guidelines	2	2		1
PC15. inspect that part is as per the drawing and required quality and if non-conforming, take action as per organizational guidelines	2	2		1
PC16. find out the measurement errors between 3D printed files and drafted files provided	2	1		
PC17. carryout the optimization process of the product to rectify the difference	1	2		1
PC18. store & preserve the automotive parts manufactured as per organizational guidelines and procedures	1	1		
Support in maintenance of 3D printing and allied machinery	**8**	**7**		**4**
PC19. prepare the maintenance plan and checklist as per machinery requirement	2	2		1
PC20. support the operators in performing minor repairs, adjustments and alignment of loose bolts, belts, drive slacks, guards and covers of the machine	2	2		1
PC21. ensure that repaired 3D printing machine is working properly and running smoothly	2	2		1
PC22. maintain records of maintenance activities done on machine as per organizational procedure	2	1		1
NOS Total	**40**	**40**	**-**	**20**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N6437
NOS Name	Develop product prototype by 3D printing
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Production Engineering
NSQF Level	6
Credits	TBD
Version	1.0
Last Reviewed Date	28th July, 2022
Next Review Date	28th July, 2025
NSQC Clearance Date	28th July, 2022

Assessment Guidelines and Assessment Weightage

Assessment Guidelines

1. Criteria for assessment for each Qualification Pack will be created by the Sector Skill Council. Each Performance Criteria (PC) (PC) will be assigned marks proportional to its importance in NOS. SSC will also lay down proportion of marks for Theory and Skills Practical for each PC.

2. The assessment for the theory part will be based on knowledge bank of questions created by the SSC.

3. Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training centre (as per assessment criteria below).

4. Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/ training centre based on these criteria.

5. In case of successfully passing only certain number of NOSs, the trainee is eligible to take

subsequent assessment on the balance NOS's to pass the Qualification Pack.

6. In case of unsuccessful completion, the trainee may seek reassessment on the Qualification Pack

Minimum Aggregate Passing % at QP Level : 70

(**Please note**: Every Trainee should score a minimum aggregate passing percentage as specified above, to successfully clear the Qualification Pack assessment.)

Assessment Weightage

Compulsory NOS

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
ASC/N9810.Manage work and resources (Manufacturing)	50	30	0	20	100	15
ASC/N9812.Interact effectively with team, customers and others	50	30	-	20	100	10
ASC/N6435: Prepare for product designing	40	40	-	20	100	25
ASC/N6436: Design automotive component, jigs & fixtures using CAD Software	40	40	0	20	100	25

ASC/N6437: Develop product prototype by 3D printing	40	40	-	20	100	25
Total	**220**	**180**	**-**	**100**	**500**	**100**

Acronyms

NOS	National Occupational Standard(s)
NSQF	National Skills Qualifications Framework
QP	Qualifications Pack
TVET	Technical and Vocational Education and Training
AMC	Annual Maintenance Contract
PPE	Personal Protective Equipment
ERP	Enterprise Resource Planning
PM	Predictive Maintenance
QMS	Quality Management System

Glossary

Sector	Sector is a conglomeration of different business operations having similar business and interests. It may also be defined as a distinct subset of the economy whose components share similar characteristics and interests.
Sub-sector	Sub-sector is derived from a further breakdown based on the characteristics and interests of its components.
Occupation	Occupation is a set of job roles, which perform similar/ related set of functions in an industry.
Job role	Job role defines a unique set of functions that together form a unique employment opportunity in an organisation.
Occupational Standards (OS)	OS specify the standards of performance an individual must achieve when carrying out a function in the workplace, together with the Knowledge and Understanding (KU) they need to meet that standard consistently. Occupational Standards are applicable both in the Indian and global contexts.
Performance Criteria (PC)	Performance Criteria (PC) are statements that together specify the standard of performance required when carrying out a task.
National Occupational Standards (NOS)	NOS are occupational standards which apply uniquely in the Indian context.
Qualifications Pack (QP)	QP comprises the set of OS, together with the educational, training and other criteria required to perform a job role. A QP is assigned a unique qualifications pack code.
Unit Code	Unit code is a unique identifier for an Occupational Standard, which is denoted by an 'N'
Unit Title	Unit title gives a clear overall statement about what the incumbent should be able to do.
Description	Description gives a short summary of the unit content. This would be helpful to anyone searching on a database to verify that this is the appropriate OS they are looking for.
Scope	Scope is a set of statements specifying the range of variables that an individual may have to deal with in carrying out the function which have a critical impact on quality of performance required.
Knowledge and Understanding (KU)	Knowledge and Understanding (KU) are statements which together specify the technical, generic, professional and organisational specific knowledge that an individual needs in order to perform to the required standard.

Organisational Context	Organisational context includes the way the organisation is structured and how it operates, including the extent of operative knowledge managers have of their relevant areas of responsibility.
Technical Knowledge	Technical knowledge is the specific knowledge needed to accomplish specific designated responsibilities.
Core Skills/ Generic Skills (GS)	Core skills or Generic Skills (GS) are a group of skills that are the key to learning and working in today's world. These skills are typically needed in any work environment in today's world. These skills are typically needed in any work environment. In the context of the OS, these include communication related skills that are applicable to most job roles.
Electives	Electives are NOS/set of NOS that are identified by the sector as contributive to specialization in a job role. There may be multiple electives within a QP for each specialized job role. Trainees must select at least one elective for the successful completion of a QP with Electives.
Options	Options are NOS/set of NOS that are identified by the sector as additional skills. There may be multiple options within a QP. It is not mandatory to select any of the options to complete a QP with Options.