Qualification Pack

3D Printing Operator

QP Code: MES/Q0511

Version: 1.0

NSQF Level: 4

Media & Entertainment Skills Council || Commercial premises No Ja522, 5th Floor, DLF Tower A, Jasola, New Delhi
110025

Contents

MES/Q0511: 3D Printing Operator

Brief Job Description

A 3D printing operator is a competent individual with technical and creative skills in additive manufacturing. They use computer-aided (CAD) software to develop designs to be 3D printed into finished works. 3D Printing technicians assist in the designing and programming of products, ranging from prosthetic products to 3D miniatures. They may also provide 3D printing maintenance, check 3D renders for customers and run 3D printing tests. 3D printing technicians can also repair, maintain and clean 3D printers.

Personal Attributes

Individual at this job role have creative and knowledge to draw free hand, being great a 3D modeling tools, managing 3D printers. They have Effective skills in writing, reading and oral communication (listening and speaking skills) with required clarity. Basic mathematical skills in collecting, communicating and presenting materials based on sound social political and natural environment. Effective team work and safety of self and colleagues. Responsible for self-learning goals.

Applicable National Occupational Standards (NOS)

Compulsory NOS:

1. MES/N2528: Analyse 3D Technology for printing

2. MES/N0104: Maintain Workplace Health & Safety

3. MES/N0533: Prepare 3D design, digital models and prototypes

4. MES/N0534: Data preparation and printing

5. MES/N0535: Operate 3D scanning and printing machinery

6. MES/N0536: Conduct servicing and repairing equipment

Qualification Pack (QP) Parameters

Sector	Media & Entertainment
Sub-Sector	Print
Occupation	Art and Design
Country	India

NSQF Level	4
Credits	17
Aligned to NCO/ISCO/ISIC Code	NCO-2015/2141.2400
Minimum Educational Qualification & Experience	11th Class (pass) OR 10th Class (pass plus 1 year NTC/NAC) OR 10th Class (pass and pursuing continuous schooling)
Minimum Level of Education for Training in School	Not Applicable
Pre-Requisite License or Training	NA
Minimum Job Entry Age	18 Years
Last Reviewed On	NA
Next Review Date	31/03/2027
NSQC Approval Date	31/03/2022
Version	1.0
Reference code on NQR	2022/ME/MESC/05697
NQR Version	1.0

Remarks:

MES/N2528: Analyse 3D Technology for printing

Description

This unit is about analyzing 3D printing technology and creating a 3D printed object

Scope

The scope covers the following :

- Discuss and demonstrate ways to analyze 3D printing technology
- Create a 3D printed object

Elements and Performance Criteria

Analyze 3D printing technology

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

PC1. • Analyse 3D print technology- 3D printing or additive manufacturing is a process of making three dimensional
     • solid objects from a digital file

PC2. creation of a 3D printed object is achieved using additive processes

PC3. Identify and install 3D software to be used

Create a 3D printed object

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

PC4. Slicing - slicing up a 3D model into hundreds or thousands of layers

PC5. Demonstration of different stages of AM (Additive Manufacturing) Process

PC6. Programming of AM Parts.

PC7. Working with 3D printer

PC8. Select and use correct CAD formats to manufacture a 3D printed part.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. the Quantity and the quality as per the specification.

KU2. to make less wastage.

KU3. to increase the production and efficiency of the machine.

KU4. to discuss and distribute the work among the team.

KU5. to maintain quality control as production scales

KU6. Install 3D software

KU7. how to select appropriate CAD formats

KU8. how to do slicing of a 3D model

KU9. different stages of Additive manufacturing process

KU10. various AM technologies

KU11. ways to select Laser Sintering Polyjet, Materials for Additive Manufacturing & 3D Printing

KU12. various technologies including Computer-Aided Design Technology - Other Associated Technologies, Lasers, Printing Technologies, Programmable Logic Controllers

KU13. process of Material Extrusion, Power bed fusion and Sheet Lamination

KU14. various slicing tools, Finite Element Analysis

KU15. Preparing STLs for 3D Printing

KU16. how to process Simulations Using Finite Element Analysis

KU17. use of AM to Support Medical Applications, Surgical and Diagnostic Aids, Prosthetics Development

KU18. processes of contact and noncontact 3D scanning

KU19. how to create and plot assembly and detail views of simple geometrical solid with Dimension, Tolerance &Annotation in 3D Modelling

KU20. different measurement to be performed to check the components for functionality and conformance

KU21. use of various instruments such as VernierCaliper, Vernier height gauge, Micrometer, depth gauge, Bevel protector, sine bar and dial test indicator

KU22. how to apply process algorithm

KU23. keeping 3D printer well lubricated

KU24. how to clear any dust and debris from the extruder feeder wheels

KU25. how to maintain 3D printer

Generic Skills (GS)

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

GS1. prepare the production report/ documentation including samples to accompany the job docket.

GS2. read and understand the user and technical specifications of jobs.

GS3. discuss and understand requirements and specifications from the Print Coordinator and the team.

GS4. discuss any problems with the brief that could impact the production process and solicit suggestions for resolving them.

GS5. To plan and prioritize work according to the requirements.

GS6. Complete the job within a period of time by increasing the efficiency of the machine.

GS7. make decision for suitable course of action.

GS8. quality standards/final output meet customer requirements and organizational standards.

GS9. ensure that the work requires technical assistance to meet the desired outcomes and resolve the same.

GS10. solve the problems while printing without stoppage of machine unless & until it is necessary.

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Analyze 3D printing technology	**20**	**50**	**-**	**-**
PC1. • Analyse 3D print technology- 3D printing or additive manufacturing is a process of making three dimensional • solid objects from a digital file	5	-	-	-
PC2. creation of a 3D printed object is achieved using additive processes	10	-	-	-
PC3. Identify and install 3D software to be used	5	-	-	-
Create a 3D printed object	**30**	**-**	**-**	**-**
PC4. Slicing - slicing up a 3D model into hundreds or thousands of layers	5	-	-	-
PC5. Demonstration of different stages of AM (Additive Manufacturing) Process	10	-	-	-
PC6. Programming of AM Parts.	5	-	-	-
PC7. Working with 3D printer	5	-	-	-
PC8. Select and use correct CAD formats to manufacture a 3D printed part.	5	-	-	-
NOS Total	**50**	**50**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	MES/N2528
NOS Name	Analyse 3D Technology for printing
Sector	Media & Entertainment
Sub-Sector	Print
Occupation	Asset Creation, Art and Design
NSQF Level	4
Credits	TBD
Version	1.0
Last Reviewed Date	NA
Next Review Date	31/03/2027
NSQC Clearance Date	31/03/2022

MES/N0104: Maintain Workplace Health & Safety

Description

This OS unit is about contributing towards maintaining a healthy, safe and secure working environment

Elements and Performance Criteria

Understanding the health, safety and security risks prevalent in the workplace

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

PC1. understand and comply with the organizations current health, safety and security policies and procedures

PC2. understand the safe working practices pertaining to own occupation

PC3. understand the government norms and policies relating to health and safety including emergency procedures for illness, accidents, fires or others which may involve evacuation of the premises

PC4. participate in organization health and safety knowledge sessions and drills

Knowing the people responsible for health and safety and the resources available

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

PC5. identify the people responsible for health and safety in the workplace, including those to contact in case of an emergency

PC6. identify security signals e.g. fire alarms and places such as staircases, fire warden stations, first aid and medical rooms

Identifying and reporting risks

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

PC7. identify aspects of your workplace that could cause potential risk to own and others health and safety

PC8. ensure own personal health and safety, and that of others in the workplace though precautionary measures

PC9. identify and recommend opportunities for improving health, safety, and security to the designated person

PC10. report any hazards outside the individuals authority to the relevant person in line with organizational procedures and warn other people who may be affected

Complying with procedures in the event of an emergency

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

PC11. follow organizations emergency procedures for accidents, fires or any other natural calamity in case of a hazard

PC12. identify and correct risks like illness, accidents, fires or any other natural calamity safely and within the limits of individuals authority

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. Organizations norms and policies relating to health and safety
KU2. Government norms and policies regarding health and safety and related emergency procedures
KU3. Limits of authority while dealing with risks/ hazards
KU4. The importance of maintaining high standards of health and safety at a workplace
KU5. The different types of health and safety hazards in a workplace
KU6. Safe working practices for own job role
KU7. Evacuation procedures and other arrangements for handling risks
KU8. Names and contact numbers of people responsible for health and safety in a workplace
KU9. How to summon medical assistance and the emergency services, where necessary
KU10. Vendors or manufacturers instructions for maintaining health and safety while using equipment, systems and/or machines

Generic Skills (GS)

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

GS1. how to write and provide feedback regarding health and safety to the concerned people
GS2. how to write and highlight potential risks or report a hazard to the concerned people
GS3. read instructions, policies, procedures and norms relating to health and safety
GS4. highlight potential risks and report hazards to the designated people
GS5. listen and communicate information with all anyone concerned or affected
GS6. make decisions on a suitable course of action or plan
GS7. plan and organize people and resources to deal with risks/ hazards that lie within the scope of ones individual authority
GS8. apply problem solving approaches in different situations
GS9. understand hazards that fall within the scope of individual authority and report all hazards that may supersede ones authority
GS10. apply balanced judgments in different situations
GS11. How to write and provide feedback regarding health and safety to the concerned people
GS12. How to write and highlight potential risks or report a hazard to the concerned people
GS13. Read instructions, policies, procedures and norms relating to health and safety
GS14. Highlight potential risks and report hazards to the designated people
GS15. Listen and communicate information with all anyone concerned or affected
GS16. Make decisions on a suitable course of action or plan
GS17. Plan and organize people and resources to deal with risks/ hazards that lie within the scope of ones individual authority
GS18. Apply problem solving approaches in different situations
GS19. build and maintain positive and effective relationships with colleges and customers
GS20. analyze data and activites
GS21. Understand hazards that fall within the scope of individual authority and report all hazards that may supersede ones authority

GS22. Apply balanced judgments in different situations

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Understanding the health, safety and security risks prevalent in the workplace	**15**	**15**	**-**	**-**
PC1. understand and comply with the organizations current health, safety and security policies and procedures	5	5	-	-
PC2. understand the safe working practices pertaining to own occupation	5	5	-	-
PC3. understand the government norms and policies relating to health and safety including emergency procedures for illness, accidents, fires or others which may involve evacuation of the premises	3	2	-	-
PC4. participate in organization health and safety knowledge sessions and drills	2	3	-	-
Knowing the people responsible for health and safety and the resources available	**10**	**10**	**-**	**-**
PC5. identify the people responsible for health and safety in the workplace, including those to contact in case of an emergency	5	5	-	-
PC6. identify security signals e.g. fire alarms and places such as staircases, fire warden stations, first aid and medical rooms	5	5	-	-
Identifying and reporting risks	**18**	**17**	**-**	**-**
PC7. identify aspects of your workplace that could cause potential risk to own and others health and safety	5	5	-	-
PC8. ensure own personal health and safety, and that of others in the workplace though precautionary measures	5	5	-	-
PC9. identify and recommend opportunities for improving health, safety, and security to the designated person	3	2	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC10. report any hazards outside the individuals authority to the relevant person in line with organizational procedures and warn other people who may be affected	5	5	-	-
Complying with procedures in the event of an emergency	**7**	**8**	**-**	**-**
PC11. follow organizations emergency procedures for accidents, fires or any other natural calamity in case of a hazard	5	5	-	-
PC12. identify and correct risks like illness, accidents, fires or any other natural calamity safely and within the limits of individuals authority	2	3	-	-
NOS Total	**50**	**50**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	MES/N0104
NOS Name	Maintain Workplace Health & Safety
Sector	Media & Entertainment
Sub-Sector	Film, Television, Animation, Gaming, Radio, Advertising
Occupation	Ad sales/Account Management/Scheduling/Traffic
NSQF Level	5
Credits	2
Version	1.0
Last Reviewed Date	30/12/2021
Next Review Date	31/03/2027
NSQC Clearance Date	31/03/2022

MES/N0533: Prepare 3D design, digital models and prototypes

Description

This unit is about various AM technologies and to use 3D printers to create digital models and prototypes

Scope

The scope covers the following :

- Define various milestones in AM Development
- Demonstrate ways to use 3D printers to create digital models and prototypes

Elements and Performance Criteria

Elaborate various AM technologies and AM processes

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

PC1. Selection of Laser Sintering Polyjet, Materials for Additive Manufacturing & 3D Printing

PC2. Development of AM Technologies, Computers, Computer-Aided Design Technology - Other Associated Technologies, Lasers, Printing Technologies, Programmable Logic Controllers, Materials, Computer

PC3. • Use of layers , classification of AM Processes, New AM Classification Schemes, Metal Systems, Hybrid
• Systems, Milestones in AM Development, AM Around the World, Rapid Prototyping Develops into
• Direct Digital Manufacturing

Prepare 3D design, digital models and prototypes

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

PC4. Use 3D printers in their design process to create prototypes

PC5. • Apply additive manufacturing type
• • Vat Photopolymerisation – Stereolithography, Digital Light processing, Continuous liquid interface production
• • Material Jetting
• • Binder Jetting
• • Material Extrusion – Fused deposition modelling, Fused, Filament fabrication
• • Power bed fusion: Multi Jet Fusion, Selective laser sintering,
• • Direct metal laser sintering
• • Sheet Lamination
• • Directive energy deposition

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. the Quantity and the quality as per the specification.

KU2. to make less wastage.

KU3. to increase the production and efficiency of the machine.

KU4. to discuss and distribute the work among the team.

KU5. to maintain quality control as production scales

KU6. Install 3D software

KU7. how to select appropriate CAD formats

KU8. how to do slicing of a 3D model

KU9. different stages of Additive manufacturing process

KU10. various AM technologies

KU11. ways to select Laser Sintering Polyjet, Materials for Additive Manufacturing & 3D Printing

KU12. various technologies including Computer-Aided Design Technology - Other Associated Technologies, Lasers, Printing Technologies, Programmable Logic Controllers

KU13. process of Material Extrusion, Power bed fusion and Sheet Lamination

KU14. various slicing tools, Finite Element Analysis

KU15. Preparing STLs for 3D Printing

KU16. how to process Simulations Using Finite Element Analysis

KU17. use of AM to Support Medical Applications, Surgical and Diagnostic Aids, Prosthetics Development

KU18. processes of contact and noncontact 3D scanning

KU19. how to create and plot assembly and detail views of simple geometrical solid with Dimension, Tolerance &Annotation in 3D Modelling

KU20. different measurement to be performed to check the components for functionality and conformance

KU21. use of various instruments such as VernierCaliper, Vernier height gauge, Micrometer, depth gauge, Bevel protector, sine bar and dial test indicator

KU22. how to apply process algorithm

KU23. keeping 3D printer well lubricated

KU24. how to clear any dust and debris from the extruder feeder wheels

KU25. how to maintain 3D printer

Generic Skills (GS)

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

GS1. prepare the production report/ documentation including samples to accompany the job docket.

GS2. read and understand the user and technical specifications of jobs.

GS3. discuss and understand requirements and specifications from the Print Coordinator and the team.

GS4. discuss any problems with the brief that could impact the production process and solicit suggestions for resolving them.

GS5. To plan and prioritize work according to the requirements.

GS6. Complete the job within a period of time by increasing the efficiency of the machine.

GS7. make decision for suitable course of action.

GS8. quality standards/final output meet customer requirements and organizational standards.

GS9. ensure that the work requires technical assistance to meet the desired outcomes and resolve the same.

GS10. solve the problems while printing without stoppage of machine unless & until it is necessary.

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Elaborate various AM technologies and AM processes	**15**	**70**	**-**	**-**
PC1. Selection of Laser Sintering Polyjet, Materials for Additive Manufacturing & 3D Printing	5	-	-	-
PC2. Development of AM Technologies, Computers, Computer-Aided Design Technology - Other Associated Technologies, Lasers, Printing Technologies, Programmable Logic Controllers, Materials, Computer	5	-	-	-
PC3. • Use of layers , classification of AM Processes, New AM Classification Schemes, Metal Systems, Hybrid • Systems, Milestones in AM Development, AM Around the World, Rapid Prototyping Develops into • Direct Digital Manufacturing	5	-	-	-
Prepare 3D design, digital models and prototypes	**15**	**-**	**-**	**-**
PC4. Use 3D printers in their design process to create prototypes	5	-	-	-
PC5. • Apply additive manufacturing type • • Vat Photopolymerisation – Stereolithography, Digital Light processing, Continuous liquid interface production • • Material Jetting • • Binder Jetting • • Material Extrusion – Fused deposition modelling, Fused, Filament fabrication • • Power bed fusion: Multi Jet Fusion, Selective laser sintering, • • Direct metal laser sintering • • Sheet Lamination • • Directive energy deposition	10	-	-	-
NOS Total	**30**	**70**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	MES/N0533
NOS Name	Prepare 3D design, digital models and prototypes
Sector	Media & Entertainment
Sub-Sector	Print
Occupation	Art and Design
NSQF Level	4
Credits	2
Version	1.0
Last Reviewed Date	NA
Next Review Date	31/03/2027
NSQC Clearance Date	31/03/2022

MES/N0534: Data preparation and printing

Description

This unit is about preparing relevant data and carrying out the process of printing

Scope

The scope covers the following :

- Carry out the process of printing
- Prepare relevant data required for the process of printing

Elements and Performance Criteria

Carry out the process of printing

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

PC1. Use of slicing tools

PC2. Prepare STLs for 3D Printing

PC3. Prepare CAD Models with STL file

PC4. Process Simulations Using Finite Element Analysis

PC5. Functional Testing, Rapid Tooling

PC6. Use of AM to Support Medical Applications, Surgical and Diagnostic Aids, Prosthetics Development

Prepare relevant data required for the process of printing

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

PC7. Outline on Manufacturing, Tissue Engineering and Organ Printing

PC8. Able to give Software Support, Product Prototyping, Art, Jewellery

PC9. identify opportunities to apply 3D printing Technology for time and cost saving.

PC10. Ensure 3D printing task successfully and confirm as deliverable. Also identify Entrepreneurial opportunities in 3D Printing

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. the Quantity and the quality as per the specification.

KU2. to make less wastage.

KU3. to increase the production and efficiency of the machine.

KU4. to discuss and distribute the work among the team.

KU5. to maintain quality control as production scales

KU6. Install 3D software

KU7. how to select appropriate CAD formats

KU8. how to do slicing of a 3D model

KU9. different stages of Additive manufacturing process

KU10. various AM technologies

KU11. ways to select Laser Sintering Polyjet, Materials for Additive Manufacturing & 3D Printing

KU12. various technologies including Computer-Aided Design Technology - Other Associated Technologies, Lasers, Printing Technologies, Programmable Logic Controllers

KU13. process of Material Extrusion, Power bed fusion and Sheet Lamination

KU14. various slicing tools, Finite Element Analysis

KU15. Preparing STLs for 3D Printing

KU16. how to process Simulations Using Finite Element Analysis

KU17. use of AM to Support Medical Applications, Surgical and Diagnostic Aids, Prosthetics Development

KU18. processes of contact and noncontact 3D scanning

KU19. how to create and plot assembly and detail views of simple geometrical solid with Dimension, Tolerance &Annotation in 3D Modelling

KU20. different measurement to be performed to check the components for functionality and conformance

KU21. use of various instruments such as VernierCaliper, Vernier height gauge, Micrometer, depth gauge, Bevel protector, sine bar and dial test indicator

KU22. how to apply process algorithm

KU23. keeping 3D printer well lubricated

KU24. how to clear any dust and debris from the extruder feeder wheels

KU25. how to maintain 3D printer

Generic Skills (GS)

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

GS1. prepare the production report/ documentation including samples to accompany the job docket.

GS2. read and understand the user and technical specifications of jobs.

GS3. discuss and understand requirements and specifications from the Print Coordinator and the team.

GS4. discuss any problems with the brief that could impact the production process and solicit suggestions for resolving them.

GS5. To plan and prioritize work according to the requirements.

GS6. Complete the job within a period of time by increasing the efficiency of the machine.

GS7. make decision for suitable course of action.

GS8. quality standards/final output meet customer requirements and organizational standards.

GS9. ensure that the work requires technical assistance to meet the desired outcomes and resolve the same.

GS10. solve the problems while printing without stoppage of machine unless & until it is necessary.

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Carry out the process of printing	**30**	**50**	**-**	**-**
PC1. Use of slicing tools	5	-	-	-
PC2. Prepare STLs for 3D Printing	5	-	-	-
PC3. Prepare CAD Models with STL file	5	-	-	-
PC4. Process Simulations Using Finite Element Analysis	5	-	-	-
PC5. Functional Testing, Rapid Tooling	5	-	-	-
PC6. Use of AM to Support Medical Applications, Surgical and Diagnostic Aids, Prosthetics Development	5	-	-	-
Prepare relevant data required for the process of printing	**20**	**-**	**-**	**-**
PC7. Outline on Manufacturing, Tissue Engineering and Organ Printing	5	-	-	-
PC8. Able to give Software Support, Product Prototyping, Art, Jewellery	5	-	-	-
PC9. identify opportunities to apply 3D printing Technology for time and cost saving.	5	-	-	-
PC10. Ensure 3D printing task successfully and confirm as deliverable. Also identify Entrepreneurial opportunities in 3D Printing	5	-	-	-
NOS Total	**50**	**50**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	MES/N0534
NOS Name	Data preparation and printing
Sector	Media & Entertainment
Sub-Sector	Print
Occupation	Art and Design
NSQF Level	4
Credits	3
Version	1.0
Last Reviewed Date	NA
Next Review Date	31/03/2027
NSQC Clearance Date	31/03/2022

MES/N0535: Operate 3D scanning and printing machinery

Description

This unit covers how to create and plot assembly and detail views of simple geometrical solid with Dimension, Tolerance &Annotation in 3D Modelling

Scope

The scope covers the following :

- Demonstrate ways to operate 3D scanning
- Develop a prototype/end use product

Elements and Performance Criteria

Operate 3D scanning

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

PC1. • Scan the content Contact 3D scanning employs, some kind of arm, like a robotic arm, equipped with a probe.
• Non-contact 3D scanning involves collecting radiation originating from the target object and can employ active or passive techniques

PC2. Create and plot assembly and detail views of simple geometrical solid with Dimension, Tolerance &Annotation in 3D Modelling

PC3. Perform different measurements with desired accuracy to check the components for functionality and conformance to defined standard using different instruments. [Different measurement: linear, taper, surface roughness, angular, thread; Different instruments: VernierCaliper, Vernier height gauge, Micrometer, depth gauge, Bevel protector, sine bar, dial test indicator]

PC4. Explain Additive Manufacturing (AM) Technology and emerging trends in Additive Manufacturing

Create a prototype/end use product

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

PC5. Develop a prototype/ end use product

PC6. Apply process algorithm (Slicing Software)

PC7. Make a simple fixture for functional requirement.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. the Quantity and the quality as per the specification.

KU2. to make less wastage.

KU3. to increase the production and efficiency of the machine.

KU4. to discuss and distribute the work among the team.

KU5. to maintain quality control as production scales

KU6. Install 3D software

KU7. how to select appropriate CAD formats

KU8. how to do slicing of a 3D model

KU9. different stages of Additive manufacturing process

KU10. various AM technologies

KU11. ways to select Laser Sintering Polyjet, Materials for Additive Manufacturing & 3D Printing

KU12. various technologies including Computer-Aided Design Technology - Other Associated Technologies, Lasers, Printing Technologies, Programmable Logic Controllers

KU13. process of Material Extrusion, Power bed fusion and Sheet Lamination

KU14. various slicing tools, Finite Element Analysis

KU15. Preparing STLs for 3D Printing

KU16. how to process Simulations Using Finite Element Analysis

KU17. use of AM to Support Medical Applications, Surgical and Diagnostic Aids, Prosthetics Development

KU18. processes of contact and noncontact 3D scanning

KU19. how to create and plot assembly and detail views of simple geometrical solid with Dimension, Tolerance &Annotation in 3D Modelling

KU20. different measurement to be performed to check the components for functionality and conformance

KU21. use of various instruments such as VernierCaliper, Vernier height gauge, Micrometer, depth gauge, Bevel protector, sine bar and dial test indicator

KU22. how to apply process algorithm

KU23. keeping 3D printer well lubricated

KU24. how to clear any dust and debris from the extruder feeder wheels

KU25. how to maintain 3D printer

Generic Skills (GS)

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

GS1. prepare the production report/ documentation including samples to accompany the job docket.

GS2. read and understand the user and technical specifications of jobs.

GS3. discuss and understand requirements and specifications from the Print Coordinator and the team.

GS4. discuss any problems with the brief that could impact the production process and solicit suggestions for resolving them.

GS5. To plan and prioritize work according to the requirements.

GS6. Complete the job within a period of time by increasing the efficiency of the machine.

GS7. make decision for suitable course of action.

GS8. quality standards/final output meet customer requirements and organizational standards.

GS9. ensure that the work requires technical assistance to meet the desired outcomes and resolve the same.

GS10. solve the problems while printing without stoppage of machine unless & until it is necessary.

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Operate 3D scanning	**20**	**65**	-	-
PC1. • Scan the content Contact 3D scanning employs, some kind of arm, like a robotic arm, equipped with a probe. • Non-contact 3D scanning involves collecting radiation originating from the target object and can employ active or passive techniques	5	-	-	-
PC2. Create and plot assembly and detail views of simple geometrical solid with Dimension, Tolerance &Annotation in 3D Modelling	5	-	-	-
PC3. Perform different measurements with desired accuracy to check the components for functionality and conformance to defined standard using different instruments. [Different measurement: linear, taper, surface roughness, angular, thread; Different instruments: VernierCaliper, Vernier height gauge, Micrometer, depth gauge, Bevel protector, sine bar, dial test indicator]	5	-	-	-
PC4. Explain Additive Manufacturing (AM) Technology and emerging trends in Additive Manufacturing	5	-	-	-
Create a prototype/end use product	**15**	**-**	**-**	**-**
PC5. Develop a prototype/ end use product	5	-	-	-
PC6. Apply process algorithm (Slicing Software)	5	-	-	-
PC7. Make a simple fixture for functional requirement.	5	-	-	-
NOS Total	**35**	**65**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	MES/N0535
NOS Name	Operate 3D scanning and printing machinery
Sector	Media & Entertainment
Sub-Sector	Print
Occupation	Art and Design
NSQF Level	4
Credits	3
Version	1.0
Last Reviewed Date	NA
Next Review Date	31/03/2027
NSQC Clearance Date	31/03/2022

MES/N0536: Conduct servicing and repairing equipment

Description

This unit covers service and repairing of various components of 3D printer and other equipment.

Scope

The scope covers the following :

- Demonstrate ways to conduct service and repairing of various components of 3D printer and othern equipment.

Elements and Performance Criteria

Servicing and repairing equipment

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

PC1. Keep 3D printer well lubricated

PC2. Dust the printer and its components regularly: As the 3D printer moves around, the seals on the bearings attached to each carriage will sweep dust to the limits of the motion system. Its fans actually collect dust and can build up a sort of cobweb on them and anything near them including around the hot end.

PC3. Check for loose nuts and bolts

PC4. Clear any dust and debris from the extruder feeder wheels

PC5. Tidy up and remove loose bits of 3D printing debris

PC6. Check for overheated and deformed 3D printed parts

PC7. Tighten up belts, Maintain and replace your bowden tube

PC8. Clean or replace your nozzle often

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. the Quantity and the quality as per the specification.

KU2. to make less wastage.

KU3. to increase the production and efficiency of the machine.

KU4. to discuss and distribute the work among the team.

KU5. to maintain quality control as production scales

KU6. Install 3D software

KU7. how to select appropriate CAD formats

KU8. how to do slicing of a 3D model

KU9. different stages of Additive manufacturing process

KU10. various AM technologies

KU11. ways to select Laser Sintering Polyjet, Materials for Additive Manufacturing & 3D Printing

KU12. various technologies including Computer-Aided Design Technology - Other Associated Technologies, Lasers, Printing Technologies, Programmable Logic Controllers

KU13. process of Material Extrusion, Power bed fusion and Sheet Lamination

KU14. various slicing tools, Finite Element Analysis

KU15. Preparing STLs for 3D Printing

KU16. how to process Simulations Using Finite Element Analysis

KU17. use of AM to Support Medical Applications, Surgical and Diagnostic Aids, Prosthetics Development

KU18. processes of contact and noncontact 3D scanning

KU19. how to create and plot assembly and detail views of simple geometrical solid with Dimension, Tolerance &Annotation in 3D Modelling

KU20. different measurement to be performed to check the components for functionality and conformance

KU21. use of various instruments such as VernierCaliper, Vernier height gauge, Micrometer, depth gauge, Bevel protector, sine bar and dial test indicator

KU22. how to apply process algorithm

KU23. keeping 3D printer well lubricated

KU24. how to clear any dust and debris from the extruder feeder wheels

KU25. how to maintain 3D printer

Generic Skills (GS)

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

GS1. prepare the production report/ documentation including samples to accompany the job docket.

GS2. read and understand the user and technical specifications of jobs.

GS3. discuss and understand requirements and specifications from the Print Coordinator and the team.

GS4. discuss any problems with the brief that could impact the production process and solicit suggestions for resolving them.

GS5. To plan and prioritize work according to the requirements.

GS6. Complete the job within a period of time by increasing the efficiency of the machine.

GS7. make decision for suitable course of action.

GS8. quality standards/final output meet customer requirements and organizational standards.

GS9. ensure that the work requires technical assistance to meet the desired outcomes and resolve the same.

GS10. solve the problems while printing without stoppage of machine unless & until it is necessary.

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Servicing and repairing equipment	**40**	**60**	**-**	**-**
PC1. Keep 3D printer well lubricated	5	-	-	-
PC2. Dust the printer and its components regularly: As the 3D printer moves around, the seals on the bearings attached to each carriage will sweep dust to the limits of the motion system. Its fans actually collect dust and can build up a sort of cobweb on them and anything near them including around the hot end.	5	-	-	-
PC3. Check for loose nuts and bolts	5	-	-	-
PC4. Clear any dust and debris from the extruder feeder wheels	5	-	-	-
PC5. Tidy up and remove loose bits of 3D printing debris	5	-	-	-
PC6. Check for overheated and deformed 3D printed parts	5	-	-	-
PC7. Tighten up belts, Maintain and replace your bowden tube	5	-	-	-
PC8. Clean or replace your nozzle often	5	-	-	-
NOS Total	**40**	**60**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	MES/N0536
NOS Name	Conduct servicing and repairing equipment
Sector	Media & Entertainment
Sub-Sector	Print
Occupation	Art and Design
NSQF Level	4
Credits	2
Version	1.0
Last Reviewed Date	NA
Next Review Date	31/03/2027
NSQC Clearance Date	31/03/2022

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) 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. Assessment will be conducted for all compulsory NOS, and where applicable, on the selected elective/option NOS/set of NOS.

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

5. Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/training center based on this criterion.

6. To pass the Qualification Pack, every trainee should score a minimum of 70% of aggregate marks to successfully clear the assessment.

7. 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
MES/N2528.Analyse 3D Technology for printing	50	50	0	0	100	20
MES/N0104.Maintain Workplace Health & Safety	50	50	-	-	100	10
MES/N0533.Prepare 3D design, digital models and prototypes	30	70	-	-	100	20
MES/N0534.Data preparation and printing	50	50	-	-	100	20
MES/N0535.Operate 3D scanning and printing machinery	35	65	-	-	100	10
MES/N0536.Conduct servicing and repairing equipment	40	60	-	-	100	20
Total	**255**	**345**	**-**	**-**	**600**	**100**

Acronyms

NOS	National Occupational Standard(s)
NSQF	National Skills Qualifications Framework
QP	Qualifications Pack
TVET	Technical and Vocational Education and Training

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.