Qualification Pack

Mechanical Engineering CAD

QP Code: CSC/Q0419

Version: 1.0

NSQF Level: 4.5

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Contents

CSC/Q0419: Mechanical Engineering CAD

Brief Job Description

A Mechanical Engineering CAD (Computer-Aided Design) role involves using CAD software to create detailed designs and technical drawings for mechanical devices, equipment, and components. CAD designers collaborate with engineers and other stakeholders to develop concepts, create 2D or 3D models, and produce accurate drawings that meet project specifications and standards.

Personal Attributes

A Mechanical Engineering CAD professional uses specialized software to create detailed designs and technical drawings for mechanical systems and components. They must have a strong understanding of mechanical principles and be proficient in CAD software. Attention to detail is crucial to ensure accurate and precise designs. Problem-solving skills are essential for identifying and resolving design issues. Effective communication and teamwork are also important for collaborating with engineers and stakeholders.

Applicable National Occupational Standards (NOS)

Compulsory NOS:

1. CSC/N0459: Work organization and management(MCAD)

2. CSC/N0447: Materials, software, and hardware

3. CSC/N0448: Perform 3D modelling

4. CSC/N0449: Create photo rendered images (2D) and creation of animations

5. CSC/N0450: Reverse engineering of physical models

6. CSC/N0451: Technical drawing and measuring

Qualification Pack (QP) Parameters

Sector	Capital Goods
Sub-Sector	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods, Defence Equipment, Fire-Fighting & Safety Equipment
Occupation	Design

Country	India
NSQF Level	4.5
Credits	16
Aligned to NCO/ISCO/ISIC Code	NCO-2015
Minimum Educational Qualification & Experience	Completed 1st year of UG (UG Certificate) (Completed 1st year of UG OR Pursuing 1st year of UG and continuous education OR Pursuing 3rd year of 3-year diploma after 10th and continuous education OR Pursuing 2nd year of 2- year diploma after 12 and continuous education OR 10th Grade pass with 1 year NTC plus 1 year NAC plus 1 year CITS OR 10th grade pass with 1 year NTC plus CITS with 1 year of relevant experience OR 8th Grade pass with 2 year NTC plus 1 year NAC plus 1 year CITS with 1 year of relevant experience OR Previous relevant Qualification of NSQF Level 3.5 and with minimum education as 8th Grade pass with 3 year relevant experience OR Previous relevant Qualification of NSQF Level 4 and with minimum education as 8th Grade pass with 1.5 year 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	NA
Next Review Date	NA
NSQC Approval Date	
Version	1.0

CSC/N0459: Work organization and management(MCAD)

Description

Work organization and management involves scheduling tasks, allocating resources, delegating responsibilities, monitoring progress, and problem-solving. This role requires strong organizational, communication, and leadership skills. It is essential for ensuring efficiency, productivity, and successful project outcomes across various industries.

Scope

The scope covers the following :

- The scope of work organization and management includes scheduling tasks, allocating resources, delegating responsibilities, monitoring progress, and problem-solving. This role is essential for ensuring efficiency, productivity, and successful project outcomes. It requires strong organizational, communication, and leadership skills, as well as the ability to analyze data and make informed decisions.

Elements and Performance Criteria

Work organization and management(MCAD)

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

PC1. Apply consistently the internationally recognized standards (ISO) and standards currently used and recognized by industry

PC2. Apply and promote health and safety legislation and best practice in the workplace

PC3. Apply a thorough knowledge and understanding of mathematics, physics and geometry to CAD projects

PC4. Access and recognize standard component and symbol libraries

PC5. Use and interpret technical terminology and symbols used in preparing and presenting CAD drawings

PC6. Use recognized IT systems and related professional design software to consistently produce high quality designs and interpretations

PC7. Deal with systems problems such as error messages received, peripherals which do not respond as expected, and faults with equipment or connecting leads

PC8. Produce work that consistently meets high standards of accuracy and clarity in the design and presentation of designs to potential users

PC9. Effectively communicate and use interpersonal skills with co-workers, clients, and other related professionals to ensure that the CAD process meets requirements

PC10. Describe to clients and other professionals the role and purposes for CAD designs

PC11. Explain complex technical images to experts and non-experts, highlighting key elements

PC12. Maintain proactive continuous professional development in order to maintain current knowledge and skill in new and developing technologies and practices

PC13. Provide and apply innovative and creative solutions to technical and design problems and challenges

PC14. Visualize desired products in order to fulfil clients' briefs accurately

PC15. Apply consistently the internationally recognized standards (ISO) and standards currently used and recognized by industry

PC16. Apply and promote health and safety legislation and best practice in the workplace

PC17. Apply a thorough knowledge and understanding of mathematics, physics and geometry to CAD projects

PC18. Access and recognize standard component and symbol libraries

PC19. Use and interpret technical terminology and symbols used in preparing and presenting CAD drawings

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. familiarity with standards such as ASME Y14.5 for dimensioning and tolerancing, and ISO 128 for technical drawings.

KU2. Understanding symbols and concepts used to specify geometric characteristics of parts.

KU3. Knowledge of materials properties and various manufacturing methods to ensure designs are feasible and cost-effective.

KU4. Proficiency in using CAD software (e.g., AutoCAD, SolidWorks) to create, modify, and interpret technical drawings.

KU5. Ability to understand complex engineering drawings, including views, sections, and annotations.

KU6. Effective communication with engineers, designers, and other stakeholders to clarify specifications and resolve issues.

KU7. Understanding of quality control processes to ensure that final products meet specified requirements.

KU8. Ability to identify and resolve discrepancies between drawings and specifications.

KU9. Thoroughness in reviewing drawings and specifications to ensure accuracy and compliance.

KU10. Awareness of safety standards and regulations relevant to the industry.

KU11. Understanding of cutting tools, feeds and speeds, and machining strategies for CNC turning and milling.

KU12. Knowledge of G-code programming for CNC machines to set up and operate them effectively.

KU13. Proficiency in using CAD software (e.g., AutoCAD, SolidWorks) for mechanical design, drafting, and creating detailed drawings.

KU14. Understanding of materials used in manufacturing and their properties to select the appropriate ones for specific applications.

KU15. Knowledge of geometric dimensioning and tolerancing (GD&T) to interpret engineering drawings accurately.

KU16. Awareness of safety standards and regulations relevant to CNC machining and mechanical CAD design.

KU17. Understanding of quality control processes to ensure that manufactured parts meet specifications.

KU18. Ability to troubleshoot issues related to CNC machining, tooling, or CAD designs.

Generic Skills (GS)

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

GS1. Understanding of machining principles, CAD software, and mechanical systems.

GS2. Precision in machining and CAD design to ensure accuracy of parts and drawings.

GS3. Ability to troubleshoot issues with CNC machines, tooling, or CAD designs.

GS4. Collaboration with engineers, designers, and other team members to achieve project goals.

GS5. Efficient use of time to meet project deadlines and production schedules.

GS6. Effective communication of ideas and requirements with team members and stakeholders.

GS7. Flexibility to work with different materials, designs, and machining requirements.

GS8. Adherence to safety protocols and practices in CNC machining and CAD design environments.

GS9. Willingness to stay updated with new technologies and techniques in CNC machining and CAD design.

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Work organization and management(MCAD)	**30**	**70**	**-**	**-**
PC1. Apply consistently the internationally recognized standards (ISO) and standards currently used and recognized by industry	-	-	-	-
PC2. Apply and promote health and safety legislation and best practice in the workplace	-	-	-	-
PC3. Apply a thorough knowledge and understanding of mathematics, physics and geometry to CAD projects	-	-	-	-
PC4. Access and recognize standard component and symbol libraries	-	-	-	-
PC5. Use and interpret technical terminology and symbols used in preparing and presenting CAD drawings	-	-	-	-
PC6. Use recognized IT systems and related professional design software to consistently produce high quality designs and interpretations	-	-	-	-
PC7. Deal with systems problems such as error messages received, peripherals which do not respond as expected, and faults with equipment or connecting leads	-	-	-	-
PC8. Produce work that consistently meets high standards of accuracy and clarity in the design and presentation of designs to potential users	-	-	-	-
PC9. Effectively communicate and use interpersonal skills with co-workers, clients, and other related professionals to ensure that the CAD process meets requirements	-	-	-	-
PC10. Describe to clients and other professionals the role and purposes for CAD designs	-	-	-	-
PC11. Explain complex technical images to experts and non-experts, highlighting key elements	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC12. Maintain proactive continuous professional development in order to maintain current knowledge and skill in new and developing technologies and practices	-	-	-	-
PC13. Provide and apply innovative and creative solutions to technical and design problems and challenges	-	-	-	-
PC14. Visualize desired products in order to fulfil clients' briefs accurately	-	-	-	-
PC15. Apply consistently the internationally recognized standards (ISO) and standards currently used and recognized by industry	-	-	-	-
PC16. Apply and promote health and safety legislation and best practice in the workplace	-	-	-	-
PC17. Apply a thorough knowledge and understanding of mathematics, physics and geometry to CAD projects	-	-	-	-
PC18. Access and recognize standard component and symbol libraries	-	-	-	-
PC19. Use and interpret technical terminology and symbols used in preparing and presenting CAD drawings	-	-	-	-
NOS Total	**30**	**70**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0459
NOS Name	Work organization and management(MCAD)
Sector	Capital Goods
Sub-Sector	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods, Defence Equipment, Fire-Fighting & Safety Equipment
Occupation	Design
NSQF Level	4.5
Credits	2
Version	1.0
Next Review Date	NA

CSC/N0447: Materials, software, and hardware

Description

Materials, software, and hardware are essential in manufacturing and engineering. Materials include metals, plastics, and composites used to create products. Software such as CAD/CAM and simulation tools aid in design and production processes. Hardware includes machines like CNC machines and 3D printers, as well as measurement tools. These components work together to streamline workflows, improve efficiency, and ensure product quality in manufacturing and engineering.

Scope

The scope covers the following :

- Materials, software, and hardware are integral components of manufacturing and engineering. Materials include metals, plastics, and composites used to create products. Software, such as CAD/CAM and simulation tools, aids in design and production processes. Hardware includes machines like CNC machines and 3D printers, as well as measurement tools. Together, these components enable efficient production, quality control, and innovation in various industries.

Elements and Performance Criteria

Materials, software, and hardware

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

PC1. Power up the equipment and activate the appropriate modelling software

PC2. Set up and check peripheral devices such as keyboard, mouse, 3D mouse,plotter, and printer

PC3. Use computer operating systems and specialist software to create and manage and store files proficiently

PC4. Select correct drawing packages from an on-screen menu or graphical equivalent

PC5. Use various techniques for accessing and using CAD software such as a mouse, menu, or tool bar

PC6. Configure the parameters of the software

PC7. Plan production processes effectively to produce efficient work processes

PC8. Use plotters and printers to print and plot work

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. Expertise in using CAD software such as AutoCAD, SolidWorks, or CATIA for 2D and 3D modeling.

KU2. Understanding of mechanical engineering principles, including mechanics, materials, and manufacturing processes.

KU3. Ability to interpret technical drawings, including orthographic and isometric views, and apply geometric dimensioning and tolerancing (GD&T) principles.

KU4. Knowledge of materials and their properties to select the appropriate materials for specific designs.

KU5. Understanding of DFM principles to create designs that are cost-effective and easy to manufacture.

KU6. Ability to analyze design problems and propose effective solutions.

KU7. Effective communication with team members, clients, and suppliers to convey design ideas and requirements.

KU8. Basic project management skills to manage design projects from concept to completion, including scheduling and budgeting.

KU9. Understanding of quality control processes to ensure that designs meet specifications and standards.

KU10. Willingness to stay updated with new CAD technologies and techniques to improve design efficiency and effectiveness.

Generic Skills (GS)

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

GS1. Ensuring accuracy in designs and drawings to meet specifications.

GS2. Ability to identify and resolve design issues efficiently.

GS3. Thinking innovatively to develop unique and effective design solutions.

GS4. Collaborating effectively with engineers, designers, and other team members.

GS5. Clearly communicating design ideas and requirements to stakeholders.

GS6. Managing time effectively to meet project deadlines.

GS7. Being flexible to work on different projects and adapt to changing requirements.

GS8. Understanding of mechanical engineering principles and CAD software.

GS9. Ability to analyze complex problems and develop appropriate solutions.

GS10. Willingness to learn new technologies and improve skills to stay updated in the field.

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Materials, software, and hardware	**30**	**70**	**-**	**-**
PC1. Power up the equipment and activate the appropriate modelling software	-	-	-	-
PC2. Set up and check peripheral devices such as keyboard, mouse, 3D mouse,plotter, and printer	-	-	-	-
PC3. Use computer operating systems and specialist software to create and manage and store files proficiently	-	-	-	-
PC4. Select correct drawing packages from an on-screen menu or graphical equivalent	-	-	-	-
PC5. Use various techniques for accessing and using CAD software such as a mouse, menu, or tool bar	-	-	-	-
PC6. Configure the parameters of the software	-	-	-	-
PC7. Plan production processes effectively to produce efficient work processes	-	-	-	-
PC8. Use plotters and printers to print and plot work	-	-	-	-
NOS Total	**30**	**70**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0447
NOS Name	Materials, software, and hardware
Sector	Capital Goods
Sub-Sector	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods, Defence Equipment, Fire-Fighting & Safety Equipment
Occupation	Design
NSQF Level	4.5
Credits	3
Version	1.0
Next Review Date	NA

CSC/N0448: Perform 3D modelling

Description

Performing 3D modeling involves creating detailed three-dimensional representations of objects or structures using specialized software. This process requires a combination of artistic skill and technical proficiency to accurately depict the intended design. 3D modelers must be able to interpret 2D drawings or concepts and translate them into realistic 3D models. They collaborate with engineers, designers, and clients to ensure the models meet the project requirements.

Scope

The scope covers the following :

- The scope of 3D modeling is broad and includes industries such as product design, architecture, engineering, animation, and gaming. Professionals in roles such as 3D modelers, designers, and animators create detailed models for visualization, prototyping, and manufacturing. 3D modeling is also used in architecture for designing buildings, structures, and interiors. In engineering, it is used to design mechanical components and machinery for analysis and manufacturing.

Elements and Performance Criteria

Perform 3D modelling

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

PC1. Model components, optimizing the constructive solid geometry

PC2. Create families of components

PC3. Ascribe characteristics to the materials (density)

PC4. Ascribe colours and textures to the components

PC5. Produce assemblies from 3D models of components

PC6. Structure assemblies (sub-assemblies)

PC7. Review base information to plan work effectively

PC8. Access information from data files

PC9. Model and assemble base components of project pieces

PC10. Estimate approximate values for any missing dimensions

PC11. Assemble modelled parts into sub-assemblies as required

PC12. Apply graphics decals such as logos as required onto images

PC13. Save work for future access

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. Expertise in using CAD software such as AutoCAD, SolidWorks, or CATIA for 2D and 3D modeling.

KU2. Understanding of mechanical engineering principles, including mechanics, materials, and manufacturing processes.

KU3. Ability to interpret technical drawings, including orthographic and isometric views, and apply geometric dimensioning and tolerancing (GD&T) principles.

KU4. Knowledge of materials and their properties to select the appropriate materials for specific designs.

KU5. Understanding of DFM principles to create designs that are cost-effective and easy to manufacture.

KU6. Ability to analyze design problems and propose effective solutions.

KU7. Effective communication with team members, clients, and suppliers to convey design ideas and requirements.

KU8. Basic project management skills to manage design projects from concept to completion, including scheduling and budgeting.

KU9. Understanding of quality control processes to ensure that designs meet specifications and standards.

KU10. Willingness to stay updated with new CAD technologies and techniques to improve design efficiency and effectiveness.

Generic Skills (GS)

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

GS1. Ensuring accuracy in designs and drawings to meet specifications.

GS2. Ability to identify and resolve design issues efficiently.

GS3. Thinking innovatively to develop unique and effective design solutions.

GS4. Collaborating effectively with engineers, designers, and other team members.

GS5. Clearly communicating design ideas and requirements to stakeholders.

GS6. Managing time effectively to meet project deadlines.

GS7. Being flexible to work on different projects and adapt to changing requirements.

GS8. Understanding of mechanical engineering principles and CAD software.

GS9. Ability to analyze complex problems and develop appropriate solutions.

GS10. Willingness to learn new technologies and improve skills to stay updated in the field.

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Perform 3D modelling	**30**	**70**	**-**	**-**
PC1. Model components, optimizing the constructive solid geometry	-	-	-	-
PC2. Create families of components	-	-	-	-
PC3. Ascribe characteristics to the materials (density)	-	-	-	-
PC4. Ascribe colours and textures to the components	-	-	-	-
PC5. Produce assemblies from 3D models of components	-	-	-	-
PC6. Structure assemblies (sub-assemblies)	-	-	-	-
PC7. Review base information to plan work effectively	-	-	-	-
PC8. Access information from data files	-	-	-	-
PC9. Model and assemble base components of project pieces	-	-	-	-
PC10. Estimate approximate values for any missing dimensions	-	-	-	-
PC11. Assemble modelled parts into sub-assemblies as required	-	-	-	-
PC12. Apply graphics decals such as logos as required onto images	-	-	-	-
PC13. Save work for future access	-	-	-	-
NOS Total	**30**	**70**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0448
NOS Name	Perform 3D modelling
Sector	Capital Goods
Sub-Sector	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods, Defence Equipment, Fire-Fighting & Safety Equipment
Occupation	Design
NSQF Level	4.5
Credits	3
Version	1.0
Next Review Date	NA

CSC/N0449: Create photo rendered images (2D) and creation of animations

Description

Creating photo-rendered images involves using software to generate realistic 2D images from 3D models, showcasing products, architectural designs, or concepts. This process requires attention to detail and an understanding of lighting, textures, and camera angles to produce high-quality visualizations. Additionally, creating animations involves bringing 3D models to life by adding movement and effects, enhancing visual presentations and storytelling.

Scope

The scope covers the following :

- Creating photo-rendered images involves generating realistic 2D images from 3D models, used in product visualization and architectural design. Animation involves adding movement and effects to 3D models, enhancing visual presentations in various industries. Professionals use software like Blender, 3ds Max, or Maya to create these visualizations. These visualizations are used in advertising, entertainment, and product design for compelling storytelling and presentations.

Elements and Performance Criteria

Create photo rendered images (2D) and creation of animations

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

PC1. Save and label images to access for further use

PC2. Interpret source information and accurately apply to the computer-generated images

PC3. Apply material properties using information supplied from source drawings

PC4. Create photo rendered images of components or assemblies

PC5. Adjust colors, shading, backgrounds and camera angles to highlight key images

PC6. Use camera settings to show better angles of the project

PC7. Print completed images for presentation purposes

PC8. Create functions relative to the operation of the system being designed, using industry programmes

PC9. Create animations that demonstrate how different parts work are assembled

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. Expertise in using CAD software such as AutoCAD, SolidWorks, or CATIA for 2D and 3D modeling.

KU2. Understanding of mechanical engineering principles, including mechanics, materials, and manufacturing processes.

KU3. Ability to interpret technical drawings, including orthographic and isometric views, and apply geometric dimensioning and tolerancing (GD&T) principles.

KU4. Knowledge of materials and their properties to select the appropriate materials for specific designs.

KU5. Understanding of DFM principles to create designs that are cost-effective and easy to manufacture.

KU6. Ability to analyze design problems and propose effective solutions.

KU7. Effective communication with team members, clients, and suppliers to convey design ideas and requirements.

KU8. Basic project management skills to manage design projects from concept to completion, including scheduling and budgeting.

KU9. Understanding of quality control processes to ensure that designs meet specifications and standards.

KU10. Willingness to stay updated with new CAD technologies and techniques to improve design efficiency and effectiveness.

Generic Skills (GS)

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

GS1. Ensuring accuracy in designs and drawings to meet specifications.

GS2. Ability to identify and resolve design issues efficiently.

GS3. Thinking innovatively to develop unique and effective design solutions.

GS4. Collaborating effectively with engineers, designers, and other team members.

GS5. Clearly communicating design ideas and requirements to stakeholders.

GS6. Managing time effectively to meet project deadlines.

GS7. Being flexible to work on different projects and adapt to changing requirements.

GS8. Understanding of mechanical engineering principles and CAD software.

GS9. Ability to analyze complex problems and develop appropriate solutions.

GS10. Willingness to learn new technologies and improve skills to stay updated in the field.

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Create photo rendered images (2D) and creation of animations	**30**	**70**	**-**	**-**
PC1. Save and label images to access for further use	-	-	-	-
PC2. Interpret source information and accurately apply to the computer-generated images	-	-	-	-
PC3. Apply material properties using information supplied from source drawings	-	-	-	-
PC4. Create photo rendered images of components or assemblies	-	-	-	-
PC5. Adjust colors, shading, backgrounds and camera angles to highlight key images	-	-	-	-
PC6. Use camera settings to show better angles of the project	-	-	-	-
PC7. Print completed images for presentation purposes	-	-	-	-
PC8. Create functions relative to the operation of the system being designed, using industry programmes	-	-	-	-
PC9. Create animations that demonstrate how different parts work are assembled	-	-	-	-
NOS Total	**30**	**70**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0449
NOS Name	Create photo rendered images (2D) and creation of animations
Sector	Capital Goods
Sub-Sector	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods, Defence Equipment, Fire-Fighting & Safety Equipment
Occupation	Design
NSQF Level	4.5
Credits	3
Version	1.0
Next Review Date	NA

CSC/N0450: Reverse engineering of physical models

Description

Reverse engineering of physical models involves analyzing and reconstructing objects to create digital representations. Data is acquired using 3D scanning or other techniques, then converted into a digital 3D model using specialized software. The model is analyzed and optimized for performance or manufacturability. Reverse engineering is used in industries such as automotive, aerospace, and consumer electronics for product improvement and replication of obsolete parts.

Scope

The scope covers the following :

- The scope of reverse engineering of physical models is extensive and spans various industries and applications. It includes replicating and improving existing products, analyzing competitor products, and creating digital archives of legacy parts. Industries such as automotive, aerospace, and consumer electronics use reverse engineering for product development, quality control, and innovation.

Elements and Performance Criteria

Reverse engineering of physical models

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

PC1. Determine dimensions on physical parts by using industry accepted instruments

PC2. Create freehand sketches

PC3. Use measuring instruments to produce accurate replicas

PC4. Perform 3D Scans of models

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. Expertise in using CAD software such as AutoCAD, SolidWorks, or CATIA for 2D and 3D modeling.

KU2. Understanding of mechanical engineering principles, including mechanics, materials, and manufacturing processes.

KU3. Ability to interpret technical drawings, including orthographic and isometric views, and apply geometric dimensioning and tolerancing (GD&T) principles.

KU4. Knowledge of materials and their properties to select the appropriate materials for specific designs.

KU5. Understanding of DFM principles to create designs that are cost-effective and easy to manufacture.

KU6. Ability to analyze design problems and propose effective solutions.

KU7. Effective communication with team members, clients, and suppliers to convey design ideas and requirements.

KU8. Basic project management skills to manage design projects from concept to completion, including scheduling and budgeting.

KU9. Understanding of quality control processes to ensure that designs meet specifications and standards.

KU10. Willingness to stay updated with new CAD technologies and techniques to improve design efficiency and effectiveness.

Generic Skills (GS)

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

GS1. Ensuring accuracy in designs and drawings to meet specifications.

GS2. Ability to identify and resolve design issues efficiently.

GS3. Thinking innovatively to develop unique and effective design solutions.

GS4. Collaborating effectively with engineers, designers, and other team members.

GS5. Clearly communicating design ideas and requirements to stakeholders.

GS6. Managing time effectively to meet project deadlines.

GS7. Being flexible to work on different projects and adapt to changing requirements.

GS8. Understanding of mechanical engineering principles and CAD software.

GS9. Ability to analyze complex problems and develop appropriate solutions.

GS10. Willingness to learn new technologies and improve skills to stay updated in the field.

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Reverse engineering of physical models	**30**	**70**	**-**	**-**
PC1. Determine dimensions on physical parts by using industry accepted instruments	-	-	-	-
PC2. Create freehand sketches	-	-	-	-
PC3. Use measuring instruments to produce accurate replicas	-	-	-	-
PC4. Perform 3D Scans of models	-	-	-	-
NOS Total	**30**	**70**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0450
NOS Name	Reverse engineering of physical models
Sector	Capital Goods
Sub-Sector	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods, Defence Equipment, Fire-Fighting & Safety Equipment
Occupation	Design
NSQF Level	4.5
Credits	2
Version	1.0
Next Review Date	NA

CSC/N0451: Technical drawing and measuring

Description

Technical drawing is a precise and detailed graphical representation of an object or structure, typically used in engineering and manufacturing. It is created using standardized symbols, lines, and notations to convey dimensions, materials, and other specifications required for the construction or production of the object.

Scope

The scope covers the following :

- The scope of technical drawing and measuring is critical in various industries such as manufacturing, construction, aerospace, and automotive, where precise documentation and dimensional control are essential for the successful realization of products and structures.

Elements and Performance Criteria

Technical drawing and measuring

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

PC1. Generate working drawings in ISO standard together with any written instructions

PC2. Apply standards for conventional dimensioning and tolerancing and geometric dimensioning and tolerancing appropriate to the ISO standard

PC3. Apply the rules of technical drawing and the prevailing latest ISO standard to govern these rules

PC4. Use manuals, tables, lists of standards, and product catalogues

PC5. Insert written information such as explanation balloons and parts lists with more than one column using annotation styles that meet ISO standards

PC6. Create 2D detail technical drawings

PC7. Create exploded isometric views

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. Expertise in using CAD software such as AutoCAD, SolidWorks, or CATIA for 2D and 3D modeling.

KU2. Understanding of mechanical engineering principles, including mechanics, materials, and manufacturing processes.

KU3. Ability to interpret technical drawings, including orthographic and isometric views, and apply geometric dimensioning and tolerancing (GD&T) principles.

KU4. Knowledge of materials and their properties to select the appropriate materials for specific designs.

KU5. Understanding of DFM principles to create designs that are cost-effective and easy to manufacture.

KU6. Ability to analyze design problems and propose effective solutions.

KU7. Effective communication with team members, clients, and suppliers to convey design ideas and requirements.

KU8. Basic project management skills to manage design projects from concept to completion, including scheduling and budgeting.

KU9. Understanding of quality control processes to ensure that designs meet specifications and standards.

KU10. Willingness to stay updated with new CAD technologies and techniques to improve design efficiency and effectiveness.

Generic Skills (GS)

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

GS1. Ensuring accuracy in designs and drawings to meet specifications.

GS2. Ability to identify and resolve design issues efficiently.

GS3. Thinking innovatively to develop unique and effective design solutions.

GS4. Collaborating effectively with engineers, designers, and other team members.

GS5. Clearly communicating design ideas and requirements to stakeholders.

GS6. Managing time effectively to meet project deadlines.

GS7. Being flexible to work on different projects and adapt to changing requirements.

GS8. Understanding of mechanical engineering principles and CAD software.

GS9. Ability to analyze complex problems and develop appropriate solutions.

GS10. Willingness to learn new technologies and improve skills to stay updated in the field.

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Technical drawing and measuring	**30**	**70**	**-**	**-**
PC1. Generate working drawings in ISO standard together with any written instructions	-	-	-	-
PC2. Apply standards for conventional dimensioning and tolerancing and geometric dimensioning and tolerancing appropriate to the ISO standard	-	-	-	-
PC3. Apply the rules of technical drawing and the prevailing latest ISO standard to govern these rules	-	-	-	-
PC4. Use manuals, tables, lists of standards, and product catalogues	-	-	-	-
PC5. Insert written information such as explanation balloons and parts lists with more than one column using annotation styles that meet ISO standards	-	-	-	-
PC6. Create 2D detail technical drawings	-	-	-	-
PC7. Create exploded isometric views	-	-	-	-
NOS Total	**30**	**70**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0451
NOS Name	Technical drawing and measuring
Sector	Capital Goods
Sub-Sector	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods, Defence Equipment, Fire-Fighting & Safety Equipment
Occupation	Design
NSQF Level	4.5
Credits	3
Version	1.0
Next Review Date	NA

Assessment Guidelines and Assessment Weightage

Assessment Guidelines

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 the proportion of marks for Theory and Skills Practical for each PC.

2. The assessment for the theory part will be based on the 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 the theory part for each candidate at each examination/training centre (as per assessment criteria below).

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

6. To pass the Qualification Pack assessment, 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
CSC/N0459.Work organization and management(MCAD)	30	70	0	0	100	10
CSC/N0447.Materials, software, and hardware	30	70	0	0	100	5
CSC/N0448.Perform 3D modelling	30	70	0	0	100	30
CSC/N0449.Create photo rendered images (2D) and creation of animations	30	70	0	0	100	10
CSC/N0450.Reverse engineering of physical models	30	70	-	-	100	15
CSC/N0451.Technical drawing and measuring	30	70	-	-	100	30
Total	**180**	**420**	**-**	**-**	**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.