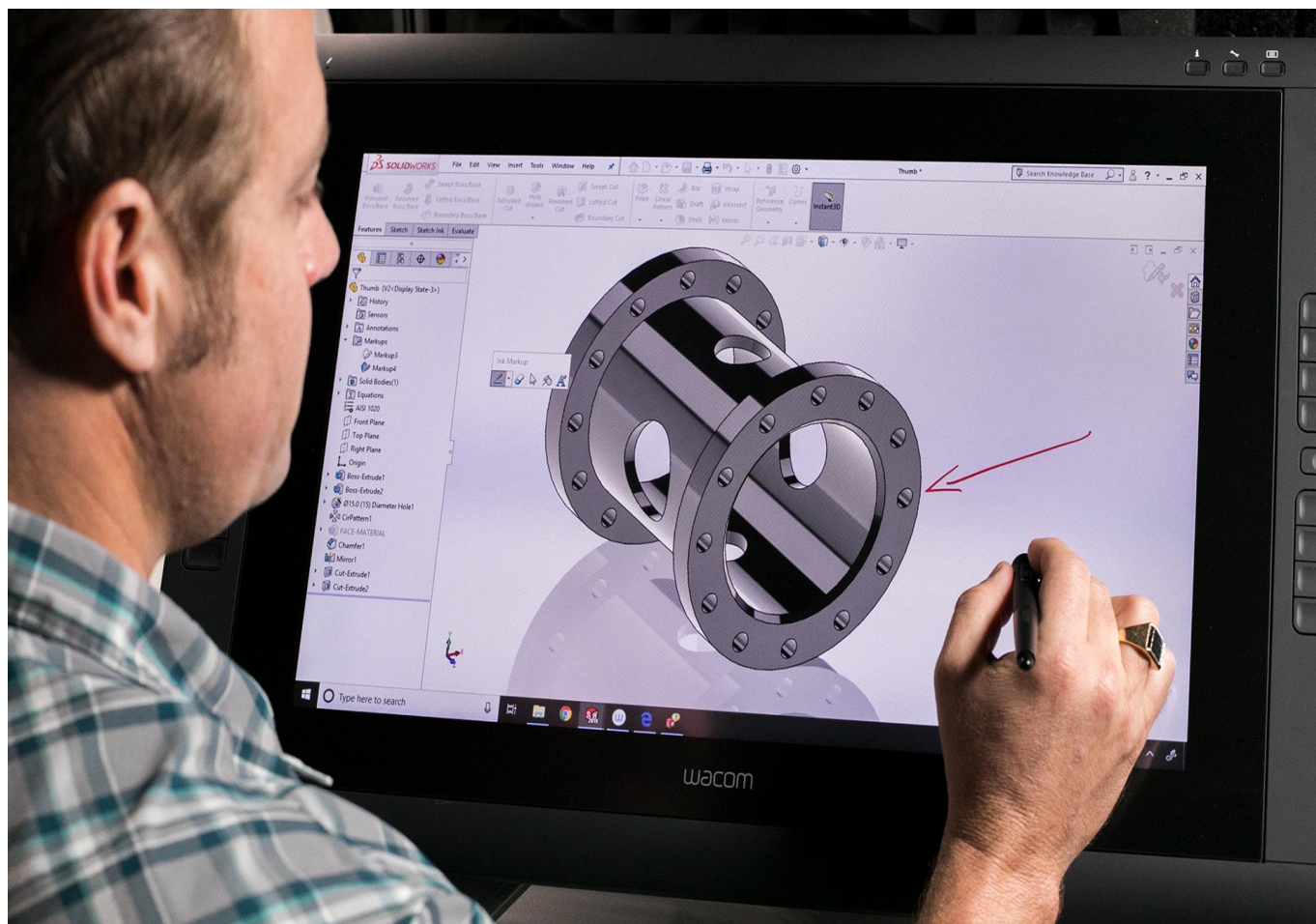


## Qualification Pack



# Designer Mechanical

QP Code: CSC/Q0405

Version: 2.0

NSQF Level: 5

Capital Goods Skill Council || 1st Floor, L-29, Outer Circle, Connaught Place  
New Delhi - 110001

## Qualification Pack

## Contents

CSC/Q0405: Designer Mechanical .....	3
Brief Job Description .....	3
Personal Attributes .....	3
Applicable National Occupational Standards (NOS) .....	3
CSC/N1335: Follow the health and safety practices at work.....	5
CSC/N1336: Coordinate with co-workers to achieve work efficiency .....	10
CSC/N0405: Determine the client's requirement and create a design brief .....	13
CSC/N0402: Create and modify 2D mechanical engineering drawings using the CAD system...	17
CSC/N0408: Create and modify 3D mechanical engineering models using the CAD system .....	22
CSC/N0407: Develop prototypes as per the design brief and carry out testing and production	26
Assessment Guidelines .....	30
Assessment Weightage .....	30
Acronyms .....	32
Glossary.....	33

## Qualification Pack

### CSC/Q0405: Designer Mechanical

#### Brief Job Description

A Designer Mechanical is responsible for determining the client's requirements with respect to the mechanical devices and equipment; creating the design brief; validating the design; allocating resources for each activity; and ensuring the designing process is completed within the agreed deadlines and in compliance with the relevant regulations. The individual identifies and evaluates design options, creates detailed design and models using the appropriate 2D and 3D software and presents them to the relevant stakeholders to get their approval and oversees production.

#### Personal Attributes

The individual must be physically fit to work for long durations. The person must have excellent computer and mathematical skills along with strong analytical and problem-solving abilities. The individual must be good at verbal and written communication and possess the ability to work with concentration and coordination with others.

#### Applicable National Occupational Standards (NOS)

##### Compulsory NOS:

1. [CSC/N1335: Follow the health and safety practices at work](#)
2. [CSC/N1336: Coordinate with co-workers to achieve work efficiency](#)
3. [CSC/N0405: Determine the client's requirement and create a design brief](#)
4. [CSC/N0402: Create and modify 2D mechanical engineering drawings using the CAD system](#)
5. [CSC/N0408: Create and modify 3D mechanical engineering models using the CAD system](#)
6. [CSC/N0407: Develop prototypes as per the design brief and carry out testing and production](#)

#### Qualification Pack (QP) Parameters

<b>Sector</b>	Capital Goods
<b>Sub-Sector</b>	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods
<b>Occupation</b>	Design

### Qualification Pack

Country	India
NSQF Level	5
Aligned to NCO/ISCO/ISIC Code	NCO-2015/NIL
Minimum Educational Qualification & Experience	<p>B. Tech/B.E. (Mechanical)</p> <p>OR</p> <p>3 Year Diploma - Mechanical (After 10th) in the relevant field with 2 years of experience in the relevant field</p> <p>OR</p> <p>10th + ITI (2 years) in the relevant field with 2 years of relevant experience in the relevant field</p> <p>OR</p> <p>12th Class Pass with 4 years of experience in the relevant field</p> <p>OR</p> <p>Certified in NSQF-L4 Draughtsman - Mechanical with 2 years of experience in the relevant field</p>
Minimum Level of Education for Training in School	
Pre-Requisite License or Training	NA
Minimum Job Entry Age	18 Years
Last Reviewed On	
Next Review Date	
Deactivation Date	
NSQC Approval Date	
Version	2.0
Reference code on NQR	2015/CCM/GCSC/00248
NQR Version	1.0

## Qualification Pack

### CSC/N1335: Follow the health and safety practices at work

#### Description

This OS unit is about following the appropriate health and safety practices at work. It covers responsibilities towards self and others to ensure a safe work environment.

#### Scope

This unit/task covers the following:

- Maintain personal health and safety
- Assist in hazard management
- Check the first aid box, firefighting and safety equipment
- Assist in waste management
- Follow the fire safety guidelines
- Follow the emergency and first-aid procedures
- Carry out relevant documentation and review

#### Elements and Performance Criteria

##### *Maintain personal health and safety*

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

- PC1.** follow the recommended practices to ensure protection from infections and transmission to others, such as the use of hand sanitiser and face mask
- PC2.** check the work conditions, assess the potential health and safety risks, and take appropriate measures to mitigate them
- PC3.** select and use the appropriate Personal Protective Equipment (PPE) relevant to the task and work conditions
- PC4.** follow the recommended techniques while lifting and moving heavy objects to avoid injury
- PC5.** follow the manufacturer's instructions and workplace safety guidelines while working on heavy machinery, tools and equipment

##### *Assist in hazard management*

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

- PC6.** identify existing and potential hazards at work
- PC7.** assess the potential risks and injuries associated with the identified hazards
- PC8.** coordinate with the supervisor or other relevant personnel to prevent or minimise the identified hazards
- PC9.** handle hazardous materials safely and store them in the designated storage

##### *Check the first aid box, firefighting and safety equipment*

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

- PC10.** check the first aid box to ensure it is updated with the relevant first aid supplies
- PC11.** check and test the firefighting and various safety equipment to ensure they are in usable condition
- PC12.** coordinate with the supervisor for the repair and replacement of firefighting and safety equipment

## Qualification Pack

### *Assist in waste management*

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

- PC13.** segregate waste into appropriate categories
- PC14.** recycle the recyclable waste appropriately
- PC15.** dispose of the non-recyclable waste in an environment-friendly manner, complying with the applicable regulations

### *Follow the fire safety guidelines*

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

- PC16.** use the appropriate type of fire extinguisher to extinguish different types of fires safely
- PC17.** follow the recommended practices for a safe rescue during a fire emergency
- PC18.** coordinate with the fire department to request assistance to extinguish a serious fire

### *Follow the emergency and first-aid procedures*

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

- PC19.** follow the organisational health and safety guidelines during workplace emergencies to ensure own and co-workers' safety
- PC20.** follow the recommended practices to minimise loss to organisational property during an emergency
- PC21.** follow the recommended procedure to free a person from electrocution
- PC22.** administer appropriate first aid to the injured personnel
- PC23.** perform Cardiopulmonary Resuscitation (CPR) on a potential victim of cardiac arrest
- PC24.** coordinate with the emergency services to request medical assistance for seriously injured/ ill personnel requiring professional medical attention or hospitalisation

### *Carry out relevant documentation and review*

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

- PC25.** carry out appropriate documentation following a health and safety incident at work, including all the required information
- PC26.** coordinate with the relevant personnel to review health and safety conditions at work regularly or following an incident
- PC27.** assist in implementing appropriate changes to improve the health and safety conditions at work

## Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1.** the recommended practices to be followed to ensure protection from infections and transmission to others, such as the use of hand sanitiser and face mask
- KU2.** the importance and process of checking the work conditions, assessing the potential health and safety risks, and take appropriate measures to mitigate them
- KU3.** the importance and process of selecting and using the appropriate PPE relevant to the task and work conditions
- KU4.** the recommended techniques to be followed while lifting and moving heavy objects to avoid injury
- KU5.** the importance of following the manufacturer's instructions and workplace safety guidelines while working on heavy machinery, tools and equipment
- KU6.** the importance and process of identifying existing and potential hazards at work
- KU7.** the process of assessing the potential risks and injuries associated with the various hazards



### Qualification Pack

- KU8.** how to prevent or minimise different types of hazards
- KU9.** how to handle and store hazardous materials safely
- KU10.** the importance of ensuring the first aid box is updated with the relevant first aid supplies
- KU11.** the process of checking and testing the firefighting and various safety equipment to ensure they are in a usable condition
- KU12.** the criteria for segregating waste into appropriate categories
- KU13.** the appropriate methods for recycling the recyclable waste
- KU14.** the process of disposing of the non-recyclable waste safely and the applicable regulations
- KU15.** use of different types of fire extinguishers to extinguish different types of fires
- KU16.** the recommended practices to be followed for a safe rescue during a fire emergency
- KU17.** how to request assistance from the fire department to extinguish a serious fire
- KU18.** the appropriate practices to be followed during workplace emergencies to ensure safety and minimise loss to organisational property
- KU19.** common health and safety hazards present in a work environment, associated risks, and how to mitigate them
- KU20.** safe working practices to be followed while working at various hazardous sites and using electrical equipment
- KU21.** the importance of ensuring easy access to firefighting and safety equipment
- KU22.** the appropriate preventative and remedial actions to be taken in the case of exposure to toxic materials, such as poisonous chemicals and gases
- KU23.** various causes of fire in different work environments and the recommended precautions to be taken to prevent fire accidents
- KU24.** different methods of extinguishing fire
- KU25.** different materials used for extinguishing fire, such as sand, water, foam, CO<sub>2</sub>, dry powder, etc.
- KU26.** the applicable rescue techniques to be followed during a fire emergency
- KU27.** the importance of placing safety signs and instructions at strategic locations in a workplace and following them
- KU28.** different types of first aid treatment to be provided for different types of injuries
- KU29.** potential injuries associated with incorrect manual handling
- KU30.** how to move an injured person safely
- KU31.** various hazards associated with the use of various machinery, tools, implements, equipment and materials
- KU32.** the importance of ensuring no obstruction and free access to fire exits
- KU33.** how to free a person from electrocution safely
- KU34.** how to administer appropriate first aid to an injured person
- KU35.** how to perform Cardiopulmonary Resuscitation (CPR)
- KU36.** the importance of coordinating with the emergency services to request urgent medical assistance for persons requiring professional medical attention or hospitalisation
- KU37.** the appropriate documentation to be carried out following a health and safety incident at work, and the relevant information to be included
- KU38.** the importance and process of reviewing the health and safety conditions at work regularly or following an incident
- KU39.** the importance and process of implementing appropriate changes to improve the health and safety conditions at work

### Generic Skills (GS)

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

### Qualification Pack

- GS1. maintain work-related notes and records
- GS2. communicate clearly and politely with co-workers and clients
- GS3. read the relevant literature to get the latest updates about the field of work
- GS4. listen attentively to understand the information being shared
- GS5. plan and prioritise tasks to ensure timely completion
- GS6. take quick decisions to deal with workplace emergencies and accidents
- GS7. identify possible disruptions to work and take appropriate preventive measures
- GS8. coordinate with the co-workers to achieve the work objectives
- GS9. evaluate all possible solutions to a problem to select the best one



## Qualification Pack

### National Occupational Standards (NOS) Parameters

NOS Code	CSC/N1335
NOS Name	Follow the health and safety practices at the work
Sector	Capital Goods
Sub-Sector	Machine Tools, Process Plant Machinery, Dies, Moulds and Press Tools, Electrical and Power Machinery, Plastics Manufacturing Machinery, Light Engineering Goods, Textile Manufacturing Machinery
Occupation	Machining
NSQF Level	3
Credits	TBD
Version	2.0
Last Reviewed Date	
Next Review Date	
Deactivation Date	
NSQC Clearance Date	

## Qualification Pack

### CSC/N1336: Coordinate with co-workers to achieve work efficiency

#### Description

This OS unit is about working in coordination with co-workers to achieve the work objectives efficiently. It also covers practising inclusion at work.

#### Scope

This unit/task covers the following:

- Work effectively with co-workers
- Communicate effectively with co-workers
- Practice inclusion at work

#### Elements and Performance Criteria

##### *Work effectively with co-workers*

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

- PC1. plan daily tasks at work to ensure their timely completion and efficient use of time
- PC2. carry out work responsibilities adhering to the limits of authority
- PC3. follow the supervisor's instructions to ensure adherence to the applicable quality standards and timescales
- PC4. coordinate with the co-workers to achieve the work objectives efficiently
- PC5. prepare the relevant documents and reports as per the supervisor's instructions, providing appropriate information clearly and systematically
- PC6. coordinate with the supervisor or relevant personnel to deal with out of authority tasks and concerns
- PC7. mentor and assist subordinates in the execution of their work responsibilities
- PC8. identify possible disruptions to work through coordination with the relevant stakeholders and take appropriate preventive measures
- PC9. use various resources efficiently to ensure maximum utilisation and minimum wastage
- PC10. follow the recommended practices to avoid and resolve conflicts at work
- PC11. follow the relevant organisational policies to ensure disciplined behaviour with maximum productivity at work

##### *Communicate effectively with co-workers*

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

- PC12. follow the organisational policy for the efficient and timely dissemination of information to the authorised personnel
- PC13. communicate clearly and politely to ensure effective communication with co-workers
- PC14. follow the appropriate techniques for active listening during interactions

##### *Practice inclusion at work*

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

- PC15. empathise with Persons with Disabilities (PwD)
- PC16. adopt gender-neutral behaviour at work

#### Knowledge and Understanding (KU)

## Qualification Pack

The individual on the job needs to know and understand:

- KU1.** the importance and process of effective communication in the workplace
- KU2.** the barriers to effective communication and how to overcome them
- KU3.** the importance of teamwork in an organisation's and individual's success
- KU4.** the importance of active listening in the work environment
- KU5.** the appropriate techniques to be followed for active listening
- KU6.** importance of tone and pitch in effective communication
- KU7.** importance of avoiding casual expletives and unpleasant terms while communicating professional circles
- KU8.** the importance of maintaining discipline and ethical behaviour at work
- KU9.** the common reasons for interpersonal conflict and how to resolve them
- KU10.** the importance of developing effective working relationships for professional success
- KU11.** how expressing and addressing grievances appropriately and effectively
- KU12.** the importance and process of planning daily tasks to ensure their timely completion and efficient use of time
- KU13.** the importance of adhering to the limits of authority at work
- KU14.** the importance of following the applicable quality standards and timescales at work
- KU15.** the importance of coordinating with the co-workers to achieve the work objectives efficiently
- KU16.** the relevant documentation requirements
- KU17.** the importance of providing appropriate information clearly and systematically in work documents
- KU18.** the escalation matrix to be followed to deal with out of authority tasks and concerns
- KU19.** the importance and process of mentoring and assisting subordinates in the execution of their work responsibilities
- KU20.** how to identify possible disruptions to work prevent them
- KU21.** how to use various resources efficiently to ensure maximum utilisation and minimum wastage
- KU22.** the recommended practices to be followed at work to avoid and resolve conflicts at work
- KU23.** the importance and process of efficient and timely dissemination of information to the authorised personnel
- KU24.** how to communicate clearly and politely to ensure effective communication
- KU25.** the importance of following the recommended practices to ensure an inclusive environment for PwD and all genders at work

## Generic Skills (GS)

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

- GS1.** maintain work-related notes and records
- GS2.** read work-related and other relevant literature
- GS3.** communicate politely and -professionally
- GS4.** listen attentively to understand the information or instructions being shared
- GS5.** plan and prioritise tasks to ensure timely completion
- GS6.** take prompt decisions to deal with workplace emergencies and accidents
- GS7.** evaluate all possible solutions to a problem to select the best one

## Qualification Pack

### National Occupational Standards (NOS) Parameters

NOS Code	CSC/N1336
NOS Name	Coordinate with co-workers to achieve work efficiency
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
Occupation	Machining
NSQF Level	3
Credits	TBD
Version	2.0
Last Reviewed Date	
Next Review Date	
Deactivation Date	
NSQC Clearance Date	

## Qualification Pack

# CSC/N0405: Determine the client's requirement and create a design brief

## Description

This OS unit is about determining the client's engineering design requirements and creating an engineering design brief using the appropriate techniques as per approved procedures.

## Scope

This unit/task covers the following:

- Prepare for creating the design brief
- Prepare the design brief

## Elements and Performance Criteria

### *Prepare for creating the design brief*

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

- PC1.** determine the client's requirements, applications and expectations from the engineering product, its operational and functional requirements along with the quality criteria by referring to appropriate sources of information
- PC2.** identify the resources necessary to undertake the design process
- PC3.** select the relevant personnel and assign them appropriate responsibilities concerning various aspects of the design process
- PC4.** develop a schedule for the design process, setting the priorities to ensure completion of the design process within the timescales agreed with the client
- PC5.** identify the design brief constraints, such as safety, capacity, capability, copyright, logistical constraints, etc.
- PC6.** check the feasibility of achieving the client's requirements
- PC7.** identify potential issues with the design process and take appropriate preventive measures
- PC8.** record all the relevant information using the appropriate information system

### *Prepare the design brief*

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

- PC9.** perform relevant calculations such as tolerance, dimensions, and thermal and structural analysis regarding the proposed design brief
- PC10.** prepare technical drawings, sketches and designs using input from engineers and relevant experts
- PC11.** plan and create mechanical designs using Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), and 3D CAD programs, ensuring compliance with the client requirements, company procedure, and applicable regulations
- PC12.** coordinate with the stakeholders and production team to obtain approval for drawings
- PC13.** create the design brief using the relevant software, ensuring it captures all the client's requirements
- PC14.** coordinate with the relevant personnel to identify any issues in the design brief and determine if any modifications are required
- PC15.** implement necessary changes to the design brief and save it using the relevant software as per the organisational procedure
- PC16.** coordinate with the engineering and production during the design process to ensure the product design brief serves the intended purpose or addresses the relevant issues, and is feasible to produce
- PC17.** ensure the design process and final design brief conform to the applicable regulations,

## Qualification Pack

directives and guidelines

- PC18.** carry out appropriate documentation concerning the design process, maintaining version control

## Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1.** the applicable regulations, directives and guidelines
- KU2.** the relevant documentation required in the job role
- KU3.** the use of relevant information systems for recording design information
- KU4.** different types of design briefs and the purpose of creating one
- KU5.** how to determine the specifications of the product to be designed and the valid sources of information for that
- KU6.** different types of design features to be incorporated in a design brief
- KU7.** various factors with an impact on the feasibility of achieving a client's requirements and the process of assessing the feasibility
- KU8.** the information and level of detail to be included in a design brief
- KU9.** the importance of identifying design constraints
- KU10.** how to prepare a brief confirming the requirements of the customer
- KU11.** the relevant stakeholders to be consulted on the various aspects of a design brief
- KU12.** the importance of taking client's feedback on the design brief
- KU13.** various design brief constraints such as technology, environmental/sustainability, legal, logistical, financial, safety, ease of maintenance, etc.
- KU14.** the applicable procedures to be followed while disseminating information
- KU15.** how to resolve various problems encountered during the design process
- KU16.** the importance and process of preparing a contingency plan
- KU17.** how to prioritise and schedule design activities
- KU18.** how to determine the requirement of resources for the designing process
- KU19.** relevant organisational and regulatory guidelines and processes
- KU20.** how to perform relevant calculations and maintain data
- KU21.** the process of determining the feasibility and functionality of a design
- KU22.** the importance of taking health, safety and environmental aspects into consideration while preparing the design brief

## Generic Skills (GS)

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

- GS1.** maintain work-related notes and records
- GS2.** read the relevant literature to learn about the latest developments in the field of work
- GS3.** listen attentively to understand the information or instructions being shared
- GS4.** undertake work-related numerical computations
- GS5.** use the appropriate units of measurement and measuring techniques
- GS6.** communicate politely and professionally
- GS7.** organise and analyse work-related information
- GS8.** plan and prioritise tasks to ensure timely completion
- GS9.** take prompt decisions to deal with workplace emergencies and accidents
- GS10.** identify possible disruptions to work and take appropriate preventive measures
- GS11.** evaluate all possible solutions to a problem to select the best one





## Qualification Pack

**GS12.** coordinate with co-workers to achieve the work objectives

## Qualification Pack

### National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0405
NOS Name	Determine the client's requirement and create a design brief
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
Occupation	Design
NSQF Level	5
Credits	TBD
Version	2.0
Last Reviewed Date	
Next Review Date	
Deactivation Date	
NSQC Clearance Date	

## Qualification Pack

# CSC/N0402: Create and modify 2D mechanical engineering drawings using the CAD system

## Description

This OS unit is about setting up and using a CAD system to produce drawings for engineering activities following the approved procedures.

## Scope

This unit/task covers the following:

- Prepare for 2D mechanical engineering drawings
- Perform the set-up activities
- Create or modify 2D mechanical engineering drawings
- Use resources optimally

## Elements and Performance Criteria

### *Prepare for 2D mechanical engineering drawings*

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

- PC1.** use appropriate sources such as drawing brief to obtain the technical information relevant to the drawing to be created
- PC2.** identify design features appropriate to the drawing being produced
- PC3.** check the data and information received to ensure it is correct and complete
- PC4.** establish the drawing requirements from the data and information received
- PC5.** follow the organisational procedure to report and rectify any incorrect and inconsistent information in the job specification documents
- PC6.** select the relevant drawing software and drafting equipment appropriate to the selected drawing method

### *Perform the set-up activities*

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

- PC7.** customize system variables, menus and drawing defaults to produce the drawing to the appropriate scale
- PC8.** develop macros as per the approved procedures
- PC9.** set up and check that all relevant devices are connected and operating
- PC10.** check if an interface with ERP is required and available
- PC11.** set the drawing datum at a convenient point along with drawing parameters such as layers, line types, colour, text styles according to the drawing to be produced

### *Create or modify 2D mechanical engineering drawings*

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

- PC12.** analyse and produce mechanical drawings, using first angle orthographic projections, isometric/oblique projections, third angle orthographic projections, sectional views
- PC13.** follow the drafting principles to produce various types of drawings that are consistent with applicable standards and procedures for use in various engineering activities
- PC14.** create a drawing template using the appropriate drawing tool according to the required

### Qualification Pack

standards, including all the necessary details

- PC15.** use the relevant terminologies in the drawings
- PC16.** use the recommended techniques to create drawings in the required formats, ensuring the drawings are detailed
- PC17.** use various menus available in the CAD system along with relevant codes and references
- PC18.** draw temporary fasteners and rivets, components details, assembly drawings, piping layouts, gears and machine foundation, jigs and fixtures, nailed drawings of dies, moulds and press tools dimensions
- PC19.** label the drawings as per approved procedures
- PC20.** create detailed views using various scales to as per the requirement
- PC21.** coordinate with the relevant person to get the drawings checked and approved
- PC22.** edit the drawings as per the feedback, ensuring any changes are made as per the organisational procedures
- PC23.** check the drawings are correctly titled and referenced
- PC24.** save the drawing to an appropriate storage medium such as a hard drive or USB pen drive, while creating a backup to protect against accidental loss
- PC25.** prepare the bill of materials as per organisational guidelines after determining the required component, material specifications, and appropriate quantities
- PC26.** use the CAD system appropriately as per the user manual

#### *Use resources optimally*

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

- PC27.** optimise the usage of electricity and other resources in various tasks and processes
- PC28.** connect the electrical tools and equipment safely, and turn them off when not in use

### Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1.** use of relevant information systems for retrieving and storing drawing data
- KU2.** the relevant customizable system variables in a CAD software
- KU3.** the needs and process for customizing identified system variables
- KU4.** applicable drafting standards and procedures
- KU5.** the needs and process for customizing menus and system defaults
- KU6.** the needs and process for developing macros
- KU7.** the appropriate projection for the drawing purpose
- KU8.** the relevant reasons for including auxiliary views in drawings
- KU9.** the procedures for producing component, layout and assembly drawings
- KU10.** relevant drawing specifications and common symbols used in drawings
- KU11.** the relevant sources and methods for obtaining any required technical information relevant to the drawing
- KU12.** the common practices that make systems vulnerable to cyber-attacks, viruses and damage
- KU13.** how to protect a computer from cyber-attacks and viruses
- KU14.** the appropriate procedure to be followed to deal with virus attacks on a computer
- KU15.** how to set up and use a computer system and the relevant peripherals light pen, digitizer and tablet, printer or plotter, scanner, etc.
- KU16.** how to various computer drawing software
- KU17.** the importance of using CAD software as per the instructions in the user manual
- KU18.** relevant principles of engineering and manufacturing operations that are applied in manufacturing processes such as casting and forging; fabrication; machining methods; joining

### Qualification Pack

processes; assembly and installation, etc.

- KU19.** different types of drawings that may be produced using a CAD software
- KU20.** the process of selecting standard components in the designing process
- KU21.** the functionality of different components, their interrelation with other components and assemblies
- KU22.** how to set up the viewing screen to show multiple views of the drawing
- KU23.** relevant standards and conventions used for drawings
- KU24.** how to set up the drawing template parameters
- KU25.** the application and use of various drawing tools
- KU26.** how to access and use a wide range of standard components and symbol libraries from the CAD equipment
- KU27.** the need for document control
- KU28.** the importance and process of saving and storing drawings
- KU29.** the importance and process of creating backup copies, and saving them safely
- KU30.** how to produce hard copies of drawings, and the advantages and disadvantages of printers and plotters
- KU31.** the technical information relevant to the drawing to be created such as drawing brief, overall dimensions, materials to be used, applicable special procedures for manufacturing, limits and fits, tapping drill charts, contraction allowances, etc.
- KU32.** the applicable design features such as interface, tolerance, etc.
- KU33.** use of relevant computer peripherals such as light pen, digitizer/tablet, scanner, printer, plotter, etc.
- KU34.** different types of drawings such as detail drawings, sub-assembly drawings, general arrangement drawings, installation drawings, etc.
- KU35.** the applicable standards and procedures such as organizational guidelines and procedures, relevant directives or codes of practice, CAD software standards/protocols, national and international standards and directives, etc.
- KU36.** applicable health, safety and environmental concerns
- KU37.** relevant engineering activities such as processing of materials, fabrication, finishing, assembly, joining, commissioning/decommissioning, equipment installation, etc.
- KU38.** operational activities such as movement of materials, preparation of workplace layouts and work-flow diagrams
- KU39.** various functions of drawing template in the CAD software such as layers of drawings, scale, paper size, colour setup, line types, dimension system, title, drawing number, date, text styles, curved/contour lines, angled lines, circles or ellipses, geometrical and dimensional tolerance, elevation, plane view, side view, sectional view, detailed view, etc.
- KU40.** the relevant activities to be undertaken while preparing drawings in the CAD software such as hatching and shading on drawings, adding dimensions and text to drawings, producing layers of drawings, etc.
- KU41.** relevant symbols and abbreviations
- KU42.** the benefits and methods of resource optimisation

### Generic Skills (GS)

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

- GS1.** maintain work-related notes and records
- GS2.** read the relevant literature to learn about the latest developments in the field of work
- GS3.** communicate politely and professionally
- GS4.** listen attentively to understand the information or instructions being shared

### Qualification Pack

- GS5.** plan and schedule tasks to ensure timely completion
- GS6.** identify possible disruptions to work and take appropriate preventive measures
- GS7.** take quick decisions to deal with workplace emergencies/ accidents
- GS8.** evaluate all possible solutions to a problem to select the best one



## Qualification Pack

### National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0402
NOS Name	Create and modify 2D mechanical engineering drawings using the CAD system
Sector	Capital Goods
Sub-Sector	Machine Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods
Occupation	Design
NSQF Level	4
Credits	TBD
Version	2.0
Last Reviewed Date	
Next Review Date	
Deactivation Date	
NSQC Clearance Date	

### Qualification Pack

## CSC/N0408: Create and modify 3D mechanical engineering models using the CAD system

### Description

This OS unit is about creating and modifying 3D mechanical engineering models using a CAD system. It involves extracting all the necessary information to carry out the modelling operations based on a model design brief.

### Scope

This unit/task covers the following:

- Prepare for performing 3D mechanical engineering modelling
- Create and edit 3D mechanical engineering models

### Elements and Performance Criteria

#### *Prepare for performing 3D mechanical engineering modelling*

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

- PC1.** plan the 3D modelling activities after extracting the required information from the relevant sources such as model brief, sketches, engineer drawings, etc.
- PC2.** select the appropriate modelling software and tools such as solid modelling, wire frame modelling, surface modelling, etc.
- PC3.** check the computer system and other relevant equipment is correctly connected safely and is in working condition
- PC4.** follow the user manual instructions for using the relevant 3D software
- PC5.** set up the modelling environment and select an appropriate template
- PC6.** set the drawing datum at an appropriate point to create a modelling template with title, file number, material, date
- PC7.** establish the coordinate system, orientation and views as per the job requirement

#### *Create and edit 3D mechanical engineering models*

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

- PC8.** create and modify entities in 3D space as per job requirement
- PC9.** create 3D views by manipulating drawing planes and inserting 3D geometric shapes
- PC10.** create swept, extruded and revolved solids in 3D space
- PC11.** construct sectioned models with cutting planes and cross hatching
- PC12.** use pre-drawn library files and primitives to produce a 3D model
- PC13.** extract mass and area properties from solid models
- PC14.** use relevant features of a solid modelling software package such as extrude cut, wireframe, fillet, solid views and others to construct models
- PC15.** prepare drawings for solid modelling
- PC16.** use pan, isometric and zoom CAD operations to highlight design areas in the modelling environment
- PC17.** modify parts in the assembly environment using the appropriate features such as hatching and shading, angular surfaces, curved surfaces, circles or ellipses, surface texture, etc.
- PC18.** produce 3D drawings incorporating section views with all the required necessary annotation
- PC19.** construct models for export to different manufacturing systems, such as Direct Numerically Controlled (DNC), Computer Numerically Controlled (CNC), etc.

### Qualification Pack

- PC20.** ensure compliance with the applicable regulations, codes of practice, national and international standards
- PC21.** use the appropriate codes and references that follow the required conventions
- PC22.** ensure the prepared model conforms to the expected cost, physical space, quality, operating environment, tolerances, interfaces, ergonomics, safety, aesthetics, etc.
- PC23.** ensure the models are checked and approved by the relevant stakeholders
- PC24.** follow the applicable organisational procedure for saving the prepared models and sharing them with the stakeholder
- PC25.** coordinate with the relevant personnel to resolve any issues encountered while creating 3D models

### Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1.** the relevant health, safety and environmental standards
- KU2.** applicable organisational procedures for storing drawing data using the relevant information systems
- KU3.** the relevant sources and methods for obtaining any required technical information relevant to the model being produced, such as drawing briefs, specification sheets, etc.
- KU4.** the importance of determining and incorporating technical information in the drawings, such as limits and fits, contraction allowances, bearing selection, surface finish, etc.
- KU5.** use of various accessories, such as a mouse, light pen, digitizer and tablet, printer or plotter, and scanner
- KU6.** how to use different types of computer modelling software
- KU7.** how to use the help file to aid efficient operation of the relevant drawing system
- KU8.** the documentation required for 3D designing such as design briefs, specification sheets, etc.
- KU9.** different types of drawings that may be produced by using a 3D modelling software
- KU10.** how to set up the viewing screen to show multiple views of the component such as isometric front and side elevations, to help with creating drawing creation
- KU11.** relevant national, international and organisational standards and conventions used for the creating models/drawings
- KU12.** the application of modelling tools
- KU13.** how to access, identify and use a wide range of standard components and symbol libraries from the CAD equipment
- KU14.** the applications of different 3D modelling programs such as surface modelling, solid modelling, wireframe modelling
- KU15.** how to produce models with sufficient information to allow them to be successfully exported to the relevant manufacturing system
- KU16.** the importance of ensuring that completed models are approved, labelled and stored on a suitable storage medium
- KU17.** the importance and process of creating data backup
- KU18.** the purpose and advantages of creating 3D models
- KU19.** the importance and process of selecting an appropriate coordinate system according to the job requirement
- KU20.** how to set the orientation of a model with respect to the coordinate system
- KU21.** the appropriate number of views required to establish the model
- KU22.** the process of creating and modifying various entities in 3D space
- KU23.** the applications of ruled and revolved surfaces and the process of creating them in 3D space
- KU24.** the process of modifying existing 3D models

### Qualification Pack

- KU25.** how to save drawing files in a 3D software and various formats for saving them
- KU26.** the physical properties of shapes created in 3D space that can be extracted
- KU27.** the process of extracting data with respect to the physical properties of shapes created in 3D space
- KU28.** how to use the exploded view in assembly drawings to show the relationship between different components and how they fit together
- KU29.** the process of creating own toolbox in a 3D software
- KU30.** the process of creating intelligent models using parametric modelling in the relevant 3D software
- KU31.** how to produce composite models with composite regions and solids
- KU32.** how to produce sectioned models with cutting planes and cross hatching
- KU33.** how to use pre-drawn library files and primitives to produce a 3D model
- KU34.** how to extract mass and area properties from a solid model
- KU35.** how to applying rendering techniques to a 3D model, such as rendering types and preferences, render lighting techniques, views and scenes
- KU36.** how to save 3D models in various file formats for retrieval into other CAD application software
- KU37.** various solid modelling features such as extrude, extrude cut, mirror, revolve, wireframe, radius/chamfer, hide, rib, rectangular pattern, fillet, circular pattern, shell, etc.
- KU38.** the use of development view, motion analysis, animation, defining material property, exploded views
- KU39.** how to extract physical properties from a 3D model according to the job requirement, including volume, mass and centre of gravity
- KU40.** how to create a dynamic simulation of physical models
- KU41.** the process of creating and analysing the digital prototype of a physical model to predict its actual performance

### Generic Skills (GS)

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

- GS1.** maintain work-related notes and records
- GS2.** read work-related and other relevant literature
- GS3.** communicate politely and -professionally
- GS4.** perform work-related calculations
- GS5.** listen attentively to understand the information or instructions being shared
- GS6.** plan and prioritise tasks to ensure timely completion
- GS7.** identify potential disruptions to work and take appropriate preventive measures
- GS8.** take prompt decisions to deal with workplace emergencies and accidents
- GS9.** evaluate all possible solutions to a problem to select the best one

## Qualification Pack

### National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0408
NOS Name	Create and modify 3D mechanical engineering models using the CAD system
Sector	Capital Goods
Sub-Sector	Machine Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery
Occupation	Design
NSQF Level	5
Credits	TBD
Version	2.0
Last Reviewed Date	
Next Review Date	
Deactivation Date	
NSQC Clearance Date	

## Qualification Pack

### CSC/N0407: Develop prototypes as per the design brief and carry out testing and production

#### Description

This OS unit is about developing prototypes as per the approved design brief and carry out testing. It also involves making appropriate improvements according to the tests, carrying out appropriate documentation, and stating production.

#### Scope

This unit/task covers the following:

- Develop and test prototypes
- Finalise prototypes and oversee production

#### Elements and Performance Criteria

##### *Develop and test prototypes*

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

- PC1.** conduct relevant research and select the appropriate designing and engineering methods required for the development of prototypes
- PC2.** plan the development of prototypes with the involvement of relevant stakeholders
- PC3.** follow the relevant principles of physics, chemistry and mechanics during the development of the prototype
- PC4.** coordinate with the engineering and production team for the development and testing of prototypes
- PC5.** perform computer simulations and experiments to virtually test and refine the designs
- PC6.** measure the level of function of prototypes to assess their performance against the relevant performance criteria
- PC7.** document the design process, iterations, and test analytics, collecting and analyse data on the performance of prototypes
- PC8.** prepare and present relevant progress reports

##### *Finalise prototypes and oversee production*

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

- PC9.** liaise with the client, and engineering and production teams to seek their feedback on the prototypes
- PC10.** undertake appropriate improvements in the prototypes according to the feedback
- PC11.** carry out further testing to ensure relevant processes and performance of prototypes conform to the applicable performance standards and design specifications are met
- PC12.** oversee the process of finalising designs through coordination with the production team
- PC13.** ensure the latest technologies, design trends, and engineering best practices are followed during the finalisation process
- PC14.** prepare technical reports, design specification documents, and operations manuals
- PC15.** calculate the cost estimates for final product designs, and prepare relevant reports incorporating costs of labour, material, delivery and overhead
- PC16.** supervise the manufacturing process for the finalised and approved prototypes
- PC17.** coordinate with the production team during product manufacturing, advising them on design specifications and providing assistance, when required



## Qualification Pack

**PC18.** manage project timelines, resources, and budgets

### Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1.** the relevant activities to be carried out during the development of a prototype
- KU2.** the process of testing prototypes, seeking feedback from stakeholders and making necessary amendments
- KU3.** the importance of carrying out relevant documentation during the prototype development and testing process
- KU4.** the process of finalising a prototype and starting production
- KU5.** the importance of coordinating with the engineering and production teams to ensure the final product meets the applicable specifications and serves the purpose it was designed for
- KU6.** applicable organisational procedures for using the relevant information systems for storing design and configuration data
- KU7.** the engineering and manufacturing principles and concepts relevant to the production of fit for purpose prototypes
- KU8.** various materials and their properties;
- KU9.** different types of materials used for developing prototypes such as metals, plastic, ceramics, etc.
- KU10.** basic metallurgy and heat treatment
- KU11.** thermal properties and thermal stress analysis-heat treatment process
- KU12.** the structural engineering/analytics and finite element analysis
- KU13.** various manufacturing and fabrication technologies; welding principles;
- KU14.** kinematics and dynamics principles
- KU15.** how to perform various design calculations such as pressure, force, capacity, etc.
- KU16.** the applicable trigonometry and geometry principles
- KU17.** acceptable dimensional and geometric tolerances
- KU18.** applicable regulations, standards, directives and codes of practice, and their implications on the design
- KU19.** design formats and methods for achieving different types of designs in prototypes
- KU20.** potential risks to the process of designing prototypes and how to minimise them
- KU21.** the process of making amendments to the design to develop prototypes as per the feedback of relevant stakeholders
- KU22.** the importance of establishing and recording responsibilities for the production process
- KU23.** the need for effective document and data control and the implications of not following them
- KU24.** applicable patent, copyright and intellectual processes and relevant issues
- KU25.** the principles of dynamics and kinematics that must be observed to ensure the designed product works as expected
- KU26.** the importance of ensuring compliance with the applicable design regulations, standards and codes of practice such as health, safety and environmental regulations
- KU27.** the importance of protecting the designs following the applicable copyright regulations
- KU28.** various factors with an impact on the designing process such as product specifications and required functions, finance, manufacturing, installation and commissioning; technology, aesthetics, performance/capability, maintenance, the life cycle of the product, etc.
- KU29.** applicable design evaluation methods such as market research; software simulation; analysis of the design documentation; prototype assessment, pilot trial, small-scale production, etc.

## Qualification Pack

### Generic Skills (GS)

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

- GS1.** maintain work-related notes and records
- GS2.** undertake work-related numerical computations
- GS3.** use the appropriate units of measurement and measuring techniques
- GS4.** read the relevant literature to learn about the latest developments in the field of work
- GS5.** listen attentively to understand the information or instructions being shared
- GS6.** communicate politely and professionally
- GS7.** plan and prioritise tasks to ensure timely completion
- GS8.** coordinate with co-workers to achieve the work objectives
- GS9.** evaluate all possible solutions to a problem to select the best one
- GS10.** take prompt decisions to deal with workplace emergencies and accidents

## Qualification Pack

### National Occupational Standards (NOS) Parameters

<b>NOS Code</b>	CSC/N0407
<b>NOS Name</b>	Develop prototypes as per the design brief and carry out testing and production
<b>Sector</b>	Capital Goods
<b>Sub-Sector</b>	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods
<b>Occupation</b>	Design
<b>NSQF Level</b>	5
<b>Credits</b>	TBD
<b>Version</b>	2.0
<b>Last Reviewed Date</b>	
<b>Next Review Date</b>	
<b>Deactivation Date</b>	
<b>NSQC Clearance Date</b>	

## Assessment Guidelines and Assessment Weightage

### Assessment Guidelines

1. Criteria for assessment for the Qualification Pack will be created by CGSC.
2. Performance Criteria (PC) have been assigned marks proportional to their importance in NOS. SSC will also lay down the proportion of marks for Theory and Skills Practical for each PC.
3. The assessment for the theory part will/may be based on a knowledge bank of questions approved by CGSC.
4. Assessment will be conducted for all compulsory NOS, and where applicable, on the selected elective/option NOS/set of NOS.
5. Assessment Agencies will create Assessor Guides comprising of Theory and Practical Assessment Set and Guidelines for each examination/training centre (as per assessment criteria below). The same will be approved by CGSC for adequacy.
6. To successfully attain Certification on the Qualification Pack, the trainee must score a minimum of 70% in each Core NOS and a minimum of 50% in all non-core NOS. In addition, a candidate needs to attain a minimum overall pass percentage of 70% for certification.
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

## Qualification Pack

<b>Total</b>						

## Qualification Pack

### Acronyms

NOS	National Occupational Standard(s)
NSQF	National Skills Qualifications Framework
QP	Qualifications Pack
TVET	Technical and Vocational Education and Training
CNC	Computer Numerically Controlled
CAD	Computer Aided Design
2D	2 Dimensional
3D	3 Dimensional
CO <sub>2</sub>	Carbon Dioxide
CPR	Cardiac Pulmonary Resuscitation
ISO	International Organization For Standardization
PPE	Personal Protective Equipment
CD	Compact Disc
DVD	Digital Video Disc Or Digital Versatile Disc



## Qualification Pack

### Glossary

<b>Sector</b>	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.
<b>Sub-sector</b>	Sub-sector is derived from a further breakdown based on the characteristics and interests of its components.
<b>Occupation</b>	Occupation is a set of job roles, which perform similar / related set of functions in an industry.
<b>Job role</b>	Job role defines a unique set of functions that together form a unique employment opportunity in an organisation.
<b>Occupational Standards (OS)</b>	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.
<b>Performance Criteria (PC)</b>	Performance Criteria (PC) are statements that together specify the standard of performance required when carrying out a task.
<b>National Occupational Standards (NOS)</b>	NOS are occupational standards which apply uniquely in the Indian context.
<b>Qualifications Pack (QP)</b>	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.
<b>Unit Code</b>	Unit code is a unique identifier for an Occupational Standard, which is denoted by an 'N'
<b>Unit Title</b>	Unit title gives a clear overall statement about what the incumbent should be able to do.
<b>Description</b>	Description gives a 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.
<b>Scope</b>	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.

## Qualification Pack

<b>Knowledge and Understanding (KU)</b>	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.
<b>Organisational Context</b>	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.
<b>Technical Knowledge</b>	Technical knowledge is the specific knowledge needed to accomplish specific designated responsibilities.
<b>Core Skills/ Generic Skills (GS)</b>	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.
<b>Electives</b>	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.
<b>Options</b>	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.