Qualification Pack

Clean-Room Operations (for semiconductors)

QP Code: ELE/N0166

Version: 1.0

NSQF Level: 4

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Contents

Qualification Pack

ELE/N0166: Clean-Room Operations (for semiconductors)

Brief Job Description

Clean-Room Operations (for semiconductors) trains participants in managing clean room environments for industries like semiconductor manufacturing. Covering protocols, equipment maintenance, safety, and personnel management, it equips them to ensure cleanliness, safety, and efficiency in clean room facilities.

Personal Attributes

undefined

Applicable National Occupational Standards (NOS)

Compulsory NOS:

1. ELE/N0166: Clean-Room Operations (for semiconductors)

Qualification Pack (QP) Parameters

Sector	Electronics
Sub-Sector	
Occupation	Production-S&C
Country	
NSQF Level	4
Credits	2
Aligned to NCO/ISCO/ISIC Code	
Minimum Educational Qualification & Experience	12th Class (or Equivalent (Science Stream)) OR 10th Class (with 2 years ITI in the relevant area)
Minimum Level of Education for Training in School	
Pre-Requisite License or Training	NA

Qualification Pack

Minimum Job Entry Age	Years
Last Reviewed On	NA
Next Review Date	30/04/2027
NSQC Approval Date	01/06/2024
Version	1.0
Reference code on NQR	NG-04-EH-02530-2024-V1-ESSC
NQR Version	1

Qualification Pack

ELE/N0166: Clean-Room Operations (for semiconductors)

Description

Clean-Room Operations (for semiconductors) trains participants in managing clean room environments for industries like semiconductor manufacturing. Covering protocols, equipment maintenance, safety, and personnel management, it equips them to ensure cleanliness, safety, and efficiency in clean room facilities.

Scope

The scope covers the following :

- The scope covers the following:
- Training for clean room management.
- Relevant across industries.
- Covers protocols, maintenance, safety, personnel.
- Focuses on cleanliness, safety, efficiency.

Elements and Performance Criteria

Clean Room Fundamentals and Design Principles

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

PC1. Introduction to clean rooms in semiconductor manufacturing and their importance in the production process

PC2. Understanding the significance of controlled environments for semiconductor fabrication, Cleanroom standards and classifications (e.g., ISO, Federal Standard 209), including the different levels of cleanliness and their requirements

PC3. Types of cleanrooms, including laminar flow, turbulent flow, and mixed flow cleanrooms

PC4. Basic design considerations for effective clean rooms, including layout, size, and location

PC5. Understanding the impact of HVAC systems on clean room environments, including temperature, humidity, and air pressure control

Airflow Mechanics and Filtration Technologies

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

PC6. Mechanics of airflow in clean rooms and its role in contamination control, including the importance of air velocity, direction, and turbulence

PC7. HEPA and ULPA filtration mechanisms for efficient contamination control, including their principles, efficiency, and maintenance requirements

PC8. Evaluating airflow patterns for optimal clean room performance, including the use of computational fluid dynamics (CFD) simulations

PC9. Maintenance and efficiency of filtration systems, including filter replacement and monitoring

PC10. Integrating airflow and filtration systems for contamination control, including the use of air showers, gowning rooms, and air locks

Construction and Materials for Clean Rooms

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

PC11. Best practices for clean room construction, including site selection, design, and construction management

PC12. Elements of a cleanroom, including ceilings, walls, and floors, and their impact on cleanliness and performance

PC13. Materials used in clean room construction and their impact on cleanliness, including walls, floors, ceilings, and doors

PC14. Power supply considerations for clean rooms, including redundancy, emergency power, and energy efficiency

PC15. Understanding the impact of construction materials on clean room operations, including the use of antistatic materials, non-particulating materials, and clean room compatible coatings

PC16. Design considerations for magnetic and electromagnetic flux control in clean room environments and its impact

PC17. Design considerations for electrostatic charge control in clean room environments and techniques to control it

PC18. Techniques for controlling vibration and noise in clean rooms and Design considerations

Contamination Control Strategies and Chemical Management

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

PC19. Identifying sources of contamination in clean rooms, including people, equipment, and materials

PC20. Protocols for minimizing contamination in semiconductor fabs, including cleaning, sanitizing, and disinfection

PC21. Safe handling and storage of chemicals and gases in clean rooms, including the use of chemical storage cabinets, fume hoods, and gas cylinders

PC22. Monitoring and control systems for chemical management, including the use of gas detection systems, chemical sensors, and air monitoring systems

PC23. Implementing strategies for effective contamination control, including the use of clean room apparel, gloves, and hairnets

Access Control, Personnel Practices, and Safety Procedures

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

PC24. Access control systems for clean room security, including the use of badges, access cards, and biometric systems

PC25. Personnel hygiene practices and training requirements, including the use of gloves, gowns, and face masks

PC26. Identifying potential hazards in clean rooms, including electrical hazards, fire hazards, and chemical hazards

PC27. Implementing emergency response procedures for clean room safety, including the use of fire extinguishers, spill response kits, and emergency showers

PC28. Ensuring compliance with safety regulations in semiconductor clean rooms, including OSHA, EPA, and FDA regulations

Automation, Maintenance, and Quality Assurance

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

PC29. Integration of Automated Material Handling Systems (AMHS) in clean rooms, including the use of robots, conveyors, and automated guided vehicles

PC30. Benefits and challenges of automated systems in semiconductor fabs, including cost, reliability, and maintenance requirements

PC31. Performing routine clean room inspections for maintenance, including the use of preventive maintenance programs, predictive maintenance tools, and condition-based monitoring

PC32. Monitoring and maintaining environmental parameters for optimal performance, including the use of temperature, humidity, and pressure control systems

PC33. Implementing quality assurance measures for continuous improvement, including the use of quality management systems, statistical process control, and root cause analysis

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. Clean room classifications and their significance.

KU2. Contamination control measures and their implementation.

KU3. Gowning procedures for personnel.

KU4. Identification of clean room equipment and functions.

KU5. Clean room behavior and etiquette standards.

KU6. Routine clean room inspection procedures.

KU7. Troubleshooting methods for equipment issues.

KU8. Execution of preventive maintenance tasks.

KU9. Importance of adherence to cleanliness standards.

KU10. Monitoring and maintaining environmental parameters.

KU11. Identification of potential hazards in clean rooms.

KU12. Implementation of emergency response procedures.

Generic Skills (GS)

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

GS1. Technical Proficiency

GS2. Problem-solving

GS3. Attention to Detail

GS4. Adaptability

GS5. Critical Thinking

GS6. Interview Preparation

GS7. Networking

GS8. Job Search Strategies

GS9. Continuous Learning

GS10. Professional Development

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Clean Room Fundamentals and Design Principles	**9**	**2**	**-**	**-**
PC1. Introduction to clean rooms in semiconductor manufacturing and their importance in the production process	1	-	-	-
PC2. Understanding the significance of controlled environments for semiconductor fabrication, Cleanroom standards and classifications (e.g., ISO, Federal Standard 209), including the different levels of cleanliness and their requirements	2	-	-	-
PC3. Types of cleanrooms, including laminar flow, turbulent flow, and mixed flow cleanrooms	2	-	-	-
PC4. Basic design considerations for effective clean rooms, including layout, size, and location	2	-	-	-
PC5. Understanding the impact of HVAC systems on clean room environments, including temperature, humidity, and air pressure control	2	2	-	-
Airflow Mechanics and Filtration Technologies	**10**	**8**	**-**	**-**
PC6. Mechanics of airflow in clean rooms and its role in contamination control, including the importance of air velocity, direction, and turbulence	2	-	-	-
PC7. HEPA and ULPA filtration mechanisms for efficient contamination control, including their principles, efficiency, and maintenance requirements	2	2	-	-
PC8. Evaluating airflow patterns for optimal clean room performance, including the use of computational fluid dynamics (CFD) simulations	2	2	-	-
PC9. Maintenance and efficiency of filtration systems, including filter replacement and monitoring	2	2	-	-
PC10. Integrating airflow and filtration systems for contamination control, including the use of air showers, gowning rooms, and air locks	2	2	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Construction and Materials for Clean Rooms	**16**	**10**	**-**	**-**
PC11. Best practices for clean room construction, including site selection, design, and construction management	2	-	-	-
PC12. Elements of a cleanroom, including ceilings, walls, and floors, and their impact on cleanliness and performance	2	-	-	-
PC13. Materials used in clean room construction and their impact on cleanliness, including walls, floors, ceilings, and doors	2	-	-	-
PC14. Power supply considerations for clean rooms, including redundancy, emergency power, and energy efficiency	2	2	-	-
PC15. Understanding the impact of construction materials on clean room operations, including the use of antistatic materials, non-particulating materials, and clean room compatible coatings	2	2	-	-
PC16. Design considerations for magnetic and electromagnetic flux control in clean room environments and its impact	2	2	-	-
PC17. Design considerations for electrostatic charge control in clean room environments and techniques to control it	2	2	-	-
PC18. Techniques for controlling vibration and noise in clean rooms and Design considerations	2	2	-	-
Contamination Control Strategies and Chemical Management	**10**	**5**	**-**	**-**
PC19. Identifying sources of contamination in clean rooms, including people, equipment, and materials	2	1	-	-
PC20. Protocols for minimizing contamination in semiconductor fabs, including cleaning, sanitizing, and disinfection	2	1	-	-
PC21. Safe handling and storage of chemicals and gases in clean rooms, including the use of chemical storage cabinets, fume hoods, and gas cylinders	2	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC22. Monitoring and control systems for chemical management, including the use of gas detection systems, chemical sensors, and air monitoring systems	2	1	-	-
PC23. Implementing strategies for effective contamination control, including the use of clean room apparel, gloves, and hairnets	2	1	-	-
Access Control, Personnel Practices, and Safety Procedures	**10**	**5**	**-**	**-**
PC24. Access control systems for clean room security, including the use of badges, access cards, and biometric systems	2	1	-	-
PC25. Personnel hygiene practices and training requirements, including the use of gloves, gowns, and face masks	2	1	-	-
PC26. Identifying potential hazards in clean rooms, including electrical hazards, fire hazards, and chemical hazards	2	1	-	-
PC27. Implementing emergency response procedures for clean room safety, including the use of fire extinguishers, spill response kits, and emergency showers	2	1	-	-
PC28. Ensuring compliance with safety regulations in semiconductor clean rooms, including OSHA, EPA, and FDA regulations	2	1	-	-
Automation, Maintenance, and Quality Assurance	**10**	**5**	**-**	**-**
PC29. Integration of Automated Material Handling Systems (AMHS) in clean rooms, including the use of robots, conveyors, and automated guided vehicles	2	1	-	-
PC30. Benefits and challenges of automated systems in semiconductor fabs, including cost, reliability, and maintenance requirements	2	1	-	-
PC31. Performing routine clean room inspections for maintenance, including the use of preventive maintenance programs, predictive maintenance tools, and condition-based monitoring	2	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC32. Monitoring and maintaining environmental parameters for optimal performance, including the use of temperature, humidity, and pressure control systems	2	1	-	-
PC33. Implementing quality assurance measures for continuous improvement, including the use of quality management systems, statistical process control, and root cause analysis	2	1	-	-
NOS Total	**65**	**35**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	ELE/N0166
NOS Name	Clean-Room Operations (for semiconductors)
Sector	Electronics
Sub-Sector	
Occupation	Production-S&C
NSQF Level	4
Credits	2
Version	1.0
Last Reviewed Date	30/04/2024
Next Review Date	30/04/2027
NSQC Clearance Date	30/04/2024

Assessment Guidelines and Assessment Weightage

Assessment Guidelines

Guidelines are same as mentioned in the Qualification File.

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

Qualification Pack

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
ELE/N0166.Clean-Room Operations (for semiconductors)	65	35	-	-	100	100
Total	**65**	**35**	**-**	**-**	**100**	**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.