



Qualification Pack

Advanced Program on Nanoscience and Technology

QP Code: ELE/N6106

Version: 1.0

NSQF Level: 6.5

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Qualification Pack

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ELE/N6106: Advanced Program on Nanoscience and Technology

Brief Job Description

Personnel working in the High-End research and development (Academic & Industry)/ Faculty in the Nanoelectronics, Microsystems, smart materials technologies, and related areas is responsible for the fabrication and characterization of the micro/ nano scale devices.

Personal Attributes

undefined

Applicable National Occupational Standards (NOS)

Compulsory NOS:

1. [ELE/N6106: Advanced Program on Nanoscience and Technology](#)

Qualification Pack (QP) Parameters

Sector	Electronics
Sub-Sector	Semiconductor & Components
Occupation	Research and Design-I&A
Country	
NSQF Level	6.5
Credits	3
Aligned to NCO/ISCO/ISIC Code	
Minimum Educational Qualification & Experience	M.Sc (Relevant field - basic knowledge of nano science) OR Pursuing 1st year of PG- Eng (Relevant Field- Basic Knowledge of Nano Science)
Minimum Level of Education for Training in School	
Pre-Requisite License or Training	NA



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Minimum Job Entry Age	Years
Last Reviewed On	NA
Next Review Date	28/02/2026
NSQC Approval Date	29/09/2023
Version	1.0
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NQR Version	1.0



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ELE/N6106: Advanced Program on Nanoscience and Technology

Description

Personnel working in the High-End research and development (Academic & Industry)/ Faculty in the Nanoelectronics, Microsystems, smart materials technologies, and related areas is responsible for the fabrication and characterization of the micro/ nano scale devices.

Scope

The scope covers the following :

- Basic concepts of nanotechnology
- Various use cases of nanotechnology
- Introduction to the research infrastructure available at the Nano Centers in the form of lab tours and hands-on training
- Various Fabrication modules
- Understanding of various Characterization tools, such as, Probe Station, FTIR & Zeta PALS, AFM, LDV, XRD, Raman, SEM, XPS, TEM, Solar Simulator, Quantum Efficiency
- Advanced understanding of various processes and equipment nanotechnology/ nanoelectronics
- Advanced understanding of semiconductor technology
- Gaining knowledge on how to submit a good research proposal
- Outcome of a good research proposal can lead to publication in the peer-reviewed journals and filing a patent
- Summarizing a research proposal in a concise form
- Platform to show-case the proposed research work to reviewers and participants
- Technical discussions which will lead to improvise the research problem

Elements and Performance Criteria

Classroom Lectures

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

- PC1.** Introduction to the research infrastructure
- PC2.** In-depth information about the equipment and their capabilities
- PC3.** In-depth information about the labs, equipment and their capabilities
- PC4.** RCA cleaning
- PC5.** Research proposal, Feasibility check, Proof of concept/ Innovative idea

Safety

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

- PC6.** Lab safety protocols (Fire, Chemical, Gas and Electrical Safety)

Thin Film Deposition

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

- PC7.** Deposition tools - Oxidation furnace, thermal evaporators, Sputter Systems, Electron Beam Evaporators, Plasma Laser Deposition System, Atomic Layer Deposition Systems, ICPCVD, HWCVD

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Lithography

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

PC8. Lithography tools - Laser writer, photolithography systems, E-Beam lithography

Etch Process

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

PC9. Etch tools - DRIE, STSRIE, Plasma Etcher, Plasma Asher, Forming gas annealing

PC10. Wet Etch Bay

Characterization

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

PC11. Electrical Characterization: Probe Station for IV/CV measurements

PC12. Mechanical Characterization: LDV

PC13. Material Characterization: XRD, XPS

PC14. Optical Characterization: FTIR, UV-Vis, Raman, PL, Zeta PALS

PC15. Surface/morphological characterizations - AFM, SEM, FESEM, TEM

PC16. Opto-electronics characterization - Solar Simulator, Quantum Efficiency

PC17. Electro - Magnetic properties: Polytronic Research Electromagnet Model, PPMS, SQUID, Hall measurement system

Packaging

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

PC18. Packaging tools - wire bonder, wafer dicer

Implantation

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

PC19. Doping tools: PDS, PIII

Hands - on Training

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

PC20. Processes: Thin Film Deposition, Lithography process, Plasma assisted etching processes, Deep Reactive Ion Etching, Plasma Doping System, X-ray Photoelectron Spectroscopy Analysis, Mask Designing Using Clewin Software, Unique 2D and 3D Zeiss Microscopy Solutions using X-Ray, microscopy, Modeling Microfluidics using COMSOL, Semiconductor Modeling using COMSOL, TCAD

PC21. Devices: MOSCAP devices, Microfluidic devices for healthcare applications, Nanomaterials and devices, Inter-digitated Electrodes for Biosensors, Impedance based biosensor, A MEMS based Explosive Trace Detector

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. How to fabricate a device in micro nano scale

KU2. How to do the measurement of various characterization tool

KU3. Semiconductor physics

KU4. Details regarding each unit process flow

KU5. Procedure of setting up all process parameters



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- KU6.** Measurements to ensure dimensions are within specification
- KU7.** Preparation of the full Standard Operating Procedure (SOP)
- KU8.** Importance of identifying the parameters for the new product verification process
- KU9.**
 - Run dummy samples/measurements, Calculate Process Capability (CPK), Process Performance (PPK), and other quality parameters
- KU10.** Process of verifying the real product using various quality and reliability checks
- KU11.** The design flow involved in design stages
- KU12.** End-product application
- KU13.** How to use CleWin software and KLayout
- KU14.** Improving the understanding of the possible translation of the chips and prototypes.
- KU15.** Introduction to the understanding of quantum technologies.
- KU16.** Improving the understanding of the applications of the basic semiconductor technologies
- KU17.** Hands on use of the clean room, fabrication, characterization, and testing facilities.
- KU18.** Understanding concepts, writing, and building a good patent document.
- KU19.** Understanding concepts, writing, and building a good research proposal.

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 get the latest updates about the field of work
- GS3.** communicate politely and professionally
- GS4.** listen attentively to understand the information being shared
- GS5.** take quick decisions to deal with work emergencies or accidents
- GS6.** identify possible disruptions to work and take appropriate preventive measures
- GS7.** evaluate all possible solutions to a problem to select the best one

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Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Classroom Lectures</i>	4	17	-	-
PC1. Introduction to the research infrastructure	1	3	-	-
PC2. In-depth information about the equipment and their capabilities	1	3	-	-
PC3. In-depth information about the labs, equipment and their capabilities	1	3	-	-
PC4. RCA cleaning	1	4	-	-
PC5. Research proposal, Feasibility check, Proof of concept/ Innovative idea	-	4	-	-
<i>Safety</i>	1	3	-	-
PC6. Lab safety protocols (Fire, Chemical, Gas and Electrical Safety)	1	3	-	-
<i>Thin Film Deposition</i>	1	4	-	-
PC7. Deposition tools - Oxidation furnace, thermal evaporators, Sputter Systems, Electron Beam Evaporators, Plasma Laser Deposition System, Atomic Layer Deposition Systems, ICPCVD, HWCVD	1	4	-	-
<i>Lithography</i>	1	4	-	-
PC8. Lithography tools - Laser writer, photolithography systems, E-Beam lithography	1	4	-	-
<i>Etch Process</i>	2	8	-	-
PC9. Etch tools - DRIE, STSRIE, Plasma Etcher, Plasma Asher, Forming gas annealing	1	4	-	-
PC10. Wet Etch Bay	1	4	-	-
<i>Characterization</i>	7	28	-	-
PC11. Electrical Characterization: Probe Station for IV/CV measurements	1	4	-	-
PC12. Mechanical Characterization: LDV	1	4	-	-

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Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC13. Material Characterization: XRD, XPS	1	4	-	-
PC14. Optical Characterization: FTIR, UV-Vis, Raman, PL, Zeta PALS	1	4	-	-
PC15. Surface/morphological characterizations - AFM, SEM, FESEM, TEM	1	4	-	-
PC16. Opto-electronics characterization - Solar Simulator, Quantum Efficiency	1	4	-	-
PC17. Electro - Magnetic properties: Polytronic Research Electromagnet Model, PPMS, SQUID, Hall measurement system	1	4	-	-
<i>Packaging</i>	1	4	-	-
PC18. Packaging tools - wire bonder, wafer dicer	1	4	-	-
<i>Implantation</i>	1	4	-	-
PC19. Doping tools: PDS, PIII	1	4	-	-
<i>Hands - on Training</i>	2	8	-	-
PC20. Processes: Thin Film Deposition, Lithography process, Plasma assisted etching processes, Deep Reactive Ion Etching, Plasma Doping System, X-ray Photoelectron Spectroscopy Analysis, Mask Designing Using Clewin Software, Unique 2D and 3D Zeiss Microscopy Solutions using X-Ray, microscopy, Modeling Microfluidics using COMSOL, Semiconductor Modeling using COMSOL, TCAD	1	4	-	-
PC21. Devices: MOSCAP devices, Microfluidic devices for healthcare applications, Nanomaterials and devices, Inter-digitated Electrodes for Biosensors, Impedance based biosensor, A MEMS based Explosive Trace Detector	1	4	-	-
NOS Total	20	80	-	-

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National Occupational Standards (NOS) Parameters

NOS Code	ELE/N6106
NOS Name	Advanced Program on Nanoscience and Technology
Sector	Electronics
Sub-Sector	Semiconductor & Components
Occupation	Research and Design-I&A
NSQF Level	6.5
Credits	3
Version	1.0
Last Reviewed Date	28/02/2023
Next Review Date	28/02/2026
NSQC Clearance Date	28/02/2023

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



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National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
ELE/N6106.Advanced Program on Nanoscience and Technology	20	80	-	-	100	100
Total	20	80	-	-	100	100



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Acronyms

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

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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.

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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.