Qualification Pack

Foundation Program on Nano Science and Technology

QP Code: ELE/N6105

Version: 1.0

NSQF Level: 6

Contents

ELE/N6105: Foundation Program on Nano Science and Technology

Brief Job Description

Familiarization introduces different aspects of Nanoelectronics and provides exposure to the research infrastructure available at the Nano centers. Familiarization is organized in modules, such as MEMS cantilever, microfluidics, spintronics, 2D MoS2 transistors, interdigitated electrode devices, GaN LEDs, photovoltaics and nano-photonics.

Personal Attributes

undefined

Applicable National Occupational Standards (NOS)

Compulsory NOS:

1. ELE/N6105: Foundation Program on Nano Science and Technology

Qualification Pack (QP) Parameters

Sector	Electronics
Sub-Sector	Semiconductor & Components
Occupation	Research and Design-I&A
Country	
NSQF Level	6
Credits	2
Aligned to NCO/ISCO/ISIC Code	
Minimum Educational Qualification & Experience	Pursuing 4th year UG (in case of 4-year UG with honours/ honours with research) (Engineering in Relevant Field) OR M.Sc (Pursuing first year of M.Sc in the relevant field)
Minimum Level of Education for Training in School	

Pre-Requisite License or Training	NA
Minimum Job Entry Age	Years
Last Reviewed On	NA
Next Review Date	28/02/2026
NSQC Approval Date	29/09/2023
Version	1.0
Reference code on NQR	NG-06-EH-00197-2023-V1-ESSC
NQR Version	1.0

ELE/N6105: Foundation Program on Nano Science and Technology

Description

Familiarization introduces different aspects of Nanoelectronics and provides exposure to the research infrastructure available at the Nano centers. Familiarization is organized in modules, such as MEMS cantilever, microfluidics, spintronics, 2D MoS2 transistors, interdigitated electrode devices, GaN LEDs, photovoltaics and nano-photonics.

Scope

The scope covers the following :

- basic concepts/ understanding of nanotechnology/nanoelectronics/semiconductor Technology
- various processes in nanotechnology/nanoelectronics
- awareness about various facilities available at the nanocenter
- overview of ongoing research activities at each nanocenter
- tool capabilities and specifications
- 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
- enhancing the technical aptitude
- assessment of the understanding the concepts taught during the lectures

Elements and Performance Criteria

General

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

PC1. Basic concepts of Nanotechnology/ Nanoelectronics

PC2. Awareness about facilities available at the Nanocenter

PC3. Facilities available for each process

PC4. Capabilities of the available tools

PC5. MEMS/ NEMS Technology

PC6. 2D Materials & Devices

PC7. Laser/ CMOS Technology

PC8. Photovoltaics

PC9. Silicon Photonic Integrated Circuits

PC10. Nano-voyagers

PC11. Spintronics

PC12. Quantum Computation and Devices

PC13. Logic & Memory Devices

PC14. Compound Semiconductor Devices

PC15. Sensors

PC16. Next Generation of Computing

Packaging

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

PC17. Packaging Application

PC18. 3D Integration

Thin Film Deposition

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

PC19. Device Physics

PC20. VLSI Technology

PC21. Semiconductor Physics

Characterization

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

PC22. Electrical Characterization

PC23. Metrology

PC24. Materials Technologies for Computer Memories

PC25. Surface Structuring and Biomimetics

Safety

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

PC26. Introduction to Safety

Lithography

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

PC27. Introduction to Lithography

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. system design modules and concepts of circuit design

KU2. semiconductor physics, CMOS transistors, diodes, triodes, etc.

KU3. the Hardware description language (HDL) such as Verilog, VHDL

KU4. the basics on HDL simulation and synthesis

KU5. the design flow involved in design stages of various nano fabrication process

KU6. the circuit design, network analysis, control theory for analogue design requirement

KU7. the high-level language for design such as C, C plus, MATLAB, COMSOL

KU8. the end-product application, i.e., industry for which sample is designed

KU9. cleanroom safety and precautions

KU10. basics of system-on-chip (SOC) design

KU11. improving the understanding on the possible translation of the chips and prototypes

KU12. introduction to the understanding of quantum physics

KU13. improving the understanding of the physics behind the semiconductor technologies

KU14. understanding the importance of clean room, fabrication, characterization, and testing facilities related to nanofabrication.

KU15. understanding concepts, writing, and building a good patent document.

KU16. 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

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
General	**58**	-	-	-
PC1. Basic concepts of Nanotechnology/ Nanoelectronics	2	-	-	-
PC2. Awareness about facilities available at the Nanocenter	2	-	-	-
PC3. Facilities available for each process	3	-	-	-
PC4. Capabilities of the available tools	3	-	-	-
PC5. MEMS/ NEMS Technology	4	-	-	-
PC6. 2D Materials & Devices	4	-	-	-
PC7. Laser/ CMOS Technology	4	-	-	-
PC8. Photovoltaics	4	-	-	-
PC9. Silicon Photonic Integrated Circuits	4	-	-	-
PC10. Nano-voyagers	4	-	-	-
PC11. Spintronics	4	-	-	-
PC12. Quantum Computation and Devices	4	-	-	-
PC13. Logic & Memory Devices	4	-	-	-
PC14. Compound Semiconductor Devices	4	-	-	-
PC15. Sensors	4	-	-	-
PC16. Next Generation of Computing	4	-	-	-
Packaging	**8**	-	-	-
PC17. Packaging Application	4	-	-	-
PC18. 3D Integration	4	-	-	-
Thin Film Deposition	**12**	-	-	-
PC19. Device Physics	4	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC20. VLSI Technology	4	-	-	-
PC21. Semiconductor Physics	4	-	-	-
Characterization	**16**	**-**	**-**	**-**
PC22. Electrical Characterization	4	-	-	-
PC23. Metrology	4	-	-	-
PC24. Materials Technologies for Computer Memories	4	-	-	-
PC25. Surface Structuring and Biomimetics	4	-	-	-
Safety	**3**	**-**	**-**	**-**
PC26. Introduction to Safety	3	-	-	-
Lithography	**3**	**-**	**-**	**-**
PC27. Introduction to Lithography	3	-	-	-
NOS Total	**100**	**-**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	ELE/N6105
NOS Name	Foundation Program on Nano Science and Technology
Sector	Electronics
Sub-Sector	Semiconductor & Components
Occupation	Research and Design-I&A
NSQF Level	6
Credits	2
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

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
ELE/N6105.Foundation Program on Nano Science and Technology	100	-	-	-	100	100
Total	**100**	**-**	**-**	**-**	**100**	**100**

Qualification Pack

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.