National Occupational Standards

# Advanced Program on Nano Science and Technology

Unit Code: ELE/N6106

Version: 2.0

NSQF Level: 6.5

Electronics Sector Skills Council of India || 155, 2nd Floor, ESC House Okhla Industrial Area-Phase 3
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## Description

Personnel working in the High-End research and development (Academic & Industry)/ Faculty in the Nano electronics, Microsystems, smart materials technologies, and related areas 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

*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, Microfuidic 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.** Knowledge of semiconductor research infrastructure laboratory facilities equipment and their capabilities

**KU2.** Knowledge of laboratory safety protocols including fire chemical gas electrical and cleanroom safety

**KU3.** Knowledge of thin film deposition lithography etching doping implantation and semiconductor packaging processes

**KU4.** Knowledge of electrical mechanical material optical surface optoelectronic and electromagnetic characterization techniques

**KU5.** Knowledge of semiconductor device fabrication microfluidics nanomaterials biosensors MEMS and simulation tools

## Generic Skills (GS)

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

**GS1.** Ability to identify and select appropriate semiconductor laboratory facilities equipment and processes for research activities

**GS2.** Ability to operate semiconductor fabrication and characterization equipment by following standard operating procedures and safety practices

**GS3.** Ability to perform thin film deposition lithography etching doping and characterization processes during hands on training

**GS4.** Ability to use software tools for mask design microfluidic modelling semiconductor modelling and TCAD simulation

**GS5.** Ability to analyze experimental results develop proof of concept ideas and document research activities effectively

## Assessment Criteria

| Assessment Criteria for Outcomes | Theory Marks | Practical Marks | Project Marks | Viva Marks |
|---|---|---|---|---|
| *Classroom Lectures* | **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 | - | - |
| *Safety* | **1** | **3** | **-** | **-** |
| **PC6.** Lab safety protocols (Fire, Chemical, Gas and Electrical Safety) | 1 | 3 | - | - |
| *Thin Film Deposition* | **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 | - | - |
| *Lithography* | **1** | **4** | **-** | **-** |
| **PC8.** Lithography tools - Laser writer, photolithography systems, E-Beam lithography | 1 | 4 | - | - |
| *Etch Process* | **2** | **8** | **-** | **-** |
| **PC9.** Etch tools - DRIE, STSRIE, Plasma Etcher, Plasma Asher, Forming gas annealing | 1 | 4 | - | - |
| **PC10.** Wet Etch Bay | 1 | 4 | - | - |
| *Characterization* | **7** | **28** | **-** | **-** |
| **PC11.** Electrical Characterization: Probe Station for IV/CV measurements | 1 | 4 | - | - |
| **PC12.** Mechanical Characterization: LDV | 1 | 4 | - | - |

| 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 | - | - |
| *Packaging* | **1** | **4** | **-** | **-** |
| **PC18.** Packaging tools - wire bonder, wafer dicer | 1 | 4 | - | - |
| *Implantation* | **1** | **4** | **-** | **-** |
| **PC19.** Doping tools: PDS, PIII | 1 | 4 | - | - |
| *Hands – on Training* | **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, Microfuidic 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** | **-** | **-** |

## National Occupational Standards (NOS) Parameters

| | |
|---|---|
| **NOS Code** | ELE/N6106 |
| **NOS Name** | Advanced Program on Nano Science and Technology |
| **Sector** | Electronics |
| **Sub-Sector** | Semiconductor & Components |
| **Occupation** | Product Design-S&C |
| **NSQF Level** | 6.5 |
| **Credits** | 3 |
| **Minimum Job Entry Age** | 16 |
| **Minimum Educational Qualification & Experience** | Pursuing 1st year of PG- Eng (Electronics and Communication/ Chemical /Mechanical) with NA of experience NA<br>OR<br>M.Sc (Electronics and Communication/ Chemical /Mechanical ) with NA of experience NA<br>OR<br>Previous relevant Qualification of NSQF Level (6) with 1.5 years of experience Relevant Experience in the filed Nanoscience, semiconductor, physics (research) |
| **Version** | 2.0 |
| **Last Reviewed Date** | 08/07/2026 |
| **Next Review Date** | 08/07/2029 |
| **NSQC Clearance Date** | 08/07/2026 |
| **Reference code on NQR** | NG-6.5-EH-05285-2026-V1-ESSCI |
| **NQR Version** | 1 |
| **CCN Category** | 1 |