



Model Curriculum

NOS Name: ADVANCED PROGRAM ON NANOSCIENCE AND TECHNOLOGY

OEM Name: ADVANCED PROGRAM ON NANOSCIENCE AND TECHNOLOGY

NOS Code: ELE/N6106

NOS Version: 2.0

NSQF Level: 6.5

Model Curriculum Version: 2.0

Table of Contents

Training Parameters.....	3
Program Overview	4
Training Outcomes.....	4
Compulsory Modules.....	5
Module Details.....	7
Module 1: Introduction to Facilities/ Equipment	7
Module 2: Hand-on training on Fabrication modules	8
Module 3: Hands-on training on Characterization tools	9
Module 4: HW/Reading material	10
Module 5: Preparation of Research Proposal	12
Module 6: Research Proposal presentation	13
Module 7: MC Quiz.....	14
Annexure.....	15
Trainer Requirements	15
Assessor Requirements.....	16
Assessment Strategy	16
References	18
Glossary.....	18
Acronyms and Abbreviations.....	19

Training Parameters

Sector	Electronics
Sub-Sector	Semiconductor & Components
Occupation	Product Design-S&C
Country	India
NSQF Level	6.5
Aligned to NCO/ISCO/ISIC Code	NCO-2015/NIL
Minimum Educational Qualification and Experience	Pursuing First year of PG Engineering in Electronics and communication/Chemical/ Mechanical Domain OR M.Sc in Electronics and Communication/ Chemical / Mechanical Domain OR Previous relevant Qualification of NSQF Level 6 with 1.5 years of experience #Foundation Program on Nano Science & Technology # Relevant Experience in the filed Nanoscience, semiconductor, physics (research)
Pre-Requisite License or Training	NA
Minimum Job Entry Age	21
Last Reviewed On	08.07.2026
Next Review Date	08.07.2029
NSQC Approval Date	08.07.2026
NOS Version	2.0
Model Curriculum Creation Date	08.07.2026
Model Curriculum Valid Up to Date	08.07.2029
Model Curriculum Version	2.0
Maximum Duration of the Course	90
Minimum Duration of the Course	90

Program Overview

This section summarizes the end objectives of the program along with its duration.

Training Outcomes:

- At the end of the program, the learner should have acquired the listed knowledge and skills:
- As an objective to extend the facilities available at the nanocentre for research and process/product development, the hands-on training program encourages the learner to become equipped with the following skillsets as a leverage:

Compulsory:

- Introduction to the research infrastructure available at the Nano Centers in the form of hands-on training. These would provide in-depth information about the equipment and their capabilities.
- Introduction to the research infrastructure available at the Nano Centers in the form of lab tours. This would provide an overview about the labs and equipment that are in-use for the processes.
- Hands-on training for each process step. These would provide in-depth information about the lab samples, equipment and their capabilities as well as other requirements.
- Expert talks on the nanoelectronics/semiconducting material by the faculty members and expert speakers.
- Hands-on training on Fabrication modules, such as, introduction to Wet Etch Bay, Furnaces, Introduction to Thin Films, Lithography, Dry Etch, RCA cleaning, Diffusion, PSG etching, Front/ back Metal Deposition, Photoresist stripping, Forming gas annealing
- Hands-on training on Characterization tools, such as, Probe Station, FTIR & Zeta PALS, AFM, LDV, XRD, Raman, SEM, XPS, TEM, Solar Simulator, Quantum Efficiency.
- Hands on training on some of the simulations like TCAD, COMSOL, etc.
- Study of the relevant literature for the in depth understanding of the various processes and equipment.
- Preparation and presentation of the research proposal.
- Self-assessment of the knowledge acquired by organizing an MC Quiz.

Compulsory Modules:

The table lists the modules and their duration corresponding to the Compulsory NOS of the QF

NOS and Module Details	Theory Duration (In Hours)	Practical/OJT Duration (In Hours)	On-the-Job Training Duration (in hours) (Mandatory)	On-the-Job Training Duration (in hours) (Recommended)	Total Duration (In Hours)
Module 1 (Introduction to Facilities/ Equipment)	02:00	08:00	00:00	00:00	10:00
ELE/N6106	02:00	08:00	00:00	00:00	10:00
Module 2 (Hand-on training on Fabrication modules)	02:00	32:00	00:00	00:00	34:00
ELE/N6106	02:00	32:00	00:00	00:00	34:00
Module 3 (Hands-on training on Characterization tools)	02:00	32:00	00:00	00:00	34:00
ELE/N6106	02:00	32:00	00:00	00:00	34:00
Module 4 (HW/Reading material)	05:00	00:00	00:00	00:00	05:00
ELE/N6106	05:00	00:00	00:00	00:00	05:00
Module 5 (Preparation of Research Proposal)	04:00	00:00	00:00	00:00	04:00
ELE/N6106	04:00	00:00	00:00	00:00	04:00

Module 6 (Research Proposal presentation)	02:00	00:00	00:00	00:00	02:00
ELE/N6106	02:00	00:00	00:00	00:00	02:00
Module 7 (MC Quiz)	01:00	00:00	00:00	00:00	01:00
ELE/N6106	01:00	00:00	00:00	00:00	01:00
Total Duration	18:00	72:00	00:00	00:00	90:00

Module Details

Module 1: Introduction to Facilities Equipment

Terminal Outcomes:

- Explain the basic concepts of nanotechnology/ nanoelectronics/ semiconductor
- Describe various use cases of nanotechnology/ nanoelectronics/ semiconductor
- Introduction to the research infrastructure available at the Nano Centers in the form of lab tours and hands-on training.

Duration: 10:00 hrs

Theory and Practical - Key Learning Outcomes

- Introduction to the research infrastructure available at the Nano Centers in the form of lab tours and hands-on training.
- These would provide in-depth information about the equipment and their capabilities.
- These would provide in-depth information about the different labs, equipment and their capabilities as well as other requirements.

Tools, Equipment and Other Requirements

Labs equipped with the following:

- PCs/Laptops
- Notepad and pens
- Internet with Wi-Fi (Min 2 Mbps dedicated)

Module 2: Hands-on training on Fabrication modules

Terminal Outcomes:

Understanding of various Fabrication modules such as Wet Etch Bay, Furnaces, Introduction to Thin Films, Lithography, Dry Etch, RCA cleaning, Diffusion, PSG etching, Front/ back Metal Deposition, Photoresist stripping, Forming gas annealing, etc.

Duration: 34:00 hrs

Theory & Practical- Key Learning Outcomes

- Introduction and Hands-on training on various Fabrication modules
 - Cleanroom Practices & Wafer Preparation: Cleanroom orientation, safety protocols, contamination control, documentation discipline, wafer handling, RCA/solvent cleaning, and surface preparation for fabrication.
 - Thin-Film Deposition Technologies: Thermal and plasma-based deposition including oxidation, CVD/PECVD, ALD fundamentals, and PVD techniques (thermal, e-beam evaporation, sputtering) with focus on process control and film uniformity.
 - Lithography & Pattern Transfer: Photoresist processing, mask alignment and exposure, development, mask-less lithography, and introductory e-beam lithography for fine patterning.
 - Etching, Doping & Process Modification: Wet and dry etching (RIE, DRIE exposure), diffusion and ion implantation concepts, plasma ashing, and annealing processes for device modification.
 - Metallization, Inspection & Characterization: Front- and back-side metallization, contact formation, optical and SEM-based inspection, thickness measurement concepts, and defect analysis linked to process steps.
 - Process Integration, Packaging & Tool Exposure: End-to-end fabrication flow, sequencing and troubleshooting, wafer dicing, wire bonding, basic packaging, and guided hands-on exposure to key cleanroom tools and equipment.

Tools, Equipment and Other Requirements

Labs equipped with the following:
Tools mentioned above (as per the Institute-wise)

- PCs/Laptops
- Notepad and pens
- Internet with Wi-Fi (Min 2 Mbps dedicated)

Module 3: Hands-on training on Characterization tools

Terminal Outcomes:

- Understanding of various Characterization tools, such as, Probe Station, FTIR & Zeta PALS, AFM, LDV, XRD, Raman, SEM, XPS, TEM, Solar Simulator, Quantum Efficiency, etc.

Duration: 34:00 hrs

Practical- Key Learning Outcomes

- Introduction and Hand-on training on Characterization tools, such as,
 - Electrical Characterization: Probe Station for IV/CV measurements
 - Mechanical Characterization: LDV
 - Material Characterization: XRD, XPS
 - Optical Characterization: FTIR, UV-Vis, Raman, PL, Zeta PALS
 - Surface/morphological characterizations - AFM, SEM, FESEM, TEM
 - Opto-electronics characterization - Solar Simulator, Quantum Efficiency
 - Electro - Magnetic properties: Polytronic Research Electromagnet Model, PPMS, SQUID, Hall measurement system

Tools, Equipment and Other Requirements

Labs equipped with the following:

- PCs/Laptops
- Notepad and pens
- Internet with Wi-Fi (Min 2 Mbps dedicated)

Module 4: HW/Reading material

Terminal Outcomes:

- Advanced understanding of various processes and equipment nanotechnology/ Nanoelectronics
- Advanced understanding of Semiconductor Technology

Duration: 05:00 hrs

Practical - Key Learning Outcomes

- Study of the relevant literature for the in depth understanding of the various processes and equipment as well as novel devices.

Overview of nano centres at the Institute

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

Simulation:

- Modeling Microfluidics using COMSOL
- Semiconductor Modeling using COMSOL
- TCAD

Devices:

- MOSCAP devices/ MIM Capacitors
- Microfluidic devices for healthcare applications
- Nanomaterials and devices
- Inter-digitated Electrodes for Biosensors
- Impedance based biosensor
- A MEMS based Explosive Trace Detector
- 2D MOS2 devices
- Spintronic devices
- Anisotropic Magnetoresistance devices
- GaN LED
- Microheaters
- Cantilever

Tools, Equipment and Other Requirements

Labs equipped with the following:

- PCs/Laptops
- Chart paper and sketch pens
- Internet with Wi-Fi (Min 2 Mbps dedicated)

Module 5: Preparation of Research Proposal

Terminal Outcomes:

- 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.

<i>Duration: 04:00 hrs</i>
Theory & Practical - Key Learning Outcomes
• How to write the research proposal • Writing the technical process clearly • Outcome of the research proposal • Problem statement is addressed clearly • Proof of concept/ Innovative idea
Classroom Aids:
• Whiteboard and Markers • Chart paper and sketch pens • LCD Projector and Laptop for presentations
Tools, Equipment and Other Requirements
Labs equipped with the following: • PCs/Laptops • Notebook and pens • Internet with Wi-Fi (Min 2 Mbps dedicated)

Module 6: Research Proposal Presentation

Terminal Outcomes:

- 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 improvising the research problem.

Duration: 02:00 hrs

Theory & Practical - Key Learning Outcomes

- How to prepare a poster
- How to present a poster
- Feasibility check of the research proposal
- Handling the cross questioning

Classroom Aids:

- Whiteboard and Markers
- Chart paper and sketch pens
- LCD Projector and Laptop for presentations

Tools, Equipment and Other Requirements

Labs equipped with the following:

- PCs/Laptops
- Notebook and pens
- Internet with Wi-Fi (Min 2 Mbps dedicated)

Module 7: MC Quiz

Terminal Outcomes:

- Enhancing technical aptitude.
- Assessment of the understanding of the concepts taught during the lectures.

<i>Duration: 01:00 hrs</i>
Theory & Practical - Key Learning Outcomes
• Understanding the concepts taught during lectures
Classroom Aids:
• Whiteboard and Markers • Chart paper and sketch pens • LCD Projector and Laptop for presentations
Tools, Equipment and Other Requirements
Labs equipped with the following: • PCs/ Laptops • Notebook and sketch pens • Internet with Wi-Fi (Min 2 Mbps dedicated)

Annexure

Trainer Requirements

Trainer Prerequisites						
Minimum Educational Qualification	Specialization	Relevant Industry Experience		Training Experience		Remarks
		Years	Specialization	Years	Specialization	
Doctorate in Science & Engineering	Electronics / Physics	3	Semiconductor Technology	3	Semiconductor Technology	

Trainer Certification	
Domain Certification	Platform Certification
Any Semiconductor Job Role Minimum accepted score is 80%.	"Trainer, MEP/Q2601," V2.0, Minimum accepted score is 80%.

Assessor Requirements

Assessor Prerequisites						
Minimum Educational Qualification	Specialization	Relevant Industry Experience		Training/Assessment Experience		Remarks
		Years	Specialization	Years	Specialization	
Doctorate in Science & Engineering	Electronics/ Physics	3	Semiconductor technology	3	Semiconductor technology	

Assessor Certification	
Domain Certification	Platform Certification
Any Semiconductor Job Role Minimum accepted score is 80%.	"Assessor, MEP/Q2701", V2.0, Minimum accepted score is 80%.

Assessment Strategy

1. Assessment System Overview:

- Batches assigned to the assessment agencies for conducting the assessment on SDMS/SIP or email
- Assessment agencies send the assessment confirmation to VTP/TC looping SSC
- Assessment agency deploys the ToA certified Assessor for executing the assessment
- SSC monitors the assessment process & records

2. Testing Environment:

- Confirm that the centre is available at the same address as mentioned on SDMS or SIP
- Check the duration of the training.
- Check the Assessment Start and End time to be as 10 a.m. and 5 p.m.
- If the batch size is more than 30, then there should be 2 Assessors.
- Check that the allotted time to the candidates to complete Theory & Practical Assessment is correct.
- Check the mode of assessment—Online (TAB/Computer) or Offline (OMR/PP).
- Confirm the number of TABs on the ground are correct to execute the Assessment smoothly.
- Check the availability of the Lab Equipment for the particular Job Role.

3. Assessment Quality Assurance levels / Framework:

- Question papers created by the Subject Matter Experts (SME)
- Question papers created by the SME verified by the other subject Matter Experts
- Questions are mapped with NOS and PC
- Question papers are prepared considering that level 1 to 3 are for the unskilled & semi-skilled individuals, and level 4 and above are for the skilled, supervisor & higher management
- Assessor must be ToA certified & trainer must be ToT Certified
- Assessment agency must follow the assessment guidelines to conduct the assessment

4. Types of evidence or evidence-gathering protocol:

- Time-stamped & geotagged reporting of the assessor from assessment location
- Centre photographs with signboards and scheme specific branding
- Biometric or manual attendance sheet (stamped by TP) of the trainees

during the training period

- Time-stamped & geotagged assessment (Theory + Viva + Practical) photographs & videos

5. Method of verification or validation:

- Surprise visit to the assessment location
- Random audit of the batch
- Random audit of any candidate

6. Method for assessment documentation, archiving, and access

- Hard copies of the documents are stored
- Soft copies of the documents & photographs of the assessment are uploaded / accessed from Cloud Storage
- Soft copies of the documents & photographs of the assessment are stored in the Hard Drives

Reference

s Glossary

Term	Description
Key Learning Outcome	Key learning outcome is the statement of what a learner needs to know, understand and be able to do to achieve the terminal outcomes. A set of key learning outcomes will make up the training outcomes. Training outcome is specified in terms of knowledge, understanding (theory) and skills (practical/OJT application).
Training Outcome	Training outcome is a statement of what a learner will know, understand and be able to do upon the completion of the training
Terminal Outcome	Terminal outcome is a statement of what a learner will know, understand and be able to do upon the completion of a module . A set of terminal outcomes help to achieve the training outcome.
National Occupational Standard	National Occupational Standard specify the standard of performance an individual must achieve when carrying out a function in the workplace
Persons with Disability	Persons with Disability are those who have long-term physical, mental, intellectual, or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others

Acronyms and Abbreviations

Term	Description
QF	Qualification File
NSQF	National Skills Qualification Framework
NSQC	National Skills Qualification Committee
NOS	National Occupational Standards

SSC	Skill Sectors Councils
NASSCOM	National Association of Software & Service Companies
NCO	National Classification of Occupations
ISO	International Organization for Standardization
SLA	Service Level Agreement
IT	Information Technology
CRM	Customer Relationship Management
PC	Performance Criteria
PwD	Persons with Disability
SOP	Standard Operating Procedure