



## Model Curriculum

**NOS Name: FOUNDATION PROGRAM ON NANOSCIENCE AND TECHNOLOGY**

**NOS Code: ELE/N6105**

**NOS Version: 1.0**

**NSQF Level: 6.0**

**Model Curriculum Version: 1.0**

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## Training Parameters

<b>Sector</b>	Electronics
<b>Sub-Sector</b>	Semiconductor & Components
<b>Occupation</b>	Design & Manufacturing
<b>Country</b>	India
<b>NSQF Level</b>	6
<b>Aligned to NCO/ISCO/ISIC Code</b>	NCO-2015/NIL
<b>Minimum Educational Qualification and Experience</b>	Pursuing 4th year of UG – Engineering in the relevant field OR Pursuing first year of M.Sc in the relevant field
<b>Pre-Requisite License or Training</b>	NA
<b>Minimum Job Entry Age</b>	21
<b>Last Reviewed On</b>	28/02/2023
<b>Next Review Date</b>	27/02/2026
<b>NSQC Approval Date</b>	28/02/2023
<b>NOS Version</b>	1.0
<b>Model Curriculum Creation Date</b>	28/02/2023
<b>Model Curriculum Valid Up to Date</b>	27/02/2026
<b>Model Curriculum Version</b>	1.0
<b>Maximum Duration of the Course</b>	60

## 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:

### Compulsory:

- Basic lecture introduces different aspects of Nanoelectronics and exposure to the current research activities at a particular nano center.
- Provides exposure to the research infrastructure available at the Nano Centers in the form of series of lectures and application notes. This would provide in-depth information about the equipment and their capabilities.
- The lecture series is organized as modules, such as MEMS/ NEMS sensors and microfluidics, compounded semiconductor devices, spintronics, 2D materials and devices, photovoltaics and nanophotonic, etc.

### Compulsory Modules:

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

NOS and Module Details	Theory / Demonstration 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)
<i>Module 1 (Literature survey)</i>	10:00	00:00	00:00	00:00	10:00
ELE/N6105	10:00	00:00	00:00	00:00	10:00
<i>Module 2 (Introduction to the Facilities)</i>	03:00	00:00	00:00	00:00	03:00
ELE/N6105	03:00	00:00	00:00	00:00	03:00
<i>Module 3 (Lecture on Nanoscience and</i>	20:00	00:00	00:00	00:00	20:00

<i>Engineering)</i>					
ELE/N6105	20:00	00:00	00:00	00:00	20:00
<i>Module 4 (HW/Reading material)</i>	15:00	00:00	00:00	00:00	15:00
ELE/N6105	15:00	00:00	00:00	00:00	15:00
<i>Module 5 (Research Proposal preparation)</i>	05:00	00:00	00:00	00:00	05:00
ELE/N6105	05:00	00:00	00:00	00:00	05:00
<i>Module 6 (Participant Poster presentations)</i>	06:00	00:00	00:00	00:00	06:00
ELE/N6105	06:00	00:00	00:00	00:00	06:00
<i>Module 7 (MC Quiz)</i>	01:00	00:00	00:00	00:00	01:00
ELE/N6105	01:00	00:00	00:00	00:00	01:00
<b>Total Duration</b>	<b>60:00</b>	<b>00:00</b>	<b>00:00</b>	<b>00:00</b>	<b>60:00</b>

## Module Details

### Module 1: Literature survey

#### Terminal Outcomes:

- Explain the basic concepts of nanotechnology/nanoelectronics
- Describe various processes in nanotechnology/nanoelectronics

*Duration: 10:00 hrs*

#### Theory - Key Learning Outcomes

- Basic concepts of nanotechnology/nanoelectronics
- VLSI technology
- Semiconductor Physics
- Electrical/ Material characterization
- Device Physics

#### 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: Introduction to the Facilities

### Terminal Outcomes:

- Awareness about various facilities available at the nanocenter.
- Tool capabilities and specifications

<i>Duration: 03:00 hrs</i>
<b>Theory - Key Learning Outcomes</b>
<ul style="list-style-type: none"><li>• Awareness about various facilities available at the nanocenter</li><li>• Facilities available for each processes</li><li>• Capabilities of the available tools</li></ul>
<b>Classroom Aids: (If Offline mode)</b>
<ul style="list-style-type: none"><li>• Whiteboard and Markers</li><li>• Chart paper and sketch pens</li><li>• LCD Projector and Laptop for presentations</li></ul>
<b>Tools, Equipment and Other Requirements</b>
Labs equipped with the following: <ul style="list-style-type: none"><li>• PCs/ Laptops</li><li>• Notepad and pens</li><li>• Internet with Wi-Fi (Min 2 Mbps dedicated)</li></ul>

### Module 3: Lecture on Nanoscience and Engineering

#### Terminal Outcomes:

- Concepts of Nanoscience and Engineering

<i>Duration: 20:00 hrs</i>
<b>Theory - Key Learning Outcomes (any six or more)</b>
<ul style="list-style-type: none"> <li>• MEMS/ NEMS Technology</li> <li>• 2D materials &amp; devices</li> <li>• Laser/ CMOS Technology</li> <li>• Photovoltaics</li> <li>• Silicon Photonic Integrated Circuits</li> <li>• Materials Technologies for Computer Memories</li> <li>• 3D Integration</li> <li>• Nano-voyagers</li> <li>• Packaging Application</li> <li>• Spintronics</li> <li>• Quantum computation and devices</li> <li>• Logic &amp; Memory Devices</li> <li>• Compound Semiconductor Devices</li> <li>• Sensors</li> </ul>
<b>Classroom Aids:</b>
<ul style="list-style-type: none"> <li>• Whiteboard and Markers</li> <li>• Chart paper and sketch pens</li> <li>• LCD Projector and Laptop for presentations</li> </ul>
<b>Tools, Equipment and Other Requirements</b>
<p>Labs equipped with the following:</p> <ul style="list-style-type: none"> <li>• PCs/Laptops</li> <li>• Notepad and pens</li> <li>• Internet with Wi-Fi (Min 2 Mbps dedicated)</li> </ul>



## Module 4: HW/Reading material

### Terminal Outcomes:

- Basic understanding of Nanotechnology/Nanoelectronics
- Basic understanding of Semiconductor Technology

<i>Duration: 15:00 hrs</i>
<b>Theory - Key Learning Outcomes</b>
<ul style="list-style-type: none"> <li>• Understanding the concepts more clearly</li> <li>• Improve the efficiency of understanding</li> <li>• Enhancing theoretical skills</li> <li>•</li> </ul>
<b>Classroom Aids:</b>
<ul style="list-style-type: none"> <li>• Whiteboard and Markers</li> <li>• Chart paper and sketch pens</li> <li>• LCD Projector and Laptop for presentations</li> </ul>
<b>Tools, Equipment and Other Requirements</b>
<p>Labs equipped with the following:</p> <ul style="list-style-type: none"> <li>• PCs/Laptops</li> <li>• Notepad and pens</li> <li>• Internet with Wi-Fi (Min 2 Mbps dedicated)</li> </ul>

## Module 5: Research Proposal preparation

### 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

*Duration: 05:00 hrs*

### Theory - Key Learning Outcomes

- How to write a research proposal
- Writing the technical process clearly
- Outcome of the research proposal
- Addressing problem statement 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: Participant Poster presentations

### 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 improvise the research problem

*Duration: 06:00 hrs*

### Theory - 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)

**Terminal Outcomes:**

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

<i>Duration: 01:00 hrs</i>
<b>Theory - Key Learning Outcomes</b>
<ul style="list-style-type: none"><li>• Understanding the concepts taught during lectures</li></ul>
<b>Classroom Aids:</b>
<ul style="list-style-type: none"><li>• Whiteboard and Markers</li><li>• Chart paper and sketch pens</li><li>• LCD Projector and Laptop for presentations</li></ul>
<b>Tools, Equipment and Other Requirements</b>
Labs equipped with the following: <ul style="list-style-type: none"><li>• PCs/ Laptops</li><li>• Notebook and sketch pens</li><li>• Internet with Wi-Fi (Min 2 Mbps dedicated)</li></ul>

## Annexure

### Trainer Requirements

Trainer Prerequisites						
Minimum Educational Qualification	Specialization	Relevant Industry Experience		Training Experience		Remarks
		Years	Specialization	Years	Specialization	
Doctorate in Science & Engineering	Electrical/ 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," 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	Electrical/ 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" 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

## References

## Glossary

Term	Description
<b>Key Learning Outcome</b>	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).
<b>Training Outcome</b>	Training outcome is a statement of what a learner will know, understand and be able to do <b>upon the completion of the training</b>
<b>Terminal Outcome</b>	Terminal outcome is a statement of what a learner will know, understand and be able to do <b>upon the completion of a module</b> . A set of terminal outcomes help to achieve the training outcome.
<b>National Occupational Standard</b>	National Occupational Standard specify the standard of performance an individual must achieve when carrying out a function in the workplace
<b>Persons with Disability</b>	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



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