Model Curriculum

QF Name: FOUNDATION PROGRAM ON NANOSCIENCE AND NANOTECHNOLOGY

QF Code:

QF Version:

NSQF Level: 6

Model Curriculum Version:

Electronic Sector Skill Council of India || 155, 2nd Floor, ESC House, Okhla Industrial Area - Phase 3, New Delhi – 110020

Table of Contents

Training Parameters

Sector	Electronics
Sub-Sector	Research in Semiconductor devices
Occupation	High End research and development (Academic & Industry)/ Faculty in the Nanoelectronics, Microsystems, smart materials technologies, and related areas
Country	India
NSQF Level	6
Aligned to NCO/ISCO/ISIC Code	
Minimum Educational Qualification and Experience	After BE/ BTech/ Integrated MSc program and above (Any engineering graduates/ science background)
Pre-Requisite License or Training	NA
Minimum Job Entry Age	18+
Last Reviewed On	NA
Next Review Date	
NSQC Approval Date	
QF Version	
Model Curriculum Creation Date	
Model Curriculum Valid Up to Date	
Model Curriculum Version	
Minimum Duration of the Course	60
Maximum Duration of the Course	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 nanocenter.
- 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 nanophotonics, etc.

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 (Literature survey)	10:00	00:00	00:00	00:00	10:00
NOS Version No.	10:00	00:00	00:00	00:00	10:00
Module 2 (Introduction to the Facilities)	03:00	00:00	00:00	00:00	03:00
NOS Version No.	03:00	00:00	00:00	00:00	03:00
Module 3 (Lecture on	20:00	00:00	00:00	00:00	20:00

Nanoscience and Engineering)					
NOS Version No.	20:00	00:00	00:00	00:00	20:00
Module 4 (HW/Reading material)	15:00	00:00	00:00	00:00	15:00
NOS Version No.	15:00	00:00	00:00	00:00	15:00
Module 5 (Research Proposal preparation)	05:00	00:00	00:00	00:00	05:00
NOS Version No.	05:00	00:00	00:00	00:00	05:00
Module 6 (Participant Poster presentations)	06:00	00:00	00:00	00:00	06:00
NOS Version No.	06:00	00:00	00:00	00:00	06:00
Module 7 (MC Quiz)	01:00	00:00	00:00	00:00	01:00
NOS Version No.	01:00	00:00	00:00	00:00	01:00
OJT	00:00	00:00	00:00	00:00	00:00
Total Duration	60:00	00:00	00:00	00:00	**60:00**

Module Details

Module 1: Literature survey

Bridge Module

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

Bridge Module

Terminal Outcomes:

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

Duration: 03:00 hrs
Theory - Key Learning Outcomes
• Awareness about various facilities available at the nanocenter • Facilities available for each processes • Capabilities of the available tools
Classroom Aids: (If Offline mode)
• 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 • Notepad and pens • Internet with Wi-Fi (Min 2 Mbps dedicated)

Module 3: Lecture on Nanoscience and Engineering
Bridge Module
Terminal Outcomes:

- Concepts of Nanoscience and Engineering
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Duration: 20:00 hrs
Theory - Key Learning Outcomes (any six or more)
• MEMS/ NEMS Technology • 2D materials & devices • Laser/ CMOS Technology • Photovoltaics • Silicon Photonic Integrated Circuits • Materials Technologies for Computer Memories • 3D Integration • Nano-voyagers • Packaging Application • Spintronics • Quantum computation and devices • Logic & Memory Devices • Compound Semiconductor Devices • Sensors
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 • Notepad and pens • Internet with Wi-Fi (Min 2 Mbps dedicated)

Module 4: HW/Reading material

Bridge Module

Terminal Outcomes:

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

Duration: 15:00 hrs
Theory - Key Learning Outcomes
• Understanding the concepts more clearly • Improve the efficiency of understanding • Enhancing theoretical skills •
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 • Notepad and pens • Internet with Wi-Fi (Min 2 Mbps dedicated)

Module 5: Research Proposal preparation

Bridge Module

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

Bridge Module

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)

Module 7: MC Quiz
Bridge Module
Terminal Outcomes:

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

Duration: 01:00 hrs
Theory - 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	Electrical/ Physics	~3	Semiconductor technology	~3	Semiconductor technology	

Trainer Certification	
Domain Certification	**Platform Certification**

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**

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
Key Learning	Key learning outcome is the statement of what a learner needs to know,

Outcome	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