QUALIFICATION FILE – Standalone NOS

Foundation Program on Nano Science and Technology

☒ Horizontal/Generic ☐ Vertical/Specialization

☒ Upskilling ☐ Dual/Flexi Qualification ☐ For ToT ☐ For ToA

☐General ☐ Multi-skill (MS) ☐ Cross Sectoral (CS) ☒ Future Skills

NCrF/NSQF Level: 6

Submitted By:

Electronics Sector Skills Council of India

Head Office: 155, 2nd Floor, ESC House

Okhla Industrial Area - Phase 3, New Delhi – 110020 Tel: +91 -84477-38-501

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Section 1: Basic Details

<table>
<tr><td>1.</td><td>NOS-Qualification Name</td><td colspan="2">Foundation Program on Nano Science and Technology</td></tr>
<tr><td>2.</td><td>Sector/s</td><td colspan="2">Electronics</td></tr>
<tr><td>3.</td><td>Type of Qualification ☒ New ☐ Revised</td><td>NQR Code & version of the existing /previous qualification: NA</td><td>Qualification Name of the existing/previous version:NA</td></tr>
<tr><td>4.</td><td>National Qualification Register (NQR) Code & Version (Will be issued after NSQC approval.)</td><td>NG-06-EH-00197-2023-V1-ESSC & V1.0</td><td>5. NCrF/NSQF Level:6</td></tr>
<tr><td>6.</td><td>Brief Description of the Standalone NOS</td><td colspan="2">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.</td></tr>
<tr><td>7.</td><td>Eligibility Criteria for Entry for a Student/Trainee/Learner/Employee</td><td colspan="2">a. Entry Qualification & Relevant Experience:
<table>
<tr><th>S. No.</th><th>Academic/Skill Qualification (with Specialization - if applicable)</th><th>Relevant Experience (with Specialization - if applicable)</th></tr>
<tr><td>1</td><td>Pursuing 4th year of UG – Engineering in the relevant field</td><td>NA</td></tr>
<tr><td>2</td><td>Pursuing first year of M.Sc in the relevant field</td><td>NA</td></tr>
</table>
b. Age <Please specify age only in case of any legal restrictions>: 21+</td></tr>
<tr><td>8.</td><td>Credits Assigned to this NOS-Qualification, Subject to Assessment (as per National Credit Framework (NCrF))</td><td>2</td><td>9. Common Cost Norm Category (I/II/III) (wherever applicable): I</td></tr>
<tr><td>10.</td><td>Any Licensing Requirements for Undertaking Training on This Qualification (wherever applicable)</td><td colspan="2">NA</td></tr>
<tr><td>11.</td><td>Training Duration by Modes of Training Delivery (Specify Total Duration as per selected training delivery modes and as per requirement of the qualification)</td><td colspan="2">☐ Offline Only ☒ Online Only ☐ Blended
<table>
<tr><th>Training Delivery Mode</th><th>Theory (Hours)</th><th>Practical (Hours)</th><th>Total (Hours)</th></tr>
<tr><td>Classroom (offline)</td><td></td><td></td><td></td></tr>
<tr><td>Online</td><td>60</td><td>0</td><td>60</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>12.</td><td>Assessment Criteria</td><td colspan="2"><table><tr><th>Theory Marks</th><th>Practical Marks</th><th>Project (Marks)</th><th>Viva (Marks)</th><th>Total (Marks)</th><th>Passing %age</th></tr><tr><td>100</td><td></td><td></td><td></td><td>100</td><td>70</td></tr></table></td></tr>
<tr><td>13.</td><td>Is the NOS Amenable to Persons with Disability</td><td colspan="2">☐ Yes ☒ No If “Yes”, specify applicable type of Disability:</td></tr>
<tr><td>14.</td><td>Progression Path After Attaining the Qualification, wherever applicable (Please show Professional and Academic progression)</td><td colspan="2">Advanced Program on Nano Science and Technology</td></tr>
<tr><td>15.</td><td>How participation of women will be encouraged?</td><td colspan="2">Through higher academic institutions</td></tr>
<tr><td>16.</td><td>Other Indian languages in which the Qualification & Model Curriculum are being submitted</td><td colspan="2">NA</td></tr>
<tr><td>17.</td><td>Is similar NOS available on NQR-if yes, justification for this qualification</td><td colspan="2">☐ Yes ☒ No URLs of similar Qualifications:</td></tr>
<tr><td>18.</td><td>Name and Contact Details Submitting / Awarding Body SPOC
(In case of CS or MS, provide details of both Lead AB & Supporting ABs)</td><td colspan="2">Name: Dr. Abhilasha Gaur
Email: ceo@essc-india.org
Contact No.: +91 -84477-38-501
Website: www.essc-india.org</td></tr>
<tr><td>19.</td><td>Final Approval Date by NSQC: 28.02.2023</td><td>20. Validity Duration:
27.02.2026</td><td>21. Next Review Date:
27.02.2026</td></tr>
</table>

Section 2: Training Related

1.	**Trainer’s Qualification and experience in the relevant sector (in years)** *(as per NCVET guidelines)*	Minimum Doctorate with 3 years of experience
2.	**Master Trainer’s Qualification and experience in the relevant sector (in years)** *(as per NCVET guidelines)*	Minimum Doctorate with 7 years of experience
3.	**Tools and Equipment Required for the Training**	☐Yes ☒No *(If “Yes”, details to be provided in Annexure)*
4.	**In Case of Revised NOS, details of Any Upskilling Required for Trainer**	NA

Section 3: Assessment Related

1.	**Assessor's Qualification and experience in relevant sector (in years)** *(as per NCVET guidelines)*	Minimum Doctorate with 3 years of experience
2.	**Proctor's Qualification and experience in relevant sector (in years)** *(as per NCVET guidelines), (wherever applicable)*	Minimum Doctorate with 7 years of experience
3.	**Lead Assessor's/Proctor's Qualification and experience in relevant sector (in years)** *(as per NCVET guidelines)*	Minimum Doctorate with 7 years of experience
4.	**Assessment Mode** *(Specify the assessment mode)*	Blended
5.	**Tools and Equipment Required for Assessment**	☒ Same as for training ☐ Yes ☐ No *(details to be provided in Annexure-if it is different for Assessment)*

Section 4: Evidence of the Need for the Standalone NOS

Provide Annexure/Supporting documents name.

1.	Government /Industry initiatives/ requirement (Yes/No): Yes (Indian Nanoelectronics Users' Programme INUP by MeitY)
2.	Number of Industry validation provided: *2*
3.	Estimated number of people to be trained: *2500*
4.	Evidence of Concurrence/Consultation with Line/State Departments (In case of regulated sectors): (Yes/No): *In Progress* If "No", why:

Section 5: Annexure & Supporting Documents Check List

Specify Annexure Name / Supporting document file name

1.	**Annexure:** NCrF/NSQF level justification based on NCrF/NSQF descriptors *(Mandatory)*	IISc Bangalore, IIT Bombay and IIT Guwahati, IIT Madras, IIT Delhi and IIT Kharagpur are involved in this along with MeitY
2.	**Annexure:** List of tools and equipment relevant for NOS *(Mandatory, except in case of online course)*	NA
3.	**Annexure:** Performance and Assessment Criteria *(Mandatory)*	*Available*
4.	**Annexure:** Assessment Strategy *(Mandatory)*	*Available*

5.	**Annexure:** Blended Learning *(Mandatory, in case selected Mode of delivery is Blended Learning)*	*Available*
6.	**Annexure:** Acronym and Glossary *(Optional)*	
7.	**Annexure/Supporting Document:** Standalone NOS-Performance Criteria Details Annexure/Document with PC-wise detailing as per NOS format (Mandatory-Public view)	*Available*
8.	**Supporting Document:** Model Curriculum *(Mandatory – Public view)*	*Available*

Annexure: Evidence of Level

NCrF/NSQF Level Descriptors	Key requirements of the job role/ outcome of the qualification	How the job role/ outcomes relate to the NCrF/NSQF level descriptor	NCrF/NSQF Level
Professional Theoretical Knowledge/Process	• Knowledge of the nano – technology • Knowledge of company's policy on turnaround time, working hours Achieving productivity, quality and safety standards as per company's policy	The individual at work Planning, Design & Installation modules and sub parts together that form the electronic system of the product.	6
Professional and Technical Skills/ Expertise/ Professional Knowledge	A range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study. • Communicate with the team to understand the work requirement Complete the documentation	A Professional must be able to tackle all the issues related to Nano science and technology	6
Employment Readiness & Entrepreneurship	Reasonably good in: • Various processes in nanotechnology/nanoelectronics	A professional must have knowledge of various procedures related to nano technology	6

Skills & Mind-set/Professional Skill	Overview of ongoing research activities at nanocentres		
Broad Learning Outcomes/Core Skill	Will become professional in: Photovoltaics, Sensors, Quantum Compution etc.	Basic concepts/ understanding of nanotechnology/nanoelectronics/semiconductor Technology	6
Responsibility	Responsibility of completing the work assigned and reporting the same as per standards. • Understand the job role and follow the organisational policy • Follow safety regulations at work place Work and interact effectively with colleagues and superiors	Basic concepts/ understanding of nanotechnology/nanoelectronics/semiconductor Technology	6

Annexure: Tools and Equipment (lab set-up)

List of Tools and Equipment: NA

Batch Size:

S. No.	Tool / Equipment Name	Specification	Quantity for specified Batch size

Classroom Aids

The aids required to conduct sessions in the classroom are:

1. White Board
2. Marker
3. Projector
4. Laptop
5. PPT Presentation

Annexure: Industry Validations Summary

S. No	Organization Name	Representative Name	Designation	Contact Address	Contact Phone No	E-mail ID	Linked In Profile *(if available)*
1	Applied Materials	Dr. Ashwini Agrawal	Director	Applied Materials	9910555970	Ashwini_Aggarwal@amat.com	
2	Elbrus Labs	Sh. Hemant Vats	Founder	Elbrus Labs	9911836467	vats.hemant@elbruslabs.com	

Annexure: Training Details

Training Projections:

Year	Estimated Training # of Total Candidates	Estimated training # of Women	Estimated training # of People with Disability
1	400	100	NA
2	800	200	NA
3	800	200	NA

Data to be provided year-wise for next 3 years.

Annexure: Blended Learning

Blended Learning Estimated Ratio & Recommended Tools:

Refer NCVET "Guidelines for Blended Learning for Vocational Education, Training & Skilling" available on:
https://ncvet.gov.in/sites/default/files/Guidelines%20for%20Blended%20Learning%20for%20Vocational%20Education,%20Training%20&%20Skilling.pdf

S. No.	Select the Components of the NOS	List Recommended Tools – for all Selected Components	Offline: Online Ratio
1	☒Theory/ Lectures - Imparting theoretical and conceptual knowledge	Laptop/ Desktop/ White Board	
2	☐Imparting Soft Skills, Life Skills and Employability Skills /Mentorship to Learners	NA	
3	☐Showing Practical Demonstrations to the learners	NA	
4	☐Imparting Practical Hands-on Skills/ Lab Work/ workshop/ shop floor training	NA	
5	☐Tutorials/ Assignments/ Drill/ Practice	NA	
6	☒Proctored Monitoring/ Assessment/ Evaluation/ Examinations	Classroom/ Blended	
7	☐On the Job Training (OJT)/ Project Work Internship/ Candidate Training	NA	

Annexure: Standalone NOS- Performance Criteria details

1. **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.

2. **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

3. **Elements and Performance Criteria**

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

   General:

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:
PC17. Packaging Application
PC18. 3D Integration

Thin Film Deposition:
PC19. Device Physics
PC20. VLSI Technology
PC21. Semiconductor Physics

Characterization:
PC22. Electrical Characterization
PC23. Metrology
PC24. Materials Technologies for Computer Memories
PC25. Surface Structuring and Biomimetics

Safety:
PC26. Introduction to Safety

Lithography:
PC27. Introduction to Lithography

4. **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.

5. 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

Annexure: Assessment Criteria

Detailed PC-wise assessment criteria and assessment marks for the NOS are as follows:

S. No.	Assessment Criteria for Performance Criteria	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	-	-	-
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	-	-	-
Total Marks		**100**			

Annexure: Assessment Strategy

This section includes the processes involved in identifying, gathering, and interpreting information to evaluate the Candidate on the required competencies of the program.

1. Assessment System Overview:

- Batches assigned to the assessment agencies for conducting the assessment on 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:

- Check the Assessment location, date and time
- 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.

3. Assessment Quality Assurance levels/Framework:

- Question bank is created by the Subject Matter Experts (SME) are verified by the other SME
- Questions are mapped to the specified assessment criteria
- Assessor must be ToA certified & trainer must be ToT Certified

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

5. Method of verification or validation:

- Surprise visit to the assessment location

6. Method for assessment documentation, archiving, and access

- Hard copies of the documents are stored

Annexure: Acronym and Glossary

Acronym

Acronym	Description
AA	Assessment Agency
AB	Awarding Body
NCrF	National Credit Framework
NOS	National Occupational Standard(s)
NQR	National Qualification Register
NSQF	National Skills Qualifications Framework

Glossary

Term	Description
National Occupational Standards (NOS)	NOS define the measurable performance outcomes required from an individual engaged in a particular task. They list down what an individual performing that task should know and also do.
Qualification	A formal outcome of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards

Qualification File	A Qualification File is a template designed to capture necessary information of a Qualification from the perspective of NSQF compliance. The Qualification File will be normally submitted by the awarding body for the qualification.
Sector	A grouping of professional activities on the basis of their main economic function, product, service or technology.