

## QUALIFICATION FILE-Standalone NOS

### Fundamentals of Design for Manufacturability (DFM)

- ☐ Horizontal/Generic ☐ Vertical/Specialization
- ☐ Upskilling ☐ Dual/Flexi Qualification ☐ For ToT ☐ For ToA
- ☐ General ☐ Multi-skill (MS) ☐ Cross Sectoral (CS) ☒ Future Skills ☐ OEM

NCrF/NSQF Level: 4.5

Submitted By:

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**Section 1: Basic Details**

| 1.     | <b>NOS-Qualification Name</b>                                                                                                      | <b>Fundamentals of Design for Manufacturability (DFM)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                |        |                                                                    |                                                           |    |                                                                                                                        |    |    |                                                                                                                                    |    |    |                                                                              |    |    |                       |                                     |    |                                                                               |                                     |
|--------|------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|--------|--------------------------------------------------------------------|-----------------------------------------------------------|----|------------------------------------------------------------------------------------------------------------------------|----|----|------------------------------------------------------------------------------------------------------------------------------------|----|----|------------------------------------------------------------------------------|----|----|-----------------------|-------------------------------------|----|-------------------------------------------------------------------------------|-------------------------------------|
| 2.     | <b>Sector</b>                                                                                                                      | <b>Electronics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                |        |                                                                    |                                                           |    |                                                                                                                        |    |    |                                                                                                                                    |    |    |                                                                              |    |    |                       |                                     |    |                                                                               |                                     |
| 3.     | <b>Type of Qualification</b> <input checked="" type="checkbox"/> New <input type="checkbox"/> Revised                              | <b>NQR Code &amp; version of the existing /previous qualification:</b> NA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Qualification Name of the existing/previous version:</b> NA |        |                                                                    |                                                           |    |                                                                                                                        |    |    |                                                                                                                                    |    |    |                                                                              |    |    |                       |                                     |    |                                                                               |                                     |
| 4.     | <b>National Qualification Register (NQR) Code &amp; Version</b>                                                                    | <b>NG-4.5-EH-03734-2025-V1-NIELIT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>5. NCrF/NSQF Level: 4.5</b>                                 |        |                                                                    |                                                           |    |                                                                                                                        |    |    |                                                                                                                                    |    |    |                                                                              |    |    |                       |                                     |    |                                                                               |                                     |
| 6.     | <b>Brief Description of the Standalone NOS</b>                                                                                     | This Standalone NOS provides a comprehensive overview of Design for Manufacturability (DFM). It covers DFM for semiconductor manufacturing and Material Selection and Process Compatibility. It also explores Design for Assembly (DFA) and Tolerance Design and Statistical Process Control (SPC). The course also addresses DFM Implementation and Case Studies including DFM Implementation in Semiconductor and Electronics Industries.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                |        |                                                                    |                                                           |    |                                                                                                                        |    |    |                                                                                                                                    |    |    |                                                                              |    |    |                       |                                     |    |                                                                               |                                     |
| 7.     | <b>Eligibility Criteria for Entry for a Student/Trainee/Learner/Employee</b>                                                       | <b>a. Entry Qualification &amp; Relevant Experience:</b> <table border="1"> <thead> <tr> <th>S. No.</th> <th>Academic/Skill Qualification (with Specialization - if applicable)</th> <th>Required Experience (with Specialization - if applicable)</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>3-Years Diploma in Electronics and Communication Engineering/ Electrical Engineering/ allied branches after class 10th</td> <td>NA</td> </tr> <tr> <td>2.</td> <td>3rd year of 3-Years Diploma in Electronics and Communication Engineering/ Electrical Engineering/ allied branches after class 10th</td> <td>NA</td> </tr> <tr> <td>3.</td> <td>1<sup>st</sup> year of UG in Electronics Engineering/Physics/ allied fields</td> <td>NA</td> </tr> <tr> <td>4.</td> <td>12<sup>th</sup> Pass</td> <td>1.5-year experience in ESDM Sector.</td> </tr> <tr> <td>5.</td> <td>10<sup>th</sup> pass plus 2-year NTC in relevant field of Electronics Sector</td> <td>1.5-year experience in ESDM Sector.</td> </tr> </tbody> </table> |                                                                | S. No. | Academic/Skill Qualification (with Specialization - if applicable) | Required Experience (with Specialization - if applicable) | 1. | 3-Years Diploma in Electronics and Communication Engineering/ Electrical Engineering/ allied branches after class 10th | NA | 2. | 3rd year of 3-Years Diploma in Electronics and Communication Engineering/ Electrical Engineering/ allied branches after class 10th | NA | 3. | 1 <sup>st</sup> year of UG in Electronics Engineering/Physics/ allied fields | NA | 4. | 12 <sup>th</sup> Pass | 1.5-year experience in ESDM Sector. | 5. | 10 <sup>th</sup> pass plus 2-year NTC in relevant field of Electronics Sector | 1.5-year experience in ESDM Sector. |
| S. No. | Academic/Skill Qualification (with Specialization - if applicable)                                                                 | Required Experience (with Specialization - if applicable)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                |        |                                                                    |                                                           |    |                                                                                                                        |    |    |                                                                                                                                    |    |    |                                                                              |    |    |                       |                                     |    |                                                                               |                                     |
| 1.     | 3-Years Diploma in Electronics and Communication Engineering/ Electrical Engineering/ allied branches after class 10th             | NA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                |        |                                                                    |                                                           |    |                                                                                                                        |    |    |                                                                                                                                    |    |    |                                                                              |    |    |                       |                                     |    |                                                                               |                                     |
| 2.     | 3rd year of 3-Years Diploma in Electronics and Communication Engineering/ Electrical Engineering/ allied branches after class 10th | NA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                |        |                                                                    |                                                           |    |                                                                                                                        |    |    |                                                                                                                                    |    |    |                                                                              |    |    |                       |                                     |    |                                                                               |                                     |
| 3.     | 1 <sup>st</sup> year of UG in Electronics Engineering/Physics/ allied fields                                                       | NA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                |        |                                                                    |                                                           |    |                                                                                                                        |    |    |                                                                                                                                    |    |    |                                                                              |    |    |                       |                                     |    |                                                                               |                                     |
| 4.     | 12 <sup>th</sup> Pass                                                                                                              | 1.5-year experience in ESDM Sector.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                |        |                                                                    |                                                           |    |                                                                                                                        |    |    |                                                                                                                                    |    |    |                                                                              |    |    |                       |                                     |    |                                                                               |                                     |
| 5.     | 10 <sup>th</sup> pass plus 2-year NTC in relevant field of Electronics Sector                                                      | 1.5-year experience in ESDM Sector.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                |        |                                                                    |                                                           |    |                                                                                                                        |    |    |                                                                                                                                    |    |    |                                                                              |    |    |                       |                                     |    |                                                                               |                                     |

| 8.                      | <b>Credits Assigned to this NOS-Qualification, Subject to Assessment</b> (as per National Credit Framework (NCrF))                                                         | 1 Credit                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>9. Common Cost Norm Category (I/II/III) (wherever applicable):</b><br>Category-I |               |              |                         |                   |                   |               |                     |              |     |    |    |    |     |    |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------|--------------|-------------------------|-------------------|-------------------|---------------|---------------------|--------------|-----|----|----|----|-----|----|
| 10.                     | <b>Any Licensing Requirements for Undertaking Training on This Qualification</b> (wherever applicable)                                                                     | NA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                     |               |              |                         |                   |                   |               |                     |              |     |    |    |    |     |    |
| 11.                     | <b>Training Duration by Modes of Training Delivery</b> (Specify <b>Total Duration</b> as per selected training delivery modes and as per requirement of the qualification) | <input checked="" type="checkbox"/> Offline <input type="checkbox"/> Online <input type="checkbox"/> Blended<br><table border="1"> <thead> <tr> <th>Training Delivery Modes</th><th>Theory (Hours)</th><th>Practical (Hours)</th><th>Total (Hours)</th></tr> </thead> <tbody> <tr> <td>Classroom (offline)</td><td>12</td><td>18</td><td>30</td></tr> </tbody> </table>                                                                                                            |                                                                                     |               |              | Training Delivery Modes | Theory (Hours)    | Practical (Hours) | Total (Hours) | Classroom (offline) | 12           | 18  | 30 |    |    |     |    |
| Training Delivery Modes | Theory (Hours)                                                                                                                                                             | Practical (Hours)                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Total (Hours)                                                                       |               |              |                         |                   |                   |               |                     |              |     |    |    |    |     |    |
| Classroom (offline)     | 12                                                                                                                                                                         | 18                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 30                                                                                  |               |              |                         |                   |                   |               |                     |              |     |    |    |    |     |    |
| 12.                     | <b>Assessment Criteria</b>                                                                                                                                                 | <table border="1"> <thead> <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> </thead> <tbody> <tr> <td>100</td><td>60</td><td>20</td><td>20</td><td>200</td><td>50</td></tr> </tbody> </table> <p>The centralized online assessment is conducted by the Examination Wing, NIELIT Headquarters.</p> <p>*Assessment strategy shall be as per NIELIT Norms prevailing at times.</p> |                                                                                     |               |              | Theory (Marks)          | Practical (Marks) | Project (Marks)   | Viva (Marks)  | Total (Marks)       | Passing %age | 100 | 60 | 20 | 20 | 200 | 50 |
| Theory (Marks)          | Practical (Marks)                                                                                                                                                          | Project (Marks)                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Viva (Marks)                                                                        | Total (Marks) | Passing %age |                         |                   |                   |               |                     |              |     |    |    |    |     |    |
| 100                     | 60                                                                                                                                                                         | 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 20                                                                                  | 200           | 50           |                         |                   |                   |               |                     |              |     |    |    |    |     |    |
| 13.                     | <b>Is the NOS Amenable to Persons with Disability</b>                                                                                                                      | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No<br>Leprosy Cured Person, Dwarfism, Thalassemia, Hemophilia, Hearing Impairment (Hard of Hearing), Acid Attack Victims.                                                                                                                                                                                                                                                                                         |                                                                                     |               |              |                         |                   |                   |               |                     |              |     |    |    |    |     |    |
| 14.                     | <b>Progression Path After Attaining the Qualification, wherever applicable</b> (Please show Professional and Academic progression)                                         | MEMS Backend Fabrication Engineer -> Semiconductor Fabrication Engineer                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                     |               |              |                         |                   |                   |               |                     |              |     |    |    |    |     |    |
| 15.                     | <b>How participation of women will be encouraged?</b>                                                                                                                      | Participation by women can be ensured through Government Schemes. Occasionally, exclusive batches for women would be run for the proposed courses. Funding is available for women's participation under other schemes launched by the Government from time to time.                                                                                                                                                                                                                |                                                                                     |               |              |                         |                   |                   |               |                     |              |     |    |    |    |     |    |
| 16.                     | <b>Other Indian languages in which the Qualification &amp; Model Curriculum are being submitted</b>                                                                        | Qualification file is available in English and Hindi languages.                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                     |               |              |                         |                   |                   |               |                     |              |     |    |    |    |     |    |
| 17.                     | <b>Is similar NOS available on NQR-if yes, justification for this qualification</b>                                                                                        | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No   URLs of similar Qualifications:                                                                                                                                                                                                                                                                                                                                                                              |                                                                                     |               |              |                         |                   |                   |               |                     |              |     |    |    |    |     |    |

|     |                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18. | <b>Name and Contact Details Submitting / Awarding Body SPOC</b><br><i>(In case of CS or MS, provide details of both Lead AB &amp; Supporting ABs)</i> | <p> <b>Name:</b> Sh. Saurabh Kesari<br/> <b>Email:</b> saurabhk@nielit.gov.in<br/> <b>Contact No.:</b> 0240-2982021<br/> <b>Website:</b> <a href="https://www.nielit.gov.in">https://www.nielit.gov.in</a> </p> <p> <b>Name:</b> Sh. Shashank Kumar Singh<br/> <b>Email:</b> shashank@nielit.gov.in<br/> <b>Contact No.:</b> 0240-2982021<br/> <b>Website:</b> <a href="https://www.nielit.gov.in">https://www.nielit.gov.in</a> </p> <p> <b>Name:</b> Sh. Ravi Ranjan Kumar<br/> <b>Email:</b> raviranjana@nielit.gov.in<br/> <b>Contact No.:</b> 0240-2982021<br/> <b>Website:</b> <a href="https://www.nielit.gov.in">https://www.nielit.gov.in</a> </p> |
| 19. | Final Approval Date by NSQC: 18.02.2025                                                                                                               | <div data-bbox="994 668 1532 738">20. Validity Duration: 3 Years</div> <div data-bbox="1532 668 2101 738">21. Next Review Date: 18.02.2028</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

### Section 2: Training Related

|    |                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----|------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. | <b>Trainer's Qualification and experience in the relevant sector (in years) (as per NCVET guidelines)</b>        | <p>B.E./B. Tech in Electronics/ Electronics &amp; Communication/ Electrical/ Electrical and Electronics/Instrumentation/ Electronics &amp; Instrumentation / Instrumentation &amp; Control and allied branches with 2 years of relevant experience in the field of Semiconductor Manufacturing / Semiconductor Fabrication and Packaging/VLSI Design.</p> <p>Or</p> <p>M.Sc. in Physics/Electronics/Material Science and allied branches; with 2 years of relevant experience in the field of Semiconductor Manufacturing / Semiconductor Fabrication and Packaging/VLSI Design.</p> |
| 2. | <b>Master Trainer's Qualification and experience in the relevant sector (in years) (as per NCVET guidelines)</b> | <p>B.E./B. Tech in Electronics/ Electronics &amp; Communication/ Electrical/ Electrical and Electronics/Instrumentation/ Electronics &amp; Instrumentation / Instrumentation &amp; Control and allied branches with 3 years of relevant experience in the field of Semiconductor Manufacturing / Semiconductor Fabrication and Packaging/VLSI Design.</p> <p>Or</p> <p>M.Sc. in Physics/Electronics/Material Science and allied branches; with 3 years of relevant experience in the field of Semiconductor Manufacturing / Semiconductor Fabrication and</p>                        |

|    |                                                                                         |                                                                                                 |
|----|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
|    |                                                                                         | Packaging/VLSI Design.                                                                          |
| 3. | <b>Tools and Equipment Required for Training</b>                                        | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No<br>Available at Annexure-II |
| 4. | <b>In Case of Revised Qualification, Details of Any Upskilling Required for Trainer</b> | NA                                                                                              |

### Section 3: Assessment Related

|    |                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. | <b>Assessor's Qualification and experience in relevant sector (in years) (as per NCVET guidelines)</b>                | B.E./B. Tech in Electronics/ Electronics & Communication/ Electrical/ Electrical and Electronics/Instrumentation/ Electronics & Instrumentation / Instrumentation & Control and allied branches with 3 years of relevant experience in the field of Semiconductor Manufacturing / Semiconductor Fabrication and Packaging/VLSI Design.<br>Or<br>M.Sc. in Physics/Electronics/Material Science and allied branches 3 years of relevant experience in the field of Semiconductor Manufacturing / Semiconductor Fabrication and Packaging/VLSI Design.                                                                                                                                  |
| 2. | <b>Proctor's Qualification and experience in relevant sector (in years) (as per NCVET guidelines)</b>                 | The assessor carries out theory online assessments through the remote proctoring methodology. Theory examination would be conducted online, and the paper comprise of MCQ. Conduct of assessment is through trained proctors. Once the test begins, remote proctors have full access to the candidate's video feeds and computer screens. Proctors authenticate the candidate based on registration details, pre-test image captured and I- card in possession of the candidate. Proctors can chat with candidates or give warnings to candidates. Proctors can also take screenshots, terminate a specific user's test session, or re-authenticate candidates based on video feeds. |
| 3. | <b>Lead Assessor's/Proctor's Qualification and experience in relevant sector (in years) (as per NCVET guidelines)</b> | External Examiners/ Observers (Subject matter experts) are deployed including NIELIT scientific officers who are subject experts for evaluation of Practical examination/ internal assessment / Project/Presentation/ assignment and Major Project (if applicable). Qualification is generally B.Tech.                                                                                                                                                                                                                                                                                                                                                                               |
| 4. | <b>Assessment Mode (Specify the assessment mode)</b>                                                                  | Centralized online examination will be conducted                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 5. | <b>Tools and Equipment Required for Assessment</b>                                                                    | <input checked="" type="checkbox"/> Same as for training <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (details to be provided in Annexure-if it is different for Assessment)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

#### Section 4: Evidence of the Need for the Standalone NOS

|    |                                                                                                                                                                                                                                                        |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. | Government /Industry initiatives/ requirement (Yes/No): Yes                                                                                                                                                                                            |
| 2. | Number of Industry validation provided: The course has been developed in collaboration with TATA Electronics to support the development of skilled manpower for the upcoming semiconductor industry.                                                   |
| 3. | Estimated number of people to be trained: 500                                                                                                                                                                                                          |
| 4. | Evidence of Concurrence/Consultation with Line/State Departments (In case of regulated sectors): NIELIT is recognized as AB and AA under Government Category. NIELIT is an HRD arm of MeitY, therefore, the Line Ministry Concurrence is not required. |

#### Section 5: Annexure & Supporting Documents Check List

*Specify Annexure Name / Supporting document file name*

|    |                                                                                                                                                                          |                                                                        |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| 1. | <b>Annexure:</b> NCrf/NSQF level justification based on NCrf level/NSQF descriptors ( <i>Mandatory</i> )                                                                 | Available at Annexure-I: Evidence of Level                             |
| 2. | <b>Annexure:</b> List of tools and equipment relevant for qualification ( <i>Mandatory, except in case of online course</i> )                                            | Available at Annexure-II: Tools and Equipment                          |
| 3. | <b>Annexure:</b> Industry Validation                                                                                                                                     | Available at Annexure-III: Industry Validation                         |
| 4. | <b>Annexure:</b> Training Details                                                                                                                                        | Available at Annexure-IV: Training Details                             |
| 5. | <b>Annexure:</b> Blended Learning ( <i>Mandatory, in case selected Mode of delivery is "Blended Learning"</i> )                                                          | Available at Annexure-V: Blended Learning                              |
| 6. | <b>Annexure/Supporting Document:</b> Standalone NOS- Performance Criteria Details<br>Annexure/Document with PC-wise detailing as per NOS format (Mandatory- Public view) | Available at Annexure-VI: Standalone NOS- Performance Criteria details |
| 7. | <b>Annexure:</b> Detailed Assessment Criteria ( <i>Mandatory</i> )                                                                                                       | Available at Annexure-VII: Assessment Criteria                         |
| 8. | <b>Annexure:</b> Assessment Strategy ( <i>Mandatory</i> )                                                                                                                | Available at Annexure-VIII: Assessment Strategy                        |

|     |                                                                                 |                                                |
|-----|---------------------------------------------------------------------------------|------------------------------------------------|
| 9.  | <b>Annexure:</b> Acronym and Glossary ( <i>Optional</i> )                       | Available at Annexure-IX: Acronym and Glossary |
| 10. | <b>Supporting Document:</b> Model Curriculum ( <i>Mandatory – Public view</i> ) | Available at Annexure-A: Model Curriculum      |

**Annexure I: 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 |
|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-----------------|
| <b>Professional Theoretical Knowledge/Process</b>                                           | Understanding of DFM principles, semiconductor manufacturing processes, material selection, and quality assurance (tolerances, SPC).                     | Provides foundational knowledge for optimizing semiconductor design and ensuring process compatibility.   | 4.5             |
| <b>Professional and Technical Skills/ Expertise/ Professional Knowledge</b>                 | Proficiency in DFM tools (e.g., EDA software), DFA techniques, material evaluation, and SPC implementation for process optimization.                     | Equips learners with technical skills to analyze and enhance semiconductor designs and manufacturing.     | 4.5             |
| <b>Employment Readiness &amp; Entrepreneurship Skills &amp; Mind-set/Professional Skill</b> | Prepared for roles like DFM Engineer or Layout Analyst; skilled in problem-solving, teamwork, and technical communication.                               | Aligns job readiness and entrepreneurial mindset with industry requirements and collaborative practices.  | 4.5             |
| <b>Broad Learning Outcomes/Core Skill and Responsibility</b>                                | Accountability for resolving manufacturability issues, optimizing designs, and ensuring yield and quality through collaboration and technical expertise. | Prepares learners to take ownership of critical tasks in design and manufacturing with measurable impact. | 4.5             |

**Annexure II: Tools and Equipment (Lab Set-Up)**

| Sl. No | Description           | Qty. | Specifications |
|--------|-----------------------|------|----------------|
| 1      | Classroom             | 1    | 30 Sq. m       |
| 2      | Student Chair         | 30   | -              |
| 3      | Student Table         | 30   | -              |
| 4      | LCD Projector         | 1    | -              |
| 5      | Trainer Chair & Table | 1    | -              |
| 6      | Pin up Board          | 1    | -              |
| 7      | White Board           | 1    | -              |

|   |                                   |    |                                                                                                              |
|---|-----------------------------------|----|--------------------------------------------------------------------------------------------------------------|
| 8 | Desktop Computer with accessories | 30 | Processor: Intel Core i5 (sixth generation newer) or equivalent<br>Memory: 16GB RAM, Internal Storage: 500GB |
| 9 | Desk jet printer                  | 1  | A4                                                                                                           |

#### List of Tools and Equipment:

##### DFM Tools and Software

- Computer-Aided Design (CAD) Software (e.g., AutoCAD, SolidWorks)
- DFM Analysis Tools (e.g., Mentor Graphics Calibre, ANSYS, Synopsys)
- Statistical Process Control (SPC) Software

##### Semiconductor and Electronics Manufacturing Tools

- Lithography Equipment (Spin Coaters, Mask Aligners)
- Metrology Tools (Profilometer, Ellipsometer)
- Assembly Tools (Jigs, Fixtures)

##### Material Selection and Testing Tools

- Material Property Testing Equipment (Hardness Testers, Tensile Testers)
- Microscopes for Surface and Material Analysis

##### Quality Control Tools

- Tolerance Analysis Tools
- Measurement Devices (Calipers, Micrometers)
- Statistical Analysis Tools (MATLAB, Python with NumPy, Pandas)

##### General Equipment

- Desktop Computers with Design and Analysis Software
- Projectors and Whiteboards for Presentations

##### Consumables

- Test Materials and Samples for Analysis
- Process Simulation Materials (Mock Layouts, Test Wafers)

#### Annexure III: Industry Validations Summary

The course has been developed in collaboration with TATA Electronics to support the development of skilled manpower for the upcoming semiconductor industry.

**Annexure IV: Training & Employment Details****Training Projections:**

| Year    | Estimated Training # of Total Candidates | Estimated training # of Women | Estimated training # of People with Disability |
|---------|------------------------------------------|-------------------------------|------------------------------------------------|
| 2025-26 | 100                                      | 50                            | 10                                             |
| 2026-27 | 200                                      | 70                            | 15                                             |
| 2027-28 | 200                                      | 70                            | 15                                             |

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

**Annexure V: Blended Learning**

**Blended Learning Estimated Ratio & Recommended Tools: NA**

**Annexure VI: Standalone NOS - Performance Criteria details****1. Description:**

This course provides a comprehensive understanding of Design for Manufacturability (DFM) with a focus on semiconductor and electronics manufacturing. It covers key topics including DFM principles, material selection, design for assembly, tolerance analysis, and process control. Through practical tools, analysis techniques, and real-world case studies, learners will gain skills to optimize product designs for efficient, cost-effective manufacturing.

**2. Scope:**

The scope covers the following:

- Equip learners with the knowledge and tools to optimize semiconductor designs for improved manufacturability, yield, and cost efficiency.
- Develop technical skills in using DFM software, material selection, and process compatibility analysis for semiconductor manufacturing.
- Prepare individuals for roles in design and manufacturing teams, ensuring seamless integration of design and production workflows.

### 3. Elements and Performance Criteria

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

| Elements                                                      | Performance Criteria                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Introduction to Design for Manufacturability (DFM)</b>     | <p><b>PC1:</b> Demonstrate understanding of DFM principles by explaining their importance, benefits, and role in simplifying and optimizing product designs.</p> <p><b>PC2:</b> Analyze product designs for manufacturability using basic DFM tools, identifying potential issues and proposing suitable improvements</p>                                            |
| <b>DFM for Semiconductor Manufacturing</b>                    | <p><b>PC3:</b> Identify and address key manufacturability challenges in semiconductor design, including lithography constraints, mask design, and feature size limitations.</p> <p><b>PC4:</b> Optimize semiconductor layouts to improve yield, reliability, and cost-effectiveness using DFM best practices and analysis tools.</p>                                 |
| <b>Material Selection and Process Compatibility</b>           | <p><b>PC5:</b> Evaluate and select appropriate materials based on their compatibility with semiconductor manufacturing processes, considering cost, performance, and manufacturability trade-offs.</p> <p><b>PC6:</b> Analyze the impact of material properties on production efficiency and product reliability through case studies and practical assessments.</p> |
| <b>Design for Assembly (DFA)</b>                              | <p><b>PC7:</b> Simplify product designs by reducing part count and optimizing assembly processes to enhance efficiency and minimize costs.</p> <p><b>PC8:</b> Incorporate DFA principles to ensure compatibility with automated assembly, focusing on tolerances, jigs, and fixtures for streamlined production.</p>                                                 |
| <b>Tolerance Design and Statistical Process Control (SPC)</b> | <p><b>PC9:</b> Perform tolerance analysis to evaluate and mitigate the impact of tolerance stack-ups on manufacturability and product quality.</p> <p><b>PC10:</b> Apply Statistical Process Control (SPC) techniques to monitor, analyze, and optimize manufacturing processes for improved quality and efficiency.</p>                                             |
| <b>DFM Implementation and Case Studies</b>                    | <p><b>PC11:</b> Demonstrate the implementation of DFM strategies by analyzing and optimizing product designs in collaboration with cross-functional teams.</p> <p><b>PC12:</b> Evaluate real-world case studies to identify successful DFM practices and derive insights for future applications in semiconductor and electronics manufacturing.</p>                 |

#### 4. Knowledge and Understanding (KU):

The individual on the job needs to know and understand:

**KU1:** Understand the integration of design choices with manufacturing processes to improve yield, reduce complexity, and optimize cost and time-to-market.

**KU2:** Learn how to adjust designs to suit semiconductor fabrication processes like photolithography and etching, ensuring manufacturability and reducing defects.

**KU3:** Familiarize with tools like Design Rule Checking (DRC) and Layout vs. Schematic (LVS) to optimize manufacturability early in the design phase.

#### 5. Generic Skills (GS):

The user/individual on the job needs to know how to:

**GS1:** Develop the ability to identify potential manufacturability issues in semiconductor designs and apply critical thinking to find effective solutions, optimizing designs for higher yield and cost efficiency.

**GS2:** Improve their skills in effectively communicating technical information, collaborating with cross-functional teams (e.g., design, manufacturing, and testing), and presenting findings or design optimizations clearly.

**GS3:** Enhance attention to detail, ensuring that every aspect of the semiconductor design process from layout to material selection is carefully considered for manufacturability, quality, and process compatibility.

#### Annexure VII: Assessment Criteria

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

| Elements                                                  | Assessment Criteria for Performance Criteria/Learning Outcomes                                                                                                                                                                                                                                                 | Theory Marks | Practical Marks | Project Marks | Viva Marks |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------|---------------|------------|
| <b>Introduction to Design for Manufacturability (DFM)</b> | <b>PC1:</b> Demonstrate understanding of DFM principles by explaining their importance, benefits, and role in simplifying and optimizing product designs.<br><b>PC2:</b> Analyze product designs for manufacturability using basic DFM tools, identifying potential issues and proposing suitable improvements | <b>16</b>    | <b>10</b>       | -             | -          |
| <b>DFM for</b>                                            | <b>PC3:</b> Identify and address key manufacturability challenges in                                                                                                                                                                                                                                           | <b>16</b>    | <b>10</b>       | -             | -          |

|                                                               |                                                                                                                                                                                                                                                                                                                                                           |            |           |           |           |
|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|-----------|-----------|
| <b>Semiconductor Manufacturing</b>                            | semiconductor design, including lithography constraints, mask design, and feature size limitations.<br><b>PC4:</b> Optimize semiconductor layouts to improve yield, reliability, and cost-effectiveness using DFM best practices and analysis tools.                                                                                                      |            |           |           |           |
| <b>Material Selection and Process Compatibility</b>           | <b>PC5:</b> Evaluate and select appropriate materials based on their compatibility with semiconductor manufacturing processes, considering cost, performance, and manufacturability trade-offs.<br><b>PC6:</b> Analyze the impact of material properties on production efficiency and product reliability through case studies and practical assessments. | <b>17</b>  | <b>10</b> | -         | -         |
| <b>Design for Assembly (DFA)</b>                              | <b>PC7:</b> Simplify product designs by reducing part count and optimizing assembly processes to enhance efficiency and minimize costs.<br><b>PC8:</b> Incorporate DFA principles to ensure compatibility with automated assembly, focusing on tolerances, jigs, and fixtures for streamlined production.                                                 | <b>17</b>  | <b>10</b> | -         | -         |
| <b>Tolerance Design and Statistical Process Control (SPC)</b> | <b>PC9:</b> Perform tolerance analysis to evaluate and mitigate the impact of tolerance stack-ups on manufacturability and product quality.<br><b>PC10:</b> Apply Statistical Process Control (SPC) techniques to monitor, analyze, and optimize manufacturing processes for improved quality and efficiency.                                             | <b>17</b>  | <b>10</b> | -         | -         |
| <b>DFM Implementation and Case Studies</b>                    | <b>PC11:</b> Demonstrate the implementation of DFM strategies by analyzing and optimizing product designs in collaboration with cross-functional teams.<br><b>PC12:</b> Evaluate real-world case studies to identify successful DFM practices and derive insights for future applications in semiconductor and electronics manufacturing.                 | <b>17</b>  | <b>10</b> | -         | -         |
| <b>Project</b>                                                | Including all Elements                                                                                                                                                                                                                                                                                                                                    | -          | -         | <b>20</b> | -         |
| <b>Viva</b>                                                   | Including all Elements                                                                                                                                                                                                                                                                                                                                    | -          | -         | -         | <b>20</b> |
| <b>GRAND TOTAL</b>                                            |                                                                                                                                                                                                                                                                                                                                                           | <b>100</b> | <b>60</b> | <b>20</b> | <b>20</b> |

### **Annexure VIII: 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.

Assessment of the qualification evaluates candidates to ascertain that they can integrate knowledge, skills and values for carrying out relevant tasks as per the defined learning outcomes and assessment criteria.

The underlying principle of assessment is fairness and transparency. The evidence of the outcomes and assessment criteria. Competence acquired by the candidate can be obtained by conducting Theory (Online) examination.

#### **About Examination Pattern:**

1. The question papers for the theory exams are set by the Examination wing (assessor) of NIELIT HQS.
2. The assessor assigns roll number.
3. The assessor carries out theory online assessments. Theory examination would be conducted online and the paper comprise of MCQ
4. Pass percentage would be 50% marks.
5. The examination will be conducted in English language only.

Quality assurance activities: A pool of questions is created by a subject matter expert and moderated by other SME. Test rules are set beforehand. Random set of questions which are according to syllabus appears which may differ from candidate to candidate. Confidentiality and impartiality are maintained during all the examination and evaluation processes.

**Annexure-IX: Acronym and Glossary****Acronym**

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

**Glossary**

| <b>Term</b>                                  | <b>Description</b>                                                                                                                                                                                                                     |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>National Occupational Standards (NOS)</b> | 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.                                               |
| <b>Qualification</b>                         | 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                                                       |
| <b>Qualification File</b>                    | 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. |
| <b>Sector</b>                                | A grouping of professional activities on the basis of their main economic function, product, service or technology.                                                                                                                    |