**QUALIFICATION FILE–Standalone NOS**

# Essentials of AI for Embedded Application

☐ 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: 5**

**Submitted By:**

**NATIONAL INSTITUTE OF ELECTRONICS AND INFORMATION TECHNOLOGY (NIELIT)**

**NIELIT Bhawan, Plot No. 3, PSP Pocket, Sector-8,**
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## Table of Contents

## Section 1: Basic Details

<table>
<tr><td>1.</td><td>NOS-Qualification Name</td><td colspan="2">Essentials of AI for Embedded Application</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</td><td>NG-05-EH-02897-2024-V1-NIELIT</td><td>5. NCrF/NSQF Level: 5</td></tr>
<tr><td>6.</td><td>Brief Description of the Standalone NOS</td><td colspan="2">This NOS provides a comprehensive understanding of Artificial Intelligence (AI) and its applications in embedded systems. It covers a wide range of topics related to implementing AI on embedded devices, including machine learning fundamentals, neural networks, edge AI frameworks, hardware considerations, and optimization techniques for deploying AI models on microcontrollers and embedded platforms.</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>2nd year of UG in Electronics and Communication Engineering/ Electrical Engineering/CS/IT/Physics/Electronics and allied branches</td><td>NA</td></tr>
<tr><td>2</td><td>3 Years of Diploma in Electronics and Communication Engineering/ Electrical Engineering/CS/IT/Physics/Electronics and allied branches after class 10th</td><td>1.5 Years</td></tr>
<tr><td>3</td><td>2 Year of diploma in Electronics and Communication Engineering/ Electrical Engineering/CS/IT/Physics/Electronics and allied branches after class 12th</td><td>NA</td></tr>
<tr><td>4</td><td>NSQF Level 4.5 in Electronics and Communication Engineering/ Electrical Engineering/CS/IT/Physics/Electronics and allied branches</td><td>1.5 Years</td></tr>
</table></td></tr>
</table>

<table>
<tr><td></td><td></td><td>
<table>
<tr><td>5</td><td>NSQF Level 4 Electronics and Communication Engineering/ Electrical Engineering/CS/IT/Physics/Electronics and allied branches</td><td>1.5 Years</td></tr>
</table>
b. Age:18 years
</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 Credits</td><td>9. Common Cost Norm Category (I/II/III) (wherever applicable):<br><br>Category I (Electronics System Design)</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 ☐ Online ☐ 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>30</td><td>30</td><td>60</td></tr>
</table>
Training shall be conducted in any of the 3 modes depending on the regional need.<br><br>(Refer Blended Learning Annexure-V for details)</td></tr>
<tr><td>12.</td><td>Assessment Criteria</td><td colspan="2">
<table>
<tr><th>Theory (Marks)</th><th>Practical (Marks)</th><th>Project/ Presentation /Assignment (Marks)</th><th>Viva/ Internal Assessment (Marks)</th><th>Total (Marks)</th><th>Passing %age</th></tr>
<tr><td>100</td><td>60</td><td>20</td><td>20</td><td>200</td><td>50</td></tr>
</table>
The centralized online assessment is conducted by the Examination Wing, NIELIT Headquarters.</td></tr>
<tr><td>13.</td><td>Is the NOS Amenable to Persons with Disability</td><td colspan="2">☒ Yes ☐ No<br>If “Yes”, specify applicable type of Disability:<br><br>a. Locomotor Disability: Leprosy Cured Person, Dwarfism, Muscular Dystrophy and Acid Attack Victims<br>b. Visual Impairment: Low Vision</td></tr>
<tr><td>14.</td><td>Progression Path After Attaining the Qualification, wherever applicable</td><td colspan="2">Embedded Software Engineer</td></tr>
</table>

| | | | |
|---|---|---|---|
| **15.** | **How will the participation of women be encouraged?** | 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.** | **Other Indian languages in which the Qualification & Model Curriculum are being submitted** | Qualification file available in English & Hindi Language. | |
| **17.** | **Is similar NOS available on NQR-if yes, justification for this qualification** | **☐Yes ☒ No** | |
| **18.** | **Name and Contact Details Submitting / Awarding Body SPOC**<br>*(In the case of CS or MS, provide details of both Lead AB & Supporting ABs)* | **Name:** Rajesh M<br>**Email:** rajesh.m@nielit.gov.in<br>**Website:** https://nielit.gov.in/<br>**Name:** Anirban Jyoti Hati<br>**Email:** anirban@nielit.gov.in<br>**Website:** https://nielit.gov.in/<br>**Name:** Ankit Kumar<br>**Email:** ankit@nielit.gov.in<br>**Website:** https://nielit.gov.in/ | |
| **19.** | **Final Approval Date by NSQC: 25.07.2024** | **20. Validity Duration: 3 years** | **21. Next Review Date: 25.07.2027** |

**Section 2: Training Related**

| | | |
|---|---|---|
| 1. | **Trainer's Qualification and experience in the relevant sector (in years) (as per NCVET guidelines)** | B.E./B. Tech in Electronics/ Electronics & Communication/ Electrical/ Electrical and Electronics/Instrumentation/ Electronics & Instrumentation / Instrumentation & Control /Computer Science/Information Technology<br><br>Minimum 2 year of experience in the field of Embedded Systems Design |
| 2. | **Master Trainer's Qualification and experience in the relevant sector (in years) (as per NCVET guidelines)** | B.E./B. Tech in Electronics/ Electronics & Communication/ Electrical/ Electrical and Electronics/Instrumentation/ Electronics & Instrumentation / Instrumentation & Control /Computer Science/Information Technology<br><br>Minimum 3 year of experience in the field of Embedded Systems Design |
| 3. | **Tools and Equipment Required for the Training** | ☒ Yes ☐No<br>Available at Annexure-II |
| 4. | **In Case of Revised NOS, details of Any Upskilling Required for Trainer** | Not Applicable |

**Section 3: Assessment Related**

| | | |
|---|---|---|
| 1. | **Assessor's Qualification and experience in relevant sector (in years)** *(as per NCVET guidelines)* | B.Tech or Equivalent as per NCrF + 3 years relevant experience |
| 2. | **Proctor's Qualification and experience in relevant sector (in years)** *(as per NCVET guidelines), (wherever applicable)* | The assessor carries out theory online assessments through the remote proctoring methodology. Theory examination would be conducted online and the paper comprises 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. | **Lead Assessor's/Proctor's Qualification and experience in relevant sector (in years)** *(as per NCVET guidelines)* | 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. | **Assessment Mode***(Specify the assessment mode)* | Centralized online examination will be conducted |
| 5. | **Tools and Equipment Required for Assessment** | Same as for training ☒ Yes ☐ No |

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

| | |
|---|---|
| 1. | Government /Industry initiatives/ requirement (Yes/No): Yes, Available at Annexure-A: Evidence of Need |
| 2. | Number of Industry validations provided: 8 |
| 3. | Estimated number of people to be trained: 500 persons per year shall be trained. |
| 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. |
| 5. | Latest Skill Gap Study (not older than 2 years) (Yes/No): Yes, Available in Annexure-A: Evidence of Need |
| 6. | Latest Market Research Reports or any other source (not older than 2 years) (Yes/No): Yes, Available at Annexure-A: Evidence of Need |

## 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)* | *Available at* Annexure-I: Evidence of Level |
| 2. | **Annexure:** List of tools and equipment relevant for NOS *(Mandatory, except in case of online course)* | *Available at* Annexure-II: Tools and Equipment |
| 3. | **Annexure: Industry Validation** | *Available at* Annexure-III: Industry Validation |
| 4. | **Annexure: Training Details** | *Available at* Annexure-IV: Training Details |
| 5. | **Annexure:** Blended Learning *(Mandatory, in case the selected Mode of delivery is Blended Learning)* | *Available at* Annexure-V: Blended Learning |
| 6. | **Annexure/Supporting Document:** Standalone NOS-Performance Criteria Details Annexure/Document with PC-wise detailing as per NOS format (Mandatory- Public view) | *Available at* Annexure-VI: Standalone NOS- Performance Criteria details |
| 7. | **Annexure:** Performance and Assessment Criteria *(Mandatory)* | *Available at* Annexure-VII: Detailed Assessment Criteria |

| | | |
|---|---|---|
| 8. | **Annexure:** Assessment Strategy *(Mandatory)* | *Available at* Annexure-VIII: Assessment Strategy |
| 9. | **Annexure:** Acronym and Glossary *(Optional)* | *Available at* Annexure-IX: Acronym and Glossary |
| 10. | **Supporting Document:** Model Curriculum | *Available at* Annexure-C: 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 |
|---|---|---|---|
| **Professional Theoretical Knowledge/Process** | • Proficiency in using embedded AI frameworks such as TensorFlow Lite, PyTorch, ONNX, Caffe2, and others for deploying AI models on edge devices.<br>• Learning through detailed study of documentation, framework-specific tutorials, and practical implementation of AI models on hardware like Edge TPU, NVIDIA Jetson, and ARM CMSIS-NN<br>• Ability to integrate AI models with sensors and optimize their performance for real-time applications on embedded systems. | • Engaging with detailed documentation and tutorials provides a theoretical foundation on how to utilize these frameworks and hardware.<br>• Understanding the architecture, capabilities, and limitations of various embedded AI frameworks is essential.<br>• Gaining a deep understanding of sensor technologies, data preprocessing techniques, and real-time system requirements is crucial. | 5 |
| **Professional and Technical Skills/ Expertise/ Professional Knowledge** | • Ability to create efficient AI models tailored for specific hardware constraints, ensuring optimal performance and resource utilization on embedded devices.<br>• Capability to integrate and leverage various AI accelerators and frameworks, facilitating the deployment of high-performance AI applications on embedded platforms.<br>• Proficiency in designing and implementing AI-enabled features that seamlessly interface with sensors, enabling real-time data processing. | • This outcome requires practical skills in optimizing AI models to fit within the memory, processing power, and energy constraints of embedded devices.<br>• This outcome entails hands-on experience with different AI accelerators like Edge TPU, NVIDIA Jetson, and ARM CMSIS-NN, and understanding how to effectively utilize these accelerators for specific applications.<br>• This outcome requires technical skills in sensor integration, signal processing, and interfacing | 5 |

| | | | |
|---|---|---|---|
| | | AI models with sensor data streams. | |
| **Employment Readiness & Entrepreneurship Skills & Mind-set/Professional Skill** | • Ability to develop, optimize, and deploy AI models specifically tailored for embedded devices, ensuring efficient resource usage and real-time processing capabilities.<br>• Expertise in integrating AI models with embedded systems, including the incorporation of sensor data and real-time data processing for practical applications.<br>• Capability to identify innovative use cases for AI in embedded applications, design AI-enabled features | • This outcome equips individuals with the technical proficiency needed to meet industry demands for AI and embedded systems expertise.<br>• This skill fosters the ability to think creatively and identify new opportunities for AI applications in various fields. | 5 |
| **Broad Learning Outcomes/ Core Skill** | • Proficiency in developing and optimizing machine learning and deep learning models for deployment on embedded systems.<br>• Capability to integrate AI models with embedded systems, utilizing specialized hardware accelerators such as Edge TPU, NVIDIA Jetson, and Intel OpenVINO.<br>• Skills in interfacing sensors with embedded systems, preprocessing sensor data, and ensuring real-time data processing for AI model inputs. | • This proficiency reflects strong analytical and problem-solving skills, essential for understanding and applying complex AI algorithms within the constraints of embedded systems.<br>• This capability demonstrates technical competence and hands-on skills in integrating advanced hardware with software solutions.<br>• This skill highlights practical experience and technical adeptness in managing real-time data and interfacing with physical components. | 5 |
| **Responsibility** | • Design, train, and optimize machine learning and deep learning models specifically for deployment on embedded hardware.<br>• Develop and deploy AI-enabled features by integrating sensors, preprocessing sensor data, and ensuring real-time data processing and interfacing on embedded devices. | • This outcome emphasizes the responsibility of ensuring that AI models are not only effective but also efficient and compatible with the limitations and capabilities of embedded hardware.<br>• This outcome highlights the responsibility for creating end-to-end AI solutions that are robust and functional in real-time applications. | 5 |

## Annexure II: Tools and Equipment (lab set-up)

List of Tools and Equipment: **Batch Size: 30**

| S. No. | Tool / Equipment Name | Specification | Quantity for specified Batch size |
|---|---|---|---|
| 1 | Classroom | 1 (750 Sq. ft to 1000 Sq. ft.) | 30 |
| 2 | Students Chair | 30 | 30 |
| 3 | Students Table | 15 (2 students sharing 1 table) | 15 |
| 4 | Desktop computer with accessories / Laptop | Laptop with minimum specifications: Intel I3 or Celeron processor with at least 8GB RAM, 512GB SSD Hard disk integrated with graphics card, Display size 15.6-inch, Wi-Fi connectivity and Wired Optical Mouse | 15 |
| 5 | Internet Connectivity | Seamless internet connectivity with at least 100 Mbps without firewall | |
| 6 | Development Board & Tools | Embedded development boards, sensors, TensorFlow Lite, PyTorch, ONNX, Caffe2, Edge TPU, NVIDIA Jetson, Intel OpenVINO, Arm CMSIS-NN, Xilinx Vitis AI, and relevant documentation on AI frameworks and embedded systems. | 15 |

Classroom Aids for offline and blended mode of training:

The aids required to conduct sessions in the classroom are:

1. LCD Projector/Smart Board

## Annexure III: Industry Validations/ Government Recognition Summary

| S. No | Organization Name | Representative Name | Designation | Contact Address | Contact Phone No | E-mail ID |
|---|---|---|---|---|---|---|
| 1 | Aajivika Global Skill Private Limited | Mukesh Kumar Verma | Director | Beside Vishal Trade, dasmile chowk, Khunti Road Ranchi, Jharkhand-835221 | 9507952882 | aajivikaglobal@gmail.com |
| 2 | AISECT Ltd. | Teena Panthi | Assistant Manager | AISECT Ltd. 1-1-387, 3rd floor, Flat No. 403/404, GNR Heights, Above SBI,Bakaram Road, Musheerabad, Hydrabad-500020 | 7879982075 | Teena.panthi@aisect.org |
| 3 | B. G. Infotech | Amal Das | Centre Head | Kakdihi, Mecheda, Purba, Medinipur | 9434996748 | Bginfotech2007@gmail.com |
| 4 | Devendra Nath Institute of Information Mation Technology (DNIIT) | Amit Kumar Tripathy | Director | Uska Road, Near Naveen Sabji Mandi, Tetari Bazar, Siddharth Nagar-272207 | 8765562815 | aktjob@gmail.com |
| 5 | Inditech Software Wizard Pvt. Ltd. | Sandip Ghosh | Course Coordinator | Mohiari Chanpiritala, Po: Andul Mouri, PS: Domjur, Distt: Howrah, West Bengal-711302 | 9230027415 | swizardrecruitment@gmail.com |
| 6 | Prasanthi Polytechnic | D. Prasad | Principal | Duppituru (Vill), Atchutapuram (Md). Visakhapatnam (Dist), Andhara Pradesh-531011 | 9849952573 | prasadreddy.1279@gmail.com |
| 7 | Sidhi Vinayak Academy | Neha Verma | Director | Shiv Narayan Kunj, B Block, Shivaji Nagar, Hethu, Ranchi, JH-834002 | 8789837772 | sidhiacadmey@gmail.com |
| 8 | Surekha IT Services | Anjani K | Manager | 8-3-191/84/302, Sharan Residency, Vengalrao Nagar, Hyderabad-500038, Telangana | 8125134134 | info@surekhaitservices.com |

## Annexure IV: Training Details

**Training Projections:**

| Year | Estimated Training # of Total Candidates | Estimated training# of Women | Estimated training# of People with Disability |
|---|---|---|---|
| 2024-25 | 500 | 200 | 20 |
| 2025-26 | 500 | 200 | 20 |
| 2026-27 | 1000 | 200 | 20 |

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

## Annexure V: Blended Learning

**Blended Learning Estimated Ratio & Recommended Tools**

| S. No. | Select the Components of the Qualification | List Recommended Tools – for all Selected Components | Offline : Online Ratio |
|---|---|---|---|
| 1 | Theory/ Lectures - Imparting theoretical and conceptual knowledge | Online interaction platforms like JitSi Meet, Bharat VC, Google Meet, MS Teams, etc. | 70:30 |
| 2 | Imparting Soft Skills, Life Skills, and Employability Skills /Mentorship to Learners | Online interaction platforms like JitSi Meet, Bharat VC, Google Meet, MS Teams, etc. | 70:30 |
| 3 | Showing Practical Demonstrations to the learners | Through Virtual Software and Online interaction platforms like JitSi Meet, Bharat VC, Google Meet, MS Teams, etc. | 70:30 |
| 4 | Imparting Practical Hands-on Skills/ Lab Work/ workshop/ shop floor training | Through Virtual Software and Online interaction platforms like JitSi Meet, Bharat VC, Google Meet, MS Teams, etc. | 70:30 |
| 5 | Tutorials/ Assignments/ Drill/ Practice | Online interaction platforms like JitSi Meet, Bharat VC, Google Meet, MS Teams, etc. | 70:30 |
| 6 | Proctored Monitoring/ Assessment/ Evaluation/ Examinations | NIELIT Remote Proctored Software | Online: 100% Theory<br>Offline: 100% Practical |
| 7 | On the Job Training (OJT)/ Project Work Internship/ Apprenticeship Training | Virtual Software Platform | Either 100% online in a virtual environment |

| | | | |
|---|---|---|---|
| | | | Or 100% offline in the Industry. |

## Annexure VI: Standalone NOS- Performance Criteria details

### 1. Description

This NOS provides a comprehensive introduction to Artificial Intelligence (AI) with a focus on its applications in embedded systems. Starting with an overview of AI and its various applications, students will delve into the basics of machine learning (ML) and deep learning (DL), understanding neural networks and their components. The course then addresses the unique challenges of running AI models on embedded devices, covering hardware considerations for AI acceleration in embedded systems.

### 2. Scope

The course aims to cover the basics of machine learning and deep learning, introduce neural networks and their components, and delve into the challenges of running AI models on embedded devices.

### 3. Elements and Performance Criteria

*Introduction to Artificial Intelligence:*

- Ability to explain the history and evolution of AI, including its key milestones and applications.
- Demonstrate understanding of AI challenges such as ethical considerations, bias, and data privacy.
- Analyze case studies showcasing AI applications in various fields like healthcare, finance, and autonomous systems.

*Embedded AI Frameworks and Tools:*

- Implement AI models using TensorFlow Lite, PyTorch, or ONNX on embedded devices.
- Evaluate the performance of AI frameworks on hardware accelerators like Edge TPU or NVIDIA Jetson.
- Compare and contrast different frameworks and tools based on their suitability for specific embedded AI applications.

*Integration of AI with Embedded Systems:*

- Successfully integrate sensors with embedded systems and collect sensor data for AI model input.
- Develop and deploy AI-enabled features on embedded platforms, ensuring real-time data processing and low latency.
- Optimize AI models for resource-constrained environments such as microcontrollers, focusing on efficiency and accuracy.

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

The individual on the job needs to know and understand:

**Knowledge of AI Fundamentals:**

- Understanding the core concepts of artificial intelligence, machine learning, and deep learning.
- Knowledge of neural network architectures, activation functions, and training algorithms.
- Familiarity with AI applications in various domains and industries.

**Understanding Embedded Systems and Hardware Acceleration:**

- Knowledge of embedded systems architecture, including processors, memory, and I/O interfaces.
- Understanding of hardware accelerators for AI, such as Edge TPU, NVIDIA Jetson, and microcontroller-based solutions.
- Awareness of hardware constraints and considerations for deploying AI models on embedded devices.

**Proficiency in AI Frameworks and Tools:**

- Familiarity with popular AI frameworks like TensorFlow Lite, PyTorch, and Caffe2 for embedded applications.
- Understanding of ONNX format for representing deep learning models and its interoperability with different frameworks.
- Knowledge of specialized libraries and tools for implementing AI on microcontrollers and optimizing AI models for edge computing.

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

User/individual on the job needs to know how to:

**Problem-Solving Skills:**

- Ability to analyze and solve complex problems related to AI model deployment on embedded devices.
- Critical thinking to troubleshoot hardware and software issues in AI applications on embedded systems.

- Capability to devise innovative solutions for optimizing AI performance and resource utilization on constrained hardware.

**Communication and Collaboration:**

- Effective communication skills for presenting AI concepts and solutions to technical and non-technical stakeholders.

- Collaboration with teams to integrate AI models with embedded systems and sensors, ensuring seamless functionality.
- Interdisciplinary collaboration with hardware engineers, software developers, and domain experts for comprehensive AI-enabled system design.

**Adaptability and Continuous Learning:**

- Flexibility to adapt to evolving AI technologies, frameworks, and hardware platforms in the embedded space.
- Willingness to learn new tools, libraries, and techniques for optimizing and deploying AI models on diverse embedded devices.
- Continuous learning mindset to stay updated with industry trends, best practices, and advancements in embedded AI technologies.

## Annexure VII: Assessment Criteria

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

| NOS/Module Name | Assessment Criteria for Performance Criteria | Theory Marks | Practical Marks | Project /Presentation /Assignment Marks | Viva/ Internal Assessment (Marks) |
|---|---|---|---|---|---|
| **NOS1: Essentials of AI for Embedded Application**<br><br>**NOS Code: NIE/ELE/N0229** | *Introduction to Artificial Intelligence:* | **30** | **20** | - | **6** |
| | • Ability to explain the history and evolution of AI, including its key milestones and applications. | - | - | - | - |
| | • Demonstrate understanding of AI challenges such as ethical considerations, bias, and data privacy. | - | - | - | - |
| | • Analyze case studies showcasing AI applications in various fields like healthcare, finance, and autonomous systems. | - | - | - | - |
| | *Embedded AI Frameworks and Tools:* | **30** | **20** | - | **7** |
| | • Implement AI models using TensorFlow Lite, PyTorch, or ONNX on embedded devices. | - | - | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | • Evaluate the performance of AI frameworks on hardware accelerators like Edge TPU or NVIDIA Jetson. | - | - | - | - |
| | • Compare and contrast different frameworks and tools based on their suitability for specific embedded AI applications. | - | - | - | - |
| | *Integration of AI with Embedded Systems:* | **40** | **20** | - | **7** |
| | • Successfully integrate sensors with embedded systems and collect sensor data for AI model input. | - | - | - | - |
| | • Develop and deploy AI-enabled features on embedded platforms, ensuring real-time data processing and low latency. | - | - | - | - |
| | • Optimize AI models for resource-constrained environments such as microcontrollers, focusing on efficiency and accuracy. | - | - | - | - |
| | | **100** | **60** | **20** | **20** |
| | **NOS Total** | **200** | | | |



## Annexure VIII: Assessment Strategy

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), Practical assessment, internal assessment, Project/Presentation/ Assignment, Major Project. The emphasis is on the practical demonstration of skills & knowledge gained by the candidate through the training. Each OUTCOME is assessed & marked separately. A candidate is required to pass all OUTCOMES individually based on the passing criteria.

**About Examination Pattern:**

1. The question papers for the theory and practical 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 through remote proctoring methodology. Theory examination would be conducted online and the paper comprise of MCQ. Conduct of assessment are through trained proctors. Once the test begins, remote proctors have full access to 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.

4. An External Examiner/ Observer may be deployed including NIELIT officials for evaluation of Practical examination/ internal assessment / Project/ Presentation/. Major Project (if applicable) would be evaluated preferably by external/ subject expert including NIELIT officials.

5. Pass percentage would be 50% marks in each component.

6. Candidates may apply for re-examination within the validity of registration (only in the assessment component in which the candidate failed).

7. For re-examination prescribed examination fee is required to be paid by the candidate only for the assessment component in which the candidate wants to reappear.

8. There would be no exemption for any paper/module for candidates having similar qualifications or skills.

9. 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**

| 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. |