



# Model Curriculum

**QP Name: Embedded Full-Stack IoT Analyst**

**QP Code: ELE/Q1404**

**QP Version: 3.0**

**NSQF Level: 5**

**Model Curriculum Version: 3.0**

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## Training Parameters

<b>Sector</b>	Electronics
<b>Sub-Sector</b>	Semiconductor & Components
<b>Occupation</b>	Product Design
<b>Country</b>	India
<b>NSQF Level</b>	5
<b>Aligned to NCO/ISCO/ISIC Code</b>	NCO-2015/2512.0501
<b>Minimum Educational Qualification and Experience</b>	<p>Diploma (After 10th (Electrical/Electronics)) with 1 Year of experience relevant experience</p> <p>OR</p> <p>12th grade pass with 1 year NTC/ NAC with 1 Year of experience relevant experience</p> <p>OR</p> <p>12th grade Pass with 2 Years of experience relevant experience</p> <p>OR</p> <p>Previous relevant Qualification of NSQF Level (4) with 3 Years of experience relevant experience</p> <p>OR</p> <p>10th grade pass with 4 Years of experience relevant experience</p>
<b>Pre-Requisite License or Training</b>	NA
<b>Minimum Job Entry Age</b>	21 Years
<b>Last Reviewed On</b>	27.01.2022
<b>Next Review Date</b>	27.01.2025
<b>NSQC Approval Date</b>	27.01.2022
<b>QP Version</b>	3.0
<b>Model Curriculum Creation Date</b>	27.01.2022

<b>Model Curriculum Valid Up to Date</b>	27.01.2025
<b>Model Curriculum Version</b>	3.0
<b>Maximum Duration of the Course</b>	600 Hours

## Program Overview

This section summarizes the end objectives of the program along with its duration.

### Training Outcomes

At the end of the program, the learner should have acquired the listed knowledge and skills:

- Describe the process of developing and testing design for IoT based system.
- Demonstrate the process of building GUI and applications in a framework.
- Demonstrate the process testing and troubleshooting the firmware.
- Explain the importance of working effectively at the workplace.
- Demonstrate various practices to be followed to maintain health and safety at work.

### Compulsory Modules

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

NOS and Module Details	Theory Duration	Practical Duration	On-the-Job Training Duration (Recommended)	On-the-Job Training Duration (Mandatory)	Total Duration
<b><i>Bridge Module</i></b>	<b>21:00</b>	<b>09:00</b>	<b>00:00</b>	<b>00:00</b>	<b>30:00</b>
Module 1: Introduction and orientation to the role of an Embedded Full-Stack IoT Analyst	30:00	09:00	00:00	00:00	30:00
<b>ELE/N1406: Develop and Test Design for IoT Based System</b>	<b>30:00</b>	<b>70:00</b>	<b>00:00</b>	<b>50:00</b>	<b>150:00</b>
Module 2: Process of developing and testing design for IoT Based System	30:00	70:00	00:00	50:00	150:00
<b>ELE/N1410: Build GUI and Applications in a Framework</b>	<b>50:00</b>	<b>80:00</b>	<b>00:00</b>	<b>50:00</b>	<b>180:00</b>
Module 3: Process of Building GUI and Applications in a Framework	50:00	80:00	00:00	50:00	180:00
<b>ELE/N1411: Test and Troubleshoot the Firmware</b>	<b>40:00</b>	<b>60:00</b>	<b>00:00</b>	<b>50:00</b>	<b>150:00</b>
Module 4: Process of testing and troubleshooting the firmware	40:00	60:00	00:00	50:00	150:00

<b>ELE/N1002: Apply health and safety practices at the workplace</b>	<b>15:00</b>	<b>15:00</b>	<b>00:00</b>	<b>00:00</b>	<b>30:00</b>
Module 5: Apply health and Safety Practices at Workplace	15:00	15:00	00:00	00:00	30:00
<b>DGT/VSQ/N0102- Employability Skills (60 Hours)</b>	<b>24:00</b>	<b>36:00</b>	<b>00:00</b>	<b>00:00</b>	<b>60:00</b>
Module 6: Employability Skills (60 Hours)	24:00	36:00	00:00	00:00	60:00
<b>Total Duration</b>	<b>180:00</b>	<b>270:00</b>	<b>00:00</b>	<b>150:00</b>	<b>600:00</b>

# Module Details

## Module 1: Introduction and orientation to the role of an Embedded Full-Stack IoT Analyst

### Bridge Module

#### Terminal Outcomes:

- Discuss the job role of an Embedded Full-Stack IoT Analyst.

<b>Duration: 21:00</b>	<b>Duration: 09:00</b>
<b>Theory – Key Learning Outcomes</b>	<b>Practical – Key Learning Outcomes</b>
<ul style="list-style-type: none"> <li>• Describe the size and scope of the electronics industry and its sub-sectors.</li> <li>• Discuss the role and responsibilities of an Embedded Full-Stack IoT Analyst.</li> <li>• Describe various employment opportunities for an Embedded Full-Stack IoT Analyst.</li> </ul>	<ul style="list-style-type: none"> <li>• Familiarization with the embedded system</li> <li>• Understanding of IoT</li> </ul>
<b>Classroom Aids</b>	
Training Kit - Trainer Guide, Presentations, Whiteboard, Marker, Projector, Laptop	
<b>Tools, Equipment and Other Requirements</b>	
NA	

## Module 2: Process of developing and testing design for IoT Based System

### Mapped to ELE/N1406

#### Terminal Outcomes:

- Describe the process of preparing the design for IoT based system.
- Describe the process of using the appropriate techniques to develop embedded design.
- Demonstrate the process of testing and debugging the embedded system for proper functionality.

Duration: 30:00	Duration: 70:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul style="list-style-type: none"> <li>• Identify the high-level design and connectivity requirements for meeting the system needs</li> <li>• Explain the importance of using appropriate techniques to assess software and firmware requirements and carry out feasibility analysis of the proposed embedded product design and evaluate required parameters.</li> <li>• Identify the protocols that facilitate the handshakes between different connected devices in the IoT system</li> <li>• Identify embedded OS, development machines, tools and language for developing a new product</li> <li>• Identify the modifications required to an existing microprocessor/microcontroller software</li> <li>• Identify continuous integration / continuous development platform requirements and automation test case requirements and functional specifications of each components and as a system</li> <li>• Identify the steps to maintain IP confidentiality rights and protect intellectual property from unauthorised use</li> <li>• Identify the feasible solutions which will work within the constraints and meet the overall cost objective</li> </ul>	<ul style="list-style-type: none"> <li>• Prepare a requirement specification document by analysing the needs of all the stakeholders</li> <li>• Prepare the M2M information in a flow chart or a connected diagram depicting inputs and the outputs of the system</li> <li>• Apply safety and security aspects required in all the stages of the design</li> <li>• Assess the technical specifications and requirement for coding and licensed software as per globally accepted regulatory standards</li> <li>• Prepare different design specifications, including High Level Design (HLD) and Low level Design</li> <li>• Prepare a summary of the requirement specifications along with the variables to be recorded, need for specific connectivity at each interface, etc.</li> <li>• Develop device drivers for various components (sensors, timers, data communication ports, analog-to-digital and digital-to-analog converters) and peripherals</li> <li>• Analyse and record the test results to plan corrective action.</li> <li>• Use software debugging tools; emulators, debuggers, etc., design constraints and complete design cycle from understanding customer's specifications to production</li> <li>• Use syntax and semantics of the C</li> </ul>



	<p>language for embedded programming and understanding of basic tools of editor, compiler and configuration management</p> <ul style="list-style-type: none"> <li>• Use different types of tools, hardware and software and testing devices and approved techniques to check defects/malfunctions</li> <li>• Develop applications to perform signal processing, data acquisition, event processing, and data management and communication functions and systems using real-time embedded OS (VxWorks, QNX, etc.)</li> <li>• Use correct syntax when developing code</li> <li>• Execute unit-test cases (UTCs) by white box testing method</li> <li>• Develop embedded systems with embedded operating systems</li> <li>• Prepare design of IoT system after discussion with experts with respect to possible overall IoT system(s) solution, the technical evaluation criteria and appropriate components to be deployed</li> <li>• Use the reusable components, relevant best practices and design standards from the organization's knowledge base</li> <li>• Prepare the work plan with deliverables and time line</li> <li>• Develop strategies for energy efficiency, environmental standards and safety measures</li> <li>• Perform testing and debugging of the assembled system and report problems into a bug tracking system</li> </ul>
<p><b>Classroom Aids</b></p>	
<p>Training kit (Trainer guide, Presentations). Whiteboard, Marker, projector, laptop</p>	
<p><b>Tools, Equipment and Other Requirements</b></p>	
<p>Microcontroller, microprocessors, sensors, planning tools such as JIRA and Microsoft Project, embedded operating systems like MbedOS, RTX Kernel, FreeRTOS, Yocto Linux, configuration management tools, software version control tools</p>	

## Module 3: Process of Building GUI and Applications in a Framework

### Mapped to ELE/N1410

#### Terminal Outcomes:

- Demonstrate the process of developing application for IoT system.
- Demonstrate the process of developing the appropriate GUI/web UI for the entire IoT system.

Duration: 50:00	Duration: 80:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul style="list-style-type: none"> <li>• Identify the style of interface</li> <li>• Identify the steps to validate the design and interface</li> <li>• Use right syntax, lightweight framework, responsive design, event handling methods, interactivity etc in GUI designing</li> <li>• Develop python-based application for communication and interfacing between devices and cloud server using various application protocols</li> <li>• Monitor the performance metrics of the application</li> </ul>	<ul style="list-style-type: none"> <li>• Prepare timeliness of activities and strategy for efficient programming based on software requirement specification</li> <li>• Use the appropriate development kit, programming and software based on requirements</li> <li>• Perform IoT application development after selecting the right platform</li> <li>• Create user flow diagram, design map for the interface, wireframe, mock up, prototype</li> <li>• Demonstrate the steps such as identification, selection, installation and troubleshooting of different modules/devices for real applications for Smart cities, healthcare etc</li> <li>• Use proper GUI programming language to develop a good UI design for the application</li> <li>• Comply with security aspects for IoT applications</li> </ul>
<b>Classroom Aids</b>	
Training kit (Trainer guide, Presentations). Whiteboard, Marker, projector, laptop	
<b>Tools, Equipment and Other Requirements</b>	
Microcontroller, microprocessors, sensors, planning tools such as JIRA and Microsoft Project, embedded operating systems like MbedOS, RTX Kernel, FreeRTOS, Yocto Linux, configuration management tools, software version control tools	

## Module 4: Process of testing and troubleshooting the firmware

### Mapped to ELE/N1411

#### Terminal Outcomes:

- Demonstrate the process of testing the software solutions for embedded IoT products
- Demonstrate the process of testing and rectify malfunctions in the IoT prototype
- Demonstrate the process of validating and configuring the entire embedded IoT system

Duration: 40:00	Duration: 60:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul style="list-style-type: none"> <li>• Apply key features of the programming language to test the solutions such as use of registers, addressing modes, assembler instructions, subroutines and flags, etc.</li> <li>• Use debugging techniques to rectify and compile the code</li> <li>• Check for functional correctness after loading the code into embedded software and testing and debugging the same using tools such as JTAG, GDB etc</li> <li>• Identify and debug malfunctions in the constructed prototype devices/components using appropriate software, hardware and testing methods</li> <li>• Analyse failure to develop corrective action</li> <li>• Identify how to configure the system in different combination to be used by various applications</li> </ul>	<ul style="list-style-type: none"> <li>• Develop testing procedure to analyse code and to determine root cause of problems</li> <li>• Demonstrate interoperability testing with other elements in the IoT framework</li> <li>• Develop and automate test plans and bug tracking system</li> <li>• Resolve problems and fix the problem as per standard operating procedure</li> <li>• Retest the prototype and document the new product design</li> <li>• Interpret the test results and specifications for compliance</li> <li>• Conduct root cause analysis in case problem still exists to debug and rectify the issue</li> </ul>
Classroom Aids	
Training kit (Trainer guide, Presentations)	
Tools, Equipment and Other Requirements	
Microcontroller, microprocessors, sensors, planning tools such as JIRA and Microsoft Project, embedded operating systems like MbedOS, RTX Kernel, FreeRTOS, Yocto Linux, configuration management tools, software version control tools	

## Module 5: Apply work and health safety practices

### Terminal Outcomes:

- Apply health and safety practices at the workplace.

Duration: 15:00	Duration: 15:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul style="list-style-type: none"> <li>• Discuss job-site hazards, risks and accidents.</li> <li>• Explain the organizational safety procedures for maintaining electrical safety, handling tools and hazardous materials.</li> <li>• Elaborate the electronic waste disposal procedures.</li> <li>• Describe the process of disposal of hazardous waste</li> <li>• List the name and location of concerned people, documents and equipment for maintaining health and safety in the workplace.</li> <li>• Describe how to interpret warning signs while accessing sensitive work areas.</li> <li>• Explain the importance of good housekeeping.</li> <li>• Describe the importance of maintaining appropriate postures while lifting heavy objects.</li> <li>• List the types of fire and fire extinguishers.</li> <li>• Explain the importance of efficient utilisation of water, electricity and other resources.</li> <li>• List the common sources of pollution and ways to minimize it.</li> <li>• Describe the concept of waste management and methods of disposing hazardous waste.</li> <li>• Explain various warning and safety signs.</li> <li>• Describe different ways of preventing accidents at the workplace.</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrate the use of protective equipment suitable as per tasks and work conditions.</li> <li>• Report any abnormal situation/behavior of any equipment/system to the relevant authorities.</li> <li>• Administer first aid in case of a minor accident.</li> <li>• Demonstrate the steps to free a person from electrocution safely.</li> <li>• Administer Cardiopulmonary Resuscitation (CPR).</li> <li>• Demonstrate the application of defined emergency procedures such as raising alarm, safe/efficient, evacuation, moving injured people, etc.</li> <li>• Prepare a sample incident report.</li> <li>• Use a fire extinguisher in case of a fire incident.</li> <li>• Demonstrate the correct method of lifting and handling heavy objects.</li> </ul>
<b>Classroom Aids</b>	
Training kit (Trainer guide, Presentations)	
<b>Tools, Equipment and Other Requirements</b>	
Personal Protection Equipment: safety glasses, head protection, rubber gloves, safety footwear, warning signs and tapes, fire extinguisher, first aid kit, fire extinguishers and warning signs.	

## Module 6: Employability Skills (60 Hours)

### Mapped to DGT/VSQ/N0102

#### Terminal Outcomes:

- Discuss about Employability Skills in meeting the job requirements
- Describe opportunities as an entrepreneur.
- Describe ways of preparing for apprenticeship & Jobs appropriately.

<b>Duration: 24:00</b>	<b>Duration: 36:00</b>
<b>Theory – Key Learning Outcomes</b>	<b>Practical – Key Learning Outcomes</b>
<ul style="list-style-type: none"> <li>• Explain constitutional values, civic rights, responsibility towards society to become a responsible citizen</li> <li>• Discuss 21<sup>st</sup> century skills</li> <li>• Explain use of basic English phrases and sentences.</li> <li>• Demonstrate how to communicate in a well-behaved manner</li> <li>• Demonstrate how to work with others</li> <li>• Demonstrate how to operate digital devices</li> <li>• Discuss the significance of Internet and Computer/ Laptops</li> <li>• Discuss the need for identifying business opportunities</li> <li>• Discuss about types of customers.</li> <li>• Discuss on creation of biodata</li> <li>• Discuss about apprenticeship and opportunities related to it.</li> </ul>	<ul style="list-style-type: none"> <li>• List different learning and employability related GOI and private portals and their usage</li> <li>• Show how to practice different environmentally sustainable practices.</li> <li>• Exhibit 21st century skills like Self-Awareness, Behavior Skills, time management, etc.</li> <li>• Show how to use basic English sentences for everyday conversation in different contexts, in person and over the telephone</li> <li>• Demonstrate how to communicate in a well-mannered way with others.</li> <li>• Demonstrate how to communicate effectively using verbal and nonverbal communication etiquette</li> <li>• Utilize virtual collaboration tools to work effectively</li> <li>• Demonstrate how to maintain hygiene and dressing appropriately.</li> <li>• Perform a mock interview</li> </ul>
<b>Classroom Aids</b>	
Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop	
<b>Tools, Equipment and Other Requirements</b>	
Computer, UPS, Scanner, Computer Tables, LCD Projector, Computer Chairs, White Board OR Computer Lab	

## Module 7: On-the-Job Training

### Mapped to Embedded Full-Stack IoT Analyst

<b>Mandatory Duration: 150:00</b>	<b>Recommended Duration: 00:00</b>
<b>Location: On Site</b>	
<p><b>Terminal Outcomes</b></p> <ol style="list-style-type: none"> <li>1. Explain the protocols that facilitate the handshakes between different connected devices in the IoT system.</li> <li>2. Prepare the M2M information in a flow chart or a connected diagram depicting inputs and the outputs of the system.</li> <li>3. Prepare design of IoT system after discussion with experts with respect to possible overall IoT system(s) solution, the technical evaluation criteria and appropriate components to be deployed.</li> <li>4. Perform testing and debugging of the assembled system and report problems into a bug tracking system.</li> <li>5. Create user flow diagram, design map for the interface, wireframe, mock up, prototype.</li> <li>6. Use proper GUI programming language to develop a good UI design for the application.</li> <li>7. Develop and automate test plans and bug tracking system.</li> <li>8. Conduct root cause analysis in case problem still exists to debug and rectify the issue.</li> <li>9. Perform assigned work within the turnaround time and as per the defined quality standards.</li> <li>10. Demonstrate how to maintain a healthy, safe and secure working environment.</li> </ol>	

# Annexure

## Trainer Requirements

Trainer Prerequisites						
Minimum Educational Qualification	Specialization	Relevant Industry Experience		Training Experience		Remarks
		Years	Specialization	Years	Specialization	
Diploma / ITI/ Degree	Mechanical/ Electrical/ Electronics	2	Semiconductor, Components Manufacturing	1 year preferably	Electronics & Semiconductors Manufacturing	

Trainer Certification	
Domain Certification	Platform Certification
“Embedded Full-Stack IoT Analyst”, “ELE/Q1404, v3.0”, Minimum accepted score is 80%	Recommended that the Trainer is certified for the <b>Embedded Full - Stack IoT Analyst</b> “Trainer (VET and Skills)”, mapped to the Qualification Pack: “MEP/Q2601, V2.0”, with minimum score of 80%

## Assessor Requirements

Assessor Prerequisites						
Minimum Educational Qualification	Specialization	Relevant Industry Experience		Training/Assessment Experience		Remarks
		Years	Specialization	Years	Specialization	
Diploma / ITI/ Degree	Mechanical/ Electrical/ Electronics	3	Semiconductor, Components Manufacturing	1 year preferably	Electronics & Semiconductors Manufacturing	

Assessor Certification	
Domain Certification	Platform Certification
<p><b>“Embedded Full-Stack IoT Analyst”,</b>  <b>“ELE/Q1404, v3.0”,</b> Minimum accepted score is 80%</p>	<p>Recommended that the Assessor is certified for the <b>Embedded Full – Stack IoT Analyst “Assessor (VET and Skills)”</b>, mapped to the Qualification Pack: <b>“MEP/Q2701, V2.0”,</b> with minimum score of 80%</p>



## Assessment Strategy

### 1. Assessment System Overview:

- Batches assigned to the assessment agencies for conducting the assessment on SDMS/SIP or email
- Assessment agencies send the assessment confirmation to VTP/TC looping SSC
- The assessment agency deploys the ToA certified Assessor for executing the assessment
- SSC monitors the assessment process & records

### 2. Testing Environment

To ensure a conducive environment for conducting a test, the trainer will:

- Confirm that the centre is available at the same address as mentioned on SDMS or SIP
- Check the duration of the training.
- Check the Assessment Start and End time to be 10 a.m. and 5 p.m. respectively
- Ensure there are 2 Assessors if the batch size is more than 30.
- Check that the allotted time to the candidates to complete Theory & Practical Assessment is correct.
- Check the mode of assessment—Online (TAB/Computer) or Offline (OMR/PP).
- Confirm the number of TABs on the ground are correct to execute the Assessment smoothly.
- Check the availability of the Lab Equipment for the particular Job Role.

### 3. Assessment Quality Assurance levels / Framework:

- Question papers created by the Subject Matter Experts (SME)
- Question papers created by the SME verified by the other subject Matter Experts
- Questions are mapped with NOS and PC
- Question papers are prepared considering that level 1 to 3 are for the unskilled & semi-skilled individuals, and level 4 and above are for the skilled, supervisor & higher management
- The assessor must be ToA certified and the trainer must be ToT Certified
- The assessment agency must follow the assessment guidelines to conduct the assessment

### 4. Types of evidence or evidence-gathering protocol:

- Time-stamped & geotagged reporting of the assessor from assessment location
- Centre photographs with signboards and scheme-specific branding
- Biometric or manual attendance sheet (stamped by TP) of the trainees during the training period
- Time-stamped & geotagged assessment (Theory + Viva + Practical) photographs & videos

### 5. Method of verification or validation:

To verify the details submitted by the training centre, the assessor will undertake:

- A surprise visit to the assessment location
- A random audit of the batch
- A random audit of any candidate

### 6. Method for assessment documentation, archiving, and access

To protect the assessment papers and information, the assessor will ensure:

- Hard copies of the documents are stored

- Soft copies of the documents & photographs of the assessment are uploaded / accessed from Cloud Storage
- Soft copies of the documents & photographs of the assessment are stored on the Hard drive

# References

## Glossary

Term	Description
<b>Declarative knowledge</b>	Declarative knowledge refers to facts, concepts and principles that need to be known and/or understood in order to accomplish a task or to solve a problem.
<b>Key Learning</b>	Key learning outcome is the statement of what a learner needs to know, understand and be able to do in order to achieve the terminal outcomes. A set of key learning outcomes will make up the training outcomes. Training outcome is specified in terms of knowledge, understanding (theory) and skills (practical application).
<b>OJT (M)</b>	On-the-job training (Mandatory); trainees are mandated to complete specified hours of training on site
<b>OJT (R)</b>	On-the-job training (Recommended); trainees are recommended the specified hours of training on site
<b>Procedural Knowledge</b>	Procedural knowledge addresses how to do something, or how to perform a
<b>Training Outcome</b>	Training outcome is a statement of what a learner will know, understand and be able to do <b>upon the completion of the training.</b>
<b>Terminal Outcome</b>	Terminal outcome is a statement of what a learner will know, understand and be able to do <b>upon the completion of a module.</b> A set of terminal outcomes help to achieve the training outcome.

## Acronyms and Abbreviations

Term	Description
DC	Direct Current
ISO	International Organization for Standardization
NCO	National Occupational Standards
NOS	National Skills Qualification Committee
NSQF	National Skills Qualification Framework
OJT	On-the-Job Training
OMR	Optical Mark Recognition
PC	Performance Criteria
PwD	Persons with Disabilities
QP	Qualification Pack
SDMS	Skill Development & Management System
SIP	Skill India Portal
SME	Small and Medium Enterprises
SOP	Standard Operating Procedure
SSC	Sector Skill Council
TC	Trainer Certificate
ToA	Training of Assessors
ToT	Training of Trainers
TP	Training Provider