# Model Curriculum

**NOS Name: Essentials of Internet of Things**

**NOS Code: ELE/N0167**

**NOS Version: 1.0**

**NSQF Level: 4.5**

**Model Curriculum Version: 1.0**

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

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# Training Parameters

| | |
|---|---|
| **Sector** | Electronics |
| **Sub-Sector** | Semiconductor & Components |
| **Occupation** | Product Design-S&C |
| **Country** | India |
| **NSQF Level** | 4.5 |
| **Aligned to NCO/ISCO/ISIC Code** | NCO-2015/2512.0501 |
| **Minimum Educational Qualification and Experience** | UG Certificate or Equivalent No Experience required OR<br>12th 1.5 years relevant experience OR<br>3 year diploma after 10th No Experience required OR<br>10th Grade pass 3 years relevant experience OR<br>Previous relevant Qualification of NSQF Level 4 3 years relevant experience |
| **Pre-Requisite License or Training** | NA |
| **Minimum Job Entry Age** | 18 |
| **Last Reviewed On** | 27.08.2024 |
| **Next Review Date** | 27.08.2027 |
| **NSQC Approval Date** | 27.08.2024 |
| **NOS Version** | 1.0 |
| **Model Curriculum Creation Date** | 27.08.2024 |
| **Model Curriculum Valid Up to Date** | 27.08.2027 |
| **Model Curriculum Version** | 1.0 |
| **Maximum Duration of the Course** | 240 |

# 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:

Understand the IoT ,Pyhton programming with Raspberry Pi, Git/GitHub. etc

**Compulsory:**

- Basic lecture introduces different aspects of IoT and exposure to future world.
- It will prepare the learner to understand, develop, and engage with IoT technologies in various professional and academic contexts.
- The lecture series is organized as modules, such as internet of things overview, hardware & Sensor integration and programming with Python, etc.

**Compulsory Modules:**

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

| NOS and Module Details | Theory / Demonstration Duration (In Hours) | Practical/OJT Duration (In Hours) | On-the-Job Training Duration (in hours) (Mandatory) | On-the-Job Training Duration (in hours) (Recommended) | Total Duration (In Hours) |
|---|---|---|---|---|---|
| ELE/N0167: Essentials of Internet of Things | 160:00 | 80:00 | 00:00 | 00:00 | 240:00 |
| Module 1: IoT Overview | 30:00 | 00:00 | 00:00 | 00:00 | 30:00 |
| Module 2: Hardware & Sensor overview | 35:00 | 00:00 | 00:00 | 00:00 | 35:00 |
| Module 3: Git & Git/Hub Control | 30:00 | 00:00 | 00:00 | 00:00 | 30:00 |
| Module 4: Introduction to Python on | 35:00 | 00:00 | 00:00 | 00:00 | 35:00 |

| | | | | | |
|---|---|---|---|---|---|
| Raspberry Pi | | | | | |
| Module 5: Introduction to Network Communication | 30:00 | 00:00 | 00:00 | 00:00 | 30:00 |
| Module 6: IoT Capstone Project | 00:00 | 80:00 | 00:00 | 00:00 | 80:00 |
| **Total** | **160:00** | **80:00** | **00:00** | **00:00** | **240:00** |

# Module Details

**Module 1: IoT Overview**
**Mapped to ELE/N0167**

**Terminal Outcomes:**
Students will have a comprehensive understanding of the foundational concepts, technologies, and applications of the Internet of Things (IoT).

| *Duration: 30:00 hrs* |
|---|
| **Theory - Key Learning Outcomes** |
| • Articulate the core concepts, architecture, and components of IoT systems.<br>• Describe the various IoT communication protocols and their specific use cases.<br>• Identify and explain the functions of key IoT hardware such as sensors, actuators, and microcontrollers.<br>• They will understand the role of IoT platforms, gateways, and cloud services in enabling IoT applications.<br>• Recognize common security challenges and vulnerabilities associated with IoT devices and networks.<br>• Discuss the ethical implications of IoT, including privacy concerns and data ownership issues.<br>• Analyze how IoT is transforming industries such as healthcare, agriculture, smart cities, and manufacturing.<br>• Identify emerging trends and future directions in IoT technology and applications.<br>• Design and build basic IoT prototypes using platforms like Arduino or Raspberry Pi. |

- Implement simple IoT applications that collect and transmit data from sensors to a central system.
- Configure and use different IoT communication protocols (e.g., MQTT, CoAP) to connect devices and transmit data.
- Develop and troubleshoot communication between IoT devices and cloud services.
- Set up IoT devices to collect data and use appropriate tools to manage and store this data.
- Apply basic data analytics techniques to analyze IoT data and extract meaningful insights.

**Practical - Key Learning Outcomes**

- Implement basic security measures to protect IoT devices and data.
- Perform vulnerability assessments on IoT systems and propose mitigation strategies.
- Work on a capstone project that involves designing, developing, and presenting an IoT solution to a real-world problem.
- Collaborate in teams to manage the project lifecycle, from concept to deployment and presentation.

**Classroom Aids: (If Offline mode)**

- Interactive Whiteboard or Smartboard
- Projector and Screen:
- High-Speed Internet Connection

**Tools, Equipment and Other Requirements**

- IoT Development Kits
- Sensors and Actuators
- Networking Equipment
- Software Tools
- Debugging and Testing Tools

## Module 2: Hardware and Sensor overview

**Mapped to ELE/N0167**

**Terminal Outcomes:**

Students will be well-prepared to work with hardware and sensors in various IoT applications, enabling them to design, develop, and troubleshoot sensor-based systems effectively. They will

have a strong foundation to pursue further studies or careers in IoT, electronics, and related fields.

| *Duration: 35:00 hrs* |
|---|
| **Theory - Key Learning Outcomes** |
| • Understand the roles and functions of essential hardware components in IoT systems, including microcontrollers, microprocessors, and integrated circuits.<br>• Able to identify and explain the principles and applications of various types of sensors (e.g., temperature, humidity, motion, light, pressure).<br>• Acquire skills in integrating sensors with microcontrollers or microprocessors, using platforms like Arduino and Raspberry Pi.<br>• Learn methods for acquiring, converting, and processing data from sensors, including analog-to-digital conversion and signal conditioning.<br>• Gain hands-on experience in assembling, prototyping, and testing sensor-based circuits and systems.<br>• Become proficient in using Integrated Development Environments (IDEs) and other software tools for programming and debugging sensor-based IoT systems. |
| **Practical - Key Learning Outcomes** |
| • Understand and implement basic communication protocols (e.g., I2C, SPI, UART) used to connect sensors to processing units.<br>• Learn best practices for deploying sensors in various environments, considering factors like accuracy, reliability, and maintenance.<br>• Develop skills to diagnose and troubleshoot common hardware and sensor issues, and perform necessary calibration to ensure optimal performance.<br>• Complete a capstone project involving the design and implementation of a sensor-based IoT system, and effectively present their project outcomes. |
| **Classroom Aids: (If Offline mode)** |
| • Interactive Whiteboard or Smartboard<br>• Projector and Screen:<br>• High-Speed Internet Connection |
| **Tools, Equipment and Other Requirements** |
| • Development Boards<br>• Sensors<br>• Actuators<br>• Prototyping Tools |

## Module 3: Git & Git/Hub Control

**Mapped to ELE/N0167**

**Terminal Outcomes:**

Students will have a thorough understanding of version control principles and will be proficient in using Git and GitHub for managing and collaborating on software projects.

| *Duration: 30:00 hrs* |
|---|
| **Theory - Key Learning Outcomes** |
| • Explain the importance of version control in software development.<br>• Describe the fundamental concepts of version control systems (VCS), including repositories, branches, commits, merges, and conflicts.<br>• Initialize and clone repositories.<br>• Create, manage, and switch between branches.<br>• Stage, commit, and amend changes.<br>• Merge branches and resolve merge conflicts.<br>• Use advanced Git commands for rebasing, cherry-picking, and reverting changes.<br>• Organize project files and directories in a repository.<br>• Understand and create meaningful commit messages.<br>• Use Git hooks to automate tasks.<br>• Create and manage repositories on GitHub.<br>• Understand and utilize GitHub workflows, including forking, cloning, and pull requests.<br>• Collaborate on projects using branches, pull requests, and code reviews.<br>• Manage repository settings, including access control and permissions.<br>• Add and manage remote repositories.<br>• Push changes to and pull updates from remote repositories.<br>• Understand and handle remote-tracking branches.<br>• Use GitHub Issues for bug tracking and feature requests.<br>• Employ GitHub Projects for project management.<br>• Create and use GitHub Actions for CI/CD pipelines.<br>• Leverage GitHub Pages for hosting project documentation and websites.<br>• Follow best practices for branching strategies (e.g., Git Flow, GitHub Flow).<br>• Maintain a clean and organized commit history.<br>• Implement effective collaboration strategies in team environments. |
| |
| **Practical - Key Learning Outcomes** |

- Diagnose and resolve common issues with Git commands and repositories.
- Use Git tools to inspect the commit history and revert to previous states.
- Employ strategies for recovering from errors and mistakes in Git workflows.
- Build and maintain a professional portfolio on GitHub.
- Contribute to open source projects and understand the etiquette of open source contributions.
- Utilize GitHub for showcasing projects and collaborating with the developer community.

**Classroom Aids: (If Offline mode)**

- Interactive Whiteboard or Smartboard
- Projector and Screen:
- High-Speed Internet Connection

**Tools, Equipment and Other Requirements**

- **Git:**-This includes command-line tools (Git Bash on Windows, Terminal on macOS/Linux) or graphical user interface (GUI) tools like GitKraken, Sourcetree, or GitHub Desktop.
- **Integrated Development Environment (IDE)**

## Module 4: Introduction to Python on Raspberry Pi

**Mapped to ELE/N0167**

**Terminal Outcomes:** Students will possess a thorough understanding of Python programming fundamentals and be proficient in utilizing Python on the Raspberry Pi platform for various applications. Specifically, they will be able to:

*Duration: 35:00 hrs*

**Theory - Key Learning Outcomes**

- Understand Python syntax, data types, control structures (loops, conditionals), functions, and object-oriented programming (OOP) concepts.
- Write Python scripts and programs to solve computational problems and manipulate data.
- Import and use standard Python libraries (e.g., os, sys, math) and third-party modules on the Raspberry Pi.
- Interface with hardware components (e.g., GPIO pins, sensors) using Python libraries such as RPi.GPIO or Adafruit CircuitPython libraries.

- Utilize the capabilities of the Raspberry Pi (e.g., camera module, I/O pins) to create interactive and responsive Python programs.
- Navigate and operate within the Linux environment of the Raspberry Pi.
- Use command-line tools and utilities to manage files, directories, and processes.
- Interface Python scripts with external devices connected to the Raspberry Pi, including sensors, actuators, and displays.
- Communicate with external APIs and web services using Python requests library or MQTT for IoT applications.
- Collaborate with peers in team projects involving Python programming on the Raspberry Pi.

**Practical - Key Learning Outcomes**

- Design and implement Python-based projects and applications on the Raspberry Pi, such as IoT projects, automation tasks, or multimedia applications.
- Employ debugging techniques to identify and fix errors in Python code running on the Raspberry Pi.
- Handle common issues related to hardware interaction, network communication, and software integration.
- Optimize Python code for performance and efficiency on the Raspberry Pi platform.
- Implement best practices for code organization, documentation, and version control using Git.
- Present and demonstrate Python-based projects effectively, showcasing technical skills and problem-solving capabilities.

**Classroom Aids: (If Offline mode)**

- Interactive Whiteboard or Smartboard
- Projector and Screen:
- High-Speed Internet Connection

**Tools, Equipment and Other Requirements**

- Raspberry Pi Operating System
- Python IDEs
- Terminal and Command-Line Tools
- Python Libraries and Packages

## Module 5: Introduction to Network Communication

**Mapped to ELE/N0167**

**Terminal Outcomes:** Students will be well-prepared to understand, configure, troubleshoot, and secure computer networks in various environments. They will possess foundational knowledge and practical skills necessary for further studies or careers in network administration, cybersecurity, and related fields.

*Duration: 30:00 hrs*

**Theory - Key Learning Outcomes**

- Explain the basic principles of computer networks, including types of networks (LAN, WAN, MAN), network topologies, and network architecture (client-server vs. peer-to-peer).
- Identify and describe key networking protocols and standards, such as TCP/IP, UDP, HTTP, HTTPS, FTP, DNS, DHCP, and SNMP.
- Understand the OSI (Open Systems Interconnection) model and its layers, and TCP/IP protocol suite.
- Understand IP addressing, subnetting, and routing principles.
- Discuss common network security threats and vulnerabilities.
- Implement basic security measures such as firewalls, encryption, VPNs (Virtual Private Networks), and access control lists (ACLs).
- Describe wireless networking technologies and standards (e.g., Wi-Fi, Bluetooth, Zigbee).
- Configure and troubleshoot wireless networks, including security considerations.
- Discuss emerging trends in network communication such as IoT (Internet of Things), 5G networks, SDN (Software-Defined Networking), and cloud computing.
- Understand their impact on traditional network infrastructures and deployment scenarios.
- Design and implement basic network configurations and setups.
- Collaborate effectively in team-based network projects, demonstrating skills in planning, implementation, and documentation.
- Discuss legal and ethical considerations related to network communication, including privacy, data protection, and regulatory compliance (e.g., GDPR, HIPAA).
- Articulate network concepts, principles, and solutions effectively in oral presentations and written reports.

| Practical - Key Learning Outcomes |
|---|
| • Configure network settings on various devices, including computers, routers, switches, and access points.<br>• Identify and troubleshoot common network connectivity issues using appropriate tools (e.g., ping, traceroute, nslookup).<br>• Analyze network performance using tools like Wireshark for packet analysis.<br>• Demonstrate professional communication skills in discussing network architectures, solutions, and implementations |
| **Classroom Aids: (If Offline mode)** |
| • Interactive Whiteboard or Smartboard<br>• Projector and Screen:<br>• High-Speed Internet Connection |
| **Tools, Equipment and Other Requirements** |
| Labs equipped with the following:<br>• Necessary hardware, software, and resources, students will have a conducive environment to learn and network communication techniques.<br>• This setup will facilitate hands-on experience and practical learning, preparing students to handle real-world data projects effectively. |

## Module 6: IoT Capstone Project

**Mapped to ELE/N0167**

**Terminal Outcomes:**

- Demonstrate the ability to identify a real-world problem that can be solved through IoT.
- Design, develop, and implement an IoT system from concept to execution.
- Showcase skills in sensor integration, data handling, and user interface development.
- Present a working prototype that demonstrates the practical application of IoT technologies.

| *Duration: 80:00 hrs* |
|---|
| **Theory - Key Learning Outcomes** |
| • Understand the process of selecting an appropriate IoT solution for a given problem statement. |

- Gain insights into project planning, resource allocation, and time management for IoT projects.
- Learn the importance of UI/UX design in IoT systems and how to optimize user interaction.
- Study methodologies for effective data handling, ensuring data integrity and security.
- Understand the evaluation process for IoT solutions and how to measure project success.

**Practical - Key Learning Outcomes**

- Build a complete IoT project, integrating hardware (sensors, microcontrollers) with software (Python, IoT platforms).
- Troubleshoot and debug hardware connections, sensor outputs, and communication issues in real-time.
- Develop and implement software for data acquisition, control, and reporting, creating a seamless IoT system.
- Create a functional and intuitive user interface for the project, focusing on user experience and responsiveness.
- Present a working prototype, documenting the entire development process and demonstrating its real-world applications and outcomes.

**Classroom Aids: (If Offline mode)**

- Interactive Whiteboard or Smartboard
- Projector and Screen:
- High-Speed Internet Connection

**Tools, Equipment and Other Requirements**

1. IoT Development Boards:
2. Sensors and Actuators:
3. Connectivity Modules:
4. Integrated Development Environments (IDEs):
5. Programming Languages and Libraries:

# Annexure

## Trainer Requirements

| Trainer Prerequisites | | | | | | |
|---|---|---|---|---|---|---|
| **Minimum Educational Qualification** | **Specialization** | **Relevant Industry Experience** | | **Training Experience** | | **Remarks** |
| | | **Years** | **Specialization** | **Years** | **Specialization** | |
| Graduate Science & Engineering | Electrical/ Mechanical/ Electronics/Computer Science | 1 | IoT Field | 1 | IoT Field | |
| Diploma/ITI | Electrical/ Mechanical/ Electronics/ Computer Science | 2 | IoT Field | 1 | IoT Field | |

| Trainer Certification | |
|---|---|
| **Domain Certification** | **Platform Certification** |
| "**Essentials of Internet of Things**, ELE/N0167, version 1.0". Minimum accepted score is 80%. | Recommended that the Trainer is certified for the **Essentials of Internet of Things** "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 Experience** | | **Remarks** |
| | | **Years** | **Specialization** | **Years** | **Specialization** | |
| Graduate Science & Engineering | Electrical/ Mechanical/ Electronics/ Computer Science | 2 | IoT Field | 1 | IoT Field | |
| Diploma/ITI | Electrical/ Mechanical/ Electronics/ Computer Science | 3 | IoT Field | 1 | IoT Field | |

| Assessor Certification | |
|---|---|
| **Domain Certification** | **Platform Certification** |
| "**Essentials of Internet of Things**, ELE/N0167, version 1.0". Minimum accepted score is 80%. | Recommended that the Assessor is certified forthe **Essentials of Internet of Things** "Assessor (VET and Skills)", mapped to the Qualification Pack: "MEP/Q2701, V2.0", with minimum score of 80% |

## Assessment Strategy

1. Assessment System Overview:
   - Batches assigned to the assessment agencies for conducting the assessment on SDMS/SIP or email
   - Assessment agencies send the assessment confirmation to VTP/TC looping SSC
   - Assessment agency deploys the ToA certified Assessor for executing the assessment

- SSC monitors the assessment process & records

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

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

4. Types of evidence or evidence-gathering protocol:

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

5. Method of verification or validation:

   - Surprise visit to the assessment location

- Random audit of the batch
- Random audit of any candidate

6. Method for assessment documentation, archiving, and access

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

## References

## Glossary

| Term | Description |
|---|---|
| **Key Learning Outcome** | Key learning outcome is the statement of what a learner needs to know, understand and be able to do to achieve the terminal outcomes. A set of key learning outcomes will make up the training outcomes. Training outcome is specified in terms of knowledge, understanding (theory) and skills (practical/OJT application). |
| **Training Outcome** | Training outcome is a statement of what a learner will know, understand and be able to do **upon the completion of the training** |
| **Terminal Outcome** | Terminal outcome is a statement of what a learner will know, understand and be able to do **upon the completion of a module**. A set of terminal outcomes help to achieve the training outcome. |
| **National Occupational Standard** | National Occupational Standard specify the standard of performance an individual must achieve when carrying out a function in the workplace |
| **Persons with Disability** | Persons with Disability are those who have long-term physical, mental, intellectual, or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others |

## Acronyms and Abbreviations

| Term | Description |
|---|---|
| **QF** | Qualification File |
| **NSQF** | National Skills Qualification Framework |
| **NSQC** | National Skills Qualification Committee |
| **NOS** | National Occupational Standards |
| **SSC** | Skill Sectors Councils |
| **NASSCOM** | National Association of Software & Service Companies |
| **NCO** | National Classification of Occupations |
| **ISO** | International Organization for Standardization |
| **SLA** | Service Level Agreement |
| **IT** | Information Technology |
| **CRM** | Customer Relationship Management |
| **PC** | Performance Criteria |
| **PwD** | Persons with Disability |
| **SOP** | Standard Operating Procedure |