Model Curriculum

QP Name: Electronic Hardware Design Engineer

QP Code: ELE/Q6102

QP Version: 4.0

NSQF Level: 5

Model Curriculum Version: 4.0

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

Table of Contents

Training Parameters 3

Program Overview 4

Training Outcomes 4

Compulsory Modules 4

Module 1: Process of developing design for manufacture 5

Module 2: Ensuring Compliance and Standards 7

Module 3: Employability Skills (60 Hours) 9

Module 4: On-the-Job Training 9

Annexure 11

Trainer Requirements 11

Assessor Requirements 12

Assessment Strategy 13

References 15

Glossary 15

Acronyms and Abbreviations 16

Training Parameters

Sector	Electronics
Sub-Sector	PCB Design and Manufacturing
Occupation	Research and Design-PCB
Country	India
NSQF Level	5
Aligned to NCO/ISCO/ISIC Code	NCO-2015/2152.0801
Minimum Educational Qualification and Experience	Completed 2nd year of UG (UG Diploma) (Physics/ Electronics /Electrical/Computer Science) with 1.5 years of Relevant Experience OR Completed 3-year diploma (after 10th) (Electronics/Electrical /Computer Science) with 3 Years of Relevant Experience OR Certificate-NSQF (Level 4.5) with 1.5 years of Relevant Experience # Relevant Experience in PCB design & Manufacturing.
Pre-Requisite License or Training	NA
Minimum Job Entry Age	18 Years
Last Reviewed On	01.05.2025
Next Review Date	30.04.2028
NSQC Approval Date	08.05.2025
QP Version	4.0
Model Curriculum Creation Date	01.05.2025
Model Curriculum Valid Up to Date	30.04.2028
Model Curriculum Version	4.0
Minimum Duration of the Course	570 Hours
Maximum Duration of the Course	570 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:

- Demonstrate the process of developing design for manufacture.
- Explain the importance of following inclusive practices for all genders and PwD at work.
- 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 (Mandatory)	On-the-Job Training Duration (Recommended)	Total Duration
ELE/N8707: Develop and testing of PCB prototype	**90:00**	**120:00**	**90:00**	**00:00**	**300:00**
Module 1: Process of developing design for manufacture	90:00	120:00	90:00	00:00	300:00
ELE/8708: Ensuring Product Excellence and Collaboration	**66:00**	**54:00**	**90:00**	**00:00**	**210:00**
Module 2: Ensuring Compliance and Standards	66:00	54:00	90:00	00:00	210:00
DGT/VSQ/N0102: Employability Skills (60 Hours)	**24:00**	**36:00**	**00:00**	**00:00**	**60:00**
Module 3: Employability Skills (60 Hours)	24:00	36:00	00:00	00:00	60:00
Total Duration	**180:00**	**210:00**	**180:00**	**00:00**	**570:00**

Module Details

Module 1: Process of developing design for manufacture

Mapped to ELE/N8707

Terminal Outcomes:

- Explain the need of understanding new product specifications.
- Demonstrate the process of designing and creating layouts.
- Demonstrate the process of testing prototype and modifying design.
- Explain the importance of verifying and approving the design.
- Explain the importance of achieving productivity and quality standards.

Duration: 90:00	Duration: 120:00
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Understand and interpret customer hardware requirements for new product development. • Analyze product feasibility and provide constructive technical feedback to stakeholders. • Collaborate with cross-functional teams to define precise hardware specifications and performance goals. • Research and assess new technologies and components to meet evolving product needs. • Create electronic circuit schematics using professional design software tools. • Select appropriate electronic components based on performance, reliability, and cost. • Design and simulate high-performance electronic circuits for various application scenarios. • Develop PCB layouts following design rules, signal integrity, and manufacturing constraints. • Validate hardware designs through testing, debugging, and performance verification.	• Demonstrate effective communication with customers to gather hardware and functional requirements. • Analyze and assess the technical feasibility of product specifications in a practical context. • Work collaboratively with teams to define and refine real-world hardware design parameters. • Evaluate and select suitable technologies and components for hands-on product development. • Create accurate schematic diagrams using tools like Altium, KiCad, or OrCAD. • Select, test, and validate electronic components for reliability and performance. • Design and simulate electronic circuits under varying real-world conditions. • Develop and verify PCB layouts while ensuring adherence to manufacturing constraints. • Assemble and test hardware prototypes, identifying and resolving functional issues.

• Document all design, testing, and troubleshooting processes for future reference and traceability.	• Conduct debugging, troubleshooting, and thorough documentation of testing procedures and results.
Classroom Aids	
Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop	
Tools, Equipment and Other Requirements	
Cadence Orcad, Mentor Graphics PADS Logic, Zuken CADSTAR, Altium, etc. Mentor Graphics Hyperlinx, MIL grade components, Computer system with Linux and Windows Operating Systems, PCB designing testing software such as PCB artist, Ultiboard, Altium Designer 17 etc.	

Module 2: Ensuring Compliance and Standards

Mapped to ELE/N8708

Terminal Outcomes:

- Understand the compliances and standards to maintain the quality.

Duration: 66:00	Duration: 54:00
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Understand and apply industry standards such as IPC, RoHS, CE, and FCC in hardware design. • Gain theoretical knowledge of EMI/EMC testing and regulatory compliance processes. • Learn the principles of designing for safety, reliability, and thermal management. • Understand the process of transitioning designs into manufacturing and production workflows. • Explore the development and application of test jigs and fixtures for hardware testing. • Identify strategies for cost reduction and performance enhancement in hardware products. • Stay informed about new tools, components, and trends in hardware design innovation. • Learn effective collaboration techniques with cross-disciplinary teams for system integration. • Develop communication skills for presenting technical designs and participating in reviews. • Understand quality assurance principles and the importance of documentation and defect resolution.	• Apply industry standards (e.g., IPC, RoHS, CE, FCC) to ensure hardware design compliance. • Perform EMI/EMC testing procedures to validate regulatory adherence. • Implement safety, reliability, and thermal management features in real-world hardware designs. • Collaborate with production teams for smooth design-to-manufacturing handover. • Design and build test jigs and fixtures for functional and production-level testing. • Troubleshoot and resolve practical manufacturing and assembly issues on the production floor. • Execute cost and performance optimization techniques in existing hardware designs. • Use updated tools and technologies in hands-on design and prototyping tasks. • Work with cross-functional teams to integrate hardware with firmware, software, and mechanical components. • Maintain and update technical documentation, test reports, and design revision records.
Classroom Aids	
Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop	
Tools, Equipment and Other Requirements	

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 3: 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.

Duration: *24:00*	**Duration:** *36:00*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Explain constitutional values, civic rights, responsibility towards society to become a responsible citizen • Discuss 21st century skills • Explain use of basic English phrases and sentences. • Demonstrate how to communicate in a well-behaved manner • Demonstrate how to work with others • Demonstrate how to operate digital devices • Discuss the significance of Internet and Computer/ Laptops • Discuss the need for identifying business opportunities • Discuss about types of customers. • Discuss on creation of biodata • Discuss about apprenticeship and opportunities related to it.	• List different learning and employability related GOI and private portals and their usage • Show how to practice different environmentally sustainable practices. • Exhibit 21st century skills like Self-Awareness, Behavior Skills, time management, etc. • Show how to use basic English sentences for everyday conversation in different contexts, in person and over the telephone • Demonstrate how to communicate in a well-mannered way with others. • Demonstrate how to communicate effectively using verbal and nonverbal communication etiquette • Utilize virtual collaboration tools to work effectively • Demonstrate how to maintain hygiene and dressing appropriately. • Perform a mock interview
Classroom Aids	
Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop	
Tools, Equipment and Other Requirements	
Computer, UPS, Scanner, Computer Tables, LCD Projector, Computer Chairs, White Board OR Computer Lab	

Module 4: On-the-Job Training

Mapped to Electronic Hardware Design Engineer

Mandatory Duration: 180:00	Recommended Duration: 00:00
Location: On Site	

Terminal Outcomes

1. Explain CADSTAR, Cadence Or CAD & Allegro, AutoCAD LT, Eagle, Protel, Altium, AutoCAD, Hyper lynx and layout techniques for good signal integrity.
2. Explain PCB manufacturing process, fabrication drawings and assembly process.
3. Create schematic symbols and layer stack up.
4. Build circuits according to engineering instructions, technical manuals, knowledge of electronic systems and components.
5. Create design blueprints using computer software.
6. Examine, debug and validate hardware design.
7. Analyse and interpret test data against customer's specifications.
8. Demonstrate the use of professional language and behaviour that is respectful of PwD and all genders.
9. Administer first aid in case of a minor accident.
10. Use a fire extinguisher in case of a fire incident.

Annexure

Trainer Requirements

Trainer Prerequisites						
Minimum Educational Qualification	**Specialization**	**Relevant Industry Experience**		**Training Experience**		**Remarks**
		Years	***Specialization***	***Years***	***Specialization***	
Diploma/ Degree/ ITI/ Certified in relevant CITS Trade	(Electrical/Electronics/ Mechanical)	2	PCB design & Manufacturing	1	Electronics	

Trainer Certification	
Domain Certification	**Platform Certification**
"**Electronic Hardware Design Engineer**", "ELE/Q6102, v4.0", Minimum accepted score is 80%	Recommended that the Trainer is certified for the **Electronic Hardware Design Engineer** "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/ Degree/ ITI/ Certified in relevant CITS Trade	(Electrical/Electronics/ Mechanical)	3	PCB design & Manufacturing	1	Electronics	

Assessor Certification	
Domain Certification	**Platform Certification**
"**Electronic Hardware Design Engineer**", "ELE/Q6102, v4.0", Minimum accepted score is 80%	Recommended that the Assessor is certified for the **Electronic Hardware Design Engineer** "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
    - 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
Declarative knowledge	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.
Key Learning	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).
OJT (M)	On-the-job training (Mandatory); trainees are mandated to complete specified hours of training on site
OJT (R)	On-the-job training (Recommended); trainees are recommended the specified hours of training on site
Procedural Knowledge	Procedural knowledge addresses how to do something, or how to perform a
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.

Acronyms and Abbreviations

Term	Description
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