Model Curriculum

QP Name: Electronic Hardware Design Engineer

QP Code: ELE/Q6102

QP Version: 3.0

NSQF Level: 5

Model Curriculum Version: 3.0

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

Table of Contents

Training Parameters

Sector	Electronics
Sub-Sector	Industrial Automation
Occupation	Designing
Country	India
NSQF Level	5
Aligned to NCO/ISCO/ISIC Code	NCO-2015/2152.0801
Minimum Educational Qualification and Experience	Diploma (After 10 (Electronics/Mechanical)) with 1 Year of relevant experience OR 12th grade pass with 1 year NTC/ NAC with 1 Year of relevant experience OR 12th grade Pass with 2 Years of relevant experience OR Previous relevant Qualification of NSQF Level (4) with 3 Years of relevant experience OR 10th grade pass with 4 Years of relevant experience
Pre-Requisite License or Training	NA
Minimum Job Entry Age	21 Years
Last Reviewed On	27.01.2022
Next Review Date	27.01.2025
NSQC Approval Date	27.01.2022
QP Version	3.0
Model Curriculum Creation Date	27.01.2022
Model Curriculum Valid Up to Date	27.01.2025
Model Curriculum Version	3.0
Maximum Duration of the Course	750 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
Bridge Module	**21:00**	**39:00**	**00:00**	**00:00**	**60:00**
Module 1: Introduction and orientation to the role of an Electronic Hardware Design Engineer	21:00	39:00	00:00	00:00	60:00
ELE/N6102: Develop PCB Design	**150:00**	**240:00**	**210:00**	**00:00**	**600:00**
Module 2: Process of developing design for manufacture	150:00	240:00	210:00	00:00	600:00
ELE/N1002 Apply health and safety practices at the workplace	**15:00**	**15:00**	**00:00**	**00:00**	**30:00**
Module 3: Basic Health and Safety Practice	15:00	15:00	00:00	00:00	30:00
DGT/VSQ/N0102- Employability Skills (60 Hours)	**24:00**	**36:00**	**00:00**	**00:00**	**60:00**
Module 4: Employability Skills (60 Hours)	24:00	36:00	00:00	00:00	60:00
Total Duration	**210:00**	**330:00**	**210:00**	**00:00**	**750:00**

Module Details

Module 1: Introduction and orientation to the role of an Electronic Hardware Design Engineer
Bridge Module

Terminal Outcomes:

- Discuss the job role of an Electronic Hardware Design Engineer.

Duration: 21:00	Duration: 39:00
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
- Describe the size and scope of the electronics industry and its sub-sectors. - Discuss the role and responsibilities of an Electronic Hardware Design Engineer. - Describe various employment opportunities for an Electronic Hardware Design Engineer.	- Hands-on on the various designing tools - Overview of the software - Awareness of the various electronic products - Verification and testing of the prototype
Classroom Aids	
Training Kit - Trainer Guide, Presentations, Whiteboard, Marker, Projector, Laptop	
Tools, Equipment and Other Requirements	
NA	

ESSCI
Skilling India in Electronics

Skill India
कौशल भारत-कुशल भारत

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

Module 2: Process of developing design for manufacture
Mapped to ELE/N6102

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: 150:00	Duration: 240:00
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
- Explain company's policies on: incentives, delivery and quality standards, personnel management and IPR. - Explain the importance of the individual's role in the workflow. - Explain various safety and quality standards followed in the organization. - Explain electronics and electrical engineering. - List various components values and polarities. - Describe CADSTAR, Cadence Or CAD & Allegro, AutoCAD LT, Eagle, Protel, Altium, AutoCAD, Hyper lynx and layout techniques for good signal integrity. - Explain mentor graphics, Valor NPI, DXDesigner and PADs with DXDatabook, CAD packages,CAM350 and other software for schematic capture. - Describe PCB manufacturing process, fabrication drawings and assembly process. - Explain modular design techniques, designing for double side and multilayer. - Explain various quality standards associated with PCB design. - Describe the process of installing and	- Demonstrate how to create schematic symbols and layer stack up. - Show how to convert the schematic to PCB layout including component symbol, footprint and manufacturing data packages. - Demonstrate the process of building circuits according to engineering instructions, technical manuals, knowledge of electronic systems and components. - Demonstrate the process of creating design blueprints using computer software. - Show how to create Gerber artwork file. - Demonstrate how to create prototype, hand or machine assembled. - Demonstrate how to examine, debug and validate hardware design. - Show how to analyse and interpret test data against customer's specifications. - Show how to review layouts and designs according to engineering specifications using application software. - Demonstrate the process of creating final Gerber file.

configuring Operating Systems (Linux, Windows), Storage subsystems. • Describe the procedure to make changes to the design. • State various research sources for obtaining technical information. • Explain statutory regulations, standards and codes of practice and their implications. • Explain the importance of keeping designs developed confidential and consequences of breaching IPR clause. • State IPC standards for printed circuit board.	

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 3: Basic Health and Safety Practice
Mapped to ELE/N1002

Terminal Outcomes:

- Apply health and safety practices at the workplace.

Duration: 15:00	Duration: 15:00
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
- Discuss job-site hazards, risks and accidents. - Explain the organizational safety procedures for maintaining electrical safety, handling tools and hazardous materials. - Elaborate on electronic waste disposal procedures. - Describe the process of disposal of hazardous waste - List the name and location of concerned people, documents and equipment for maintaining health and safety in the workplace. - Describe how to interpret warning signs while accessing sensitive work areas. - Explain the importance of good housekeeping. - Describe the importance of maintaining appropriate postures while lifting heavy objects. - List the types of fire and fire extinguishers. - Explain the importance of efficient utilisation of water, electricity and other resources. - List the common sources of pollution and ways to minimize it. - Describe the concept of waste management and methods of disposing hazardous waste. - Explain various warning and safety signs. - Describe different ways of preventing accidents at the workplace.	- Demonstrate the use of protective equipment suitable as per tasks and work conditions. - Prepare a report to inform the relevant authorities about any abnormal situation/behaviour of any equipment/system. - Administer first aid in case of a minor accident. - Demonstrate the steps to free a person from electrocution safely. - Administer Cardiopulmonary Resuscitation (CPR). - Demonstrate the application of defined emergency procedures such as raising alarm, safe/efficient, evacuation, moving injured people, etc. - Prepare a sample incident report. - Use a fire extinguisher in case of a fire incident. - Demonstrate the correct method of lifting and handling heavy objects.

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 4: 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 5: On-the-Job Training
Mapped to Electronic Hardware Design Engineer

Mandatory Duration: 210:00	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	Electronic Designing	1	Electronics	

Trainer Certification	
Domain Certification	**Platform Certification**
"**Electronic Hardware Design Engineer**", "ELE/Q6102, v3.0", 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	Electronic Designing	1	Electronics	

Assessor Certification	
Domain Certification	**Platform Certification**
"**Electronic Hardware Design Engineer**", "ELE/Q6102, v3.0", 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