



Model Curriculum

QP Name: Telecom Embedded Hardware Developer

QP Code: TEL/Q2303

QP Version: 3.0

NSQF Level: 4

Model Curriculum Version: 1.0

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Training Parameters

Sector	Telecom
Sub-Sector	Handset
Occupation	Terminal Equipment Application Developer
Country	India
NSQF Level	4
Aligned to NCO/ISCO/ISIC Code	NCO-2015/3114.1501
Minimum Educational Qualification& Experience	12th grade pass OR Completed 2nd year of 3-year diploma (after 10th) OR Pursuing 2nd year of 3-year regular Diploma (after 10th) OR 10th grade pass with two years of any combination of NTC/NAC/CITS or equivalent OR 8th pass plus 2-year NTC plus 1-Year NAC plus 1-Year CITS OR 10th grade pass and pursuing continuous schooling With No Experience required OR Previous relevant Qualification of NSQF Level 3.0 with 3-year relevant experience
Pre-Requisite License or Training	NA
Minimum Job Entry Age	17 Years
Last Reviewed On	27/01/2022
Next Review Date	27/01/2025
NSQC Approval Date	27/01/2022
Version	3.0
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Model Curriculum Version	1.0

Minimum Duration of the Course	540 Hours, 0 Minutes
Maximum Duration of the Course	540 Hours, 0 Minutes

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.

- Identify the role, responsibilities and scope of work of a Telecom Embedded Hardware Developer
- Explain the developing of Embedded Hardware
- Explain the developing of Embedded Firmware
- Discuss how to plan work effectively, implement safety practices and optimize use of resources
- Demonstrate how to communicate, develop interpersonal skills and become gender and Person with Disability (PWD) sensitive.

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	20:00	10:00	00:00	00:00	30:00
Module 1: Role and Responsibilities of a Telecom Embedded Hardware Developer	20:00	10:00	00:00	00:00	30:00
TEL/N2311 – Develop Embedded Hardware NOS Version No. 2.0 NSQF Level 4	60:00	80:00	40:00	00:00	180:00
Module 2: Developing Embedded Hardware	60:00	80:00	40:00	00:00	180:00
TEL/N2312 – Develop Embedded Firmware NOS Version No. 2.0 NSQF Level 4	50:00	80:00	80:00	00:00	210:00
Module 3: Developing Embedded Firmware	50:00	80:00	80:00	00:00	210:00
TEL/N9101 – Organise Work and Resources as per Health and Safety Standards NOS Version No. 1.0 NSQF Level 4	10:00	20:00	00:00	00:00	30:00

Module 4: Plan Work Effectively, Optimise Resources and Implement Safety Practices	10:00	20:00	00:00	00:00	30:00
TEL/N9102 – Interact effectively with team members and customers NOS Version No. 1.0 NSQF Level 4	10:00	20:00	00:00	00:00	30:00
Module 5: Communication and interpersonal skills	10:00	20:00	00:00	00:00	30:00
DGT/VSQ/N0102 Employability Skills (60 Hours)	60:00	00:00	00:00	00:00	60:00
Total Duration	210:00	210:00	120:00	00:00	540:00

Module Details

Module 1: Role and Responsibilities of a Telecom Embedded Hardware Developer Bridge Module

Terminal Outcomes:

- Identify the role and responsibilities of a Telecom Embedded Hardware Developer

Duration: 20:00	Duration: 10:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul style="list-style-type: none"> • Describe the size and scope of the Telecom industry and its various sub-sectors. • Discuss the various opportunities for a Telecom Embedded Hardware Developer in the Telecom industry. • List the role and responsibilities of a Telecom Embedded Hardware Developer. 	<ul style="list-style-type: none"> • Analyse the organisational policies on incentives, delivery standards, personnel management and public relations (PR) pertinent to the job role. • Discuss the importance of seeking help from experts during any stage of main activity in order to avoid any escalation.
Classroom Aids:	
Laptop with software like MS Office and internet, white board, marker, projector	
Tools, Equipment and Other Requirements	

Module 2: Developing Embedded Hardware

Mapped to TEL/N2311 v1.0

Terminal Outcomes:

- Identify the development of embedded hardware peripherals.
- Identify the configuration of embedded system.

Duration: 60:00	Duration: 80:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul style="list-style-type: none"> • Describe different types of components of hardware designs such as micro-controllers, real time data acquisition, control components and sensors. • Discuss the process of designing a peripheral interface for communication protocols such as Universal Asynchronous Receiver and Transmitter (UART), Radio Frequency (RF), Wi-Fi, Bluetooth, etc. • Explain the process of how to simulate digital and analog circuits using simulation tools. • Explain the process to generate the Printed Circuit Board (PCB) schematic and layout. • Describe the process of designing the layout based on the requirements using the defined properties of the layout like width, height, background etc. in XML. • Explain how to record the configuration process and report the problems to the supervisor, if required. • Discuss how to monitor the progress or delay in problem resolution. • Identify the steps for circuit testing, integration and debugging to support embedded products. • Outline Standard operation procedure (SOP) provided by companies in the telecom sector for design and development of embedded hardware. • Describe the basics of embedded hardware design for telecom devices and equipment. 	<ul style="list-style-type: none"> • Demonstrate how to derive technical specification of embedded products. • Perform hardware-software design partitioning. • Demonstrate how to create the design for embedded products and development of circuits. • Demonstrate how to develop based on the requirements. • Demonstrate the steps of tracking the system installation activities.

- Explain different types of communication protocols.
- Describe in detail about the functionalities of the applications, hardware and interfaces.
- Explain the basics of circuits and architectures used in telecom systems and devices.

Classroom Aids:

Laptop with software like MS Office and internet, white board, marker, projector

Tools, Equipment and Other Requirements

Microcontrollers, control components and sensors, Printed Circuit Boards (PCBs)

Module 3: Developing Embedded Firmware

Mapped to TEL/N2312 v1.0

Terminal Outcomes:

- Discuss how to implement embedded telecom firmware developing activities.
- Demonstrate proper techniques for troubleshooting and maintenance of telecom equipment and communication protocols.

Duration: 50:00	Duration: 80:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul style="list-style-type: none"> • Outline SOP provided by companies in the telecom sector for designing and developing embedded firmware. • Explain the typical reporting and documentation procedure for the telecom sector. • Discuss how to maintain firmware based on communication protocols interfaces. • Discuss the importance of maintaining service feedback files and documents. • Recall the concepts of embedded firmware design for telecom devices and equipment. • List the application of programming tools. • Explain the working of communication protocols like Zigbee, Bluetooth, etc. 	<ul style="list-style-type: none"> • Demonstrate how to use programming tools such as GNU compiler collection (GCC), GNU project debugger (GDB), etc. for hardware-software co-design. • Perform steps to develop memory efficient and optimal code for firmware using C/C++ and embedded programming language. • Perform steps for developing wireless connection stacks/firmware for communication protocols which is not limited to Zigbee, Bluetooth, etc. • Employ proper techniques for maintenance of firmware for telecom and support data communication equipment and services. • Employ proper techniques for troubleshooting the telecom equipment/firmware. • Demonstrate how to test and verify the firmware design and the prototype, report to the supervisor in case of any problem. • Demonstrate use of programming languages such as C, C++.
Classroom Aids:	
Whiteboard and markers, chart paper and sketch pens, LCD Projector and Laptop for presentations	
Tools, Equipment and Other Requirements	
Programming tools like GNU compiler collection (GCC), GNU project debugger (GDB), programming language software C/C++	

Module 4: Plan Work Effectively, Optimise Resources and Implement Safety Practices

Mapped to TEL/N9101 v1.0

Terminal Outcomes:

- Explain how to plan work effectively, implement safety practices and optimise use of resources.

Duration: 10:00	Duration: 20:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul style="list-style-type: none"> • List the recent skills and technologies prevalent in the telecom industry. • Discuss the commonly occurring problems with their causes and solutions. • State the importance of keeping the workplace clean, safe and tidy. • List different types of hazards and the procedure to report it to the supervisor. • List the precautionary steps one needs to follow while handling hazardous materials. • State the importance of participating in fire drills and other safety workshops. • Discuss the significance of conforming to basic hygiene practices such as washing hands, using alcohol-based hand sanitizers. • List the different methods of cleaning, disinfection, sanitization, etc. • Discuss the importance of self-quarantine or self-isolation. • Explain the path of disease transmission. • Discuss organizational hygiene and sanitation guidelines and ways of reporting breaches/gaps, if any. • Explain the ways to optimize usage of resources. • Discuss various methods of waste management and disposal. • List the different categories of waste for the purpose of segregation. • Differentiate between recyclable and non-recyclable waste. • State the importance of using appropriate color dustbins for different types of waste. • Discuss the common sources of pollution and ways to minimize it. 	<ul style="list-style-type: none"> • Prepare a time schedule to complete the tasks on the given time. • Demonstrate the use of safety equipment such as goggles, gloves, ear plugs, shoes, etc. • Demonstrate the correct postures while working and handling hazardous materials at the workplace. • Demonstrate how to evacuate the workplace in case of an emergency. • Show how to sanitize and disinfect one's work area regularly. • Demonstrate the correct way of washing hands using soap and water. • Demonstrate the correct way of sanitizing hands using alcohol-based hand rubs. • Display the correct way of wearing and removing PPE such as face masks, hand gloves, face shields, PPE suits, etc. • Demonstrate warning labels, symbols and other related signages. • Perform basic checks to identify any spills and leaks and that need to be plugged /stopped. • Demonstrate different disposal techniques depending upon different types of waste. • Employ different ways to clean and check if equipment/machines are functioning as per requirements and report malfunctioning, if observed. • Demonstrate ways for efficient utilization of material and water.
Classroom Aids	

White board/ black board marker / chalk, Duster, Computer or Laptop attached to LCD projector

Tools, Equipment and Other Requirements

Personal Protection Equipment: Safety glasses, Head protection, Rubber gloves, Safety footwear, Warning signs and tapes, Fire extinguisher and First aid kit

Module 5: Communication and Interpersonal skills

Mapped to TEL/N9102 v1.0

Terminal Outcomes:

- Discuss how to communicate effectively and develop interpersonal skills
- Explain the importance of developing sensitivity towards differently abled people

Duration: 10:00	Duration: 20:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul style="list-style-type: none"> • Discuss the importance of following the standard operating procedures of the company w.r.t priority, confidentiality and security. • Explain the standard procedure of communication and escalations of issues at the workplace. • Discuss the importance of timely rectification of issues. • State the importance of coordinating and resolving conflicts with the team members to achieve smooth workflow. • Discuss about the different types of disabilities with their respective issues. • List health and safety requirements for persons with disability. • Describe the rights, duties and benefits available at workplace for person with disability. • Explain the process of recruiting people with disability for a specific job. • Discuss the specific ways to help people with disability to overcome the challenges. 	<ul style="list-style-type: none"> • Use different modes of communication as per requirement and need. • Prepare a sample report of the commonly occurring errors and their solutions. • Demonstrate the use of gender and PwD (Person with Disability) inclusive language. • Prepare a list of institutes and government schemes that help PwD in overcoming challenges. • Demonstrate the ideal behavior with a PwD in an organization.
Classroom Aids	
Whiteboard and Markers, Chart paper and sketch pens, LCD Projector and Laptop for Presentations	
Tools, Equipment and Other Requirements	
Sample of escalation matrix, organization structure	

Module 6: On-the-Job Training

Mapped to Telecom Embedded Hardware Developer

Mandatory Duration: 120:00	Recommended Duration: 00:00
Location: On-Site	
Terminal Outcomes	
<ol style="list-style-type: none">1. Obtain technical specification of embedded products.2. Complete hardware-software design partitioning.3. Create the design for embedded products4. Create the design and development of circuits.5. Develop the system based on the requirements.6. Carry out tracking the system installation activities.7. Use programming tools.8. Develop memory efficient and optimal code for firmware.9. Develop wireless connection stacks/firmware for communication protocols.10. Maintain firmware for telecom and support data communication equipment and services.11. Troubleshoot the telecom equipment/firmware.12. Test and verify the firmware design and the prototype, report to the supervisor in case of any problem.13. Use of programming languages such as C, C++.	

Module 7: DGT/VSQ/N0102 Employability Skills (60 hours)

Mapped to Telecom Embedded Hardware Developer

Mandatory Duration: 60:00

Location: On-Site

S.No.	Module Name	Key Learning Outcomes	Duration (hours)
1.	Introduction to Employability Skills	<ul style="list-style-type: none"> Discuss the Employability Skills required for jobs in various industries. List different learning and employability related GOI and private portals and their usage. 	1.5
2.	Constitutional values - Citizenship	<ul style="list-style-type: none"> Explain the constitutional values, including civic rights and duties, citizenship, responsibility towards society and personal values and ethics such as honesty, integrity, caring and respecting others that are required to become a responsible citizen. Show how to practice different environmentally sustainable practices. 	1.5
3.	Becoming a Professional in the 21st Century	<ul style="list-style-type: none"> Discuss importance of relevant 21st century skills. Exhibit 21st century skills like Self-Awareness, Behavior Skills, time management, critical and adaptive thinking, problem-solving, creative thinking, social and cultural awareness, emotional awareness, learning to learn etc. in personal or professional life. Describe the benefits of continuous learning. 	2.5
4.	Basic English Skills	<ul style="list-style-type: none"> Show how to use basic English sentences for every day conversation in different contexts, in person and over the telephone. Read and interpret text written in basic English Write a short note/paragraph / letter/e -mail using basic English. 	10
5.	Career Development & Goal Setting	<ul style="list-style-type: none"> Create a career development plan with well-defined short- and long-term goals. 	2
6.	Communication Skills	<ul style="list-style-type: none"> Demonstrate how to communicate effectively using verbal and nonverbal communication etiquette. Explain the importance of active listening for effective communication. Discuss the significance of working collaboratively with others in a team. 	5
7.	Diversity & Inclusion	<ul style="list-style-type: none"> Demonstrate how to behave, communicate, and conduct oneself appropriately with all genders and PwD. Discuss the significance of escalating sexual harassment issues as per POSH act. 	2.5
8.	Financial and Legal Literacy	<ul style="list-style-type: none"> Outline the importance of selecting the right financial institution, product, and service. Demonstrate how to carry out offline and online financial transactions, safely and securely. List the common components of salary and compute income, expenditure, taxes, investments etc. Discuss the legal rights, laws, and aids. 	5
9.	Essential Digital	<ul style="list-style-type: none"> Describe the role of digital technology in today's life. 	10

	Skills	<ul style="list-style-type: none"> • Demonstrate how to operate digital devices and use the associated applications and features, safely and securely. • Discuss the significance of displaying responsible online behavior while browsing, using various social media platforms, e-mails, etc., safely and securely. • Create sample word documents, excel sheets and presentations using basic features. • Utilize virtual collaboration tools to work effectively. 	
10.	Entrepreneurship	<ul style="list-style-type: none"> • Explain the types of entrepreneurship and enterprises. • Discuss how to identify opportunities for potential business, sources of funding and associated financial and legal risks with its mitigation plan. • Describe the 4Ps of Marketing-Product, Price, Place and Promotion and apply them as per requirement. • Create a sample business plan, for the selected business opportunity. 	7
11	Customer Service	<ul style="list-style-type: none"> • Describe the significance of analyzing different types and needs of customers. • Explain the significance of identifying customer needs and responding to them in a professional manner. • Discuss the significance of maintaining hygiene and dressing appropriately. 	5
12	Getting Ready for Apprenticeship & Jobs	<ul style="list-style-type: none"> • Create a professional Curriculum Vitae (CV). • Use various offline and online job search sources such as employment exchanges, recruitment agencies, and job portals respectively. • Discuss the significance of maintaining hygiene and confidence during an interview. • Perform a mock interview. • List the steps for searching and registering for apprenticeship opportunities. 	8

LIST OF TOOLS & EQUIPMENT FOR EMPLOYABILITY SKILLS

S No.	Name of the Equipment	Quantity
1.	Computer (PC) with latest configurations – and Internet connection with standard operating system and standard word processor and worksheet software (Licensed) (all software should either be latest version or one/two version below)	As required
2.	UPS	As required
3.	Scanner cum Printer	As required
4.	Computer Tables	As required
5.	Computer Chairs	As required
6.	LCD Projector	As required
7.	White Board 1200mm x 900mm	As required

Note: Above Tools & Equipment not required, if Computer LAB is available in the institute.

Annexure

Trainer Requirements (Telecom Embedded Hardware Developer)

Trainer Prerequisites						
Minimum Educational Qualification	Specialization	Relevant Industry Experience		Training Experience		Remarks
		Years	Specialization	Years	Specialization	
Graduate	Science/Electrical/Electronics /Telecom and other related domain	1	Telecom Embedded Development	0	NA	Eligible for ToT Program

Trainer Certification	
Domain Certification	Platform Certification
Job Role: “Telecom Embedded Hardware Developer” “TEL/Q2303 v3.0”, Minimum accepted score is 80%	Job Role: “Trainer (VET and Skills)”, “MEP/Q2601” v2.0, Minimum accepted score is 80%

Assessor Requirements (Telecom Embedded Hardware Developer)

Assessor Prerequisites						
Minimum Educational Qualification	Specialization	Relevant Industry Experience		Training Experience		Remarks
		Years	Specialization	Years	Specialization	
Graduate	Science/Electrics/Telecom and other Related Domain	1	Telecom Embedded Development	0	NA	Eligible for ToA Program

Assessor Certification	
Domain Certification	Platform Certification
Job Role: “Telecom Embedded Hardware Developer” “TEL/Q2303 v3.0”, Minimum accepted score is 80%	Job Role: “Assessor (VET and Skills)” “MEP/Q2701”v2.0, Minimum accepted score is 80%

Trainer Requirements (Employability Skills 60 hours)

Trainer Prerequisites						
Minimum Educational Qualification	Specialization	Relevant Industry Experience		Training Experience		Remarks
		Years	Specialization	Years	Specialization	
Graduate/CITS	Any discipline			2	Teaching experience	Prospective ES trainer should:
Current ITI trainers	Employability Skills Training (3 days full-time course done between 2019-2022)					<ul style="list-style-type: none"> • have good communication skills • be well versed in English • have digital skills • have attention to detail • be adaptable • have willingness to learn
Certified current EEE trainers (155 hours)	from Management SSC (MEPSC)					
Certified Trainer	Qualification Pack: Trainer (MEP/Q0102)					

Trainer Certification	
Domain Certification	Platform Certification
Certified in 60-hour Employability NOS (2022), with a minimum score of 80% OR Certified in 120-, 90-hour Employability NOS (2022), with a minimum score of 80%	NA

Master Trainer Requirements (Employability Skills 60 hours)

Master Trainer Prerequisites						
Minimum Educational Qualification	Specialization	Relevant Industry Experience		Training Experience		Remarks
		Years	Specialization	Years	Specialization	
Graduate/CITS	Any discipline			3	Employability Skills curriculum training experience with an interest to train as well as orient other peer trainers	Prospective ES Master trainer should: <ul style="list-style-type: none"> • have good communication skills • be well versed in English • have basic digital skills
Certified Master Trainer	Qualification Pack: Master Trainer (MEP/Q2602			3	EEE training of Management SSC (MEPSC) (155 hours)	<ul style="list-style-type: none"> • have attention to detail • be adaptable • have willingness to learn • be able to grasp concepts fast and is creative with teaching practices and likes sharing back their learning with others

Master Trainer Certification	
Domain Certification	Platform Certification
Certified in 60-hour Employability NOS (2022), with a minimum score of 90% . OR Certified in 120-, 90-hour Employability NOS (2022), with a minimum score of 90%	NA

Assessment Strategy

1. Assessment System Overview:

- Batches assigned to the assessment agencies for conducting the assessment on SDSM/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
- Center photographs with sign boards 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

Assessment Strategy (Employability Skills 60 hours)

The trainee will be tested for the acquired skill, knowledge and attitude through formative/summative assessment at the end of the course and as this NOS and MC is adopted across sectors and qualifications, the respective AB can conduct the assessments as per their requirements.

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 Outcome	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 task. It is the ability to work, or produce a tangible work output by applying cognitive, affective or psychomotor skills.
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
QP	Qualification Pack
NSQF	National Skills Qualification Framework
NSQC	National Skills Qualification Committee
NOS	National Occupational Standards
SOP	Standard Operating Procedures
CRM	Customer Relationship Management
AT	Acceptance Test
DG	Diesel Generator
PIU	Power Interface Unit
SMPS	Switch Mode Power Supply
FTP	File Transfer Protocol
BSC	Base Station Controller
AMF	Auto Man Failure
PPE	Personal Protective Equipment
FM	Field Maintenance
PwD	Persons with Disabilities
EB	Electricity Board
MCB	Miniature Circuit Breaker
NOC	Network Operating Centre
SLA	Service Level Agreement
PM	Preventive Maintenance
CM	Corrective Maintenance
TRX	Transceiver
NMS	Network Monitoring System
MOP	Maintenance Operation Protocol
ES	Employability Skills