

# Model Curriculum

## Telecom Embedded Hardware Developer

**SECTOR: TELECOM**  
**SUB-SECTOR: HANDSET**  
**OCCUPATION: DEVELOPMENT TESTING AND SUPPORT**  
**REF ID: TEL/Q2303**  
**NSQF LEVEL: 4**

 Skill India वीर्यं भारत - कुशलं भारत	 Telecom Sector Skill Council	 N-S-D-C National Skill Development Corporation Transforming the skill landscape
<h2>Certificate</h2>		
<b>COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS</b>		
is hereby issued by the		
<b>TELECOM SECTOR SKILL COUNCIL</b>		
for		
<b>MODEL CURRICULUM</b>		
Complying to National Occupational Standards of Job Role/ Qualification Pack: 'Telecom Embedded Hardware Developer' QP No. <u>TEL/Q2303 NSQF Level 4</u>		
Date of Issuance:	<b>May 15<sup>th</sup>, 2016</b>	 Authorised Signatory (Telecom Sector Skill Council)
Valid up to*:	<b>May 15<sup>th</sup>, 2018</b>	
<small>*Valid up to the next review date of the Qualification Pack or the 'Valid up to' date mentioned above (whichever is earlier)</small>		

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# Telecom Embedded Hardware Developer

## CURRICULUM / SYLLABUS

This program is aimed at training candidates for the job of a “Telecom Embedded Hardware Developer”, in the “Telecom” Sector/Industry and aims at building the following key competencies amongst the learner

<b>Program Name</b>	<b>Telecom Embedded Hardware Developer</b>		
<b>Qualification Pack Name &amp; Reference ID. ID</b>	TEL/Q2303, v1.0		
<b>Version No.</b>	1.0	<b>Version Update Date</b>	14-05-2017
<b>Pre-requisites to Training</b>	<ul style="list-style-type: none"> <li>• Diploma ( Electrical/ Electronics/ Computer Science)</li> <li>• Development of Embedded Hardware Products</li> <li>• Troubleshooting and de-bugging of Telecom Hardware</li> </ul>		
<b>Training Outcomes</b>	<p><b>After completing this programme, participants will be able to:</b></p> <p>carry out the role of Telecom Embedded Hardware Developer which involves</p> <ul style="list-style-type: none"> <li>• Understand Basic Telecom Embedded Hardware Development</li> <li>• Understand basics of Electronic Hardware components &amp; troubleshooting of Embedded Hardware</li> <li>• Understand Telecom Embedded Hardware PCB design</li> <li>• Embedded Firmware Development</li> <li>• Communication Protocol Firmware Development</li> <li>• Emergency procedure in working environment</li> </ul>		

This course encompasses 3 out of 3 National Occupational Standards (NOS) of “Telecom Embedded Hardware Developer” Qualification Pack issued by “Telecom Skill Council of India”.

Sr. No.	Module	Key Learning Outcomes	Equipment Required
1	<b>Basics of Electronics</b>  <b>Theory Duration</b> (hh:mm) 20:00 <b>Practical Duration</b> (hh:mm) 00:00  Corresponding <b>NOS Code</b> TEL/N2311	<ul style="list-style-type: none"> <li>To get familiar with commonly used active and passive electronic components</li> <li>To learn the basic building blocks commonly used in making projects</li> <li>To learn software simulation tools used for circuit design and analysis</li> <li>To learn soldering and the use of test equipment in fault finding</li> <li>To construct a simple project</li> </ul>	Laptop, white board, marker, projector
2	<b>PCB Design &amp; Testing</b>  <b>Theory Duration</b> (hh:mm) 20:00 <b>Practical Duration</b> (hh:mm) 30:00  <b>Corresponding NOS Code</b> TEL/N2311	<ul style="list-style-type: none"> <li>Introduction</li> <li>Schematic creation</li> <li>Board creation</li> <li>Report generation</li> <li>Fabrication</li> </ul>	Laptop, white board, marker, projector DipTrace for PCB Designing  Arduino IDE or equivalent as per the board specifications  Keil uvision5 or equivalent as per the board  AVR Studio4 or equivalent as per the board
3	<b>Embedded Hardware Testing</b>  <b>Theory Duration</b> (hh:mm) 20:00 <b>Practical Duration</b> (hh:mm) 40:00  <b>Corresponding NOS Code</b> TEL/N2311	<ul style="list-style-type: none"> <li>Simulation of Circuit</li> <li>Testing of PCB</li> <li>Using Multimeter &amp; other Testing equipment</li> </ul>	Multimeter, PCB's, Solder Irons, Arduino Uno or equivalent Development Board, PIC Development Board & Programmer, AVR Development Board & Programmer, ARM Development Board & Programmer
4	<b>Embedded C</b>	<ul style="list-style-type: none"> <li>Working with Compilers (gcc)</li> </ul>	Programming tools like :

Sr. No.	Module	Key Learning Outcomes	Equipment Required
	<b>Programming</b>  <b>Theory Duration</b> (hh:mm) 30:00  <b>Practical Duration</b> (hh:mm) 30:00  <b>Corresponding NOS Code</b> TEL/N2312	<ul style="list-style-type: none"> <li>Basics of Programming</li> <li>Understanding Embedded C</li> <li>Memory Efficiency &amp; Optimization</li> <li>Troubleshooting &amp; Maintenance</li> </ul>	VLSI tool
5	<b>Microcontrollers &amp; other programming devices</b>  <b>Theory Duration</b> (hh:mm) 30:00  <b>Practical Duration</b> (hh:mm) 20:00  <b>Corresponding NOS Code</b> TEL/ N2312	<ul style="list-style-type: none"> <li>Architecture of Microcontrollers</li> <li>Basic Peripherals</li> <li>Input &amp; Output devices</li> <li>Working with sensors</li> </ul>	8051 Development Board & Programmer or equivalent  Microcontrollers and ICs (MAX232 , PC817 , ULN2803 , L293D , DS1307 , 555 , LM358 , LM35 , PIR Sensor , Relay , LDR , UltraSonic Sensor etc.)  Resistors , Capacitors , Switches , LCD , Motors (DC geared , Stepper , Servo)
6	<b>Communication Protocol Firmware Development</b>  <b>Theory Duration</b> (hh:mm) 10:00  <b>Practical Duration</b> (hh:mm) 45:00  <b>Corresponding NOS Code</b> TEL/N2312	<ul style="list-style-type: none"> <li>Understanding Serial Communication</li> <li>Bluetooth Communication</li> <li>SPI Interface</li> <li>ZigBee</li> <li>I2C</li> <li>SPI</li> <li>Infrared</li> <li>RF</li> <li>GSM</li> <li>GPS</li> <li>PDH/SDH/Ethernet</li> </ul>	Various Modules ,GSM, GPS, RF Receiver & Transmitter, Bluetooth, Wi-Fi Module, Zigbee, IR , USB to TTL converter
7	<b>Testing &amp; Troubleshooting of Firmware</b>  <b>Theory Duration</b> (hh:mm) 05:00  <b>Practical Duration</b> (hh:mm) 40:00  <b>Corresponding NOS Code</b> TEL/N2312	<ul style="list-style-type: none"> <li>Verify</li> <li>Test</li> <li>Debug</li> </ul>	MicroC Pro for PIC, MPLAB, Keiluvision for ARM, Proteus, HyperTerminal, XCTU or equivalent

Sr. No.	Module	Key Learning Outcomes	Equipment Required
8	<b>Healthy &amp; Secure working Environment</b>  <b>Theory Duration</b> (hh:mm) 05:00  <b>Practical Duration</b> (hh:mm) 05:00  <b>Corresponding NOS Code</b> TEL/N2313	<ul style="list-style-type: none"> <li>Follow Road safety guidelines</li> <li>Perform circuit planning and create layout for circuit safety</li> <li>Understand First – aid procedures</li> <li>Follow Soldering safety guidelines</li> <li>Follow general electrical safety guidelines</li> <li>Understand use of voltmeter</li> <li>Understand lead causes of fire in various equipments and prevent fire accidents</li> <li>Use of fire extinguishers at site</li> </ul>	Fireextinguish, Gloves, and safety kit.
	<b>Total Duration</b>  <b>Theory Duration</b> <b>140:00</b>  <b>Practical Duration</b> <b>210:00</b>	<b>Unique Equipment Required:</b> Black/ White board, marker, projector system with PC/Laptop	

Grand Total Course Duration: **350Hours, 0 Minutes**

*(This syllabus/ curriculum has been approved by [Telecom Sector Skill Council](#))*

## Trainer Prerequisites for Job role: “Telecom Embedded Hardware Developer” mapped to Qualification Pack: “TEL/Q2303, v1.0”

Sr. No.	Area	Details
1	<b>Description</b>	To deliver accredited training service, mapping to the curriculum detailed above, in accordance with the Qualification Pack “TEL/Q2303”, Version No. 1.0.
2	<b>Personal Attributes</b>	Personal Attributes: This job requires the individual to be analytical and be able to handle high-pressure situations to successfully perform the assigned responsibilities. He should have basic knowledge of electronics, embedded programming, written and oral communication skills and should be able to apply practical judgment to successfully perform the assigned responsibilities.
3	<b>Minimum Educational Qualifications</b>	Diploma(Electrical/ Electronics/ Computer Science)
4a	<b>Domain Certification</b>	Certified for Job Role: “Telecom Embedded Hardware Developer” mapped to QP: “TEL/Q2303” Version No. 1.0. Minimum accepted score as per respective TSSC guidelines.
4b	<b>Platform Certification</b>	Recommended that the Trainer is certified for the Job Role: “Trainer”, mapped to the Qualification Pack: “TEL/Q2303” Version No. 1.0. Minimum accepted score as per respective TSSC guidelines.
5	<b>Experience</b>	<ul style="list-style-type: none"> <li>• The trainer should be certified by TSSC as ‘Train the Trainer’ and Assessor and</li> <li>• Worked as Embedded Hardware Developer for minimum 4-5 years if educational qualification is ITI/ Diploma</li> <li>or</li> <li>• Worked as Embedded Hardware Developer for 2-3 years if educational qualification is Bachelor in Technology (BTech and BE)</li> </ul>



### Annexure: Assessment Criteria

<b>Assessment Criteria</b>	
<b>Job Role</b>	<b>Telecom Embedded Hardware Developer</b>
<b>Qualification Pack</b>	<b>TEL/Q2303, v1.0</b>
<b>Sector Skill Council</b>	<b>Telecom</b>

<b>Sr. No.</b>	<b>Guidelines for Assessment</b>
1	Criteria for assessment for each Qualification Pack will be created by the Sector Skill Council. Each Performance Criteria (PC) will be assigned marks proportional to its importance in NOS. TSSC will also lay down proportion of marks for Theory and Skills Practical for each PC.
2	The assessment for the theory part will be based on knowledge bank of questions created by the TSSC.
3	Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training centre(as per assessment criteria below)
4	Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training centre (as per assessment criteria below)
5	To pass the Qualification Pack, every trainee should score 70% overall.
6	In case of successfully passing only certain number of NOS's, the trainee is eligible to take subsequent assessment on the balance NOS's to pass the Qualification Pack.

Assessable Outcome	Assessment Criteria	Total Mark (200+100)	Out Of	Theory	Skills Practical	
<b>1. TEL/N2311 (Embedded Hardware Development)</b>	<b>Embedded Hardware Development</b>	PC1. handle activities such as requirement definition to derive technical specification of embedded products	100	64	19	45
		PC2. architect, design and develop circuits for embedded products				
		PC3. hardware-software design partitioning				
		PC4. design peripheral interfaces for communication protocols like I2C, SPI, UART, Infrared, RF, GSM, GPS, PDH/SDH/Ethernet, QSPI, Zigbee, Wi-Fi and Bluetooth				
		PC5. select components for the hardware design including micro-controllers, real time data acquisition and control components and sensors				
		PC6. simulate digital and analog circuits using simulation tools				
		PC7. generate PCB schematic & layout				
	<b>Embedded System Installation / Configuration</b>	monitor problems and keep track of system installation activities, progress or any delays in resolving the problems for embedded systems	36	14	22	
		develop small, intelligent communication and networking gadgets and applications				
		ensure circuit testing, integration and debugging to support and maintain embedded products				
			100	33	67	

<b>2. TEL/N2312 (Embedded Firmware development)</b>	<b>Development of Embedded Firmware</b>	PC1. develop firmware using embedded C and C++ programming language		60	22	38			
		PC2. use programming tools like gcc, gdb, eclipse and integrated design environments for HW-SW co-design							
		PC3. code firmware for micro-controllers & other programmable devices							
		PC4. develop memory efficient and computationally optimal code for telecom products							
		PC5. use & develop wireless connectivity stacks/firmware for communication protocols including, but not limited to Zigbee, Bluetooth, TCP/IP, SPI, I2C, USB, RS232, RS485							
	<b>Troubleshooting and Maintenance</b>	PC6. handle the firmware for maintenance and troubleshooting of telecom equipment					20	7	13
		PC7. support data communication equipment and services							
		PC8. test and verify firmware design and prototyping							
	<b>Report &amp; Record</b>	PC9. handle firmware of network systems based on communication protocols interfaces like I2C, SPI, UART, Infrared, RF, GSM, GPS, PDH/SDH/Ethernet, QSPI, Zigbee, Wi-Fi and Bluetooth					20	5	15
			100	34	66				

<b>TEL/N4121(</b> <b>Maintain a</b> <b>healthy, safe</b> <b>and secure</b> <b>working</b> <b>environment)</b>	<b>Emergency</b> <b>procedures</b>	PC1. Ensure that work is carried out in accordance to the level of competence and legal requirements	<b>100</b>	<b>100</b>	<b>57</b>	<b>43</b>
		PC2. Ensure that sites are assessed for health and safety risk as per company's guidelines prior to commencement of work				
		PC3. Ensure environmental conditions and hazards like Earth Potential Rise (EPR) are considered while carrying out work				
		PC4. Identify and correct any hazards that you can deal with safely, competently and within the limits of your authority				
		PC5. Report any hazards that you are not competent to deal with to the relevant person in line with organizational procedures and warn other people who may be affected				
		PC6. Follow your organization's emergency procedures promptly, calmly, and efficiently				
		PC7. Identify and recommend opportunities for improving health, safety, and security to the designated person				
		PC8. Complete any health and safety records legibly and accurately				
<b>Total</b>				100	57	43
<b>Grand Total</b>			300	300	124	176
<b>Percentage Weightage:</b>					40%	60%
<b><u>Minimum Pass% to qualify (aggregate):</u></b>					70%	