

QUALIFICATIONS PACK - OCCUPATIONAL STANDARDS FOR TELECOM INDUSTRY

What are Occupational Standards(OS)?

- OS describe what individuals need to do, know and understand in order to carry out a particular job role or function
- OS are performance standards that individuals must achieve when carrying out functions in the workplace, together with specifications of the underpinning knowledge and understanding

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Introduction

Qualifications Pack- Telecom Embedded Hardware Developer

SECTOR: TELECOM

SUB-SECTOR: HANDSET

OCCUPATION: Terminal Application Developer

REFERENCE ID: TEL/Q2303

ALIGNED TO: NCO-2015/3114.1501

Brief Job Description: This unit is about dealing with industry standard design techniques, flows and tools involved in design, prototyping and maintenance of Telecom Embedded Hardware designs, systems and products.

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.

Job Details	Qualifications Pack Code	TEL/Q2303		
	Job Role	Telecom Embedded Hardware Developer		
	Credits (NSQF)	TBD	Version number	1.0
	Sector	Telecom	Drafted on	08/01/2015
	Sub-sector	Handset	Last reviewed on	21/06/2018
	Occupation	Ter. Equipment Developer	Next review date	31/03/2019
	NSQC Clearance on	20/07/2015		

Job Role	Telecom Embedded Hardware Developer
Role Description	Telecom Embedded hardware developer is dealing with industry standard design techniques, flows and tools involved in design, prototyping and maintenance of Telecom Embedded Hardware designs, systems and products.
NSQF level	4
Minimum Educational Qualifications*	Diploma(Electrical/ Electronics/ Computer Science)
Maximum Educational Qualifications*	Graduate(Electrical/Electronics/ Computer Science)
Training (Suggested but not mandatory)	Development of Embedded Hardware Products Troubleshooting and debugging of Telecom Hardware
Minimum Job Entry Age	18 Years
Experience	0-2 years of work experience in hardware design and development
Applicable National Occupational Standards (NOS)	Compulsory: 1. TEL/N 2311 (Embedded Hardware Development) 2. TEL/N 2312 (Embedded Firmware Development) 3. TEL/N 4121 (Maintain a Healthy, Safe and Secure Working Environment)
Performance Criteria	As described in the relevant OS units

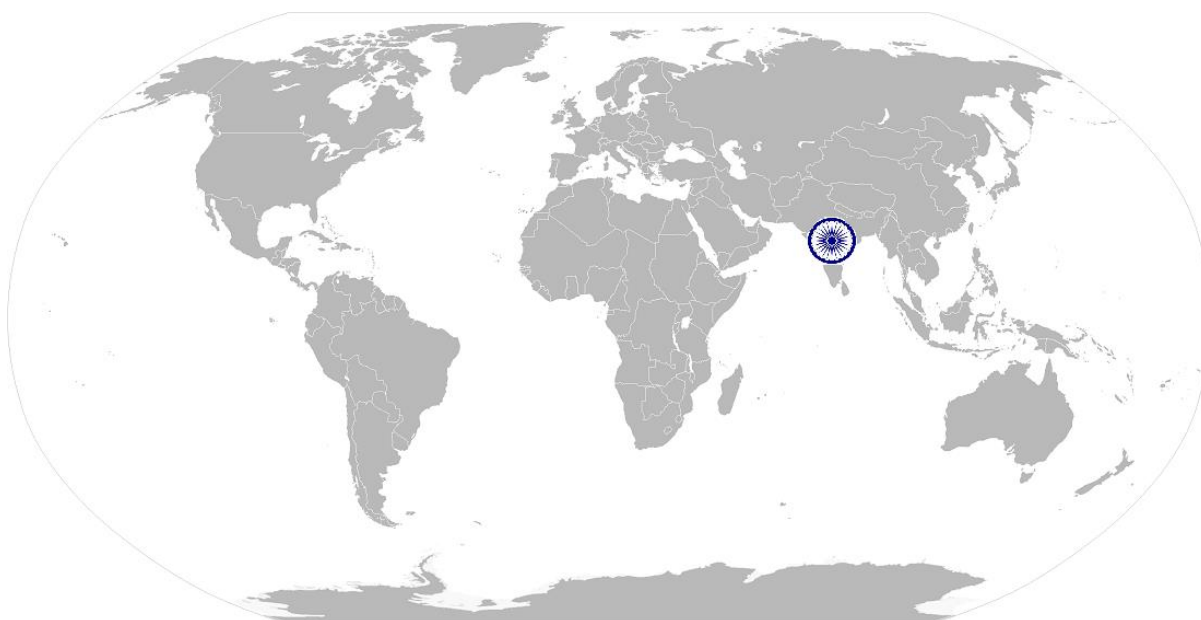
Definitions

Keywords /Terms	Description
Sector	Sector is a conglomeration of different business operations having similar businesses and interests. It may also be defined as a distinct subset of the economy whose components share similar characteristics and interests.
Sub-sector	Sub-sector is derived from a further breakdown based on the characteristics and interests of its components
Occupation	Occupation is a set of job roles, which perform similar/related set of functions in an industry.
Function	Function is an activity necessary for achieving the key purpose of the sector, occupation, or area of work, which can be carried out by a person or a group of persons. Functions are identified through functional analysis and form the basis of OS.
Job Role	Job role defines a unique set of functions that together form a unique employment opportunity in an organization.
OS	OS specify the standards of performance an individual must achieve when carrying out a function in the workplace, together with the knowledge and understanding they need to meet that standard consistently. Occupational Standards are applicable both in the Indian and global contexts.
Performance Criteria	Performance Criteria are statements that together specify the standard of performance required when carrying out a task.
NOS	NOS are Occupational Standards which apply uniquely in the Indian context.
Qualifications Pack Code	Qualifications Pack Code is a unique reference code that identifies a qualifications pack.
Qualifications Pack	Qualifications Pack comprises the set of OS, together with the educational, training and other criteria required to perform a job role. A qualifications Pack is assigned a unique qualification pack code.
Unit Code	Unit Code is a unique identifier for an Occupational Standard, which is denoted by an 'N'.
Unit Title	Unit Title gives a clear overall statement about what the incumbent should be able to do.
Description	Description gives a short summary of the unit content. This would be helpful to anyone searching on a database to verify that this is the appropriate OS they are looking for.
Knowledge and Understanding	Knowledge and Understanding are statements which together specify the technical, generic, professional and organizational specific knowledge that an individual needs in order to perform to the required standard.
Organizational Context	Organizational Context includes the way the organization is structured and how it operates, including the extent of operative knowledge managers have of their relevant areas of responsibility.

Acronyms

Technical Knowledge	Technical Knowledge is the specific knowledge needed to accomplish specific designated responsibilities.
Core Skills or Generic Skills	Core Skills or Generic Skills are a group of skills that are key to learning and working in today's world. These skills are typically needed in any work environment. In the context of the OS, these include communication related skills that are applicable to most job roles.
Keywords /Terms	Description
I2C	Inter-Integrated Circuit
UART	Universal Asynchronous Receiver and Transmitter
RF	Radio Frequency
SPI	Serial Peripheral Interface
SHE	Safety, Health & Environment
SLA	Service Level Agreement
GSM	Global System for Mobile Communications
GPS	Global Positioning System
PDH/SDH	Plesiochronous Digital Hierarchy/Synchronous Digital Hierarchy
QSPI	Quad Serial Peripheral Interface

National Occupational Standard



Overview

This unit is about dealing with industry standard design techniques, flows and tools involved in design and development of telecom embedded hardware products.

TEL/N2311

Embedded Hardware Development

National Occupational Standard

Unit Code	TEL/N2311
Unit Title (Task)	Embedded Hardware Development
Description	This unit is about dealing with industry standard design techniques, flows and tools involved in design and development of telecom embedded hardware products.
Scope	This unit/task covers the following: Embedded Hardware Development • hardware design • signal processing, data acquisition • communication interfaces Embedded System Installation/ Configuration • system configuration • bug tracking
Performance Criteria(PC) w.r.t. the Scope	
Element	Performance Criteria
Embedded Hardware Development	Competent user/individual on the job must be able to: PC1. handle activities such as requirement definition to derive technical specification of embedded products 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
Embedded System Installation / Configuration	Competent user/individual on the job must be able to: PC8. monitor problems and keep track of system installation activities, progress or any delays in resolving the problems for embedded systems PC9. develop small, intelligent communication and networking gadgets and applications PC10. ensure circuit testing, integration and debugging to support and maintain embedded products
Knowledge and Understanding (K)	
A. Organizational Context (Knowledge of the company / organization and its processes)	The user/individual on the job needs to know and understand: KA1. relevant legislation, standards, policies, and procedures followed in the company KA2. how to engage with both internal and external specialists for support in order to resolve incidents and service requests KA3. service request procedures, tools, and techniques

TEL/N2311

Embedded Hardware Development

B. Technical Knowledge	The user/individual on the job needs to know and understand: KB1. basics of embedded hardware design for telecom devices and equipment KB2. basics of core programming of telecom devices and equipment KB3. acquire knowledge of basic communication protocols KB4. basics of circuits and architectures used in telecom systems and devices KB5. maintain a knowledge-base of the known problems KB6. basic functionalities of the applications, hardware and interfaces
Skills (S) [Optional]	
A. Core Skills/ Generic Skills	Writing Skills
	The user/ individual on the job needs to know and understand how to: SA1. prepare status and progress reports SA2. fill up record sheets clearly, concisely and accurately as per company procedures SA3. write memos and e-mail to customers, co-workers, and vendors to provide them with work updates and to request appropriate information without English language errors regarding grammar or sentence construct
	Reading Skills
	The user/individual on the job needs to know and understand how to: SA4. read and comprehend test & measurement specifications of telecom device and equipment SA5. read and comprehend system requirement specifications of telecom device and equipment SA6. read the standard operating procedures for telecom device and equipment
	Oral Communication (Listening and Speaking skills)
	The user/individual on the job needs to know and understand how to: SA7. discuss task lists, schedules, and work-loads with co-workers SA8. question customers appropriately in order to understand the nature of the problem and make a diagnosis SA9. give clear instructions to customers SA10. keep customers informed about progress SA11. avoid using jargon, slang or acronyms when communicating with a customer, unless it is required
B. Professional Skills	Decision Making
	The user/individual on the job needs to know and understand how to: SB1. make decisions pertaining to the concerned area of work
	Plan and Organize
	The user/individual on the job needs to know and understand: SB2. plan and organize service feedback files/documents
	Customer Centricity
	The user/individual on the job needs to know and understand how to: SB3. manage relationships with customers who may be stressed, frustrated, confused, or angry

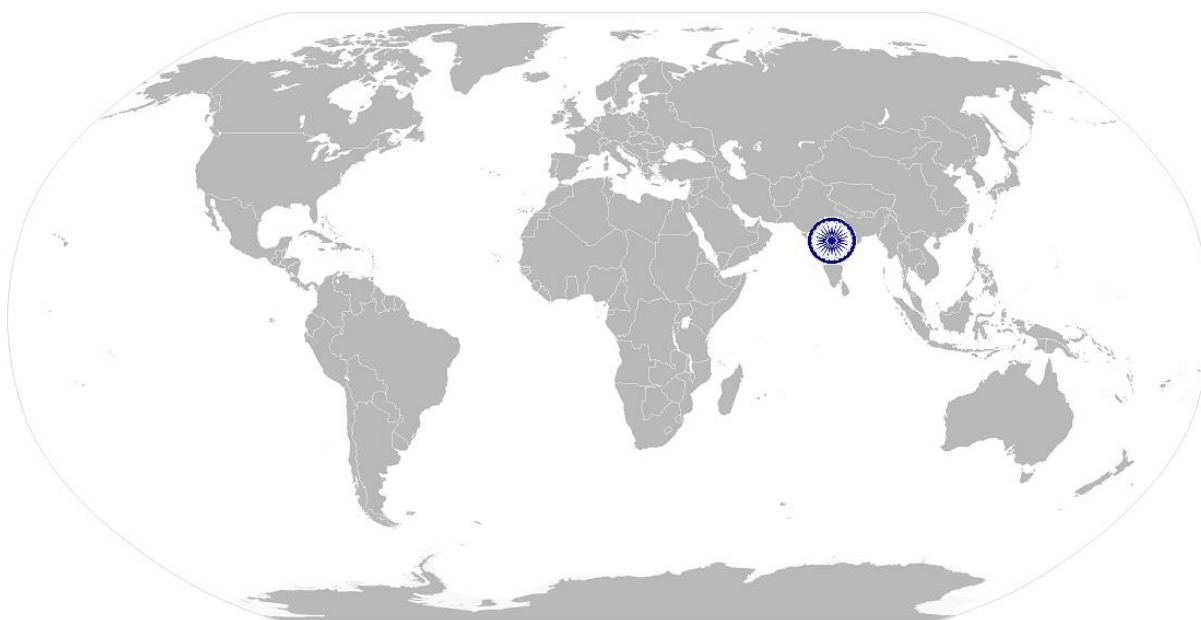
TEL/N2311

Embedded Hardware Development

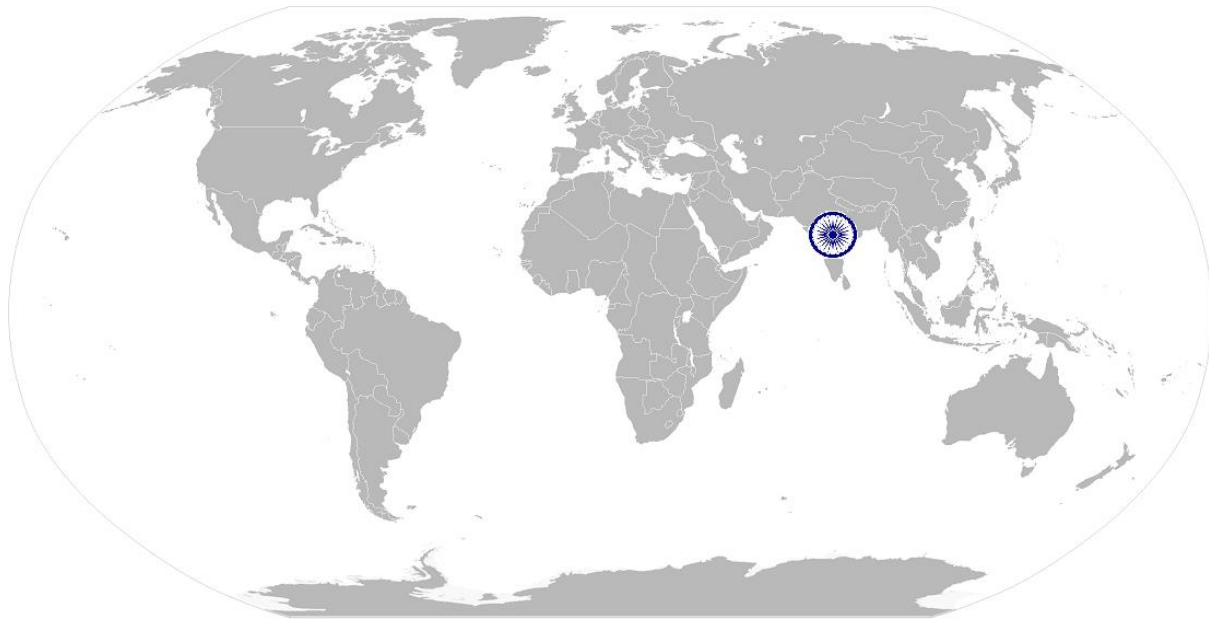
	SB4. build customer relationships and use customer centric approach
	Problem Solving
	The user/individual on the job needs to know and understand how to: SB5. think through the problem, evaluate the possible solution(s) and suggest an optimum /best possible solution(s) SB6. deal with clients lacking the technical background to solve the problem on their own SB7. identify immediate or temporary solutions to resolve delays
	Analytical Thinking
	The user/individual on the job needs to know and understand how to: SB8. use the existing data to arrive at specific data points SB9. use the existing data points for improving the call resolution time SB10. use the existing data points to generate required reports for business
	Critical Thinking
	The user/individual on the job needs to know and understand how to: SB11. apply, analyze, and evaluate the information gathered from observation, experience, reasoning, or communication, as a guide to thought and action

NOS Version Control

NOS Code	TEL/N2311		
Credits (NSQF)	TBD	Version number	1.0
Industry	Telecom	Drafted on	13/01/2015
Industry Sub-sector	Handset	Last reviewed on	21/06/2018
Occupation	Terminal Equipment Application Developer	Next review date	31/03/2019



National Occupational Standard



Overview

This unit is about dealing with industry standard design techniques, flows and tools involved in design, debug and commissioning of embedded firmware development.

TEL/N2312

Embedded Firmware Development

National Occupational Standard

Unit Code	TEL/N2312
Unit Title (Task)	Embedded Firmware Development
Description	This OS unit is industry standard design techniques, flows and tools involved in Design and Development of Telecom Embedded Firmware.
Scope	This unit/task covers the following: Development of Embedded Firmware: - firmware - middleware - drivers - connectivity stacks Troubleshooting and Maintenance: - test - verify - debug Communication Protocols Firmware Development: - network firmware
Performance Criteria(PC) w.r.t. the Scope	
Element	Performance Criteria
Development of Embedded Firmware	PC1. develop firmware using embedded C and C++ programming languages 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
Troubleshooting and Maintenance	PC6. handle the firmware for maintenance and troubleshooting of telecom equipment PC7. support data communication equipment and services PC8. test and verify firmware design and prototyping
Communication Protocols Firmware Development	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

TEL/N2312

Embedded Firmware Development

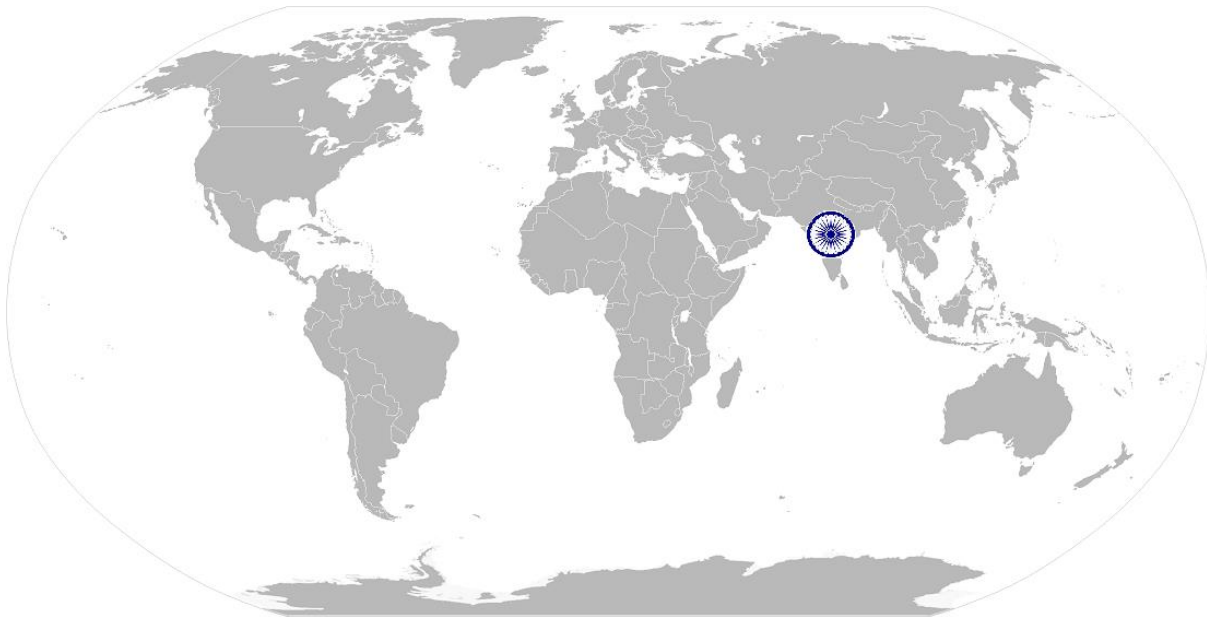
Knowledge and Understanding (K)	
B. Organizational Context (Knowledge of the company / organization and its processes)	The user/individual on the job needs to know and understand: KA1. relevant legislation, standards, policies, and procedures followed in the company KA2. how to engage with both internal and external specialists for support in order to resolve incidents and service requests KA3. service request procedures, tools, and techniques KA4. potential helpdesk customers and their typical requirements KA5. role and importance of the helpdesk in supporting business operations
B. Technical Knowledge	The user/individual on the job needs to know and understand: KB1. basics of Embedded Firmware design for Telecom Devices and Equipment KB2. basics of Core Programming of Telecom Devices and Equipment KB3. acquire knowledge of basic Communication Protocols KB4. basics of Circuits and Architectures used in Telecom Systems and Devices KB5. maintain a knowledge-base of the known problems KB6. basic functionalities of the applications, firmware and interfaces
Skills (S) [Optional]	
C. Core Skills/ Generic Skills	Writing Skills
	The user/ individual on the job needs to know and understand how to: SA1. fill up record sheets clearly and accurately as per company procedures SA2. prepare status and progress reports SA3. write memos and e-mail to customers, co-workers, and vendors to provide them with work updates and to request appropriate information without English language errors regarding grammar or sentence construct
	Reading Skills
	The user/individual on the job needs to know and understand how to: SA4. read and comprehend System Requirement Specifications of Telecom Device and Equipment SA5. read and comprehend Test & Measurement Specifications of Telecom Device and Equipment SA6. read the standard operating procedures for Telecom Device and Equipment
	Oral Communication (Listening and Speaking skills)
	The user/individual on the job needs to know and understand how to: SA7. clearly communicate relevant information to supervisors SA8. respond appropriately to queries SA9. communicate with customer/customer facing teams to understand handset performance issues SA10. communicate in the local language SA11. convey proposed solution to the customers

TEL/N2312
Embedded Firmware Development

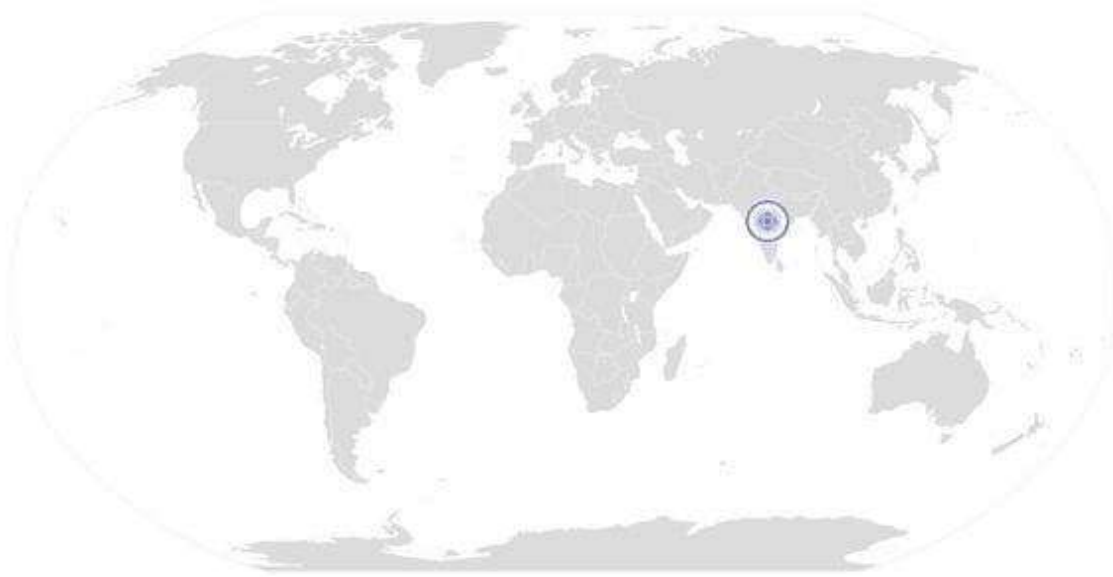
D. Professional Skills	Decision Making
	The user/individual on the job needs to know and understand how to: SB1. make decisions pertaining to the concerned area of work
	Plan and Organize
	The user/individual on the job needs to know and understand: SB2. plan and organize service feedback files/documents
	Customer Centricity
	The user/individual on the job needs to know and understand how to: SB3. manage relationships with customers who may be stressed, frustrated, confused, or angry SB4. build customer relationships and use customer centric approach
	Problem Solving
	The user/individual on the job needs to know and understand how to: SB5. think through the problem, evaluate the possible solution(s) and suggest an optimum /best possible solution(s) SB6. deal with clients lacking the technical background to solve the problem on their own SB7. identify immediate or temporary solutions to resolve delays
	Analytical Thinking
	The user/individual on the job needs to know and understand how to: SB8. use the existing data to arrive at specific data points SB9. use the existing data points for improving the call resolution time SB10. use the existing data points to generate required reports for business
	Critical Thinking
	The user/individual on the job needs to know and understand how to: SB11. apply, analyze, and evaluate the information gathered from observation, experience, reasoning, or communication, as a guide to thought and action

NOS Version Control

NOS Code	TEL/N2312		
Credits (NSQF)	TBD	Version number	1.0
Industry	Telecom	Drafted on	13/01/2015
Industry Sub-sector	Handset	Last reviewed on	21/06/2018
Occupation	Terminal Equipment Application Developer	Next review date	31/03/2019



National Occupational Standard



Overview

This unit is about monitoring the working environment and making sure it meets requirements for health, safety and security.

TEL/N4121

Maintain a Healthy, Safe and Secure Working Environment

National Occupational Standard

Unit Code	TEL/N4121
Unit Title (Task)	Maintain a healthy, safe and secure working environment
Description	This unit is about monitoring your working environment and making sure it meets requirements for health, safety and security.
Scope	This unit/task covers the following: Emergency procedures: • illness • accidents • fires • other reasons to evacuate the premises • breaches of security
Performance Criteria(PC) w.r.t. the Scope	
Element	Performance Criteria
Emergency procedures	To be competent, the user/individual on the job must be able to: PC1. ensure that work is carried out in accordance to the level of competence and legal requirements 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 the 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
Knowledge and Understanding (K)	
C. Organizational Context (Knowledge of the company / organization and its processes)	The user/individual on the job needs to know and understand: KA1. legislative requirements and organization's procedures for health, safety and security and your role and responsibilities in relation to this KA2. what is meant by a hazard, including the different types of health and safety hazards that can be found in the workplace KA3. how and when to report hazards KA4. limits of your responsibility for dealing with hazards KA5. your organization's emergency procedures for different emergency situations and the importance of following these KA6. the importance of maintaining high standards of health, safety and security KA7. implications that any non-compliance with health, safety and security may

TEL/N4121
Maintain a Healthy, Safe and Secure Working Environment

	have on individuals and the organization
B. Technical Knowledge	The user/individual on the job needs to know and understand: KB1. different types of breaches in health, safety and security and how and when to report these KB2. evacuation procedures for workers and visitors KB3. how to summon medical assistance and the emergency services, where necessary KB4. how to use the health, safety and accident reporting procedures and the importance of these KB5. government agencies in the areas of safety, health and security and their norms and services
Skills (S) [Optional]	
E. Core Skills/ Generic Skills	Writing Skills
	The user/ individual on the job needs to know and understand how to: SA1. complete accurate, well written work with attention to detail
	Reading Skills
	The user/individual on the job needs to know and understand how to: SA2. read instructions, guidelines, procedures, rules and service level agreements
	Oral Communication (Listening and Speaking skills)
	You need to know and understand how to: SA3. listen effectively and orally communicate information accurately
F. Professional Skills	Decision Making
	The user/individual on the job needs to know and understand how to: SB12. make decisions on suitable course of action
	Plan and Organize
	The user/individual on the job needs to know and understand: SB13. plan and organize your work to meet health, safety and security requirements

Maintain a Healthy, Safe and Secure Working Environment

	Problem Solving
	The user/individual on the job needs to know and understand how to: SB14. apply problem solving approaches in different situations
	Analytical Thinking
	The user/individual on the job needs to know and understand how to: SB15. analyze data and activities
	Critical Thinking
	The user/individual on the job needs to know and understand how to: SB16. apply balanced judgments to different situations
	Attention to Detail
	You need to know and understand how to: SB17. apply good attention to detail SB18. check your work is complete and free from errors SB19. get your work checked by others
	Team Work
	You need to know and understand how to: SB20. contribute to the quality of team working SB21. work independently in a team environment SB22. work independently and collaboratively

NOS Version Control

NOS Code	TEL/N4121		
Credits (NSQF)	TBD	Version number	1.0
Industry	Telecom	Drafted on	13/01/2015
Industry Sub-sector	Handset	Last reviewed on	21/06/2018
Occupation	Terminal Equipment Application Developer	Next review date	31/03/2019



CRITERIA FOR ASSESSMENT OF TRAINEES

Job Role Telecom Embedded Hardware Engineer

Qualification Pack TEL/Q2303

Sector Skill Council Telecom

Guidelines for Assessment

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. SSC 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 SSC.
3. Assessment will be conducted for all compulsory NOS, and where applicable, on the selected elective/option NOS/set of NOS.
- 4a. Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training center (as per assessment criteria below).
- 4b. Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/training center based on this criterion.
5. To pass the Qualification Pack, every trainee should score a minimum of 70% of aggregate marks to successfully clear the assessment.
6. In case of unsuccessful completion, the trainee may seek reassessment on the Qualification Pack.

Assessment Outcome		Assessment Criteria		Marks Allocation		
		Total Mark (300)	Out Of	Theory	Skills Practical	
1. TEL/N2311 (Embedded Hardware Development)	PC1. handle activities such as Requirement definition to derive technical specification of embedded products	100	10	5	5	
	PC2. architect, Design and develop circuits for embedded products		10	2	8	
	PC3. hardware-software design partitioning		4	2	2	
	PC4. design peripheral interfaces for communication protocols like I2C, SPI, UART, Infrared, RF, GSM, GPS, PDH/SDH/Ethernet, QSPI, Zigbee, Wi-Fi and Bluetooth		10	5	5	
	PC5. select Components for the hardware design including micro-controllers, real time data acquisition and control components and sensors		10	3	7	

	PC6. simulate digital and analog circuits using simulation tools		10	0	10
	PC7. generate PCB schematic & layout		10	2	8
	PC8. monitor problems and keep track of system installation activities, progress or any delays in resolving the problems for embedded systems		10	4	6
	PC9. develop small, intelligent communication and networking gadgets and applications		10	4	6
	PC10. ensure circuit testing, integration and debugging to support and maintain embedded products		16	6	10
		Total	100	33	67
2. TEL/N2312 (Embedded Firmware development)	PC1. develop Firmware using embedded C and C++ programming languages	100	10	5	5
	PC2. use programming tools like gcc, gdb, eclipse and Integrated design environments for HW-SW co-design		20	5	15
	PC3. code firmware for micro-controllers & other programmable devices		10	5	5
	PC4. develop memory efficient and computationally optimal code for telecom products		10	5	5
	PC5. use & develop Wireless connectivity stacks/firmware for communication protocols including, but not limited to Zigbee, Bluetooth, TCP/IP, SPI, I2C, USB, RS232, RS485		10	2	8
	PC6. handle the firmware for maintenance and troubleshooting of telecom equipment		10	3	7
	PC7. support Data communication equipment and services.		5	2	3

	PC8. test and Verify firmware design, prototyping		5	2	3
	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
		Total	100	34	66
3. TEL/N4121 (Maintain a Healthy, Safe and Secure Working Environment)	PC1. ensure that work is carried out in accordance to the level of competence and legal requirements	100	10	6	4
	PC2. ensure that sites are assessed for health and safety risk as per company's guidelines prior to commencement of work		12	6	6
	PC3. ensure environmental conditions and hazards like earth potential rise (EPR) are considered while carrying out the work		15	9	6
	PC4. identify and correct any hazards that you can deal with safely, competently and within the limits of your authority		15	10	5
	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		12	7	5
	PC6. follow your organization's emergency procedures promptly, calmly, and efficiently		12	6	6
	PC7. identify and recommend opportunities for improving health, safety, and security to the designated person		14	8	6
	PC8. complete any health and safety records legibly and accurately		10	5	5
		Total	100	57	43