

NSQF QUALIFICATION FILE - Certified Embedded Software Engineer
Approved in 8th NSQC Meeting – NCVET – 27th May 2021

NCVET Code
2021/ITES/NIELIT/04219

QUALIFICATION FILE - CONTACT DETAILS OF THE SUBMITTING BODY

Name and address of submitting body:

NATIONAL INSTITUTE OF ELECTRONICS AND INFORMATION TECHNOLOGY
ISTE COMPLEX, NO. 25, GANDHI MANDAPAM RD,
CHENNAI,
TAMIL NADU-600025

Name and contact details of individual dealing with the submission

Name	:	Ripunjay Singh
Position in the organization	:	Scientist-'D'
Address if different from above	:	NA
Tel number(s)	:	044-2442 1445 ext. 215, 9445220125
E-mail address	:	ripunjay@nielit.gov.in

List of documents submitted in support of the Qualifications File

- | |
|---|
| 1. Annexure I – Evidence of Job/Requirement in industry |
| 2. Annexure II – Detailed Course Curriculum |
| 3. Annexure III – Industry Validation |

NSQF QUALIFICATION FILE - Certified Embedded Software Engineer
Approved in 8th NSQC Meeting – NCVET – 27th May 2021

SUMMARY

1	Qualification Title	Certified Embedded Software Engineer
2	Qualification Code, if any	Code: NIELIT/EM/L8/026 Sector: Electronics
3	NCO code and occupation	2512.0501 and Embedded Software Engineer
4	Nature and purpose of the qualification (Please specify whether qualification is short term or long term)	Nature: This Course which will help in securing employment in Embedded firmware design. Purpose: ❖ The purpose is to develop the skillset required for Design and Development of the Embedded System Applications using suitable Hardware and Software tools. This course offers a range of topics of immediate relevance to industry and makes the participants exactly suitable for Embedded Industry
5	Body/bodies which will award the qualification	National Institute of Electronics and Information Technology NIELIT Bhawan, Plot No. 3, PSP Pocket, Sector-8, Dwarka, New Delhi-110077
6	Body which will accredit providers to offer courses leading to the qualification	National Institute of Electronics and Information Technology.
7	Whether accreditation/affiliation norms are already in place or not, if applicable (if yes, attach a copy)	The Handbook for is available at: https://www.nielit.gov.in/content/nsqf
8	Occupation(s) to which the qualification gives access	Embedded Software Engineer
9	Job description of the occupation	Design, Develop and Debug Software for Real-Time Embedded Applications.
10	Licensing requirements	NA

NSQF QUALIFICATION FILE - Certified Embedded Software Engineer
Approved in 8th NSQC Meeting – NCVET – 27th May 2021

11	Statutory and Regulatory requirement of the relevant sector (documentary evidence to be provided)	NA		
12	Level of the qualification in the NSQF	Level 7		
13	Anticipated volume of training/learning required to complete the qualification	840 Hours		
14	Indicative list of training tools required to deliver this qualification	Attached in Section 2 of Annexure II		
15	Entry requirements and/or recommendations and minimum age	B.E./B. Tech in Electronics/ Electronics & Communication/ Electrical/ Electrical and Electronics/Instrumentation/ Electronics & Instrumentation / Instrumentation & Control /Biomedical /Computer Science/Information Technology /M.Sc.(Electronics)/AMIE in Electronics/ Electronics & Communication		
16	Progression from the qualification (Please show Professional and academic progression)	Professional: Embedded Software Engineer → Team Lead (Embedded Software) → Project Manager (Embedded Software & Real-Time Systems) Academic: Advance courses in Embedded Real-time systems area like building of yocto Linux for Embedded Systems.		
17	Arrangements for the Recognition of Prior learning (RPL)	Presently only candidates who undergo training shall be assessed. It will be incorporated once RPL strategy is finalized		
18	International comparability Where known (research evidence to be provided)	Mentioned in Section-5 below.		
19	Date of planned review of the Qualification.	After Every 2 years		
20	Formal structure of qualification			
Module Code	Module Name	Mandatory/ Optional	Estimated Size (Learning Hours)	Level

NSQF QUALIFICATION FILE - Certified Embedded Software Engineer
Approved in 8th NSQC Meeting – NCVET – 27th May 2021

ED601	Embedded C and ARM Cortex Microcontrollers	Mandatory	140	7
ED602	Embedded Linux & Porting	Mandatory	70	7
ED603	Embedded RTOS	Mandatory	70	7
ED604	Internet of Things (IoT)	Mandatory	210	7
ED605	Embedded Protocols & Device Drivers	Mandatory	105	7
ED606	Seminar and Case Study	Mandatory	35	7
ED607	Project Work	Mandatory	210	7

Detail Curriculum attached at **Annexure II**.

SECTION 1

ASSESSMENT

21	<p>Body/Bodies which will carry out assessment: The Examination Section National Institute of Electronics and Information Technology NIELIT Bhawan, Plot No. 3, PSP Pocket, Sector-8, Dwarka, New Delhi-110077</p>
22	<p>How will RPL assessment be managed and who will carry it out? RPL Policy will be described as and when available.</p>
23	<p>Describe the overall assessment strategy and specific arrangements which have been put in place to ensure that assessment is always valid, reliable and fair and show that these are in line with the requirements of the NSQF.</p> <p>The emphasis is on practical demonstration of skills & knowledge based on the performance criteria. Student is required to pass in all OUTCOMES individually and marks are allotted. Following assessment methodologies are used.</p> <p>The Following assessment methodologies are used.</p> <ul style="list-style-type: none"> A. Written Assessment (Multiple Choice Questions) B. Practical Assessment & Lab Performance C. Mini Project <p>The assessment results are backed by following evidences.</p> <ol style="list-style-type: none"> 1. The assessor collects a copy of the attendance for the training done under the scheme. The attendance sheets

NSQF QUALIFICATION FILE - Certified Embedded Software Engineer
Approved in 8th NSQC Meeting – NCVET – 27th May 2021

	<p>are signed and stamped by the course coordinator of the Training Centre.</p> <ol style="list-style-type: none">2. The assessor verifies the authenticity of the candidate by checking the photo ID card issued by the institute as well as any one Photo ID card issued by the Central/Government. The same is mentioned in the attendance sheet.3. The assessor assigns roll number.4. The assessor takes signature of all the students along with the assessor in a prescribed attendance sheet.
--	---

NSQC Approved

NSQF QUALIFICATION FILE - Certified Embedded Software Engineer
Approved in 8th NSQC Meeting – NCVET – 27th May 2021

ASSESSMENT EVIDENCE

24. Title of Unit/Component:

Outcomes to be assessed	Assessment Criteria for the outcome	Means of Assessment		
		Total Marks	Written	Practical
Embedded Programming Skill with ARM Cortex Microcontroller	Develop an application using C program.	20	5	15
	Apply Knowledge on ARM Architectural Concepts	15	10	5
	Execute the code and debug applications using Embedded 'C' on ARM Cortex Microcontrollers	20	5	15
	Interfacing Peripherals with ARM Cortex Microcontrollers	20	5	15
	Implement an embedded application using Embedded 'C' & ARM Cortex Microcontrollers (Mini Project)	25	0	25
	Total		100	25
Acquire knowledge on Embedded Linux & Porting of OS to Cortex M based Micro controllers	Setting-up Linux environment for ARM based Target Boards	15	10	5
	Configuring Tool-Chain for ARM Platforms	20	5	15

NSQF QUALIFICATION FILE - Certified Embedded Software Engineer
Approved in 8th NSQC Meeting – NCVET – 27th May 2021

	Linux Booting Process and Linux Kernels Configuration	20	5	15
--	---	----	---	----

	Porting of OS in ARM Target Board	20	5	15
	Implement an application using Linux OS (Mini Project)	25	0	25
	Total	100	25	75
Take opportunity to use Real Time OS	Apply Real Time Operating System Concepts in application development	25	10	15
	Execute Real Time Application development using FreeRTOS	50	10	40
	Implement an application using FreeRTOS (Mini Project)	25	0	25
	Total	100	20	80
Demonstrate The Internet of things concepts, Building IoT applications & with the use of	Evaluate & Apply IoT application development	30	5	10
	Implement an IoT application using Development Boards	20	0	10
	Develop problem solving capability using python scripts	10	5	10

NSQF QUALIFICATION FILE - Certified Embedded Software Engineer
Approved in 8th NSQC Meeting – NCVET – 27th May 2021

Python to analyze data, create beautiful visualizations	Learn to use Data Analytics tools: Numpy, Panda for various application	15	5	15
	Learn to use Machine learning tool Scikit - Learn for various applications	10	5	15
	Develop expertise in implementation of ML algorithm using Python	15	5	15
	Total	100	25	75
Demonstrate Embedded Protocols, the Device Driver Development in Linux.	Apply the concepts of I2C, SPI, Serial, CAN, USB & PCI in embedded application development	30	10	20
	Apply Linux device driver development –character & block driver	30	10	20
	Ability to implement device driver	40	0	40
	Total	100	20	80
Seminar & case study	Evaluation of seminar & case study presentations	100	NA	100
Project Work	Project reviews, demo of project work, oral presentation and viva.	100	NA	100
Total Marks		700	115	585

Means of assessment

S. No	Examination Pattern	Modules Covered	Duration in Minutes	Maximum Marks
-------	---------------------	-----------------	---------------------	---------------

NSQF QUALIFICATION FILE - Certified Embedded Software Engineer
Approved in 8th NSQC Meeting – NCVET – 27th May 2021

1	Theory Paper 1 – Embedded Programming and ARM Architecture	1	90	100
2	Theory Paper 2 – Embedded Linux and RTOS	2,3	90	100
3	Theory Paper 3 – Embedded Driver and IoT with Analytics	4,5	90	100
4	Practical Paper 1- Embedded Programming for ARM, Linux & RTOS	1,2,3	90	90
5	Practical Paper 2 - Device Driver and IoT	4,5	90	90
6	Internal Assessment	1,2,3,4,5	-	60
7	Project/Presentation /Assignment	1,2,3,4,5	-	60
8	Major Project/Dissertation	1,2,3,4,5	-	100
	Total			700

Theory Papers:

1. Theory Paper 1 – Embedded Programming and ARM Architecture
2. Theory Paper 2 – Embedded Linux and RTOS
3. Theory Paper 3 – Embedded Driver and IoT with Analytics

Practical Papers:

1. Practical Paper 1- Embedded Programming for ARM, Linux & RTOS
2. Practical Paper 2 - Device Driver and IoT

Note:

1. Pass percentage would be 50% marks in each component, with aggregate pass percentage of 50% and above.
2. Grading will be as under:

Grade	S	A	B	C	D
Marks Range (in %)	>=85%	>=75% and <85%	>=65% and <75%	>=55% and <65%	>=50% and <55%

3. Theory examination would be conducted online and the paper comprise of MCQ and each question will carry 1 marks.
4. Practical examination/Internal Assessment/ Project/Presentation/Assignment would be evaluated internally.

NSQF QUALIFICATION FILE - Certified Embedded Software Engineer
Approved in 8th NSQC Meeting – NCVET – 27th May 2021

5. Major Project/Dissertation would be evaluated preferably by External / Subject Expert including NIELIT Officials.
6. Candidate may apply for re-examination within the validity of registration.
7. The examinations would be conducted in English Language only.

SECTION 2

25. EVIDENCE OF LEVEL

Title : Certified Embedded Software Engineer			Level : 7
NSQF Domain	Outcomes of the Qualification/ Component	How the job role relates to the NSQF Level Descriptors	NSQF Level
Process required,	Theoretical and practical knowledge in implementation of real time embedded systems	Requires a command of wide-ranging specialized theoretical and practical skills, involving variable routine and non-routine contexts.	7
Professional knowledge	Theoretical knowledge in developing embedded real time applications using microcontroller boards based on ARM cortex soft core architecture and Embedded/Real Time Operating Systems.	Wide-ranging factual and theoretical knowledge in broad contexts within a field of work or study.	7
Professional skill	Ability to develop hardware and software systems as per the requirement of the application for solving real life problems. v	Wide range of cognitive and practical skills required to generate solutions to specific problems in a field of work of study.	7
Core skill	Ability to independently develop the logic required for implementing real time embedded systems. Ability to understand the social political and natural environment	Good logical and mathematical skill understanding of social political and natural environment and organizing information,	7

NSQF QUALIFICATION FILE - Certified Embedded Software Engineer
Approved in 8th NSQC Meeting – NCVET – 27th May 2021

	and to organize the information Good communication skills to present the embedded real time system-based solutions.	communication and presentation skill.	
Responsibility	Ability to manage the system resources in the most effective manner by appropriate planning, estimation, coordination and control of the activities involved in the design & development of any Embedded Real Time System. Supervision of the work carried out by the other team members	Full responsibility for output of group and development	7

NSQC Approved

NSQC QUALIFICATION FILE - Certified Embedded Software Engineer
Approved in 8th NSQC Meeting – NCVET – 27th May 2021

SECTION 3

EVIDENCE OF NEED

<p>26</p>	<p>What evidence is there that the qualification is needed? This course has been designed meet the increasing manpower requirements in embedded system industry after discussion with our alumni working in Embedded real time system domain in various Companies in Cochin, Trivandrum and Bangalore.</p> <ul style="list-style-type: none"> a) NASSCOM Reskilling Series: The Journey of CGI-2020 b) IET Skills and Demand in Industry 2019 Survey c) <i>Towards a Reskilling Revolution-World Economic Forum-2019</i> d) Market Survey – Make in India -“<i>The Internet of Things Growth Path</i>” <i>Electronics for You, June 2016.</i> e) <i>View Point - Make in India -“A Way to Boost Manufacturing and Employment opportunities” Electronics for You, June 2016.</i> f) Evidence of Requirement in the Industry - Embedded Job Market - Salary survey http://www.payscale.com/research
<p>27</p>	<p>What is the estimated uptake of this qualification and what is the basis of this estimate? Estimated uptake is 50 students / Batch with 2 Batches / Year and on the basis of Facilities and Infrastructure in NIELIT Chennai.</p>
<p>28</p>	<p>What steps were taken to ensure that the qualification(s) does (do) not duplicate already existing or planned qualifications in the NSQF? Give justification for presenting a duplicate qualification.</p> <p>This course is a revised version of an old course ‘PG Diploma in Embedded Real Time Systems’. This course differs from the existing courses in the NQR portal from following ways:</p> <ol style="list-style-type: none"> 1. Based on qualifications available in the NQR portal in similar number of hours, the proposed QF has two unique modules: Internet of Things (including the concepts of Edge Analytics & ML) and Embedded Protocols & Device Drivers. 2. This is a 6 months duration course which includes 6-week project. In which participants will work on a real-life problem. This will create an industry ready human resource as an outcome of the program.
<p>29</p>	<p>What arrangements are in place to monitor and review the qualification(s)? What data will be used and at what point will the qualification(s) be revised or updated? Specify the review process here</p> <p>Based on feedback by participants, employers and based on market survey the qualification will be reviewed in every 2 years.</p>

NSQC Approved

SECTION 4

EVIDENCE OF PROGRESSION

30	<p>What steps have been taken in the design of this or other qualifications to ensure that there is a clear path to other qualifications in this sector?</p> <p>This course structure is designed in such a way that, the qualification acquired will meet the prerequisites of higher level courses in this domain like Team Lead (Embedded Software) → Project Manager (Embedded Software & Real-Time Systems).</p>
-----------	--

SECTION 5

EVIDENCE OF INTERNATIONAL COMPARABILITY

List any Comparisons which have been established

1. Course on Embedded Real-Time Systems

- Department of Software Technology of Delft University of Technology, Nederland offers similar course.
(Source: <http://www.st.ewi.tudelft.nl/~koen/in4073>)

2. Course on Real-Time Systems

- Norwegian University of Science and Technology, Norway offers similar course.
(Source: <https://www.ntnu.edu/studies/courses/TTK4147#ta=omEmnet>.)

3. Course on Development of Real-Time Systems

- Åbo Akademi University, Finland offers similar course.
(Source: <https://www.coursera.org/learn/real-time-systems>.)