

## **QUALIFICATION FILE**

Application Documentation: Version 1 /01 September, 2016

**NSDA Reference**

*To be added by NSDA*

### **CONTACT DETAILS OF SUBMITTING BODY**

**Name and address of submitting body:**

**C-DAC,ACTS**

**ACTS, Innovation Park, S. No. 34/B/1,**

**Panchvati, Pashan, Pune 411 008**

**Name and contact details of individual dealing with the submission**

**Name: Shri. Aditya Kumar Sinha**

**Position in the organisation: Joint Director**

**Tel number(s): 020-25503155**

**E-mail address: sadiya@cdac.in**

### **List of documents submitted in support of the Qualifications File**

1. Qualification File
2. Course Content

# QUALIFICATION FILE

## SUMMARY

<b>Qualification Title and Code:</b>	Certificate Course in Embedded Operating System
<b>Body/bodies which will award the qualification:</b>	Centre for Development of Advanced Computing (C-DAC) organization of the Ministry of Electronics and Information Technology (MeitY), Ministry of Communications & Information Technology
<b>Body which will accredit providers to offer the qualification:</b>	C-DAC
<b>Body/bodies which will be responsible for assessment:</b>	C-DAC
<b>Occupation(s) to which the qualification gives access:</b>	<p>Certificate Course in Embedded Operating System aims to groom the students to enable them to work on current technology scenarios as well as prepare them to keep pace with the changing face of technology and the requirements of the growing IT industry.</p> <p>After the completion of the course, students can work as the Embedded OS Engineer/Expert.</p>
<b>Proposed level of the qualification in the NSQF:</b>	Level 7
<b>Anticipated volume of training/learning required to complete the qualification:</b>	320 hrs of classroom/lab learning
<b>Entry requirements / recommendations:</b>	Any Engineering /Science graduate with mathematics up to 10+2 level.
<b>Progression from the qualification:</b>	<p>The course aims to groom the students to enable them to work on current technology scenarios as well as prepare them to keep pace with the changing face of technology and the requirements of the growing IT industry. The course curriculum has been designed keeping in view the emerging trends in advanced computing as well as contemporary and futuristic human resource requirements of the ICT industry.</p> <p>After doing the course the student will be able to design, develop applications using Embedded System and RTOS Concepts.</p>

## QUALIFICATION FILE

Candidate can start from level 7 and lead to further levels.			
<b>Planned arrangements for RPL:</b>	NA		
<b>International comparability where known:</b>	There are many courses available on Embedded Operating System but CDAC is providing knowledge of OS Concepts, Digital signal Processing and Management development program in one course also implementation of learning can be evaluated under project.		
<b>Formal structure of the qualification:</b>			
<b>Title of NOS/unit or other component</b> (include any identification code used)	<b>Mandatory/ Optional</b> Enter M or O for each unit/ component	<b>Estimated size (learning hours)</b> The total should be the same as the entry under “anticipated volume” above	<b>Level</b> In the NSQF, individual units or components of qualifications can have outcomes which put them at levels which are higher or lower than the whole qualification.
OS Concepts and Real-time Systems Programming	M	60	7
Linux Drivers	M	80	7
Embedded Linux	M	80	7
Management Development Program	M	60	7
Project	M	40	7
Total		320	

Please attach any document giving further detail about the structure of the qualification – eg a Curriculum or Qualification Pack.

Give details of the document here:

### **SECTION 1**

### **ASSESSMENT**

#### **Body/Bodies which will carry out assessment:**

C-DAC’s Exam, Evaluation and Certification department will carry out assessment as per evaluation guideline finalized by Academic Council/ Academic Management Committee.

**Will the assessment body be responsible for RPL assessment?**

## QUALIFICATION FILE

- Same will be finalised when the national RPL Policy will be finalised.
- Assessment is online through our e-Pariksha system or manually, depending on the strength of students.
- Issuance of qualification is centralized through C-DAC.

**Describe the overall assessment strategy and specific arrangements which have been put in place to ensure that assessment is always valid, consistent and fair and show that these are in line with the requirements of the NSQF:**

Assessment is a necessary and essential part of conducting the Certificate Course in Embedded Operating System, as it provides important feedback and inputs to both the institute as well as the student. The institute gets an idea about the relative performance of each student, which also serves as feedback about the design and conduct of the course. The student gets a clear picture of his academic standing, individually and in comparison to his fellow students.

- A separate evaluation process is to be conducted for every module of the course.
- The evaluation for each module must be completed as per guidelines given below. The mid-module /surprise test evaluation is mandatory and can be taken after discussion with the concerned faculty.
- Students are evaluated on a continuous and throughout the duration of the course to make a fair assessment of the skills acquired by them. To have a very uniform and fair assessment. The evaluation process is divided into two parts:
  - Continuous Assessment - CA (150 marks)
  - Course End Examination - CCE (150 marks)

**Continuous Assessment** :This is being done primarily by the respective faculty in the form of Lab tests, assignments, quizzes, submission of term reports, presentations etc. conducted (with the help of respective course co-coordinators) at regular intervals and as and when the portions of the subjects are completed. These are basically internal exams and local to the centre. This process is further categorized into two parts.

- Lab test
- Internal test : Assignment/Case Studies /quiz and other valuation methods like case study, viva, group discussion depending on the subject and the faculty

It is recommended to conduct Management Development Program and Organisational Behaviour sessions and also conduct surprise test for the development of soft skills, logical, analytical capabilities and managerial skills for the benefit of the students and also give assignments and conduct some surprise test related to Management Development Program and Organisational Behaviour.

The figures shown below indicate the weightage of each module in the final performance statement. The examination(s) for each module must be conducted for at least that number of marks. However, the centre may conduct evaluation for a higher number of marks, in which case the marks will be scaled down. For example, if the examination for the Operating Systems Concepts module is conducted for 100 marks, the marks earned by the student will be scaled down to out of 40.

A student must score a minimum of 40 percent marks in each component of the evaluation, and also in the aggregate score, in order to successfully clear the module. If a student scores more than 40% on aggregate but has scored less than 40% in one component of the evaluation, he will not be declared as passed.

**The weight age for each component will normally be:**

Theory examination – (CCEE)	150 marks
-----------------------------	-----------

## QUALIFICATION FILE

Laboratory examination, Internal marks 150 marks

(Internal marks: Lab Assignment Evaluation, Surprise Tests, attendance, Viva, Seminars)

The question papers for the theory as well as the laboratory examinations at all the centres will be set by C-DAC, ACTS, Pune. The centres according to guidelines provided by, ACTS, Pune, will conduct the evaluation of the laboratory and assignments locally.

### **Minimum Pass marks:**

The minimum marks to be obtained for declaring a student pass in any module is as follows:

For 40 mark QP : 16 marks

For 20 mark QP : 8 marks

For 60 mark QP : 24 marks

### **Assessment is through e-Pariksha system.**

#### **About e-Priksha System:**

ePariksha is a web based application for the automation of the examination process. The system provides a great control on exams from preparing question paper to scheduling exam and from monitoring exam to generate results.

ePariksha has a strong administration which provides complete system status in one glance.

It's Results & Reports generations functionality provides system details in all standard and required formats.

An image based, LAN based, secure, fault tolerant and scalable system through which examinations can be delivered "on demand" basis in selected examination centres spread across the country.

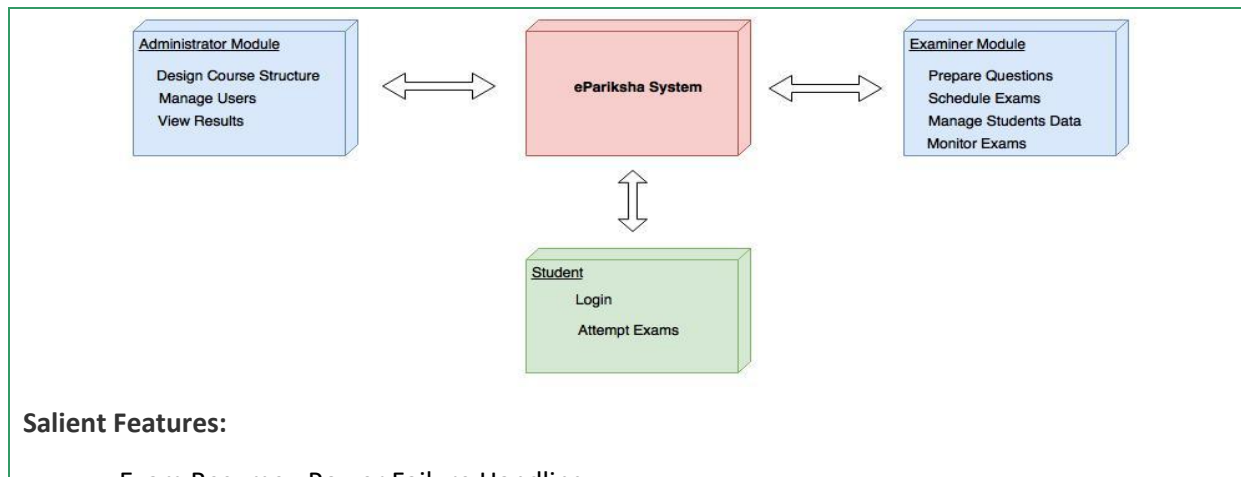
System Support:

- Decentralized mode of operation(LAN based)
- Question Paper approach
- Multi lingual and multi subject support
- Browser based

Components of the e-Pariksha System Includes:

- **Administration Module**- To design course structure, Manage users, view results.
- **ePariksha System** –Assessment of students through online system.
- **Examiner Module** -To manage the examination related activity and conduct- i.e Registration data and question paper uploading, conduct of examination, response generation
- **Student Login** –Allows students to login and attempt exams.

## QUALIFICATION FILE



### Salient Features:

- Exam Resume - Power Failure Handling
- Random Question Paper
- User friendly Interface
- Question Bank
- Instant Result
- Live Monitoring of Exams & Assignment
- Time bound exams
- Multilingual support
- Handheld devices Support
- Responsive Design

**Feedback System:** C-DAC's Advanced Computing Training School (ACTS) offers various courses and training programs through its own training centres and its network of Affiliated Training Centres (ATC) spread across the country. Each year, thousands of students and professionals are trained at these centres.

The purpose of the system i.e. Online Feedback System (OFS) is to develop a web application for getting the online faculty feedback by the students studying at centres and also at the various Authorized Training Centres (ATC) affiliated to for different training programs offered by C-DAC ACTS.

This system is for conducting "The Student Survey" for quality assurance of education. Students, Faculties and administrators can all benefit from survey. This is helpful in the continual improvements in teaching programs, processes as well as infrastructure and thereby enhancing the students' learning experience at C-DAC ACTS.

The Online Feedback System make the student feedback procedure centralized for all C-DAC centres as well as various Authorized Training Centres (ATCs) located across the country through which headquarter manager can manage student feedback of faculties as well as infrastructure studying at different training centres with different reports for feedback analysis.

Please attach any documents giving further information about assessment and/or RPL.

Give details of the document(s) here:

## QUALIFICATION FILE

### ASSESSMENT EVIDENCE

There will be 150 questions to answer in 3 hours duration in Course End Exam as per the following distribution mentioned below.

Sr. No.	Module	Learning Outcome	Theory	Lab & IA	Total Marks
1.	Operating System and Real-time Operating Systems	<ul style="list-style-type: none"><li>• Understand the basics and importance of real-time systems</li><li>• Generate a high-level analysis document based on requirements specifications</li><li>• Generate a high-level design document based on analysis documentation</li><li>• Generate a test plan based on requirements specification</li><li>• Generate a validation plan based on all documentation</li><li>• Understand basic multi-task scheduling algorithms for periodic, aperiodic, and sporadic tasks as well as understand the impact of the latter two on scheduling</li><li>• Understand capabilities of at</li></ul>	40	50	90

## QUALIFICATION FILE

		<p>least one commercial off-the-shelf R-T kernel</p> <ul style="list-style-type: none"> <li>• Participate in a team design project, utilizing varying skill sets of members.</li> </ul>			
2.	Linux Drivers	<ul style="list-style-type: none"> <li>• To introduce students to the design issues of embedded systems.</li> <li>• Developing solutions</li> <li>• Case Studies</li> </ul>	40	50	90
3.	Embedded Linux	<ul style="list-style-type: none"> <li>• Gain adequate understanding of the software architecture of the Embedded OS with case study of Linux Operating System, subsequently covering Linux Programming , The Linux Shell Environment, Commands, system level programming, POSIX compliance, compilers, debuggers, libraries so as to develop OS dependent applications in the user space</li> <li>• Exposure to programming in the Linux Environment and</li> </ul>	40	50	90



## QUALIFICATION FILE

		<p>development of simple applications for Process Management, Synchronization Techniques, Message Passing, POSIX based application development</p> <ul style="list-style-type: none"> <li>• Be introduced to the Linux Kernel environment, build system, kernel configuration and customization, compilation and setting up a Linux environment with basic understanding of kernel programming concepts like Module Programming and Device Drivers</li> <li>• Develop a character driver on x86 PCs and ARM based Linux Environments</li> <li>• Understand cross tooling environments and be exposed to development of device drivers for a target hardware platform</li> </ul>			
4.	Management Development	Students can demonstrate:	30	-	30

## QUALIFICATION FILE

	Program	<ul style="list-style-type: none"> <li>• Good conversation skills</li> <li>• Writing effective emails /business letters</li> <li>• Acquire good communication skills/Interview skills /Mock Interview</li> </ul>			
5.	Project	<ul style="list-style-type: none"> <li>• Students will apply knowledge gained during term I for project work.</li> <li>• Design, implement and evaluate computer technologies, systems, processes, components and/or programs appropriate to a defined task, while analyzing the impact on existing systems and potential future applications.</li> <li>• Think critically, relatively and analytically in technological solutions to simple and complex problems.</li> <li>• Apply formal frameworks, methods and management systems to the organization, storage and retrieval of data in ways that demonstrate an understanding of both the business enterprise and the relevant technology.</li> <li>• Implement effective business solutions across an organization that</li> </ul>	Grade		

## QUALIFICATION FILE

		<p>demonstrates appropriate consideration of alternative computer technologies, including networks, servers, programming languages and database systems.</p> <ul style="list-style-type: none"> <li>• Plan, analyze, design and construct information systems to identified specifications, using clear and efficient code in the relevant programming language(s).</li> <li>• Work effectively in a team to analyze the requirements of a complex software system, and solve problems by creating appropriate designs that satisfies these requirements</li> </ul> <p>Communicate to others the progress of the system development and the content of the design by means of reports and presentations.</p>			
<b>Total</b>			<b>150</b>	<b>150</b>	<b>300</b>

Complete a grid for each grouping of NOS, assessment unit or other component as listed in the entry on the structure of the qualification on page 1.

Title of NOS/Unit/Component:

Assessable outcomes	Assessment criteria for the outcome
Enter the learning outcomes /elements of competence which will be assessed.	List all the criteria applying to this element/outcome.

## QUALIFICATION FILE

<b>Certificate Course in Network Administration</b>	<b>A+ <math>\geq</math> 85%, A <math>\geq</math> 70% to <math>&lt;</math> 85% B <math>\geq</math> 60% to <math>&lt;</math> 70 % C <math>\geq</math> 50% to <math>&lt;</math> 60% D <math>\geq</math> 40% to <math>&lt;</math> 50% F <math>&lt;</math> 40%</b>
<b>Means of assessment 1</b> Theory portion Assessment will be done through LAN based online system. Paper will be Objective question based. Lab evaluation will be done under project evaluation.	
<b>Means of assessment 2</b> <b>Re-examinations:</b> The following conditions will be applicable for the course end re-exam: <ul style="list-style-type: none"><li>• Students who do not appear for an exam on the scheduled date will not have an automatic right to re-examination. Only those students who, in the opinion of the centre/course coordinator have a genuine reason for being absent may be allowed to appear for a re-exam.</li><li>• Students who have failed an exam may be allowed to appear for a re-exam.</li><li>• The re-exam should be conducted following the same process as the regular examination.</li><li>• Students, who failed/remained absent in the Course End Examination conducted by , shall be allowed to appear in the re-examination only once.</li><li>• Students who remain absent or fail in the re-examination will not get any further chance for appearing for the re-examination. In such case the candidate can receive the Performance Statement and the certificate of participation without any grade.</li><li>• On evaluation of their answer sheets 20% of the marks obtained by the students will be deducted (towards de-rating for re-examination) for arriving at the final score, i.e. in order to clear the module test the student has to score a minimum of 48% marks instead of 40%.</li><li>• There will be no re-exam for the re-exam</li></ul>	
<b>Pass/Fail:</b> <b>If Candidate scored below 40% in any of the component like Theory, lab or Internal will be consider as FAIL.</b>	

## QUALIFICATION FILE

### SECTION 2

#### SUMMARY EVIDENCE OF LEVEL

Level	Process Required	Professional Knowledge	Professional Skill	Core Skill	Responsibility
7	Requires a command of wide-ranging specialised theoretical and practical skills, involving variable routine and non-routine contexts.	Wide-ranging factual and theoretical knowledge in broad contexts within a field of work or study.	Wide range of cognitive and practical skills required to generate solutions to specific problems in a field of work of study.	Good logical and mathematical skill understanding of social political and natural environment and organising information, communication and presentation skill.	Full responsibility for output of group and development

Assessed outcome	Process Required	Professional Knowledge	Professional Skill	Core Skill	Responsibility
1. Operating System and Real-time Operating Systems	Person may carry out a job as Embedded System Programmer.	Learning Programming Concepts, RTOS and Digital Signal Processing will help to learner to get employment as Embedded System Programmer/ Tester.	Candidate can handle RTOS and Embedded Applications based on practical knowledge.	Candidate will be learning effective communications. Language to communicate written and oral. Aptitude, basic understanding of social political and natural environment.	Candidate can perform well and responsible for output of group and development.
2. Linux Drivers	This job demands a command of wide-ranging specialised theoretical and practical skills, involving variable routine and non-routine contexts.				
3. Embedded Linux					
4. Management Development Program					
5. Project					

### SECTION 3

#### EVIDENCE OF NEED

## QUALIFICATION FILE

### What evidence is there that the qualification is needed?

Set up the Advanced Computing Training School (ACTS) in 1993 to meet the ever-increasing skilled manpower requirements of the Information Communication Technologies (ICT) industry as well as supplement its intellectual resource base for cutting-edge research and development. Over the years has designed and delivered various postgraduate and undergraduate degree and diploma programmes. In addition, imparts ICT training to state and national governments and agencies, strategic sectors, corporate and industries, foreign countries and international students, based on specific requirements.

### What is the estimated uptake of this qualification and what is the basis of this estimate?

[http://study.com/articles/Salary\\_and\\_Career\\_Info\\_for\\_Embedded\\_Systems\\_Engineers.html](http://study.com/articles/Salary_and_Career_Info_for_Embedded_Systems_Engineers.html)

### What steps were taken to ensure that the qualification(s) does/do not duplicate already existing or planned qualifications in the NSQF?

NA

### 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?

Effective course design begins with understanding who your students are, deciding what you want them to learn; determining how you will measure student learning; and planning activities, assignments and materials that support student learning.

Our courses are specialized and market driven.

There is a dedicated team in CDAC to design and develop courses. There is a set process of reviewing and updating the by taking feedback from industry and domain experts .We are in touch with more than 500 companies and we design and updated courses with their interventions as per market demand.

## SECTION 4

### EVIDENCE OF RECOGNITION AND PROGRESSION

#### 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?

- This qualification has been designed in consultation with industry and domain expert keeping in mind today's need. Evaluation criteria have been added to ensure progression to related path ways identified as per career path.

Please attach any documents giving further information about any of the topics above.

Give details of the document(s) here:

1. Course Content

**Course Name: Certificate Course in Embedded Programming**

## QUALIFICATION FILE

### Course Modules:

Sl. No.	Modules	Hours
1	Operating System and Real-time Operating Systems	60
2	Linux Drivers	80
3	Embedded Linux	80
4	Management Development Program	60
5	Project	40
	<b>Total</b>	<b>320</b>

### Module content:

#### Real Time Operating Systems (90 Hrs)

Introduction to Operating Systems, OS services & Goals and Types of Operating Systems, Operating

Linux Commands, Linux File System, Vi editor,

Process Management-Process and Thread Concept, Scheduling

Process Synchronization Mechanism and Deadlocks,

Memory Management-Memory Allocation Problems, Paging and Segmentation

Virtual Memory, Demand Paging ,Page Replacement Algorithms, File System Management

File System Management – File concepts, Allocation and protection, Linux Architecture and System Call interface

Processes & Signal API and POSIX thread API

IPC Mechanisms (Pipes, FIFOs, Semaphores, Shared Memory, Message Queues

Introduction to Real time systems and Real Time Operating Systems Concepts, RTAI

Architecture, Installation of RTLinux / Xenomai / (any free RTOS)

Real Time FIFO, Inter Process Communication between RT Task and

Linux Process, IPC using shared memory, Mail boxes, Hard & Soft

Interrupts, Interrupt Handling in RTAI

Introduction to Real-Time Concepts, RTOS Internals & Real Time Scheduling, Performance Metrics of RTOS, Task Specifications, Schedulability Analysis, Application Programming on RTOS, Porting of RTOS, Configuring RTOS, Building RTOS Image for Target platforms

#### Linux Drivers (80 Hrs)

Introduction to Linux Kernel Architecture, Process Management, Process/Thread Management and related Data-structures, CPU Scheduling and Kernel Features, Virtual File System, File System, IPC Mechanism, Different Classes of Device-drivers, Introduction to Linux Kernel Module Architecture, Installing a Linux Kernel Source-Code Package.

Linux Kernel Re-configuration and Re-compilation , Kernel Configuration Features related to Kernel Modules, Installing a new Kernel and associated Kernel Modules, Modifying the Boot-loader Configuration File, Loading and Testing the new Kernel, Compiling a Kernel Module using special Make files, Introduction to insmod, rmmod, lsmod and modprobe Utilities.

Loading, Testing and Unloading a Kernel Module, Linux Kernel Memory Allocator Architecture, Introduction to Linux Device Model, Character Device-driver Architecture.

Character Device Registration and Unregistration, Debugging Techniques in the Kernel.

## QUALIFICATION FILE

Adding Features to Pseudo Character Driver using Advanced Mechanisms, Blocking Operations Inside the Kernel using Kernel APIs ,Software Clocks and Timers used in Kernel-space, Kernel APIs for Allocating/Accessing I/O Mapped Registers, Kernel APIs for Allocating/Accessing Memory Mapped registers and Device-memory, Writing a Polling based Device-driver for Serial-port or Parallel-port on PC, H/W Interrupts and Driver Interrupt Handler, Registering / Unregistering an Interrupt Handler, Special Rules in Writing Interrupt Handler - Length, Locking and Blocking Issues, Writing an Interrupt Driven Device-Driver for Serial-port or Parallel-port on PC, PCI Bus Architecture and PCI Bus Layer in Linux Kernel, Introduction to PCI Bus Architecture and Specifications, Introduction to PCI-X Bus Specification, PCI based Network Device-Drivers, USB Device-Drivers

### **Embedded Linux (80 hrs)**

Introduction to Embedded Operating Systems, Introduction to Bootloaders and Board Support Packages, Process Management and Interprocess Communication, Memory Management, I/O sub- system & Embedded File Systems, POSIX Thread Programming, POSIX Semaphores, Mutexes, Conditional Variables, Barriers, Message Queues, Debugging and Testing of Multithreaded Applications

Linux Device Drivers

Embedded Linux Kernel Internals, Embedded Linux Device Drivers, Linux Kernel Modules, Char Device Drivers, I/O Memory and Ports, Handling Delays, Timings, Synchronization, Locking and Interrupts, Driver Debugging Techniques

### **Management Development Program**

Introduction to communication, Barriers to communication, Kind of communication, Confidence building Non-verbal Communication, Fluency and vocabulary, Synonyms, Antonyms, Grammar, Noun Pronoun, Verb, Adjective, Preposition, Conjunction, Words of Idioms & phrases, Sentence Construction, Fill up the blanks, Pronunciation, Conversation practice, Polite Conversation, Greeting, Logical reasoning, General Aptitude, Writing: Covering letter, Resume, Email, Presentation Skill, group discussion, Interview skills, Mock interview

### **Project**