QUALIFICATION FILE

Revised Application Documentation: Version 3 /28 April, 2015

NSDA Reference
To be added by NSDA

CONTACT DETAILS OF SUBMITTING BODY

Name and address of submitting body:

Centre for Development of Advanced Computing,

Advanced computing training school,

5th floor, CDAC Innovation Park

Panchvati, Pune,

Name and contact details of individual dealing with the submission

Name: Shri. Aditya Kumar Sinha

Position in the organisation: Principal Technical Officer

Address if different from above

Tel number(s): 020-25503155

E-mail address: saditya@cdac.in

List of documents submitted in support of the Qualifications File

There are opportunities to submit supporting documents throughout the Qualification File template. The titles of all these documents should be listed here.

1. Course Content
2. Industry Feedback
3. Alumni Feedback

QUALIFICATION FILE

SUMMARY

Qualification Title and Code:	PG-Diploma in Embedded Systems Design (PG-DESD)
Body/bodies which will award the qualification:	Centre for Development of Advanced Computing (C-DAC) organization of the Department of Electronics and Information Technology (DeitY), Ministry of Communications & Information Technology
Body which will accredit providers to offer the qualification:	CDAC
Body/bodies which will be responsible for assessment:	CDAC
Occupation(s) to which the qualification gives access:	The course aims to groom the students to enable them to work on embedded 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 latest trends in embedded systems as well as contemporary and futuristic human resource requirements of the ICT industry. After doing this course students can work as developer/programmer/ tester. Candidate can mentor team and sole responsible for team work. He/She will be able to use software engineering principles.
Proposed level of the qualification in the NSQF:	Level 8
Anticipated volume of training/learning required to complete the qualification:	900 hrs of classroom/lab learning (6 Months full time course)
Entry requirements / recommendations:	1. Graduate in Engineering or equivalent (e.g. BE / BTech / 4-year BSc / AMIE / DoEACC B Level, etc.) in IT / Computer Science / Electronics / Telecommunications / Electrical / Instrumentation OR 2. Post Graduate in Engineering Sciences (e.g. MSc in Computer Science, IT, Electronics, etc.) 3. The candidates must have secured a minimum of 55% marks in their qualifying examination.

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Progression from the qualification:	These candidates will be trained in Hardware and Firmware design of Embedded System based applications, Internet of Things (IoT), Project development and Management skills. They can start career as Embedded Developer, tester and leads to project manager after having relevant experience. Candidate can start from level 8 and lead to further levels.
Planned arrangements for RPL:	NA
International comparability where known:	NA

Formal structure of the qualification:

Title of NOS/unit or other component (include any identification code used)	**Mandatory/ Optional** Enter M or O for each unit/ component	**Estimated size (learning hours)** The total should be the same as the entry under "anticipated volume" above	**Level** 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.
Programming Concepts	M	150	3
Microcontrollers and Interfacing	M	120	3
Embedded Operating Systems	M	120	4
Real Time Operating Systems	M	60	4
Internet of Things (IoT) and Mobile Programming	M	120	3
Embedded Hardware Design and Development	M	60	4
Project and Seminar	M	170	3
Aptitude and Business Communication	M	100	3

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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:
CDAC'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?

- Same will be finalised when the national RPL Policy will be finalised.
- Assessment is online through our CCAT system.
- Issuance of qualification is centralized through CDAC.

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 PG-Diploma in Embedded Systems Design, 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 (60 marks)
    - Course End Examination - CCE (40 marks)

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

- Lab test (40 marks)
- Internal test (20 mark): Assignment/Case Studies /quiz and other valuation methods like case study, viva, group discussion depending on the subject and the faculty (20 marks)

It is recommended to conduct the Effective Communications & Aptitude sessions for the benefit of the students and also conduct some surprise test for Effective Communications & Aptitude sessions.

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 Programming 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)	40%
Laboratory examination	40%
Internal marks	20%

(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 CDAC, ACTS Hyderabad. The centres according to guidelines provided by C-DAC, ACTS Hyderabad, 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 CCAT system.

About CCAT System:

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 CCAT System Includes:

- **Registration System**- To register the candidate for examination.
- **Authoring Tool** -To generate an image based encrypted question paper.
- **Examination System** -To manage the examination related activity and conduct- i.e Registration data and question paper uploading, conduct of examination, response generation
- **Result Processing System** -To generate the result for the particular examination and paper.

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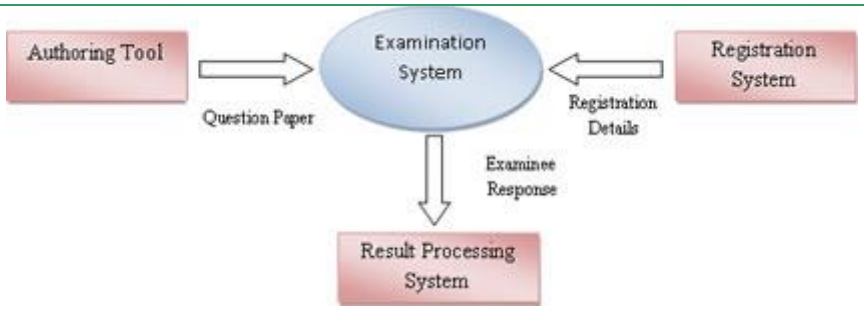

Salient Features:

- Provides end to end security as Question paper is encrypted and decrypted just minutes prior to the examination.
- Highly Scalable and support up-to 1000 candidate per center per session.
- Highly fail safe with ability to resume exam on the last saved state.
- Isolated examination Network unconnected to any other network including Internet.
- Simple and user friendly interface for Candidate
- Minimal Requirements on the client machine (just a compatible browser).
- Minimum Server requirement at each exam centre (2 Laptops -> one for redundancy).
- Question paper independent of languages, font and symbols
- Resilient to server failures
- Identical URL for Mock test and Actual exam
- Provides end -to-end audit log

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 C-DAC centers and also at the various Authorized Training Centres (ATC) affiliated to C-DAC for different training programs offered by CDAC 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 CDAC ACTS.

The Online Feedback System make the student feedback procedure centralized for all CDAC 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 C-DAC 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:

ASSESSMENT EVIDENCE

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Each module should be evaluated as per the weightage given below.

Sr. No.	Module	Learning Outcome	Theory	Lab	IA	Total Marks
1	Programming Concepts	• Basics of Program Writing & Coding Practices • Exposure to Structured Programming language C and Object oriented Programming Language Java • Optimization of C programs, Handling portability issues in C, Hardware, Time, Space and Power aware Programming • Introduction to Data Structures, Algorithms and Abstract Data Types, Complexity of Algorithms, Linked Lists, Stacks, Queues, Searching and Sorting Algorithms, Trees • Ability to properly design data structures and the algorithms to transform them	40	40	20	100
2	Microcontrollers and Interfacing	• Trends in Embedded Systems, Challenges and Design Issues in Embedded Systems, • Use of Assemblers, Compilers, Linkers, Loaders, Debuggers, JTAG, • Introduction to Host/Target Development environment using • build tools for Embedded Systems • Microprocessor Architectures and peripheral programming (Timers/Counters,	40	40	20	100

		UART, SPI, PWM, WDT, Input Capture, Output Compare Modes, I2C, CAN, LED, Switches, ADC, DAC, LCD) • Hands-on experiences of programming in Assembly and Embedded C • Develop Embedded System based application using Embedded C Programming • Demonstrate ARM Cortex M architecture with Embedded C Programming for Application Development				
3	**Embedded Operating Systems**	• 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 • Exposure to programming in the Linux Environment and development of simple applications for Process Management, Synchronization Techniques, Message Passing, POSIX based application development • Be introduced to the Linux Kernel environment, build system, kernel configuration and customization, compilation and	40	40	20	100

		setting up a Linux environment with basic understanding of kernel programming concepts like Module Programming and Device Drivers • Develop a character driver on x86 PCs and ARM based Linux Environments • Understand cross tooling environments and be exposed to development of device drivers for a target hardware platform				
4	**Real Time Operating Systems**	• Distinguish between a general purpose operating system and real time operating system through a thorough understanding of time critical implementation requirements in Scheduling, Interrupt Handling, Message Passing and Synchronization • Develop real time applications using a specific RTOS API • Understanding the OS implementation details for a microcontroller based RTOS and develop the Port Code for porting an RTOS to new hardware	40	40	20	100
5	**Internet of Things (IoT) and Mobile Programming**	• Apply the concepts of IoT Architecture and Layering • Implement IoT applications using proper hardware and software	40	40	20	100

		platforms • Develop IoT Applications with Arduino and other platforms • Explain the differences between Android and other mobile development environments and how they fit into the embedded applications • Understand the challenges while porting Android to Embedded Systems • Understand how Android applications work, their life cycle, manifest, Intents, and using external resources • Take advantage of Android's APIs for data storage, retrieval, user preferences, files, databases, and content providers • Tap into location-based services, geocoder, compass sensors, and create rich map-based applications • Utilize the power of background services, threads, and notifications. • Use Android's communication APIs for SMS, telephony, network management, and internet resources (HTTP). • Secure, tune, package, and deploy Android				

		applications				
6	Embedded Hardware Design and Development	• Gain adequate understanding so as to design a micro-controller based embedded system Hardware • Get a good grip on the design concepts involved in developing a Microcontroller based Embedded System • Design a micro-controller based Embedded System which includes its sub components like input devices, output devices, power supply and communication & networking interfacing • Be acclimatized with a design tool to develop schematics and further proceed to layout and PCB design • Have a walkthrough of PCB manufacturing process	40	40	20	100
7	Project and Seminar	• 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. • Think critically, creatively and analytically in developing technological solutions to simple and complex problems. • Apply formal frameworks, methods and management systems to the	-	-	-	100

		organization, storage and retrieval of data in ways that demonstrate an understanding of both the business enterprise and the relevant technology. • Implement effective business solutions across an organization that demonstrates appropriate consideration of alternative computer technologies, including networks, servers, programming languages and database systems. • Plan, analyze, design and construct information systems to identified specifications, using clear and efficient code in the relevant programming language(s). • work effectively in a team to analyse the requirements of a complex software system, and solve problems by creating appropriate designs that satisfies these requirements • communicate to others the progress of the system development and the content of the design by means of reports and presentations				

8	Aptitude and Business Communication	Students will be able to: • apply general mathematical models to solve a variety of problems • solve problems and correctly arrive at meaningful conclusions regarding their answers • manipulate equations and formulas in order to solve for the desired variable • interpret given information correctly, determine which mathematical model best describes the data, and apply the model correctly • Use theories of interpersonal communication to explain and evaluate their own behavior in interpersonal relationships. • Synthesize and apply appropriate and effective conflict management strategies.				**Grade**

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.
All the modules of PG-DESD	**A+ >= 85%,** **A >= 70% to < 85%** **B >= 60% to < 70 %** **C >= 50% to < 60%** **D >= 40% to < 50%** **F < 40%**

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Means of assessment 1

Theory portion Assessment will be done through LAN based online system. Paper will be Objective question based. Lab exam will be done separately as per evaluation Guidelines.

Means of assessment 2

Re-examinations:

The following conditions will be applicable for the course end re-exam:

- 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.
- Students who have failed an exam may be allowed to appear for a re-exam.
- The re-exam should be conducted following the same process as the regular examination.
- Students, who failed/remained absent in the Course End Examination conducted by C-DAC, shall be allowed to appear in the re-examination only once.
- 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.
- 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%.
- There will be no re-exam for the re-exam

Pass/Fail:

If Candidate scored below 40% in any of the component like Theory, lab or Internal will be consider as FAIL.

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SECTION 2

SUMMARY EVIDENCE OF LEVEL

Level	Process Required	Professional Knowledge	Professional Skill	Core Skill	Responsibility
8	Comprehensive, cognitive, theoretical knowledge and practical skills to develop creative solutions to abstract problems. Undertakes self-study; demonstrates intellectual independence, analytical rigour and good communication.			Exercise management and supervision in the context of work/study having unpredictable changes; responsible for the work of others.	

Assessed outcome	Process Required	Professional Knowledge	Professional Skill	Core Skill	Responsibility
1. Programming Concepts 2. Microcontrollers and Interfacing 3. Embedded Operating Systems 4. Real Time Operating Systems 5. Internet of Things (IoT) and Mobile Programming 6. Embedded Hardware Design and Development 7. Project and Seminar	Person may carry out a job as developer or tester. This requires a command of wide-ranging specialised theoretical and practical skills, involving variable routine and non-routine contexts.	Learning Embedded C Programming, AVR/ARM based microcontrollers and interfacing, Embedded Opearting Systems, Embedded RTOS, IoT, Mobile Programming, Embedded Hardware design and development will help to learner to get employment as Embedded engineer, developer or tester.	Candidate can develop/test Embedded application 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 is responsible for his/her own work and can Work closely with members of the technical team. Candidate can identify each member's strength and assigns tasks accordingly to them to achieve maximum results and delivery.

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SECTION 3

EVIDENCE OF NEED

What evidence is there that the qualification is needed?

C-DAC 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 C-DAC has designed and delivered various postgraduate and undergraduate degree and diploma programmes. In addition, C-DAC imparts ICT training to state and national governments and agencies, strategic sectors, corporate and industries, foreign countries and international students, based on specific requirements.

PG-DESD is our flagship course and has not been contested till date.

The Education and Training activities of C-DAC are governed and steered by Academic Council (AC) and Academic Management Committee (AMC). As per the Academic Council minutes and direction, a syllabus updation subcommittee is formed by combining members from different C-DAC centers. The sub-committee gave their inputs for syllabus updation. The resource centre has conducted meetings for updating required modifications in the current syllabus of PG-Diploma. After minutes of the meeting with draft syllabus contents were circulated across all the participating centers for any suggestion and comments. If any suggestions come through discussion of all concerned members, we incorporate the same and circulate again for finalization. After that we make the source book and informed to all centers for their review

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

Total uptake of course is 600 per batch. The Information Technology industry is the fastest growing sector of the Indian economy and the need for trained manpower is growing. As per the reports global ER&D industry to grow to US $ 1400 bn by 2020 Indian Share is US$ 350 bn by 2014. It is expected that the IT industry will need at least 3.0 lakh trained software professionals every year and this number is likely to increase in the near future.

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?

C-DAC 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 C-DAC has designed and delivered various postgraduate and undergraduate degree and diploma programmes. In addition, C-DAC imparts ICT training to state and national governments and agencies, strategic sectors, corporate and industries, foreign countries and international students, based on specific requirements.

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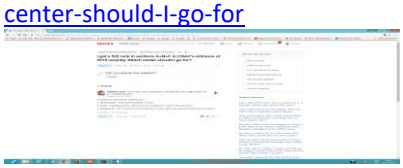
and circulate again for finalization. After that we make the source book and informed to all centers for their review

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.
  Below are some feedback :
- https://www.quora.com/I-got-a-522-rank-in-sections-A+B+C-in-CDACs-entrance-of-2015-recently-Which-center-should-I-go-for



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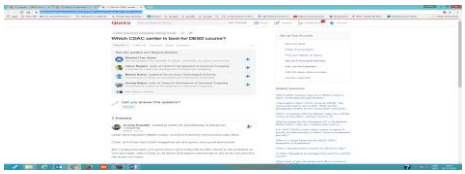
- https://www.quora.com/Which-CDAC-center-is-best-for-DESD-course



- https://www.quora.com/Which-is-the-best-C-DAC-embedded-institute

- https://www.quora.com/Is-it-worth-pursuing-a-PGDAC-from-CDAC-Pune-or-Bangalore/answer/Nayana-Naik?srid=StnY&share=017bdf28

- https://www.quora.com/Is-it-worth-pursuing-a-PGDAC-from-CDAC-Pune-or-Bangalore/answer/Ritwik-Ghosh-1?srid=StnY&share=af2fd353

- Alumni letter attached as annexure.

QUALIFICATION FILE

Please attach any documents giving further information about any of the topics above.
Give details of the document(s) here:

1. Annexure I : Course Content
2. Annexure II : Alumni Feedback
3. Annexure III: Company Feedback
4. Annexure IV: Placement Statistics