INSTITUTE OF HUMAN RESOURCES DEVELOPMENT
Prajo'e Towers, Vazhuthacaud, Thiruvananthapuram, Kerala, India. Pin-695 014
http://www.ihrd.ac.in

POST GRADUATE DIPLOMA IN EMBEDDED SYSTEM DESIGN

(6 months)

Scheme & Syllabus

2018

(Effective from January 2018 admission)

Institute of Human Resources Development
(Established by Govt. of Kerala)

Post Graduate Diploma in Embedded System Design

(6 months)

Subjects of Study and Scheme of Assessment

(Scheme-2018)

Code	Subject	No. of Hrs/ week		Minimum Marks			Maximum marks		
		T	P	W/P	CE	Total	W/P	CE	Total
PGDED101	Embedded C & Microcontroller Programming	5	-	30	10	50	75	25	100
PGDED102	Embedded Linux and Embedded RTOS	5	-	30	10	50	75	25	100
PGDED103	ARM Cortex Microcontrollers and Internet of Things	5	-	30	10	50	75	25	100
PGDED104	Embedded Product Design	5	-	30	10	50	75	25	100
PGDED105	Lab Practice – 1 (Embedded Linux, RTOS and IOT)	-	3	30	10	50	75	25	100
PGDED106	Lab Practice – 2 (Embedded C, Microcontrollers)	-	3	30	10	50	75	25	100
PGDED107	Project Work	-	4	50	50	100	100	100	200
Total Duration : 460 Hrs		20	10	Total marks:			550	250	800

** T- Theory P - Practical W - Written CE–Continuous Evaluation T – Total*

[Scheme-2018]

PGDED101 Embedded C & Microcontroller Programming

(Duration: 60 Hours)

Objectives:

This module is to make students used in C and Microcontrollers. This module covers the advanced topics in 'C' such as Memory management, Pointers, Data structures which are of high relevance in embedded software is considered in depth. This module makes use of KEIL C Compiler along with ARM 7 and Cortex Microcontrollers.This module covers the architecture of the popular 32-bit bit Microcontroller such as ARM. The ARM processor is the industry-leading 32-bit processor for highly deterministic real-time applications, specifically developed to enable partners to develop high-performance low-cost platforms for a broad range of devices including microcontrollers, automotive body systems, industrial control systems and wireless networking and sensors.

Module 1. Embedded Systems

Introduction to embedded systems, Application Areas, Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Architecture of embedded systems, Hardware architecture, Software architecture, Application Software, Communication Software, Development and debugging Tools. (15 Hrs)

Module 2. 'C' and Embedded C

Introduction to 'C' programming, Storage Classes, Data Types, Controlling program flow, Arrays, Functions, Memory Management, Pointers, Arrays and Pointers, Pointer to Functions and advanced topics on Pointers, Structures and Unions, Data Structures, Linked List, Stacks, Queues, Conditional Compilation, Pre-processor directives, File operations, Variable arguments in Functions, Command line arguments, bitwise operations, Typecasting. (15 Hrs)

Module 3. Introduction to ARM 7 Architecture

Introduction to 32-bit Processors, The ARM Architecture, Overview of ARM, Overview of Architecture, ARM Development Environment, Assembler and Compiler, Linkers and Debuggers. (10 Hrs)

Module 4. ARM 7 Microcontrollers & Peripherals

ARM7 based controller architecture, Memory mapping, Peripherals –GPIO, Timer, System timer, UARTs, LCD, ADC, interrupt handling – NVIC. (10 Hrs)

Module 5. ARMCortex-M4 Microcontrollers & Peripherals

Peripheral Interfacing, Application development on Cortex M4 controllers using standard peripheral libraries. (10 Hrs)

Text Books:

Embedded/Real Time Systems Concepts, Design and Programming Black Book, Prasad, KVK.
Let us C - by YashwantKanetkar.
The Definitive Guide to the ARM Cortex M3, Joseph Yiu, Newnes.

Reference Books:

- Embedded Systems Architecture Programming and Design: Raj Kamal, Tata McGraw Hill.
- Embedded C, Pont, Michael J
- Embedded Systems an Integrated Approach: Lyla B Das, Pearson
- C Programming by Worthington, Steve
- C Programming language, Kernighan, Brian W, Ritchie, Dennis M
- Art of C Programming, JONES, ROBIN,STEWART, IAN
- C Programming for Embedded systems, Zurell, Kirk
- Assembly language Programming ARM Cortex-M3, Vincent Mahout, Wiley
- Embedded Linux: Hardware, Software, and Interfacing, Hollabaugh, Craig.
- Embedded/Real-Time Systems: Concepts, Design and Programming: The Ultimate Reference, Dr. K.V.K.K. Prasad,

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PGDED102 Embedded Linux and Embedded RTOS

(Duration: 60 Hours)

Objectives:

The objective of the course is to provide understanding of the techniques essential to the design and implementation of embedded systems with embedded operating systems.

Module 1. Introduction

Basic Operating System Concepts-Linux as Embedded Operating System-Comparison of Embedded OS Embedded OS Tools and Development-Discussion on Embedded OS Applications and Products (10Hours)

Module 2. System architecture of a Basic OS

Internals of Linux OS-System Calls, Linux Compiler options, MakeProcess, Multithreading and Synchronization, Serial port and Network programming with Embedded Linux Kernel module programming and Device drivers. (15 Hours)

Module 3. Inter Process Communication

Pipe and FIFOs, Shared memory, Sockets, Getting Linux on a device-Linux boot sequence, Building Kernel, Building Boot image (10 Hours)

Module 4. Embedded RTOS-Introduction

Embedded Software – Real-time Vs Non Real-time-Introduction to Real-time systems and Embedded Real-time Systems-Discussion of popular RTOS-Comparison of Embedded RTOSs ,Design Goals for Real-time software-Discussion on Embedded Real-time applications, Considerations for real-time programming. (15 Hours)

Module 5. System architecture of RTLinux

Introduction RTLinux-Thread Creation and Management- Thread Synchronization Mechanisms IPC – RTFIFO, Shared Memory-Interrupt Handling (10 Hours)

Text Books:

- GNU/LINUX Application Programming, Jones, M Tims
- Embedded Linux: Hardware, Software, and Interfacing, Hollabaugh, Craig,
- Embedded Systems Architecture Programming and Design: Raj Kamal, Tata McGraw Hill
- Embedded/Real Time Systems Concepts, Design and Programming Black Book, Prasad, KVK

Reference Books:

- Building Embedded Linux Systems: Yaghmour, Karim
- Embedded Software Primer: Simon, David E.
- Linux Kernel Internals: Beck, Michael At Al
- UNIX Network Programming : Steven, Richard.

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PGDED103 ARM Cortex Microcontrollers and Internet of Things

(Duration: 60 Hours)

Objectives:

ARM is a family of instruction set architectures for computer processors based on a reduced instruction set computing (RISC) architecture developed by British company ARM Holdings. In 2005, about 98% of all mobile phones sold used at least one ARM processor. The low power consumption of ARM processors has made them very popular: 37 billion ARM processors have been produced as of 2013, up from 10 billion in 2008. The ARM architecture (32-bit) is the most widely used architecture in mobile devices, and most popular 32-bit one in embedded systems The ARM Cortex processor is the industry-leading 32-bit processor for highly deterministic real-time applications, specifically developed to enable partners to develop high-performance low-cost platforms for a broad range of devices including microcontrollers, automotive body systems, industrial control systems and wireless networking and sensors.

Module 1. Porting RTOS to ARM Cortex Microcontrollers

Building root file system, Kernel Compilation for ARM, Porting of OS to ARM. Overview of open source RTOS (Chibi-OS / FreeRTOS / MicroC-OS etc.), (10 Hours)

Module 2.

Porting open source – Embedded OS (Linux) & other RTOS (Chibi-OS / FreeRTOS / MicroC-OS etc.) on ARM Cortex Microcontrollers. RTOS based applications development on Cortex Microcontrollers. (15 Hours)

Module 3.

Introduction to IoT, WoT and M2M-Basics of Internet & Review of Internet protocols-Data logging /IoTLayering concepts. (15 Hours)

Module 4.

Wireless PAN (Bluetooth &Zigbee), GSM, Wifi-Introduction to Wireless Sensor Networks (10 Hours)

Module 5.

Routing Protocols in WSN-Database Management. (10 Hours)

Text Books:

- The Definitive Guide to the ARM Cortex M3, Joseph Yiu, Newnes
- Real-Time Embedded Multithreading, Edward L Lamie, CMP Books
- Data and Computer Communications; By: Stallings, William; Pearson Education Pte. Ltd., Delhi, 6th Edition
- Computer Networks; By: Tanenbaum, Andrew S; Pearson Education Pte. Ltd., Delhi, 4th Edition

Reference Books:

- Assembly language Programming ARM Cortex-M3, Vincent Mahout, Wiley
- Embedded Linux: Hardware, Software, and Interfacing, Hollabaugh, Craig.
- Embedded/Real-Time Systems: Concepts, Design and Programming: The Ultimate Reference, Dr. K.V.K.K. Prasad, Published by Wiley DreamTech, 2003
- ARM System Developer's Guide – Designing and Optimizing System Software by: Andrew N Sloss, Dominic Symes, Chris Wright; 2004, Elseiver.

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PGDED104 Embedded Product Design

(Duration: 60 Hours)

Objective

The objective of this module is to help fresh graduates and practicing engineers to enhance their knowledge and skills of embedded product design covering various dimensions of product development, Quality principles and tools, Project Management etc and discussion with suitable case study.

Module 1.

Quality principles and tools-Product Development Process-System level design using hardware and software-Hardware and software integration issues and testing-Hardware and software verification. (10 Hours)

Module 2.

Component cost and costing in product design-Case studies of real life designs-Industrial Design Project Management (PERT/CPM) MS Project-Interconnection design & EDA tools-Thermal Design Documentation-Team work and communication. (15 Hours)

Module 3.

Embedded Product design Syndicate-EMI/EMC-Case study of Microcontroller based Design Project Design phase-Hardware design and construction. (15 Hours)

Module 4.

Software design and development-Integration and debugging of hardware and software Final testing. (10 Hours)

Module 5.

ORCAD Schematic and PCB Layout-Mini Project. (10 Hours)

Text books:

- Product Design & Development – Karl T Ulrich & Steven D. Eppinger; Mc Graw Hill
- Total quality management Besterfield, Dale H
- Relevant Data sheets and application notes

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PGDED105 Lab Practice – 1

(Embedded Linux, RTOS and IOT)

(Duration: 60 Hours)

1. Shell scripting basics
2. Program for basic commands in Linux
3. Creating process and raising signals
4. Creating named pipes
5. Inter process communication through message queues and semaphores
6. Multithreading
7. Socketprogramming
8. Building image and kernel patching
9. Implementation of concepts in rtlinux
10. Module development
11. Application development in rtlinux
12. Porting of chibiOs
13. Application development using chibiOs
14. Python programming
14. Setting up raspbianos in raspberry pi
15. Establishing ssh protocol in rpi
16. GPIO Interfacing
17. Serial communication
18. Flask web framework programming
19. HTML Basics
20. Setting up webserver
21. MQTT based Application development

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PGDED106 Lab Practice – 2

(Embedded C, Microcontrollers)

(Duration: 60 Hours)

1. Basic programs in C
2. Understanding pointers data structures
3. Implementation of single and double linked list
4. Binary Tree
5. Files
6. Familiarisation with embedded C using arduino
7. GPIO Interfacing
8. LCD Interfacing with lpc2138
9. Timers and adc
10. Interrupt and UART
11. PWM
12. I2C (Inter Integrated circuit)
13. SPI(serial peripheral interface)
14. Pcb design with Lpc2138 application development
15. Motor Interfacing
16. Arm cortex me based microcontroller experiments

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PGDED107 Project Work

(Duration: 100 Hours)

Course Description

The students can select hardware, software or system level projects. The project can be implemented using Microcontroller or DSP or FPGA or RTOS tools which students have studied and used during the course. A total product or project can be selected.

A Project Evaluation & viva-voce will be conducted to along with practical examination for Terminal evaluation of the Project work.

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Post Graduate Diploma in Embedded System Design

1. **Question paper pattern**

Duration of Exam. : 3 Hrs. **Maximum marks : 75**

Part - A Short Answer type Questions with answer size up to 1 page per question. 5 Marks each.
Part - B Descriptive type Questions with answer size up to 2 to 3 pages per question. 15 marks each.

Marks Distribution

Part	No. of questions	Need to be answered	Marks/Question	Total
A	5	5	5	25
B	10	5	10	50
Total				75

Guidelines for Question paper setters :

1. In Part A, 5 questions, one short answer question from each module.
   In Part B, 10 questions, two questions from each module. Students have choice to opt any one of the two questions from each module. In part B, each question can be have sub divisions, but total mark per questions is 10 marks.
2. The level of difficulty shall be as follows
   i) Easy Questions : 30% -40%
   ii) Intermediate level to difficult : 30% -40%
   iii) Difficult questions : 20% -30%
3. The question paper setters must prepare and submit the question papers as per the following guidelines.
   i) Question paper must be designed and prepared to fit in an A4 size paper with one inch margin on all four sides.
   ii) Prepare the Question in MS-Word/Open office-Writer document format. Use only "TimesNewRoman" font with size 10. Align text to both left and right margins.
   iii) Please leave 5 cm. free area at the top of the front page of each question paper to place examination details/Question paper header by the examination department.
   iv) Avoid placing 1 or 2 questions in the last part in a fresh page, unless it is absolutely necessary. In such case, try to accommodate above questions in the previous page(s) by adjusting top/bottom margins and line spacing, if possible. This will reduce printing expenses.
   v) Specify marks for each question/part clearly.
   vi) Clearly specify the number of questions to be answered for each Part.
   vii) Confirm that no questions in part A is repeated in Part B also.
   viii) Avoid repeating questions in Part B from the immediate previous examination.
   ix) Key for evaluation must be prepared and enclosed in a separate cover and should be submitted along with the question paper set. Key for evaluation must specify evaluation guidelines for each part in the question paper, otherwise the key prepared will be treated as incomplete and will be rejected.
   x) Submit Question paper in Laser print out form only. Hand written and printed in poor quality printers is not acceptable.

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Post Graduate Diploma in Embedded System Design

2. Scheme for Continuous Evaluation.

1. For Theory Papers: Weightage

a). Average of minimum Two test papers : 30%
b). Average of minimum Two Assignments : 30%
c). Score for Seminar : 20%
d). Score for Class Attendance. : 10%
e). Overall performance in the class. : 10%

2. For Practical Papers: Weightage

a). Average of minimum Two Lab tests : 30%
b). Average of minimum Two Lab Assignments : 30%
c). Maintenance of Lab record : 20%
d). Score for Lab Attendance. : 10%
e). Overall performance in the Lab. : 10%

3. Teachers shall submit Mark list for Continuous Evaluation to the Head of Institution in the following format.

Subject code: Subject name:

Sl No.	Regno	Name	a.Test	b.Assignment	c.Seminar	d.Attendance	e.performance	Total

4. Head of Institution/Co-ordinator shall forward Continuous evaluation marks to the Examination Section of IHRD in the following format only.

Centre code: Centre Name:

Sl No.	Regno	Name	PGDED101 25	PGDED102 25	PGDED103 25	PGDED104 25	PGDED105 25	PGDED106 25	PGDED107 100

5. Continues evaluation(CE) marks must be published in the notice board at least one week before the commencement of theory examinations after getting approval from the Head of Institution/Co-ordinator.

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Thiruvananthapuram
February 21, 2018

Sd/-
Director