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National Institute of Electronics & IT CALICUT  
 (Formerly DOEACC Centre Calicut)  
COURSE PROSPECTUS

Name of the Group	:	Embedded System Group
Name of the Course	:	PG Diploma in Embedded System Design
Course Code	:	ED 500
Starting Date	:	15 <sup>th</sup> February 2012
Duration	:	24 weeks

### **Preamble**

In today's increasing global market place, successful companies are finding that investments in hardware and software are no longer enough to maintain a competitive edge. Human elements with specialized engineering and design skills have become the essential part of the equation.

Embedded systems monitor and control everything from spacecraft to robots, microwave ovens, car engines, VCRs, television sets and much more. They control virtually everything that is electronic in our lives.

Embedded systems are normally built around Microcontrollers, Digital Signal Processors (DSPs) and FPGAs or SOCs. Embedded System Design course focuses on the architecture and programming of embedded devices such as Microcontrollers, DSPs and FPGAs and also on Embedded and Real-Time Operating Systems.

### **Objective of the Course:**

*To mould fresh electronics engineers and to retrain working engineers into High Caliber Embedded System Designers by enhancing their knowledge and skills in various hardware and software design aspects of Embedded Systems. This course offers a range of topics of immediate relevance to industry and makes the students exactly suitable for industries engaged in Embedded System development. This course is also an excellent preparation for those wishing to engage in application research in this rapidly developing area.*

**Outcome of the Course:**

*On completion of the Course, the Participants shall get*

- *Exposure with different families and architectures of Embedded System tools such as Microcontrollers, DSPs, FPGAs etc.*
- *Expertise required to design any embedded system (H/w or S/w or both) based on any of the above devices.*
- *Expertise in Embedded Software particularly in real-time programming with industry standard RTOS such as VxWorks and RTLinux.*

**Course Structure:**

The ED 500 course contains eight modules. After completing the first seven modules, the students have to do a six weeks project using any of the topics studied to get the PG Diploma certificate.

<b>ED 500</b>	<b>MODULE NAME</b>	<b>Weeks</b>
ED 501	Embedded C and 8-bit Microcontrollers	4
ED 502	System Design using ARM Microcontrollers	3
ED 503	System Design using Digital Signal Processors	3
ED 504	Embedded Linux	2
ED 505	Embedded RTOS (RTLinux & VxWorks)	2
ED 506	System Design Using FPGAs	2
ED 507	Embedded Product Design	2
ED 508	Project Work	6
	<b>Fee for ED 500 – ₹68,000/- (Service Tax Extra)</b>	24

**Other Contents:****a. Course Fees:**

**For SC/ST Category Applicants:** Fee payable is ₹5,890/- (Service Tax Extra) subject to terms and conditions.

**General Category Applicants:** Total fee payable is ₹68,000/- (Service Tax Extra)

*The course fee can be paid in maximum of two installments as given below.*

**First installment:** ₹44,000/- (Service Tax Extra)

**Second installment:** ₹24,000/- (Service Tax Extra)

b. **Eligibility :**

1. M.E./M.Tech or B.E./B.Tech in Electronics/ Electronics & Communication/ Electrical/ Electrical and Electronics/Instrumentation/ Biomedical /Computer Science/Information Technology or MSc in Electronics/ Instrumentation/ Computer Science/Information Technology.
2. Candidates who have appeared in the qualifying examination and awaiting results may also apply.
3. On the date of counseling/admission, the candidate must produce the original mark lists up to the last semester/year of examination.

**Others**

- i. The Post Graduate Diploma certificate shall be issued to only those who complete the course successfully and produce original or provisional degree certificate and complete mark list.
- ii. Candidates who have appeared in the qualifying examination and awaiting results shall be awarded the PG Diploma certificate only after successful completion of the course as well as on production of the qualifying degree or provisional certificate and complete mark list. If a candidate is appearing for the examinations (back papers) after the completion of the PG Diploma course (ED 500) at our institute, he/she shall be eligible only for **Advanced Diploma** against PG Diploma on production of the qualifying degree result.

c. **Number of Seats : 40**

SC/ST candidates and Persons with disabilities are eligible for seat reservation as per existing rules.

d. **How to Apply :**

Students are advised to apply in the prescribed Application Form available with the course brochure/prospectus or downloaded from our website. Filled in application forms along with a Demand Draft towards advance deposit of ₹1000/- *drawn in favour of* Director, NIELIT, Calicut, *Payable at* State Bank of India, NITC Branch, Chathamangalam should be sent to the '**Training Officer, NIELIT Calicut, P. B. No. 5, NIT Campus Post, CALICUT – 673 601, Kerala**'. **The Name of the Course applied for should be super scribed on the top of the cover in which the application form is sent.**

e. **Selection of candidates :**

The selection to the course shall be based on the following criteria:

1. Selection of candidates will be based on their marks in the qualifying examination and the on-line admission test conducted by NIELIT subject to eligibility and availability of seats.
2. The list of Provisionally Selected Students will be published in our website [www.doeaccalicut.ac.in](http://www.doeaccalicut.ac.in) on **25<sup>th</sup>, 27<sup>th</sup> January and 1<sup>st</sup> February 2012.**

3. **All candidates who are provisionally selected have to pay the full fee or first installment** on or before **13-02-2012** by **DD** (Drawn in favour of Director, NIELIT, Calicut, Payable at State Bank of India, NITC Branch, Chathamangalam.) or by **direct payment into our account** from any bank where core banking facility is available. Selected candidates are requested to send the proof of remittance of fee by **14-02-2012**.
4. Payment can be made using the pay in slip available in our web site <http://www.doeacccalicut.ac.in/course/payinslip.pdf> through any branch of SBI (where this format is accepted).
5. The details required for direct payment are as given below.

<b>Savings Account No</b>	<b>:</b>	<b>31732177476</b>
<b>Bank Name</b>	<b>:</b>	<b>SBI, NITC Chathamangalam</b>
<b>Bank Code</b>	<b>:</b>	<b>2207</b>
<b>IFSC No</b>	<b>:</b>	<b>SBIN0002207</b>

The depositor should obtain the **UTR Number** from the branch while depositing cash directly into our account. Depositor should also obtain the acknowledgement duly filled up and signed by the staff of the bank through which the amount was deposited. UTR number should be mentioned in all the correspondences to us pertaining to amount.

The following details are to be given by the depositor.

1.	Name of the Depositor
2.	Name of the Student
3.	Date of Payment
4.	Amount Deposited
5.	Name of Bank/branch through which amount deposited
6.	Purpose – Course ID – Advance Deposit/Hostel Rent/Installment Fee etc.
7.	Proof of Deposit (photocopy of counterfoil/acknowledgement)
8.	UTR Number

The centre will not be responsible for any mistakes done by either the bank concerned or by the depositor while remitting the amount into our account.

6. Those candidates who are not selected for the course are eligible for refund of the advance deposit. However those students who are selected and not opting to join the course are not eligible for refund of fees.

f. **Test/Interview :**

1. Online Admission : 1 Hour  
Test Duration
2. Online Admission : **24<sup>th</sup>, 26<sup>th</sup> and 31<sup>st</sup> January 2012**  
Test Dates **(Can take test on any one of the dates)**
3. Number of Questions : 50
4. Syllabus : The pattern of the test shall be as follows  
Aptitude (20%), Logical reasoning (20%)  
C Programming (10%) and Basic Electronics (50%).

Basic Electronics includes topics of Digital, Analog, Microprocessor, Computer Organization, Signals & Systems.

5. Where to take test : Candidates can take the online test at home or any place where there is uninterrupted internet facility.
6. When to take test : Any one of the following dates **24<sup>th</sup>, 26<sup>th</sup> and 31<sup>st</sup> January 2012**
7. How to take test : All candidates who have registered and paid the advance deposit shall be provided with a username and password for logging to the DOEACC website. They can take the test after logging to the website with the instructions provided.  
All the eligible students shall receive the user name and password by e-mail at least two days before the exam. Those students who have not got the user name and password at least two days before the examination may contact the centre immediately. In case of any network failure, the same may be intimated to us immediately.
8. Mock Test : Mock Test shall be available from 28<sup>th</sup> of November 2011. Duration of the Mock test will be 10 minutes. Those desiring to take the Mock test can log in to <http://www.doeaccalicut.ac.in/html/course/ed500-800.html>

g. **Counseling/Admission :**

All candidates **provisionally selected** and **paid the fees (full or first installment)** will have to be present personally for **counseling and admission on 14<sup>th</sup> February 2012** with all the necessary documents (originals and attested copies). Those who don't bring the necessary documents (originals and attested copies) **on 14<sup>th</sup> February 2012** are not eligible for admission and counseling.

The original certificates and mark lists starting from SSLC or equivalent up to the present qualifying degree have to be produced for verification whereas the attested copies should be submitted here. The classes shall commence on **15<sup>th</sup> February 2012**.

h. **Admission Procedure :**

Students who have been selected for test/interview/counseling/admission are required to report to the Centre on the prescribed day by 9:30 hrs along with the following

1. Attested Copies of Proof of Age, Qualifications, etc
2. Original Certificate of the above
3. Two copies of photograph and one stamp size photograph for identity card.
4. SC/ST Certificate (if applicable)
5. Income Certificate (if applicable)

The students on reaching the Centre are required to meet the Front Office Councilor (FOC). The FOC then directs the student to the Course Coordinator. The student gets the enrollment form verified by the Course Coordinator and then meets the FOC who shall direct the student to the Accounts for payment of fees. A student is thus admitted.

i. **Discontinuing the course:**

No fees under any circumstances shall be refunded in the event of a student discontinuing the course. A student can however, be eligible for module certificates (applicable only for courses which provide for modular admission) which he/she has successfully completed provided he/she has paid the entire course fees.

j. **Course Timings :**

This program is a practical oriented one and hence there shall be more lab than theory classes. The classes and labs are from 9.30 am to 12.45 pm and 1.30 pm to 5.30 pm Monday to Friday. During project work, the timings are from 9.15 am to 5.30 pm. The theory to lab proportion is 30:70.

k. **Location & How to reach:**

NIELIT Calicut is about 22Kms from the Calicut (Kozhikode) city and close to NIT (REC) campus. A number of buses [Buses to NIT via Kunnamangalam] are available from "Palayam Bus Stand or KSRTC Bus Stand". Our stop is called "Panthrand" & is one stop before NIT. The bus fare is around ₹ 13/- from Calicut City to NIELIT. Calicut city is well connected by Rail, Road and Air from different parts of the country. The climatic conditions in Calicut are perhaps one of the best in India throughout the year. The maximum and minimum temperatures range between 35 °C and 20°C. The cool breeze further adds the comfort.

l. **Course enquiries :**

Students can enquire about the various courses either on telephone or by personal contact between 9.15 A.M. to 5.15 P.M. (Lunch time 1.00 pm to 1.30 pm).

**Telephone Numbers :**

Office	0495 - 2287266 / 2287268
Director's Office	0495 - 2287123
Training Officer	0495 - 2287266
<b>ED 500 Course Coordinator</b>	0495 - 2287266
<b>Office Fax</b>	0495 - 2287168

E-mail:

[trng@doeaccalicut.ac.in](mailto:trng@doeaccalicut.ac.in)

Website:

[www.doeaccalicut.ac.in](http://www.doeaccalicut.ac.in)M **Important Dates :**

Last date of receiving completed application forms	: 30 <sup>th</sup> January 2012
Dates of Online Admission Test	: 24 <sup>th</sup> , 26 <sup>th</sup> and 31 <sup>st</sup> January 2012
Selection list in website	: 25 <sup>th</sup> , 27 <sup>th</sup> January and 1 <sup>st</sup> February 2012
Payment of fee (full or first installment)	: 13-02-2012
Last date for intimation of proof of fee remittance (full or first installment)	: 14-02- 2012
Counseling/Admission	: 14-02-2012
Commencement of classes	: 15-02-2012
Payment of second installment fees	: 12-05-2012

n. **Placement :**

We have a placement cell, which provides placement assistance to students who qualify our courses.

The course improves the knowledge and skill of the students as it deals with the latest technologies and tools used in industries. This helps the student in getting a placement by

- a. Campus placement
- b. Placement by companies for whom we send the students bio data and they conduct interviews at their site.
- c. Students themselves attend interview at different companies and the course helps in the interview.

o. **Hostel facilities :**

Hostel accommodation is available for boys and girls on daily or monthly chargeable basis. *The hostel fee varies from ₹650/- to ₹1,050/- (for boys) per month and ₹650/- to ₹750/- (for Girls) per month depending on the location of accommodation.* However, students are required to pay the hostel fees for the duration of the course for which they are seeking admission at the time of joining the course.

p. **Canteen facilities :**

The Centre has a canteen functioning at the main campus and food at reasonable rates is available for breakfast, lunch, and dinner

q. **Lab Facilities :**

We have state-of-the-art lab facility in Embedded systems and Wireless communication which include,

- GSM/GPRS/GPS/Zigbee/Bluetooth/WiFi Modems.
- Java and J2ME development toolkit
- Wireless Simulators expertise in Glomosim, NS2, NS3, etc.
- 8-bit & 16-bit Microcontroller Dev. Systems - Intel 8051, 80C196, MPLAB for PIC 16 & 18 series, Cygnal etc
- 32-bit ARM9 microcontroller Development Systems – ATMEL & CIRRUS LOGIC
- ‘C’ compiler for 8051 (KEIL ‘C’ Development IDE), PIC (CCS), 80C196 (Tasking), ARM Developer Suite (ADS v1.)
- TI DSP Development Systems – ‘C6000, ‘C5400, ‘C5500, ‘C243, ‘C2812, ‘C32, ‘C50 etc.
- AD DSP Development Systems - 2191, 21065, 21061 Sharc DSPs
- Code Composer Studio, Visual DSP
- VxWorks, RTLinux & QNX RTOS, Embedded Linux
- Xilinx ISE FPGA Design Tools, Leonardo Spectrum, Model Sim Simulator
- Matlab, Simulink, TI ‘C6000 target for Matlab, LabView, Wireless LAN
- Universal DATA I/O programmer, PC Based EDA tools (ORCAD)
- Digital Storage & Mixed Signal Oscilloscopes (500, 350, 300, 100 MHz )
- EMI Test Setup, Logic Analyzer, SMD Rework station

r. **Course Contents :**

**ED 501 Embedded C and 8-bit Microcontrollers**

**Module Duration:** 20 days

**Objective**

This module is framed to set the required background in ‘C’ Language for the rest of the modules on embedded software. It aims at familiarising the students in programming in ‘C’. This module covers the advanced topics in ‘C’ such as Memory management, Pointers, Data structures which are of high relevance in embedded software are considered in depth. This module makes use of KEIL C Compiler along with 8051 microcontrollers.

This module also covers the architecture of the popular 8-bit Microcontrollers such as 8051, and PIC for lower end applications. Microcontrollers with built-in peripheral functions (such as PWMs for Motor Control or UPS, interface for Quadrature Encoders, Frequency measurement, Serial ports, 10-bit 8-channel ADCs, Digital I/Os, EPROM, RAM etc.), and lower power consumption are very popular and have drastically altered the economics of Digital System Design. The low cost, small size and programmability make them suitable for an enormous number of applications in products and systems like fuzzy logic controllers, industrial automation, home appliances etc. 8-bit and 16-bit Microcontrollers are widely used in industrial applications.

This module covers hardware and software design aspects in detail. The embedded system design aspects using 8-bit Microcontrollers are also covered in detail.

**Course Description**

**a) Embedded C**

All relevant aspects of ‘C’ programming under embedded environment are dealt with. It starts with the basics of ‘C’ language and covers the advanced topics in detail.

**Course contents**

‘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, Preprocessor directives, File operations, Variable arguments in Functions, Command line arguments, Bitwise operations, Typecasting

**b) 8051 Microcontrollers**

- Architecture of 8051 Family of Microcontrollers
- Assembly Language Programming of 8051
- Peripherals of 8051 Family of Microcontrollers
- System Design using 8051 Family of Microcontrollers
- Programming includes Keyboard Interfacing, LCD Interfacing, ADC and DAC, On chip Timers and Serial port
- Mini Project using 8051 Family of Microcontrollers

**Device Platform:** SBC-51 Development Board, Keil ‘C’ Compiler & Windows based Wise-51 Software.

**Programming Language:** ‘C’ and Assembly Language

**c) PIC Microcontrollers**

- Architecture of PIC Family of Microcontrollers (18F series)
- Programming of PIC Family of Microcontrollers
- Peripherals of PIC Family of Microcontrollers

**Device Platform:** MPLAB Simulator & 18F452 Dev Board

**Learning Outcomes**

After successful completion of the module students should be able to:

- Develop advanced programs in Embedded ‘C’
- Understand the architecture of the various types of 8-bit Microcontrollers
- Understand the programming of the various types of 8-bit Microcontrollers
- Understand the hardware interfacing of the peripherals to Microcontrollers
- Select a proper Microcontroller for a particular application
- Design new embedded systems using 8-bit Microcontrollers

**Reading List**

1. Let us C by Yashwant Kanetkar
2. Embedded C, Pont, Michael J
3. C Programming by Worthington, Steve
4. C Programming language, Kernighan, Brian W, Ritchie, Dennis M
5. Art of C Programming, JONES, ROBIN, STEWART, IAN
6. C Programming for Embedded systems, Zurell, Kirk
7. C and the 8051 Programming for Multitasking – Schultz, Thomas W
8. 8051 Microcontroller and Embedded Systems – Mazidi, Muhammad Ali, Mazidi, Janice Gillispie
9. Embedded Microcontrollers – Intel Hand Book
10. Programming and Customizing the 8051 microcontroller – Predko, Myke

11. 8051 Microcontroller: Hardware, Software and Interfacing – Stewart, James W, Miao, Kai X
12. C and the 8051: Hardware, Modular Programming and Multitasking Vol i – Schultz, Thomas W
13. 8051 microcontroller: Architecture, Programming & Applications – Ayala, Kenneth J
14. Programming and Customizing PIC Microcontroller – Predko, Myke
15. Design with PIC Microcontrollers – John B Peatman
16. PIC Microcontroller Project Book - Lovine, John

## **ED 502: System Design using ARM Microcontrollers**

**Module Duration:** 15 days

### **Objective**

The 32-bit Micro-controllers with ‘C’ language support and multifunction peripherals are being used in most of the medium and high end Embedded applications such as Mobile computing, Motion control, Wireless communication and even in Signal processing etc. The processors provide high end computing power as well as an extensive array of peripherals such as USB, LAN support, UART, Modem support, LCD/Graphics interface, General purpose I/O, I<sup>2</sup>C, CAN etc.

The 32-bit ARM processors are used in high end computation requirements such as Multimedia, Digital Camera and other high end applications. ARM processors are very popular in Industries. This module focuses on the architecture of the 32-bit ARM9 Microcontroller. The assembly language programming as well as ‘C’ language programming of the controller is also dealt in detail. The ARM Developer Suite with Multi ICE and ARM9 kit from Cirrus Logic is used.

### **Course Description**

- Introduction to ARM Family of Microcontrollers
- Architecture of ARM9 Microcontrollers
- Architecture of Cirrus Logic EDB9302/Atmel AT91RM9200 Family of Microcontrollers
- ‘C’ & Assembly Language Programming of ARM Microcontrollers
- ARM and Thumb Inter-working
- Peripherals of EDB9302/AT91RM9200 ARM9 Microcontrollers
- Mini Project

**Device Platform:** Arm Developer Suite 1.2, Multi ICE and ARM9TDMI boards (EDB9302 & EDB9315 from Cirrus Logic, AT91RM9200 from ATMEL)

**Programming Language:** Assembly Language & ‘C’

## Learning Outcomes

After successful completion of the module students should be able to:

- Understand the H/w and S/w issues related to the design of a Microcontroller based system catering to the needs of medium and higher end applications.
- Understand the architecture and programming of the 32-bit ARM Processors

## Reading List

1. ARM System Developer's Guide - Designing and Optimizing System Software by: Andrew N Sloss, Dominic Symes, Chris Wright; 2004, Elseiver
2. ARM Architecture Reference Manual by: David Seal, 2001 Addison Wesley, ENGLAND
3. ARM System - On - Chip Architecture, Furber, Steve

## ED 503: SYSTEM DESIGN USING DIGITAL SIGNAL PROCESSORS

**Module Duration:** 15 days

### Objective

Digital signal processing techniques are so powerful that sometimes it is extremely difficult for analogue signal processing to achieve the same or closer performance. This module introduces the digital signal processing fundamentals like convolution, DFT, FFT, Spectrum analysis etc. 'C' language will be used as the language for code development. The fundamentals of 'C' programming will also be covered in this module.

MATLAB is a powerful tool for design and analysis of digital signal processing algorithms. The capabilities of MATLAB tool will also be explored during the course.

The participants of this module will learn the architecture and programming of TMS320C5510 DSPs and Analog Devices SHARC DSPs. The hardware and complete implementation of selectable algorithms are dealt in detail with C5510 DSP. Programming with peripherals of this DSP is also covered in the module. Code Composer Studio IDE from Texas Instruments and Visual Studio from Analog Devices shall be used as the programming and debugging tools. A mini-project is also part of this course.

### Course Description

- Introduction to DSP Fundamentals
- FFT, Filter Design
- Introduction to MATLAB
- DSP Programming using MATLAB
- Introduction to DSP processors
- Introduction to Code Composer Studio (CCS)
- Architecture and Programming of 'C5510 DSP

- Peripherals of 'C5510 DSP
- Architecture of SHARC DSP
- Introduction to Visual DSP++
- Programming of SHARC DSP

### **Learning Outcomes**

After successful completion of this module, students should be able to:

- Understand the Fundamental algorithms in Digital Signal Processing.
- Understand the MATLAB programming Language
- Understand the use of MATLAB for DSP applications
- Implement the Fundamental DSP algorithms using the 'C' programming language.
- Understand the architecture and programming of the 'C5510 DSP.
- Understand the Fundamental algorithms in Digital Signal Processing and their implementation on the above DSPs.
- Will get familiarized with the Code Composer studio and Visual DSP Development Environment for DSP programming and debugging.

### **Reading List**

- Digital Signal Processing Design- Andrew Bateman, Warren Yates
- Introduction to Digital Signal Processing - John G Proakis, Dimitris G Manolakis
- Introduction to Digital Signal Processing - Johnny R Johnson
- Digital Signal Processing: A System Design Approach - David J Defatta
- Digital Signal Processing Laboratory Using MATLAB – Sanjit K. Mitra
- Digital Signal Processing - P Ramesh Babu
- Real - Time Digital Signal Processing: Implementations, Applications, and Experiments with the TMS320C55X, Kou, Sen M, Lee, Bob H

**ED504: Embedded Linux**

**Module Duration:** 10 days

**Objective**

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.

**Course Description**

- **Introduction**
  - Linux as Embedded Operating System
  - Comparison of Embedded OS
  - Embedded OS Tools and development
  - Discussion on Embedded OS Applications and products
  
- **System architecture of a Basic OS**
  - Internals of Linux OS
  - System Calls, Linux Compiler options, Make
  - Process, Multithreading and Synchronization
  - Serial port and Network programming with embedded Linux
  - Kernel module programming and Device drivers
  
- **Inter Process Communication**
  - Pipe and FIFOs, Shared memory, Sockets
  
- **Getting Linux on a device**
  - Linux boot sequence, Building Kernel, Building Boot image
  
- **Linux porting on ARM**
  - Building root file system, Kernel Compilation for ARM, Porting of Embedded Linux to ATMEL ARM9 kit.
  
- **Practical Sessions**
  - Embedded Linux Applications

**Learning Outcomes**

After successful completion of the module, the students shall be able to:

- Understand the Embedded operating systems that is needed to run embedded systems
- Understand Embedded Linux and its internals
- Build embedded systems using Embedded Linux operating systems

## Reading List

1. GNU/LINUX Application Programming, Jones, M Tims
2. Embedded Linux: Hardware, Software, and Interfacing, Hollabaugh, Craig,
3. Building Embedded Linux Systems: Yaghmour, Karim
4. Embedded Software Primer: Simon, David E.
5. Linux Kernel Internals: Beck, Michael At Al
6. UNIX Network Programming : Steven, Richard
7. Linux: The Complete Reference: Petersen, Richard
8. Linux Device Drivers: Rubini, Alessandro, Corbet, Jonathan
9. Linux Kernel Programming: Algorithms and Structures of version 2.4: Beck, Michael At Al
10. Linux Kernel Development: Love, Robert

## ED 505: Embedded RTOS (RTLinux & VxWorks)

**Module Duration:** 10 days

### Objective

The objectives of the course is to provide the students with an understanding of the aspects of the Real-time systems and Real-time Operating Systems and to provide an understanding of the techniques essential to the design and implementation of real-time embedded systems.

### Course Description

- **Introduction**
  - Embedded Software – Real-time Vs Non Real-time
  - Introduction to Real-time systems and Embedded Real-time Systems
  - Discussion of popular RTOS like RTLinux and VxWorks
  - Comparison of Embedded RTOSs (RTLinux and VxWorks)
  - Design Goals for Real-time software
  - Discussion on Embedded Real-time applications
  - Considerations for real-time programming
- **System architecture of RTLinux**
  - Introduction RTLinux
  - Thread Creation and Management
  - Thread Synchronization Mechanisms
  - IPC – RTFIFO, Shared Memory
  - Interrupt Handling

- **System architecture of VxWorks**
  - Introduction to VxWorks
  - Task Creation and management
  - Inter Task Communication Mechanisms
  - Semaphores, Message Queues, Pipes
  - Interrupts, Tornado tools
  
- **Practical Sessions**
  - Application Development under RTLinux and VxWorks

### **Learning Outcomes**

After successful completion of the module, the students shall be able to:

- Understand the Embedded Real Time software that is needed to run embedded systems
- Understand the RTLinux RTOS and their commands
- Understand the VxWorks RTOS and realtime application programming with it.
- Build real-time embedded systems using RTLinux and VxWorks real-time operating systems

### **Reading List**

1. Embedded Systems Architecture Programming and Design: Raj Kamal, Tata McGraw Hill
2. Embedded/Real Time Systems Concepts, Design and Programming Black Book, Prasad, KVK
3. Software Design for Real-Time Systems: Cooling, J E Proceedings of 17th IEEE Real-Time Systems Symposium December 4-6, 1996 Washington, DC: IEEE Computer Society
4. Real-time Systems – Jane Liu, PH 2000
5. Real-Time Systems Design and Analysis : An Engineer's Handbook: Laplante, Phillip A
6. Structured Development for Real - Time Systems V1 : Introduction and Tools: Ward, Paul T & Mellor, Stephen J
7. Structured Development for Real - Time Systems V2 : Essential Modeling Techniques: Ward, Paul T & Mellor, Stephen J
8. Structured Development for Real - Time Systems V3 : Implementation Modeling Techniques: Ward, Paul T & Mellor, Stephen J
9. Monitoring and Debugging of Distributed Real-Time Systems: TSAI, Jeffrey J P & Yang, J H
10. Embedded Software Primer: Simon, David E.

## **ED 506: System Design Using FPGAs**

### **Module Duration**

- 10 days

### **Objective**

FPGAs are the present day tool for implementing many embedded applications. A basic understanding of digital electronics is very useful for the proper understanding of this topic. Basics of communication is also covered for further applications.

The course is structured to include the learning of VHDL syntax and the architecture of most prominent vendor in the FPGA market, Xilinx FPGAs. Hands own experiments and a mini-project are included in the module.

### **Course Description**

#### **System Design Using FPGAs**

- Review of Basic Electronics (Digital Electronics + Communication)
- Introduction to VHDL
- VHDL Concepts, Types & Operators
- Sequential & Concurrent Statements
- VHDL Simulation
- XILINX FPGA Architecture
- Synthesis & Implementation on FPGAs
- Mini Project using FPGAs

### **Learning Outcomes**

On completion, the participants will learn about:

- Writing the VHDL Programs
- Architecture of Xilinx FPGAs
- Programming of Xilinx FPGAs using VHDL

### **Reading List:**

1. VHDL Analysis and Modeling of Digital Systems – Navabi, Zainalabedin, MGH, New York
2. VHDL Primer – Bhasker, J, PHI Learning, New Delhi
3. Guide to VHDL Syntax – Bhasker, J, PH, New Jersey
4. VHDL - Perry, Douglas L, MGH, New York
5. Digital Systems Design with VHDL and Synthesis : An Integrated Approach – Chang, K C, IEEE Computer Society Press, California
6. Designer’s guide to VHDL - Ashenden, Peter J, Harcourt India, New Delhi
7. Introductory VHDL: From Simulation to Synthesis - Yalamanchili, Sudhakar, Pearson Education (Singapore) PTE. Ltd., Delhi

8. VHDL for Digital Design – Vahid, Frank, Lysecky, Roman, John Wiley & Sons, Inc., New Jersey
9. VHDL for Engineers, Short, Kenneth L, Dorling Kindersley (India), Delhi
10. Design Warrior's Guide To FPGAs: Devices, Tools And Flows – Maxfield, Clive Max - Elsevier, New Delhi
11. FPGA Based System Design – Wolf, Wayne, Pearson Education (Singapore) PTE. Ltd., Delhi
12. Programmable Logic Databook – Xilinx Inc.

## **ED 507: Embedded Product Design**

### **Module Duration**

- 10 days

### **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.

### **Course Description**

- Quality principles and tools
- Product Development Process
  - System level design using hardware and software
  - Hardware and software integration issues and testing
  - Hardware and software coverification
  - 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
- Embedded Product design Syndicate
- EMI/EMC
- **Case study of Microcontroller based Design**
  - Project Design phase
  - Hardware design and construction
  - Software design and development
  - Integration and debugging of hardware and software
  - Final testing
  - ORCAD Schematic and PCB Layout
- Mini Project

## **Learning Outcomes**

After successful completion of the module, the students shall be able to understand and practice quality principles and tools in product development process, right from identifying customer requirements and translating them into product specifications and realization of the product specifications through electronics, mechanical and industrial design, product engineering and meeting the cost and development time constraints through better project management.

Students shall Design and Develop a standalone Data Acquisition System using Microcontroller. Conceptual design, PCB Design, PCB Assembly, Testing, Integration etc. are covered in the mini project

## **Reading List**

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

## **ED 508: Project Work**

### **Module Duration**

- 6 Weeks

### **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.