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: *19 August 2015*

Duration: *24 Weeks*

Preamble: *To better compete in the global market, successful companies are finding that investments in hardware and software are no longer enough. Human elements with specialized engineering and design skills have become the essential part of the equation.*

Embedded systems are ubiquitous. We find them everywhere- at our homes offices, in shopping malls, in hospitals, in cars, in air craft and so on. They monitor and control everything from spacecraft to robots, microwave ovens, automobiles, consumer electronics 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. This 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 wishes 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 Microcontroller, ARM, 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: *This course contains total eight modules. After completing the first seven modules, the students have to do a six weeks project using any of the topics studied to earn the PG Diploma.*

ED 500	Module Name	Weeks
ED501	Embedded C and ARM Cortex Microcontrollers	4
ED502	Embedded Linux	2
ED503	Embedded RTOS	4
ED504	Porting on ARM Cortex Microcontrollers	2
ED505	IoT (Internet of Things) Applications	2
ED 506	System Design using FPGAs/ DSPs	2
ED 507	Embedded Product Design	2
ED 508	Project Work	6
	Fee for ED 500 – Rs 70,000 + Service tax at actual	24

Other Contents

a. **Course Fees :**
   For SC/ST Category Applicants: Tuition Fees/Examination fees are waived for SC/ST students admitted under SCSP/TSP. However they are required to remit an amount of **Rs 7,980/- as Advance caution/security deposit**. This amount will be considered as caution/security deposit and will be refunded after successful completion of the course. If the student fails to complete the course successfully this amount along with any other caution/security deposits by the student will be forfeited.

   General Category Applicants: Course Fee is Rs 70,000 + Service tax at actual

   The course fee can be paid in installments as given below.

b. **Course Fee Installment Structure:**

   1. Deposit at the time of Course Registration of Rs.1000/- will be considered as caution deposit on student joining the course.

   2. Fee Installment structure for PG/Advanced Diploma programs is as follows:

Fees	Amount
Advance Fee**	Rs.10,000 /- (Students who appear in selection list may pay this fees to confirm their seats)
1st Installment	Rs.35,000 /- Plus Service Tax* = Rs.39,900/- (If Rs.10,000/- Already Paid) Net Amount Payable = Rs.29,900/-
2nd Installment	Rs.35,000 /- Plus Service Tax* = Rs.39,900/-

*Service Tax is presently 14% and revised rates are applicable as per Govt of India Orders.

** Students can also pay the full fees of Rs 79,800/- (Rs 70,000/- + Service Tax) or first installment of Rs 39,900/- (35000+ Service Tax) against advance fee. The SC/ST Students have to pay **only Rs 7,980/-.**

c. **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.*

d. **Number of Seats : 40**
SC/ST candidates and Persons with disabilities are eligible for seat reservation as per existing rules.

e. **How to Apply :**
Students are advised to apply in the prescribed Application Form available with the course brochure/course prospectus or downloaded from our website. Filled-in application forms along with a Demand Draft (or pay-in-slip) towards advance fee of Rs.1,000/- *drawn in favour of* Director, NIELIT, Calicut, *Payable at* State Bank of India, NIT Campus Branch (code: 2207), Chathamangalam should be sent to the **Training Officer, NIELIT, 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 forwarded.**

Modes of Payment: The course fee can be paid by one of the following methods as per your convenience. For details visit http://calicut.nielit.gov.in/mode-of-payments.

1	Demand Draft to be drawn in favor of Director, NIELIT, Payable at State Bank of India, Calicut NIT Branch (2207). The DD should reach here before the last date to apply.
2	Through any branch of SBI (where this format is accepted) using the pay in slip available in our web site. The **original counterfoil** should reach here before the last date to apply.
3	The fees can be paid directly into our account from any bank where core banking facility is available. The details required for direct payment are as given below. • Savings Account No: **31329537747** • Bank Name: SBI, NIT Chathamangalam • Bank Code: 2207 • IFSC No: SBIN0002207 • MICR : **673002012** The depositor should obtain the UTR Number/Journal No from the branch while depositing cash directly into our account. Depositor should also obtain the counterfoil duly filled up and signed by the staff with seal of the bank through which the amount was deposited. The following details should reach here before the last date to apply. 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 (counterfoil/acknowledgement **in original**) 8. UTR Number
4	The fees can be paid through the SBI Collect - https://www.onlinesbi.com/prelogin/icollecthome.htm Payment Gateway as well: 1. Please click the SBI Collect hyper link to enter the payment gateway. 2. Select State of Corporate/Institution as *Kerala* 3. *Select* Type of Institution *Educational Institutions* and click on *Go* button 4. Select Educational Institutions Name as NIELIT and click Submit button 5. Select Payment Category as *Course Fee* 6. Enter all the fields including amount payable and follow the instructions The following details should reach here before the due dates. 1. Name of the Depositor 2. Name of the Student 3. Date of Payment 4. Amount Deposited 5. Purpose – Course Name: 6. UTR Number

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

f. **Selection of candidates :**

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

   i. *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. Knowledge in C Programming and Basic Electronics is a pre-requisite of this course.*

   ii. *The list of Provisionally Selected Students will be published in our website* http://calicut.nielit.gov.in *on* **3ʳᵈ August 2015.**

   iii. *All candidates who ho appear in selection list may pay Rs.10,000/- on or before 11ᵗʰ August 2015 by DD (Drawn in favor 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, so as to reach the centre by* **12ᵗʰ August 2015.**

g. **Test/Interview (if applicable) :**

1.	*Online Admission Test Duration*	*1 Hour*
2.	*Online Admission Test Dates*	*21ˢᵗ, 23ʳᵈ, 24ᵗʰ, 27ᵗʰ July and 1ˢᵗ August 2015. (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 and 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*	*On any one of the dates 21ˢᵗ, 23ʳᵈ, 24ᵗʰ, 27ᵗʰ July and 1ˢᵗ August 2015.*
7.	*How to take test*	*All candidates who have **registered and paid the advance deposit** shall be provided with user name and password by e-mail at least two days before the Admission Test. Those students who have not got the user name and password at least two days before the examination may contact the course coordinator immediately. In case of any network failure during test, the same may be intimated to us immediately.*

8.   *Mock Test*   *Mock Test shall be available from 1ˢᵗ June 2015. Duration of the Mock test will be 10 minutes. Those desiring to take the Mock test can log in to http://calicut.nielit.gov.in/ed500*

h.   **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 **17ᵗʰ or 18ᵗʰ August 2015** with all the necessary documents (originals and attested copies). Working days are from Monday to Friday. Admission timings are from 9.30 am to 4.00 pm. Those who don't bring the necessary documents (originals and attested copies) **by 18ᵗʰ August 2015** are not eligible for admission and counseling.*

i.   **Spot Admission:** If spot admission is open, spot admission will close within 15 days of Counseling/Admission of a particular course. On spot admission students should provide an undertaking saying that he/she is fully aware that he/she missed so much days of class and will not ask for further extension of course.

j.   **Admission Procedure :**
Students who have been selected for test/interview/counseling/admission are required to report to the Institute 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 Institute 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.

k.   **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 has successfully completed provided he has paid the entire course fees.

l. **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.

m. **Location and how to reach :**
NIELIT Calicut is located very close to NIT campus and is about 22Kms from the Calicut (Kozhikode) city. A number of buses (Buses to NIT via Kunnamangalam) are available from "Palayam Bus Stand and KSRTC Bus Stand". The bus stop at our Institute is called "Panthrand" and is one stop before NIT. The bus fare is around *Rs15/-* from Calicut City to NIELIT. Calicut (Kozhikode) is well connected by Rail, Road and Air form different parts of the country. The maximum and minimum temperatures range between 35^0C and 20^oC.

n. **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
ED 500 Course Coordinator	0495 – 2287266
Office Fax	0495 - 2287168
E-mail:	**trng@ calicut.nielit.in**
Website:	**http://calicut.nielit.in/**

o. **Important Dates:**

Last date of receiving completed applications	:	*31st July 2015*
Dates of Online Admission Test	:	*21st, 23rd, 24th, 27th July and 1st August 2015.*
Selection lists in website	:	*25th July & 3rd August 2015.*
Payment of Advance Fee-Rs 10,000/-	:	*On or before 11th August 2015.*
Last date for intimation of proof of fee remittance (Advance Fee-Rs 10,000/-)	:	*12th August 2015.*
Counseling/Admission	:	*17th & 18th August 2015.*
Payment of first installment fees	:	*17th & 18th August 2015.*
Commencement of classes	:	*19th August 2015.*
Payment of second installment fees	:	*17th November 2015.*

p. **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.*

q. **Hostel facilities :**

Hostel accommodation is available for boys and girls on daily or monthly chargeable basis. *The hostel fee varies from Rs.850/- to Rs.1,300/- (for boys) per month and Rs.1,000/- to Rs.1,400/- (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.

r. **Canteen facilities:**

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

s. **Lab Facilities:**

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

- *8-bit &16-bit Microcontroller Dev. Systems - Intel 8051, 80C196, MPLAB for PIC 16 & 18 series, Cygnal etc*
- *32-bit ARM Microcontroller Development Systems – ARM Cortex-M3 STM32, ATMEL ARM9 EK & CIRRUS LOGIC EDB9315*
- *'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.*
- *Friendly ARM, Rasberry PI and Arduino Boards,*
- *Code Composer Studio, Visual DSP, VxWorks, RTLinux & QNX RTOS*
- *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*
- *GSM/GPRS/GPS/Zigbee/Bluetooth/WiFi Modems.*
- *Java and J2ME development toolkit*
- *Wireless Simulators expertise in Glomosim, NS2, NS3, etc.*

t. **Course Contents :**

ED 501: Embedded C and ARM Cortex Microcontrollers

Module Duration: 20 days

Objective

This module is framed to set the required background in embedded system concepts and 'C' language for the rest of the modules. It aims at familiarizing the students in embedded concepts and 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 is considered in depth. This module makes use of KEIL C Compiler along with ARM Cortex Microcontrollers.

This module covers the architecture of the popular 32-bit bit Microcontroller such as ARM. 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.

Course Description

Embedded Concepts

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.

'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, Preprocessor directives, File operations, Variable arguments in Functions, Command line arguments, bitwise operations, Typecasting.

Introduction to ARM Cortex Architecture

Introduction to 32-bit Processors, The ARM Architecture, Overview of ARM, Overview of Cortex Architecture, Cortex M3 Register Set and Modes, Cortex M3 Processor Core, Data Path and Instruction Decoding, ARM Cortex M3 Development Environment,

Assembler and Compiler, Linkers and Debuggers, ARM, Thumb & Thumb2 instructions, Mixing ARM & Thumb Instructions, Memory hierarchy, Memory Mapping, Cache.

Cortex M3 Microcontrollers & Peripherals

Cortex M3 based controller architecture, Memory mapping, Cortex M3 Peripherals – RCC, GPIO, Timer, System timer, UARTs, LCD, ADC, Cortex M3 interrupt handling – NVIC. Application development on Cortex M3 controllers using standard peripheral libraries.

Text Books:
1. Embedded/Real Time Systems Concepts, Design and Programming Black Book, Prasad, KVK.
2. Let us C by Yashwant Kanetkar.
3. The Definitive Guide to the ARM Cortex M3, Joseph Yiu, Newnes.

Reference Books:
1. Embedded Systems Architecture Programming and Design: Raj Kamal, Tata McGraw Hill.
2. Embedded C, Pont, Michael J
3. Embedded Systems an Integrated Approach: Lyla B Das, Pearson
4. C Programming by Worthington, Steve
5. C Programming language, Kernighan, Brian W, Ritchie, Dennis M
6. Art of C Programming, JONES, ROBIN,STEWART, IAN
7. C Programming for Embedded systems, Zurell, Kirk
8. Assembly language Programming ARM Cortex-M3, Vincent Mahout, Wiley
9. Embedded Linux: Hardware, Software, and Interfacing, Hollabaugh, Craig.
10. Embedded/Real-Time Systems: Concepts, Design and Programming: The Ultimate Reference, Dr. K.V.K.K. Prasad, Published by Wiley DreamTech, 2003
11. ARM System Developer's Guide - Designing and Optimizing System Software by: Andrew N Sloss, Dominic Symes, Chris Wright; 2004, Elseiver.
12. Cortex M3 Reference manual.
13. STM32Ldiscovery datasheets, reference manuals & Application notes.
14. Chibi-OS / RT API reference manuals & documents.

ED 502: 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**
  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

- **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

- **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
11. Operating System Concepts, Peter B. Galvin, Abraham Silberschatz, Gerg Gagne, Wiley Publishers

ED503: Embedded RTOS

Module Duration: 20 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. This course covers two popular real time operation systems VxWorks and RTLinux.

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 17the 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.

ED504: Porting on ARM Cortex Microcontrollers

Module Duration: 10 days

Objective

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.

The processor delivers outstanding computational performance and exceptional system response to events while meeting the challenges of low dynamic and static power constraints. The processor is highly configurable enabling a wide range of implementations from those requiring memory protection and powerful trace technology to cost sensitive devices requiring minimal area.

In this module the development of Application on ARM Cortex Microcontrollers by porting chibi-OS is detailed.

Course Description

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.), 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.

Text Books:
1. The Definitive Guide to the ARM Cortex M3, Joseph Yiu, Newnes
2. Real-Time Embedded Multithreading, Edward L Lamie, CMP Books

Reference Books:
1. Assembly language Programming ARM Cortex-M3, Vincent Mahout, Wiley
2. Embedded Linux: Hardware, Software, and Interfacing, Hollabaugh, Craig.
3. Embedded/Real-Time Systems: Concepts, Design and Programming: The Ultimate Reference, Dr. K.V.K.K. Prasad, Published by Wiley DreamTech, 2003
4. ARM System Developer's Guide - Designing and Optimizing System Software by: Andrew N Sloss, Dominic Symes, Chris Wright; 2004, Elseiver.
5. Cortex M3 Reference manual.
6. STM32Ldiscovery datasheets, reference manuals & Application notes.
7. Chibi-OS / RT API reference manuals & documents.

ED505: IoT (Internet of Things) Applications

Module Duration: 10 days

Objective

The Internet of Things (IoT) is a scenario in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. The Internet of Things (IoT, sometimes Internet of Everything) is the network of physical objects or "things" embedded with electronics, software, sensors and connectivity to enable it to achieve greater value and service by exchanging data with the manufacturer, operator and/or other connected devices. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. Experts estimate that the IoT will consist of almost 50 billion objects by 2020.

The participants of this module will learn about IoT Architecture and Layering Concepts, IoT platform, Wireless sensor networks and IoT Application development.

Course Description

- Introduction to IoT, WoT and M2M

- Basics of Internet & Review of Internet protocols

- Data logging /IoT Layering concepts

- Wireless PAN (Bluetooth & Zigbee), GSM, Wifi

- Introduction to Wireless Sensor Networks

- Routing Protocols in WSN

- Database Management

Learning Outcomes

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

- Understand the IoT Architecture and Layering Concepts.

- Understand the IoT platform hardware and software.

- Understand how to Implement IoT Applications.

Reading List

1. 6LoWPAN: The Wireless Embedded Internet, Zach Shelby, Carsten Bormann, Wiley
2. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers
3. Interconnecting Smart Objects with IP: The Next Internet, Jean-Philippe Vasseur, Adam Dunkels, Morgan Kuffmann
4. The Internet of Things: From RFID to the Next-Generation Pervasive Networked Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning
5. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , Arshdeep Bahga
6. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally
7. Asoke K Talukder and Roopa R Yavagal, "Mobile Computing," Tata McGraw Hill, 2010.
8. Computer Networks; By: Tanenbaum, Andrew S; Pearson Education Pte. Ltd., Delhi, 4th Edition
9. Data and Computer Communications; By: Stallings, William; Pearson Education Pte. Ltd., Delhi, 6th Edition
10. F. Adelstein and S.K.S. Gupta, "Fundamentals of Mobile and Pervasive Computing," McGraw Hill, 2009.
11. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
12. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010

ED 506: Elective1 - 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

- 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 506: Elective 2 – System Design using Digital Signal Processors

Module Duration: 10 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. 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 will be used as the programming and debugging tool. 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

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 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

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

- 30 Days

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.