Embedded Hardware Design(EL 203) – Autumn 2012

Course Instructor : Prof. Prabhat Ranjan (Xtn-553, Room-2104)
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Core Course : B Tech 5th Semester
Credit : 3-0-3-4.5
Evaluation : Will be based on Pop Quiz, InSem, Final Exam, Laboratory  and Project work(Optional). Course content would be shard on Moodle : courses.daiict.ac.in

Course Objectives:

This course would be introductory course to the world of embedded systems. Due to miniaturization, low cost and increasing user demand, we come across increasing number of systems in our day-today life, which have built in intelligence by the use of a processing element. At any time, we may be carrying a number of embedded devices with us. It is very fascinating to be able to realize an embedded hardware and to see it working. Robotics is one application to which this can be applied, among myriad of other applications.

The course would start by introducing the concept of embedded system. It would describe the wide spectrum of embedded devices in use now and how different processing elements are used in them. We would briefly expose students to Custom Chip Design, FPGA, 8/16 bit micro-controllers, 32-bit micro-controllers and DSP. However the course would use 8/16 bit micro-controllers as the basis of Embedded hardware design in this course.

Programming Platform – In the labs, we would use STK-500 kits using ATMega32 chips from ATMEL AVR family. We would not be using Operating Systems to be embedded on these chips and most of the programming would be done in ‘C’ language. We would use avr-gcc tool chain on running on Linux OS as development platform. A brief exposure to using assembly language would be given.

Desirable : Good knowledge of ‘C’ and Linux would be helpful in the course.

Course Outline:

- Introduction to Embedded Systems and processing elements used in them
- Micro-controllers :
  - Introduction, History, Comparison of popular micro-controllers
  - Programming AVR Microcontroller,
  - Setting up development platform, tool chain
  - Programming peripherals on micro-controller
  - Interfacing external Devices to Microcontroller
  - Clocks, Power Saving and Fuse Programming, Watchdog Timer
- Debugging
- Sensors
- Actuators
- Wireless Communication for embedded devices
- RF Based communication
- IR based communication
- Portable Embedded Device
- Power Supply for Embedded Device
- PCB Design - Eagle

**Laboratory**
- ATMEL AVR Microcontroller programming using STK-500 using avr-gcc and GNU tool chain
- Micro-controller interface with Switch, LED, LCD, Infrared and RF devices
- Micro-controller interfacing to Sensors : Light, Temperature, Vibration etc using Analog and Digital interfaces
- Standalone microcontroller based device

**Projects**
A limited number of projects would be offered (maximum 20 teams of not more than 2 team members), which would be optional.

**Outcome**
Students taking this course should be able to develop portable intelligent embedded device for variety of applications.

**Recommended Reading Material**
- John Catsoulis - Designing Embedded Hardware (O’Reilly)
- Barnett, O’Cull, Cox, Embedded C programming and the Atmel AVR (Cengage Learning)