**Birla Institute of Technology & Science, Pilani**
Hyderabad Campus

**Course Number**     :     **EEE G512**
**Course Title**     :     **EMBEDDED SYSTEM DESIGN**
**Instructor-in-Charge**  :     **SYED ERSHAD AHMED**

**Date:**

**Scope and Objective of the course**

Introduction to embedded systems; embedded architectures: Architectures and programming of microcontrollers and DSPs. Embedded applications and technologies power issues in system design introduction to software and hardware co-design.

The course intends to cover the design issues involved in embedded systems and system-on-chip technologies. The course also deals with the applications and programming languages used for embedded systems. This course introduces the students to standard Embedded System Development tools and gives a hands-on experience in developing various embedded applications.

**Text Book:**

T1. Wolf, Wayne, Computers as Components – Principles of Embedded Computing System Design, Second Edition, Elsevier, 2008.

**Reference Books:**

R1. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems ", Second Edition, Pearson Education,2008.
R2.Raj Kamal, Embedded Systems, Tata McGraw Hill, New Delhi, 2003.
R3.Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide, Designing and Optimizing System Software" Morgan Kaufmann Publishers, Elsevier, 2004.

| Lecture No. | Learning Objectives | Topics | Reference to Text books/ References |
|---|---|---|---|
| 1-2 | Basics of Embedded System | Introduction to Embedded Systems, Design Methodology and Research Areas | T1-Chapter 1, R2 - Chapter 1 + Class Notes |
| 3-5 | Processors, Memory and I/O Devices, Device Drivers | Processors in Embedded Systems. RISC and CISC Architectures. Memories, Exemplary Embedded Systems I/O Devices, Software in Embedded Systems, Device Driver Concepts | T1 & R2 - Chapter 2, 3, 4 + Class Notes |
| 6 | Microcontrollers | Introduction to 8051 Family of Microcontroller | R1- Chapter 1 + Class Notes |
| | Design of Software | 8051 Programming Model, | R1- Chapter 2-7, |

| | | | |
|---|---|---|---|
| 7-10 | Systems | Addressing Modes, Instruction Set,  Special Function Registers(SFRs), Memory Maps, C versus Assembly, Embedded Programming in C | + Class Notes |
| 11 | Interfacing Techniques | Methodology, Synchronizing Software and Processor with I/O. | Class Notes |
| 12-14 | 8051  On-chip Peripherals | 8051  Timers, Serial Ports, Programmable Counter Arrays (PCA), Keyboard Interface, Interrupt, Interrupt Vectors and Priority, Threads | R1- Chapter 9-11 (relevant topics) + Class Notes |
| 15-17 | Interfacing External Peripheral | Interfacing of LCDs, Relays, DC Motors, Stepper Motors, Sensors, External Memories, 8255 etc | R1- Chapter  12-15 + Class Notes |
| 18 | Real Time Operating System Basics | Introduction to RTOS on 8051 (RTX51 Full and RTX51 Tiny) | Class Notes |
| 19 | Case Study | General Purpose Processor based Design | Class Note |
| 20-21 | 32-bit Processor Architecture | Introduction to ARM Architecture & NXP's LPC2378 Microcontroller/AVR | R3 – Chapter 1, 2 + Class Notes |
| 22-26 | ARM Instruction Set and Programming | Addressing Modes and Instruction Set Overview, Overview of Thumb Mode Instruction Set, ARM Assembly Programming and C Programming Concepts | R3  – Chapter 3, 4, 5 + Class Notes |
| 27-28 | LPC 2378 Peripherals | System and Power Control, Clock Module, GPIOs, Timers, Vectored Interrupt Controller. | Class Notes |
| 28-32 | LPC 2378 Peripherals | UARTs, ADC, DAC and PWM | Class Notes |
| 33 | Real Time Operating System on ARM | Introduction to RTOS on ARM (RTX Kernel) | Class Notes |
| 34-35 | Case Studies | General Purpose Processor based Design | Class Notes |
| 35-41 | Bus Architectures | LPC 2378's $I^2C$ and CAN Bus Interface | Class Notes |
| 42 | Embedded System Hardware and Software Design Issues | CPU Power Consumption and Optimization, ICE, hardware  –Software co-simulation and debugging, Real-time, Design Cycle | Class Notes |

**Course Plan:**

**Evaluation Scheme:**

| EC No | Evaluation Component & Type | Duration | Weightage | *Date, Time* | Remark |
|-------|------------|----------|-----------|--------------|--------|
| **1.** | Test 1 | 60 mins | 15 % | 8/9 & 4:00-5:00 PM | CB |
|  | Test 2 | 60 mins | 15 % | 25/10 & 4:00-5:00 PM | CB |
| **2** | Assignments |  | 10 % | To be done throughout the course as and when given | OB |
| **3.** | Project |  | 15 % | To begin when announced | OB |
| **4.** | LAB |  | 15 % | To be done throughout the course as and when given | OB |
| **5.** | Comprehensive Examination | 3 hours | 30% | 06/12 FN | CB |

**Chamber Consultation Hour:** To be announced in Class
**Notices:** All notices regarding the course will be put up in EEE notice board .
**Make-up Policy:** No make-up without prior permission.

**Instructor-in-charge**
**EEE G512**