4EE61: EMBEDDED SYSTEMS

CREDITS - 4 (LTP: 3, 0, 1)

Course Objective:

To familiarize with the concept of Embedded system and recognize the domains of its applications by understanding the microcontrollers used in embedded systems and creating innovative products and solutions for real time problems.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1.	**Introduction to Internet of Things:** Brief History and evolution of IoT, IoT Architecture, Sensing, Actuation, Basics of Networking, Communication Interface, Trends in Adoption of IoT	03
2.	**Introduction to Embedded System:** Introduction to Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Design considerations & requirements, Major application areas of Embedded Systems.	03
3.	**Designing Embedded Systems with Microcontrollers:** Introduction of Single purpose processors ,General purpose processors, Application specific instruction set processors (ASIPs), DSP processors and SHARC processors, CISC vs. RISC, Factors to be considered in selecting microcontroller, an exemplary Microcontroller (MCS-51/AVR/PIC/ARM etc.), CPU Architecture and Organization, Instruction Set Architecture, Memory System Architecture, I/O Sub-system, Processor Performance Enhancement.	04
4.	**The ARM Microcontroller:** Introduction to ARM microcontroller, Internal architecture, I/O pins, Ports, Timers, Interrupts, Memory organization, Concept of Pipelining, Programming model, Instruction classification and format, Addressing modes, Data transfer instructions, Arithmetic instruction, Logical group of instructions, Branching instructions, I/O interfacing & Programming in C, ADC-DAC applications, PWM applications, MATLAB interface with ARM, Embedded code generation.	18
5.	**Embedded Design Case Studies:** Applications of embedded systems: Measurement of analog and electrical variables, control of electrical devices, user interface in embedded systems, data communication in embedded systems	4
6.	**Digital Signal Processors and Applications:** Tms320xx Digital signal processors, Introduction, Architecture, Features, timer, memory control, interrupts, external interface.	12
	Total	**44**

List of References:

1. Shibu K. V, "Introduction to Embedded Systems", 1st Edition, Tata Mc Graw Hill Publishers, 2013.
2. Raj Kamal, "Embedded Systems: Architecture, Programming and Design", 2nd Edition, Tata Mc Graw Hill Publishers, 2011.
3. Steve Furber, "ARM System-on-Chip Architecture", 2nd Edition, Pearson, 2012.
4. B. Venkataramani, M. Bhaskar, "Digital Signal Processors: Architecture, Programming and Applications", Tata McGraw-Hill Education, 2002.
6. LPC1768 32-bit Arm Cortex®-M3 Microcontroller datasheet.
7. TMS320F28335 Digital Signal Controller datasheet.

Web Resources:

1. https://nptel.ac.in/courses/106/105/106105166/ Lecture Series on Introduction to Internet of Things by Prof. Sudip Misra, Department of Computer Science & Engineering, IIT Kharagpur
2. http://www.nptelvideos.in/2012/11/embedded-systems.html Lecture Series on Embedded Systems by Dr. Santanu Chaudhury, Department of Electrical Engineering, IIT Delhi.

Course Outcomes (COs):

At the end of this course students will be able to …

1. Familiarized with the basics of Internet of Things.
2. Learn the classification of Embedded Systems based on performance, complexity and the era in which they evolved.
3. Understand ARM processor architecture and its programming.
4. Acquire knowledge about different entities of Embedded System Applications.
5. Be accustomed with the basics of Digital Signal Processors.

Suggested list of Experiments

Exp. No.	EXPERIMENT
1.	Introduction to ARM Cortex LPC1768 controller.
2.	To demonstrate LED interfacing using ARM Cortex LPC1768 controller.
3.	To demonstrate the interfacing of switches to change the status of LEDs.
4.	To demonstrate the application of LCD interfacing.
5.	To demonstrate use of Matrix Keyboard and its interfacing.
6.	Hands on Stepper motor interfacing and control.
7.	To demonstrate transmission of characters using Uart0.
8.	To demonstrate ADC and DAC interfacing.
9.	Introduction to TMS320F28335 DSP processor.
10.	PWM generation using TMS320F28335 DSP processor.
11.	Demonstration of use of timer in TMS320F28335 DSP processor.
12.	To demonstrate use of UART using TMS320F28335 DSP processor.