

Branch Name:	Information and Communication Technology
Semester/Year:	Semester I / First Year
Subject Title:	Embedded Systems and IOT
Subject Code:	2ET2080103T
Pre-requisite:	Microcontroller programming

Course Objective:

To understand fundamentals of IoT and embedded system including essence, basic design strategy and process modeling. To introduce students a set of advanced topics in embedded IoT and lead them to understand research in network. To develop comprehensive approach towards building small low cost embedded IoT system. To understand fundamentals of security in IoT, To learn to implement secure infrastructure for IoT .To learn real world application scenarios of IoT along with its societal and economic impact using case studies.

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								
					Theory (Marks)				Practical (Marks)				Total (Marks)
	L	T	P	Total	SEE		CCE		SEE		CCE		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	3	-	-	3	24	60	16	40		-	-	-	100

Subject Contents				
Sr. No	Topic	Total Hours	Weight (%)	
1	Introduction: Embedded Systems, Processor Embedded into a System, Embedded Hardware Units and Devices In a System, Embedded Software in a system, Examples of Embedded systems, Embedded systems on chip (SOC) and use of VLSI Circuit Design Technology, Complex Systems Design and Processors, Design Process in Embedded System, Formulization of System Design, Design Process and	04	11	

	Design Examples, Classification of Embedded Systems, Skills Required for an Embedded System Designer		
2	Devices for Network Embedded Systems: IO Types and examples, Serial communication devices, Parallel Device ports, Sophisticated Interfacing Feature in Devices Ports, Wireless Devices, Timer and Counting Devices, Watch dog timer, Real time clock, Network Embedded.	04	11
3	Arm Processor For Embedded Systems: Design philosophy, ARM features, Core dataflow model,Operating modes, Memory architecture, register sets, ARM instructions, Jazelle mode, Thumb mode, Programming of ARM processor.	04	11
4	Real Time Operating System: Operating system basics, Processes vs. threads, Multi-tasking, Need for realtime operating 14 systems, RTOS kernel functions, Scheduling policies, Critical section issue and semaphore, Types of RTOS.	03	08
5	Introduction to Embedded Hardware & Software: MSP430 RISC CPU architecture, Compiler-friendly features, Instruction set,Clock system, Memory subsystem. Understanding of different MSP430families. Introduction to Code Composer Studio (CCS) and use CCS for Embedded C.	03	08
6	Programming and Interfacing: Digital I/O –I/O ports programming using C, Understanding the muxingscheme of the MSP430 pins, interrupt programming, On-chip peripherals Watchdog Timer, Basic Timer, Real Time Clock (RTC),ADC, Universal Serial Communication Interface (USCI).Interfacing LED, LCD, Seven segment LED modules interfacing. Example on Real	04	11
7	Introduction to IoT: Architecture Overview, Design principles and needed capabilities, IoT Applications, Sensing Actuation, Sensing Actuation, Basics of Networking, M2M and IoT Technology	03	08
8	Elements of IoT: Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interface, Software Components- Programming API's (using Python/ Node.js/ Arduino) for Communication Protocols- MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP	05	14
9	IoT Application Development: Solution framework for IoT application- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/ local server, Authentication, authorization of devices.	04	11
10	Cloud Computing: Cloud service models – Network as a Service (NaaS), Software as a service (SaaS) Platform as a Service(PaaS), Internet as a Service (IaaS), Service (SaaS), Platform Public, private and hybrid cloud, OpenStack cloud architecture, IoT with cloud	20	07

Review Presentation: The student is expected to spend minimum 2 hours per week (as mentioned in the teaching and evaluation scheme) to refer at least two peer reviewed journal papers related to this domain/subject. The student is expected to identify issues/challenges and emerging trends in the domain/subject. Student is supposed to explore various video lectures (E.g. NPTEL) available in the domain/subject. Student is required to make a review-presentation on the work carried out for the same. Recommended sites for journal papers are (1) dl.acm.org (2) springer.com (3) sciencedirect.com (4) elsevier.com (5) ieeexplore.ieee.org (6) scholar.google.co.in (7) scopus.com or similar of similar repute.

Course Outcome:

Upon successful completion of this course the student would be able to:

- Implement an architectural design for IoT for specified requirement, Choose between available technologies and devices for stated IoT challenge
- Design of an embedded system using an ARM processor
- Understand concepts of architecture and code for embedded systems
- Understand the basic properties of a real-time operating system
- Solve the given societal challenge using IoT

List of References:

1. Embedded System Architecture, Programming and Design By Rajkamal, TMH Publication
2. Embedded System Design By Frank Vahid and Tony Givargis, John Wiley Publication.
3. Embedded Microcomputer System: Real Time Interfacing By J.W. Valvano, Brooks/Cole Publication
4. The Art of Designing Embedded Systems By Jack Ganssle, Newnes Publication.
5. An Embedded Software Primer By David Simon, Addison Wesley Publication
6. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms and Use Cases”, CRC Press
7. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi
8. Adrian McEwen, “Designing the Internet of Things”, Wiley
9. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill

E-Resources:

1. <http://www.ti.com/ww/en/launchpad/launchpads-msp430-msp-exp430g2.html#project0>
2. <http://coder-tronics.com/msp430-programming-tutorial-pt1/>
3. <http://coder-tronics.com/msp430-programming-tutorial-pt2/>
4. <http://mbspici.blogspot.in/2010/08/tutorial-10-something-completely.html>
5. <http://mbspici.blogspot.in/2011/10/tutorial-16a-getting-serial.html>
6. <http://mbspici.blogspot.in/2010/08/tutorial-09-timers.html>
7. <http://mbspici.blogspot.in/2010/07/tutorial-08-beating-heart-bcs-part-i.html>
8. <http://www.nptel.ac.in>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Introduction to Embedded Systems Processor	1 Remembering 2 Understanding
CLO2	Devices for Network Embedded Systems, IO Types and examples, Serial communication devices, Parallel Device ports	2 Understanding
CLO3	Arm processor for embedded systems, Design philosophy, ARM features.	2 Understanding 3 Applying
CLO4	Real time operating system, Operating system basics, Processes vs. threads, Multi tasking, Need for real time operating systems	3 Applying
CLO5	Introduction to Embedded Hardware & Software: MSP430 RISC CPU architecture, Compiler-friendly features.	2 Understanding 3 Applying
CLO6	Programming and Interfacing:	4 Analyze 5 Evaluate

Mapping of CLOs with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1	H		L										M			
CLO2	M		M	H		L								L		
CLO3	M		M	H		L								L		
CLO4					H	M				L		L		L		
CLO5		M	H			L	L		M				M			
CLO6		M	H			L			M				M			

H: High, M: Medium, L: Low