Semester: 2	
Programme: M.Sc. Computer Science	
Course: Internet of Things (IoT) & Embedded System	
Paper code:	**Credits: 6**
Hours/week: Theory: 3 / Practical: 2	
Category: Core/MDC/SEC/VAC: Core	
Theory / Practical / Composite: Composite	
No of modules: 2	

Course Overview: This course introduces the fundamental concepts of the Internet of Things (IoT) and Embedded Systems, covering IoT architecture, communication protocols, security, and real-world applications. It provides a comprehensive understanding of embedded hardware and software, microprocessors, microcontrollers, the 8051 architecture, and ARM processor fundamentals, along with programming and interfacing techniques. The course equips students with the knowledge required to design, analyze, and implement IoT-enabled embedded systems for a wide range of practical applications.

Course Outcome:

Internet of Things (IoT)

1. **Recall** the fundamental concepts, characteristics, applications, and challenges of the Internet of Things (IoT).
2. **Explain** the physical and logical design of IoT systems and the architecture of IoT communication.
3. **Apply** appropriate IoT communication protocols at the link, network, and application layers for different IoT scenarios.
4. **Analyze** the suitability and performance of various IoT protocols based on application requirements and network constraints.
5. **Evaluate** IoT security challenges and recommend suitable security mechanisms for secure IoT deployments.
6. **Design** IoT-based solutions by integrating appropriate architectures, communication protocols, and security measures to address real-world applications.

Embedded System

1. **Recall** the fundamental concepts, components, applications, and design challenges of Embedded Systems, microprocessors, and microcontrollers.
2. **Explain** the architecture and organization of embedded systems, including the differences between microprocessors and microcontrollers.
3. **Apply** the concepts of the 8051 microcontroller to develop simple programs utilizing input/output ports, timers, serial communication, and interrupts.
4. **Analyze** the architecture and operation of the 8051 microcontroller and evaluate the interaction of its hardware components for embedded applications.
5. **Evaluate** embedded system design considerations, hardware-software trade-offs, and the suitability of different microcontrollers and processors for specific applications.
6. **Design** and implement basic embedded system solutions using the 8051 microcontroller and apply the architectural concepts of ARM processors for embedded applications.

Prerequisites: None

SYLLABUS (Internet of Things (IoT))

UNIT/Module	CONTENT	NUMBER OF CLASSES	CO Mapping	COGNITIVE LEVEL
I.	Introduction: things in IoT; applications; characteristics; challenges.	**5**	**CO1, CO2**	**K1, K2 (Remember/Understand)**
II.	Physical design of IoT; Logical design of IoT	**5**	**CO2, CO3**	**K2, K3 (Understand/Apply)**
III.	IoT protocols: link layer (WiMax, LR-WPAN); network layer (6LoWPAN); application layer (CoAP, MQTT, XMPP, DDS, AMQP)	**4**	**CO3, CO4**	**K3, K4 (Apply/Analyze)**
IV.	IoT security: introduction; Case studies	**5**	**CO4, CO5, CO6**	**K4, K5 (Analyze/Evaluate)**
SYLLABUS (Embedded System)				
UNIT/Module	**CONTENT**	**NUMBER OF CLASSES**	**CO Mapping**	**COGNITIVE LEVEL**
I.	Introduction to Embedded Systems: Definition, Applications of ES, Embedded Hardware Units and Devices, Embedded Software, Design Metrics in ES, Challenges in ES Design.	**2**	**CO1, CO2**	**K1, K2 (Remember/Understand)**
II.	Introduction to Microprocessors, Microcontrollers, Microcontrollers survey-four-bit, eight-bit, sixteen bits, thirty-two-bit Microcontrollers, Comparing Microprocessors and Microcontrollers.	**2**	**CO2, CO4**	**K2, K4 (Understand/Analyze)**
III.	Architecture of 8051: 8051 Micro controller Hardware, Input/output Ports and Circuits, External Memory, Counter and Timers, Serial data Input/output, Interrupts, Interfacing. Programming in 8051.	**14**	**CO3, CO4, CO6**	**K3, K4, K6 (Apply/Analyze/Create)**
IV.	Embedded Processor: History and Introduction to Architecture, Interrupt vector of ARM Processor.	**2**	**CO5, CO6**	**K5, K6 (Evaluate/Create)**
Practical: Experiments on topics taught in theory classes.				

Text Books		
1. Internet of Things, Vasudevan, Nagrajan and Sundaram, Wiley India		
2. Internet of Things with Arduino and Bolt, Ashwin Pajankar, BPB		
3. Mazidi & McKinlay," The 8051 Microcontroller and Embedded Systems using Assembly and C", PHI.		
4. Myke Predko," Programming and Customizing the 8051 Micro-controller", Tata McGraw-Hill.		
5. The 8051 Microcontroller Based Embedded Systems by Manish K Patel (Author), Tata McGraw-Hill		
6. Raj Kamal, "Embedded Systems", TMH.		
7. Kenneth J. Ayala, Dhananjay V. Gadre, "The 8051 Microcontroller & Embedded Systems Using Assembly and C", Cengage Learning India Publication.		
8. Shibu K," Embedded Systems", Tata McGraw Hill Publishing		
Web Resources		
1. Introduction to Internet of Things by Prof. Sudip Misra, https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_cs53		
2. Embedded Systems: Introduction by Prof. Santanu Chaudhary, https://nptel.ac.in/courses/108102045		
Evaluation	Theory CIA: 10 Semester Exam: 50	Practical CA: 40
Paper Structure for Theory Semester Exam:	Short questions: 5 marks each; 2 out of 4	Long questions: 10 marks each; 4 out of 6

Course outcomes (COs) and Cognitive Level Mapping

Internet of Things (IoT)

COs	CO Description	Cognitive levels
CO1	Recall the fundamental concepts, characteristics, applications, and challenges of the Internet of Things (IoT).	K1–K2 (Remember/Understand)
CO2	Explain the physical and logical design of IoT systems and the architecture of IoT communication.	K2 (Understand)
CO3	Apply appropriate IoT communication protocols at the link, network, and application layers for different IoT scenarios.	K3 (Apply)
CO4	Analyze the suitability and performance of various IoT protocols based on application requirements and network constraints.	K4 (Analyze)
CO5	Evaluate IoT security challenges and recommend suitable security mechanisms for secure IoT deployments.	K5 (Evaluate)
CO6	Design IoT-based solutions by integrating appropriate architectures, communication protocols, and security measures for real-world applications.	K6 (Create)

Course outcomes (COs) and Cognitive Level Mapping

Embedded System

COs	CO Description	Cognitive levels
CO1	Recall the fundamental concepts, applications, components, and design challenges of Embedded Systems, microprocessors, and microcontrollers.	K1–K2 (Remember/Understand)
CO2	Explain the architecture of embedded systems and distinguish between microprocessors and microcontrollers.	K2 (Understand)
CO3	Apply the concepts of the 8051 microcontroller to develop programs using input/output ports, timers, serial communication, and interrupts.	K3 (Apply)
CO4	Analyze the architecture and operation of the 8051 microcontroller and its interfacing mechanisms for embedded applications.	K4 (Analyze)
CO5	Evaluate embedded system design considerations, hardware-software trade-offs, and the suitability of different processors and microcontrollers for specific applications.	K5 (Evaluate)
CO6	Design and implement basic embedded system solutions using the 8051 microcontroller and apply ARM processor concepts for embedded applications.	K6 (Create)