**20EC31O4-EMBEDDED SYSTEMS**

| **Course category:** | Open Elective | **Credits:** | 3 |
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| **Course Type:** | Theory | **Lecture - Tutorial - Practical:** | 3 - 0 - 0 |
| **Prerequisite:** | Digital Electronics, Microprocessors,  Microcontrollers. | **Sessional Evaluation :**  **External Evaluation:**  **Total Marks:** | 40  60  100 |

| **Course**  **Objectives** | Students undergoing this course are expected to understand: | |
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| 1. The basic idea regarding the nature of embedded systems 2. The hardware aspects of modern Microcontrollers. 3. Basic Microcontroller Programming. 4. Serial Communication Protocols. 5. Learning to control Analog devices in Embedded Systems. 6. IOT working principles. | |
| **Course Outcomes** | Upon successful completion of the course , the students will be able to: | |
| CO1 | Highly competitive on the national and international job market, both in the industry as high - skilled expert. After studies, the students will be able to make a career as e.g., engineers, project leaders, system architects, programmers or researchers in the fields of e.g., automotive industry, robotics, telecom, industrial process control, consumer electronics etc |
| CO2 | Able to acquire knowledge and understand fundamental embedded systems design paradigms, architectures, possibilities and challenges, with respect to both software and hardware. |
| CO3 | Able to analyze a system both as whole and in the included parts, to understand how these parts interact in the functionality and properties of the system. |
| CO4 | Able to practically apply gained theoretical knowledge in order to design, analyse and implement embedded systems, e.g. integrating embedded subsystems and applications in building a fully functional autonomous robot. |
| CO5 | Apply formal method, testing, verification, validation and simulation techniques and tools in order to engineer reliable and safe embedded systems. |
| CO6 | Demonstrate a deeper understanding of the electronics and physical principles used for embedded biomedical measuring systems. |
|  | **UNIT-I**  **INTRODUCTION TO EMBEDDED SYSTEMS:** Embedded system overview and applications, features and architecture considerations-ROM, RAM, timers, data and address bus, Memory and I/O interfacing concepts, memory mapped I/O. CISC vs RISC design philosophy, Von-Neumann Vs Harvard architecture, instruction set, instruction formats, and various addressing modes of 32-bit. Fixed point and floating point arithmetic operations. | |
| **Course**  **Content** | **UNIT – II**  **INTRODUCTION TO ADVANCED MICROCONTROLLERS:** Introduction ARM architecture and Cortex – M series, Introduction to the Tiva family viz. TM4C123x &  **TM4C129x** and its targeted applications, Tiva block diagram, address space, on-chip peripherals (analog and digital) Register sets, Addressing modes and instruction set basics.  **UNIT – III**  **MICROCONTROLLER FUNDAMENTALS FOR BASIC PROGRAMMING:** I/O pin multiplexing, pull up/down registers, GPIO control, Memory Mapped Peripherals, programming System registers, Watchdog Timer, need of low power for embedded systems, System Clocks and control, Hibernation Module on Tiva, Active vs Standby current consumption. Introduction to Interrupts, Interrupt vector table, interrupt programming.  **UNIT – IV**  **TIMERS, PWM AND MIXED SIGNALS PROCESSING:** Timer, Basic Timer, Real Time Clock (RTC), Timing generation and measurements, Analog interfacing and data acquisition: ADC, Analog Comparators, DMA, Motion Control Peripherals: PWM Module & Quadrature Encoder Interface (QEI).  **UNIT – V**  **COMMUNICATION PROTOCOLS AND INTERFACING WITH EXTERNAL DEVICES:** Synchronous/Asynchronous interfaces (like UART, SPI, I2C, USB), serial communication basics, baud rate concepts, Interfacing digital and analog external device, I2C protocol, SPI protocol & UART protocol. Implementing and programming I2C, SPI & UART, CAN & USB interfaces.  **UNIT-VI**  **EMBEDDED NETWORKING AND INTERNET OF THINGS:** Embedded Networking fundamentals, Ethernet, TCP/IP introduction IoT overview and architecture, Overview of wireless sensor networks and design examples. Various wireless protocols and its applications: NFC, ZigBee, Bluetooth, Bluetooth Low Energy, Wi-Fi. | |
| **Text Books and Reference Books** | **TEXT BOOKS :**   1. Shibu K.V.: Introduction to Embedded Systems, Tata McGraw Hill, 2009 2. Tim Wilmshurst: An introduction to the design of small-scale embedded systems, Palgrave, 2001.   **REFERENCE BOOKS :**  1.Device data sheets of ARM/PSoC/MSP430 | |
| **E-Resources** | nptel.ac.in/courses/117105079/ | |