**19EC32E5-EMBEDDED SYSTEMS**

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

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| **Course**  **Objectives:** | Students undergoing this course are expected to learn: | |
| 1. The basic idea regarding the nature of embedded systems 2. The hardware aspects of modern microcontrollers. 3. The basic microcontroller programming. 4. The serial communication protocols. 5. Control analog devices in embedded systems. 6. The IOT working principles. | |
| **Course Outcomes:** | Upon successful completion of the course, the students will be able to: | |
| **CO1** | Understand embedded system architects, programmers or researchers in the fields of e.g., automotive industry, robotics, telecom, industrial process control and consumer electronics etc |
| **CO2** | Understand fundamental embedded systems design paradigms, architectures, possibilities and challenges, with respect to both software and hardware. |
| **CO3** | 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** | Practically apply gained theoretical knowledge in order to design, analyse and implement embedded systems. |
| **CO5** | Apply formal method, testing, verification, validation and simulation techniques and tools in order to engineer reliable and safe embedded systems. |
| **CO6** | Demonstrate the electronics and physical principles used for embedded biomedical measuring systems. |
| **Course**  **Content:** | **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.  **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**  **&**  **Reference books:** | **Text books :**  1.“Introduction to embedded systems”, by Shibu K.V, Tata McGraw Hill, 2009.  2.“An introduction to the design of small-scale embedded systems”, by Tim  Wilmshurst, Palgrave, 2001.  **Reference books :**  1.Device data sheets of ARM/PSoC/MSP430 | |
| **e-Resources** | nptel.ac.in/courses/117105079/ | |