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| **ICT 3102:** | **EMBEDDED SYSTEMS** | **[3 1 0 4]** |

**Objectives:**

* Develop an understanding of the technologies behind the embedded computing systems
* To Understand various interfacing circuits and programming them using ARM
* To efficiently design software for embedded applications.

**Abstract:**

An overview of Cortext\_M- ARM Architecture, The RISC and ARM design philosophy, ARM addressing modes, ARM I/O Programming, Memory management, debugging, instruction set ,ARM processor exceptions and modes, programming using ARM C language, interrupts multi threading, I/O programming and Hardware software synchronization LED ADC, DAC, keyboard, LCD, UART, stepper motor etc, serial port interfacing, data acquisition system, Communication Systems Based on the UARTs ,Wireless Communication ,Internet of Things

**Syllabus:**

**Introduction to Embedded Systems and ARM Cortex-M Microcontroller:**

Embedded System , Computer Architecture, microprocessor versus microcontroller, CISC Vs RISC , choosing a microcontroller, ARM Cortex M Architecture, General purpose and Special Function Registers (SFRs), CPSR, System control block, ARM memory map, memory management, debugging

**[08 Hours]**

**Assembly language programming:**

Addressing modes, data transfer instructions, arithmetic and logical instructions, shift and rotate instructions, branch and conditional branch instructions, function call and return, stack, recursive functions, conditional execution, assembly language programs **[08 Hours]**

**Input/Output (IO) programming:**

Pin connect block, Pin function select registers, General Purpose Input and Output (GPIO) registers, GPIO configuration, GPIO programming using ARM C language, Interfacing: LEDs, Seven segment, multiplexed seven segments, LCD, keyboard, DC motor, Stepper motor

**[10 Hours]**

**Timer/ Counter programming:**

Timer versus counter, timer registers, timer architecture and operation, PWM timer and architecture, timer/counter programming, PWM programming

**[08 Hours]**

**Serial, ADC and DAC Interfacing:**

General introduction to serial interfacing, RS232, MAX 232, UART, UART programming, data acquisition system, Analog to Digital Converter(ADC), ADC registers, Digital to Analog converter (DAC), DAC registers, ADC and DAC programming

**[6 Hours]**

**Interrupt programming:**

Hardware and software synchronization, multithreading, Nested Vectored Interrupt Controller (NVIC), external hardware interrupts, IO interrupts, SysTick interrupts, timer/counter interrupts, ADC and DAC interrupts, UART interrupts, interrupt programming

**[06 Hours]**

**Introduction to Communication Systems:**

Fundamentals, Communication Systems Based on the UARTs, Wireless Communication , Internet of Things **[02 Hours]**

**Outcome:**

Upon successful completion of this course a student should be able to

* Familiarise salient features of embedded systems
* Understand the architecture of ARM Cortex- M microcontroller
* Familiarise efficient software design for embedded systems
* Understand software development for ARM Cortex-M microcontroller
* Design real world systems using ARM Cortex-M microcontroller

**References:**

1. Jonathan W. Valvano “Embedded systems: real-time interfacing to ARM Cortext-M microcontrollers” CreatespaceIndependent Publishing Platform volume 2 , fourth edition, June 2014, ISBN: 978-1463590154,
2. Microprocessor and Interfacing, Programming & Hardware- Douglas V Hall, 2nd Edition, Tata mcgrawHill.
3. Jonathan W. Valvano “Embedded systems: Introduction to Arm(r) Cortex -M Microcontrollers: 5th edition, June 2014, **ISBN-10:** 1477508996