

# NIRMA UNIVERSITY

<b>Institute:</b>	<b>Institute of Technology, School of Technology</b>
<b>Name of Programme:</b>	<b>BTech in Electronics and Instrumentation Engineering</b>
<b>Semester:</b>	<b>VII</b>
<b>Course Code:</b>	<b>4EI601CC25</b>
<b>Course Title:</b>	<b>Embedded System Design</b>
<b>Course Type:</b>	<b>Core</b>
<b>Year of Introduction:</b>	<b>2024-25</b>

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## Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

- 1 describe the Cortex ARM microcontroller (BL2)
- 2 develop a program for Cortex ARM controller (BL3)
- 3 utilize programming concept for peripheral modules (BL3)
- 4 develop the programming frame work using software and hardware. (BL4)

Unit	Contents	Teaching hours (Total 45)
<b>Unit-I</b>	<b>Introduction</b> Overview of Cortex microcontrollers, block diagram, file register set, memory segmentation, hardware input/output ports, memory addresses, support devices	04
<b>Unit-II</b>	<b>Programming for the Cortex processor</b> Instruction set and formats, addressing modes, programming structures, simple programs involving logical, Branch and call instructions, sorting, evaluating arithmetic expressions, conditional execution, thumb instructions, flags and processor modes, programming examples.	07
<b>Unit-III</b>	<b>Peripheral Programming</b> Overview of microcontroller parallel ports, timer and counter with programming, types of timers, Nested vector interrupt controllers, interrupts, Types of PWM, PWM Channel programming, ADC, DAC and RTC.	08
<b>Unit-IV</b>	<b>Communication with the Cortex microcontroller</b> UART, I2C, SPI and USB peripheral programming, Interfacing various communication modules with Cortex Microcontroller, SD card and graphical LCD programming.	08
<b>Unit-V</b>	<b>Interfacing with sensors and actuators</b> Servo motor interfacing, stepper motor interfacing, DC motor speed control, interfacing various sensors like gyroscope, temperature, pressure and humidity sensor with STM32.	06

<b>Unit-VI</b>	<b>Introduction to Raspberry Pi</b>	05
	Features of Raspberry pi processor, Operating system set up, Controlling the pi remotely, executing python program with IDLE, use of pi store and libraries, programming on the pi.	
<b>Unit-VII</b>	<b>Interfacing and applications of Raspberry Pi.</b>	07
	Introduction to hardware set up, understanding GPIO port, use of digital input/output, analog sensor interface using ADC, connection and working of various sensors, controlling of various motors, serial communication interface, controlling GPIO output using web interface, building embedded applications and case studies like Wireless data transmission, Home automation , IOT , IIOTs and Sensor Network deployment.	

### Self Study:

The self -study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

### Laboratory Work:

This shall consist of at least 10 practicals based on the above syllabus.

### Suggested Reading:

1. Joseph Yiu, *The Definitive Guide to the Arm® Cortex®-M0*, Newnes Publication.
2. Donald Norris, *Programming with STM32, getting started with Nucleo board and C/C++*, McGrawhill education.
3. Carmine Noviello, *Mastering STM32- A step-by-step guide to the most complete ARM Cortex-M platform, using the official STM32Cube development environment*, leanpub publication.
4. Dr Steven Lawrence Dr. Steven Lawrence Fernandes, *Raspberry Pi 3 cookbook for python programmers*, Packt Publication.

### Suggested List of Experiments:

Sr. No.	Name of Experiments/Exercises	Hours
1.	Configuration of microcontroller settings in Keil IDE and STM32 Cube software	02
2.	Program data transfer operation in Cortex microcontroller	02
3.	Program GPIO module in ARM Cortex microcontroller	02
4.	Program Timer module in ARM Cortex microcontroller	02
5.	Program PWM module in ARM Cortex microcontroller	02
6.	Program ADC module in ARM Cortex microcontroller	02
7.	Program DAC module in ARM Cortex microcontroller	02
8.	Interfacing of sensor module with ARM Cortex microcontroller	02
9.	Interfacing of Wireless module	02
10.	Program IOT module.	02