

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	Minor in Industrial Automation (Inter-disciplinary) Offered by B.Tech. in Electronics and Instrumentation Engineering
Semester:	VI
Course Code:	3EI605IE24
Course Title:	Advanced Microcontroller (Except EC)
Course Type:	Department Elective- I under Minor (Interdisciplinary)
Year of Introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
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Course Learning Outcomes (CLO):

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

1. describe the Cortex ARM microcontroller (BL2)
2. develop programs for the Cortex ARM controller using Assembly and C (BL3)
3. develop programs for various peripheral modules (BL3)
4. design the embedded system using software simulation and hardware implementation. (BL5)

	Contents	Teaching hours (Total 45)
Unit-I	Introduction Overview of Cortex microcontrollers, block diagram, file register set, memory segmentation, hardware input/output ports, memory addresses, support devices	04
Unit-II	Programming for the cortex processor Instruction formats, addressing modes, instruction set, C directives, 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
Unit-III	Peripheral programming 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
Unit-IV	Communication with the cortex microcontroller UART, I2C, SPI and USB peripheral programming, Interfacing various communication modules with Cortex Microcontroller, SD card and graphical LCD programming.	08
Unit-V	Interfacing with sensors and actuators Servo motor interfacing, stepper motor interfacing, DC motor speed control, interfacing various sensors like gyroscope, temperature, pressure and humidity sensor with STM32.	06

Unit-VI	Introduction to raspberry Pi	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.	
Unit-VII	Interfacing and applications of raspberry Pi.	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 Readings/ References:

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++, McGraw-Hill publication.
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. Steven Lawrence Fernandes, Raspberry Pi 3 cookbook for python programmers, Packt Publication.

Suggested List of Experiments:

1.	Configuration of microcontroller settings in Keil IDE and STM32 Cube software	(02 Hrs)
2.	Program data transfer operation in Cortex microcontroller	(02 Hrs)
3.	Program GPIO module in ARM Cortex microcontroller	(02 Hrs)
4.	Program Timer module in ARM Cortex microcontroller	(02 Hrs)
5.	Program PWM module in ARM Cortex microcontroller	(02 Hrs)
6.	Program ADC module in ARM Cortex microcontroller	(02 Hrs)
7.	Program DAC module in ARM Cortex microcontroller	(02 Hrs)
8.	Interfacing of sensor module with ARM Cortex microcontroller	(02 Hrs)
9.	Interfacing of Wireless module	(04 Hrs)
10.	Program IOT module.	(04 Hrs)

L = Lecture, T = Tutorial, P = Practical, C = Credit