

Bachelor of Technology (B. Tech.)

Instrumentation and Control

B. Tech.Year- Semester – VII

Subject Name: Embedded Systems with ARM Processors

Subject Code: BTIC15703

Type of course: Open Elective Course

Prerequisite (if any): Basic and Digital Electronics, Microcontrollers

List of Courses where this course will be prerequisite: Advance embedded systems, Advance Real time operating systems

Rationale:

This course is useful for the students who are interested in digital signal controller programming and embedded systems design. ARM is a family of RISC instruction set architectures for computer processors. Arm Ltd. develops the ISAs and licenses them to other companies, who build the physical devices that use the instruction set. This course focuses on STM32 based ARM Cortex M4 systems programming in a practical way.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
2	0	2	3	60	25	15	30	20	150

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

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Content:

Sr. No.	Content	Total Hrs	Module Weightage
1	Introduction Basics of STM32 ARM processors and architecture. The clock, The GPIO, GPIO initialization, system timers. The RISC, Thumb, pipeline, CMSIS library.	05	18%
2	Setting up the tool chain for programming Installation instructions for CUBEMX, KEIL, STM32CUBE IDE. Debugging and programming with embedded C.	03	11%
3	The HAL GPIO management, GPIO mode, alternate functions, driving the GPIO, interrupt management. Enabling interrupts with CUBEMX.	06	22%
4	The UART programming UART initialization, UART in polling mode, UART in interrupt mode,	04	15%
5	Timer Programming System timers in STM32 ARM Cortex Mx. SysTick timers, clock tree, interrupt modes, PWM operations with timers, Capture control.	05	19%
6	ADC and DAC programming About ADC in STM32 Cortex M4, single channel single conversion mode, continuous conversion mode, Injected conversion mode, timer	04	15%

	driven conversion, DAC operation.		
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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30 %	30 %	10 %	10 %	10 %	10 %

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

S. N.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Mastering STM32	Carminé Noviello	Learnpub	2015	---
2.	Definitive guide to ARM Cortex M3 and M4 Processors	Joseph Yiu	Elsevier, Newnes	2014	3rd

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Course Outcomes:

After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Classify digital signal controllers/processors and justify their use in real world applications.	20
CO-2	Develop basic programming skills for embedded systems.	25
CO-3	Work with advance digital signal controllers.	25
CO-4	Develop skills for system level programming to drive various peripherals.	30

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	2	2	1	1	3	2	2	1	1	1	2	2	3	2	2
CO-2	1	1	1	2	2	3	2	1	1	1	1	1	2	2	2
CO-3	1	1	3	3	2	2	2	1	1	1	1	1	2	3	2
CO-4	1	1	1	2	2	3	3	2	1	1	1	1	2	2	3

List of Open learning website:

www.st.com

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List of Practical:

1. Install the necessary software and setting up the tool chain for programming and debugging of STM32 M4 ARM Cortex.
2. Setting up GPIO as input for STM32 M4 and read digital signals from DC source.
3. Setting up GPIO as output for STM32 M4 and blinking LED.
4. Setting up simple ON-OFF control for DC motor using STM32 M4.
5. Setting UART communications and read or write data on computer serial port.
6. Using systick timer along with GPIO to read or write delayed signal.
7. Using system timers to generate PWM signals.
8. Using ADC in various modes to read data from sensor.
9. Using DAC of STM 32 M4 to generate analog signal.

List of Open Source Software:

STM32 CUBEMX, STM32 CUBE IDE

Major Equipment Needed:

Computers, STM32 M4 boards/kit stm32 nucleo boards, multimeters, DSO etc.