NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	BTech CSE, Integrated BTech (CSE)-MBA, BTech CSE (Artificial Intelligence & Machine Learning)
Course Code:	XXXX
Course Title:	Embedded Systems
Course Type:	Department Elective–I
Year of Introduction:	2024-25

L	T	Practical Component				C
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Course Learning Outcomes (CLO):

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

1. summarise the general structure of embedded systems, their design requirements, and applications (BL2)
2. make use of programming languages to develop embedded systems (BL3)
3. evaluate real-time scheduling strategies as per the application-specific needs (BL5)
4. design interfacing modules for microcontroller applications. (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction to Embedded Systems:** Embedded Systems overview, characteristics of embedded systems, applications, common design metrics, and design challenges, Processor technology, IC technology, Design Technology, Types of embedded systems, Hardware and software units of embedded systems, embedded system development tools, and examples of embedded systems.	06
Unit-II	**Processors and Controllers:** Custom single purpose processors, General purpose processors, Standard single purpose processor, ARM Processor Fundamentals and Architectures, ARM Instruction Set, ARM advanced Family processors	12
Unit-III	**Real Time Operating Systems:** OS services, RTOS in embedded systems, RTOS scheduling models, Task prioritization, Pre-emptive and cooperative inter task communication, Introduction to Open Source RTOS.	09
Unit-IV	**System on Chip and Communication Basics:** System architecture, Approach for SOC design, Chip design trade-off, Basic protocol concepts, Advanced communication principles, Serial and Parallel Protocols, Device Drivers for Interrupt-Handling, Memory Device Drivers.	09
Unit-V	**Embedded Programming and Embedded Systems Design**: Tools and Languages, Case Study of Smart STBs, multimedia streaming devices.	09

Self-Study:

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

Suggested Readings/ References:

1. Shibu K. V, Introduction to Embedded Systems, TMH.
2. Frank Vahid, Tony Givargis, Embedded system design: A unified Hardware/Software introduction, Wiley.
3. Steve Furber, ARM System-on-Chip Architecture, Addison-Wesley.
4. Andrew N. Sloss, Dominic Symes, and Chris Wright, ARM System Developer's Guide, Designing and Optimizing System Software, Elsevier.
5. Muhammad Ali Mazidi, PIC Microcontroller and Embedded Systems: Using Assembly and C, Pearson Education India
6. Steve Heath, Embedded Systems Design, Newnes.
7. Tammy Noergaard, Embedded Systems Architecture - A Comprehensive Guide for Engineers and Programmers, Elsevier.
8. Michael J. Flynn, Wayne Luk, Computer System Design: System on Chip, Wiley.
9. Changyi Gu, Building Embedded Systems: Programmable Hardware, APress.
10. Mohit Arora, Embedded System Design: Introduction to SoC System Architecture, Learning Bytes.

Laboratory Work:

Laboratory work will be based on the above syllabus with a minimum of 10 experiments to be incorporated. The students in a suitable group size will design and perform one experiment as a part of Laboratory work.

Sr. No.	List of Experiments/Exercises	Hours
1	To get familiar with Keil µVision Integrated Development Environment (IDE), its features, and Data types in the Embedded C language for Embedded System development	02
2	To develop Embedded C code for Input Output operations of the 8051 microcontrollers	02
3	To demonstrate Logic Operations in embedded C for the programming of the 8051 microcontrollers.	04
4	To Appraise the concepts of utilization of timers and counters in 8051 by preparing the Embedded C code	02
5	To explore the concept of serial communication in 8051 by formulating the Embedded C code	02
6	To analyse the concept of interrupt programming in 8051 by developing the Embedded C Code	04
7	To use the ARM Integrated Development Environment (IDE) design flow to get acquainted with ARM7 (LPC2148 CPU) Board.	04
8	To inspect the concept of GPIO interfacing by connecting LED interfacing kit ASK21 with ARM7 Board and creating proper Embedded C code	02
9	To understand the concept of LCD interfacing kit ASK01 with ARM7 Board by developing proper Embedded C Code	04
10	To formulate Embedded C code to investigate the concept of data transmission and reception using Universal Asynchronous Receive-Transmit (UART)- serial communication protocol	04