NIRMA UNIVERSITY

Institute:	Institute of Technology, School of Technology
Name of Programme:	MTech CSE, MTech CSE (Data Science)
Course Code:	6CS277ME25
Course Title:	Embedded Systems
Course Type:	Department Elective-I
Year of Introduction:	2025-26

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

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

1. explain the basics of embedded systems (BL2)
2. apply the concepts of modeling using various techniques (BL3)
3. analyse the performance of various embedded systems (BL4)
4. evaluate the implemented embedded systems. (BL5)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction to Embedded Systems:** Importance, real-time embedded systems, components of embedded systems, characteristics and working of embedded systems, requirements and feasibility analysis of embedded systems, cost estimation, usability, examples of embedded systems	08
Unit-II	**Specification and Modelling:** Models of computation like sequential models, functional models, concurrent models, Finite State Machines, Mealy State Machines and Moore State Machines, Deterministic FSM and Non-Deterministic FSM, Data Flow, Petri Nets, State charts, Synchronous Languages (Esterel, Scade), UML	10
Unit-III	**Architecture and Performance Analysis:** Architecture, Coordination, Communication, Prediction of execution times, introduction to microprocessors and microcontrollers, Scheduling in real-time systems, Real-time operating systems, Middleware	08
Unit-IV	**Implementation:** Embedded product development life cycle, Task level concurrency management, Hardware/software partitioning, Compilers for embedded systems, Design flows and tools	10
Unit-V	**Validation:** Simulation, Testing and Formal Verification, Unit testing, integration testing, system testing, acceptance testing, performance testing.	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. P. Marwedel, Embedded System Design. Springer Verlag
2. W. Wolf, Computers as components: principles of embedded computing system design. Morgan Kaufmann
3. G.C. Buttazzo, Hard real-time computing systems: predictable scheduling algorithms and applications. Kluwer Academic Publishers
4. K.V.K. Prasad, Embedded / Real-Time Systems: Concepts, Design and Programming Black Book, Dreamtech
5. James Peckol, Embedded Systems: A contemporary development tool, Wiley
6. Elicia White, Making Embedded Systems: Design Patterns for Great Software, O'Reilly.

Suggested List of Experiments:

Sr. No.	Name of Experiments/Exercises	Hours
1	Study of ARM Processor Understand the memory mapping of IO and Peripherals List the peripherals present in the processor Explain how to use an IO pin, related SFRs and instructions Explain how to use timer, UART and related SFR and instruction set	02
2	Develop an assembly level code for single precision (32 bit) arithmetic function to perform addition, subtraction, multiplication and division.	04
3	Develop an assembly level code for 32-bit or 64-bit delay routine. Calculate number of clocks taken for executing a routine and adjust the delay value as desired	04
4	Develop a UML specification and modeling based project for a specified case study. Some examples are – elevator, washing machine, air conditioner, smart television, etc.	10
5	Perform the modeling using Petrinets	06
6	Develop an embedded system using concurrency, data flow and required hardware/software.	04