NIRMA UNIVERSITY

Institute:	**Institute of Technology, School of Engineering**
Name of Programme:	**B. Tech. in Electrical Engineering**
Semester:	**VII**
Course Code:	4EE305DE25
Course Title:	**Controllers for EV Applications**
Course Type:	**Disciplinary Minor - (Elective Course-II)**
Year of Introduction:	**2025 – 26**

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Course Learning Outcomes (CLOs):

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

1. realise timers and counters using controllers (BL5)
2. perform embedded C programming for ARM based processors (BL4)
3. employ DSP for EV applications (BL5)
4. design PWM control for EV converters (BL6)

Unit	Contents	Teaching hours (Total 45)
Unit-I	**ARM Controller and its Architecture** ARM design philosophy, overview of ARM architecture, registers, modes, conditional execution, pipelining, vector tables, exception handling, architecture of Cortex-M, memory addressing, IO ports, timers/counters, PWM, ADC/DAC, UART, interrupts, displays.	11
Unit-II	**ARM Core Programming and Automotive MCU** Embedded C programming for IO ports, timers, PWM, ADC and external interfaces, choosing MCU's for automotive applications, Atmel – SMART ARM based MCU, ST-SPC5 automotive MCU, NXP automotive MCU, automotive microcontrollers for powertrain control, hybrid and electric auxiliaries, transmission and body electronics.	12
Unit-III	**Digital Signal Processors** Commercial digital signal-processing devices, introduction to TMS320C2xx: its addressing modes, memory space, program control, instructions and programming, on-Chip peripherals, general purpose input output structure, interrupts, pipeline operation .	12
Unit-IV	**PWM Control in EV Converters** Realization of PWM strategies for automotive converters using ARM Cortex and DSP - Bus clamping PWM, advanced PWM techniques.	10

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 08 laboratories based on the above syllabus.

Suggested Reading:

1. Ronald K. Jurgen, *Automotive Microcontrollers*, SAE publication
2. Joseph Yiu, *The Definitive Guide to ARM® Cortex®-M0 and Cortex-M0+ Processors*, Newness Publication
3. Jonathan Stein, *Digital Signal Processing*, John Wiley
4. Woon Seng Gan, Sen M Kuo, *Embedded Signal Processing with the Micro Signal Architecture*, Wiley IEEE Press

Suggested List of Experiments :

Sr. No.	Name of Experiments/Exercises	Hours
1.	To demonstrate ARM Cortex and Keil software.	04
2.	Write a program to interface the GPIO for real-time applications.	02
3.	Write a program to generate the user-defined interrupt in ARM cortex.	02
4.	Write a program for ADC sensing using ARM cortex.	04
5.	Write a program for the generation of fixed and variable duty cycle PWM pulses using ARM cortex.	04
6.	To demonstrate code composure studio (CCS) for DSP TMS320C2XX.	04
7.	To develop and execute programs on arithmetic and logical instructions using DSP TMS320C2XX.	02
8.	To develop and execute programs on timers and counters using DSP TMS320C2XX.	02
9.	To develop and execute programs for ADC and DAC initialization.	02
10.	Write a program for the generation of PWM pulses for EV converter.	02