Program :	**Diploma in Computer Engineering**
Course Code : **5137**	Course Title: **Embedded Systems and Real Time Operating System Lab**
Semester : **5**	Credits: **1.5**
Course Category: **Program Core**	
Periods per week: **3 (L3:T:0:P:0)**	Periods per semester: **45**

Course Objectives:

- Familiarize the functionality of development boards to implement embedded applications.
- Provide hands-on experience to develop C for microcontroller to perform required tasks.
- Introduce interfacing of external peripherals with microcontrollers.

Course Prerequisites:

Topic	Course code	Course name	Semester
Basics of Electronics Engineering		Basics of Electrical and Electronics Lab	II
Digital Electronics Principles		Digital Computer Principles Lab	III
C Programming Concepts		Programming in C Lab	III

Course Outcomes:

On completion of the course, the student will be able to:

COn	Description	Duration (Hours)	Cognitive Level
CO1	Develop C programs for time delays and I/O operations.	10	Applying
CO2	Experiment with Microcontroller based systems to interface peripherals with AVR.	14	Applying
CO3	Develop C programs using Timers/Counters.	8	Applying

CO4	Design and develop a microcontroller based system for real world applications.	10	Applying
	Lab Exam	**3**	

CO – PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3			3			
CO2	3			3			
CO3	3			3			
CO4	3	3	3	3	3	3	3

3-Strongly mapped,   2-Moderately mapped, 1-Weakly mapped

Course Outline

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Implement C programs for time delays and I/O operations.**		
M1.01	Familiarize with ATMega32 microcontroller based development system board.	1	Understanding
M1.02	Develop simple I/O port programs for input and output.	3	Applying.
M1.03	Develop simple I/O port programs to implement logic operations data conversion.	3	Applying.
M1.04	Develop simple I/O port programs for data conversion and data serialization.	3	Applying.
CO2	**Experiment with Microcontroller based systems to interface peripherals with AVR.**		
M2.01	Interface different peripheral systems – LCD, Sensors, ADC, Keyboard etc - with Microcontrollers.	14	Applying.
	Lab Exam -I	1.5	
CO3	**Develop C programs using Timers/Counters.**		

M3.01	Develop programs to verify Timers/Counters	4	Applying.
M3.02	Develop programs using Interrupts	4	Applying.
CO4	**Design and Develop a microcontroller based system for real world applications.**		
M 4.01	Open Ended Experiment: Design and Develop a microcontroller based system for real world applications	10	Applying.
	Lab Exam – II	1½	

Text / Reference

T/R	Book Title/Author
T1	**The AVR Microcontroller and Embedded Systems Using Assembly and C** By Muhammad Ali Mazidi, Sarmad Naimi, & Sepehr Naimi - Pearson Education
R1	**Introduction to Embedded Systems** - Shibu K.V, Mc Graw Hill.First Edition
R2	**Embedded C** - Michael J. Pont, Pearson Education, Second Edition
R3	**Embedded Systems** - Raj Kamal, , Mc Graw Hill, Second Edition.

Online Resources

Sl.No	Website Link
1	https://www.studyelectronics.in/embedded-programming-tutorial-chapter-1-beginners/
2	https://www.tutorialspoint.com/embedded_systems/index.htm
3	https://embeddedschool.in/avr-microcontroller-programming/

** - Sample Open Ended Projects
(Not for End Semester Examination but compulsory to be included in Continuous Internal Evaluation. Students can do open ended experiments as a group of 2-3. There is no duplication in experiments between groups.)

1. Build a flashing display for advertisement of a shop.
2. Implement automatic sprinkler control system.
3. Implement automatic alarm system.