

Program : Diploma in Computer Engineering / Computer Hardware Engineering	
Course Code : 4152	Course Title: Embedded Systems
Semester : 4	Credits: 4
Course Category: Program Core	
Periods per week: 4 (L4:T:0:P:0)	Periods per semester: 60

Course Objectives:

- Introduce the technologies behind embedded computing systems.
- Provide knowledge on the working of microcontrollers and its applications.
- Familiarize the key concepts of embedded systems such as I/O, timers, interrupts and interaction with peripheral devices.
- Introduce the basic concepts of Embedded Operating Systems.

Course Prerequisites:

Topic	Course code	Course name	Semester
Digital Electronics		Digital Computer Principles	III
Programming Concepts		Programming in C	III

Course Outcomes :

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

CO _n	Description	Duration (Hours)	Cognitive Level
CO1	Explain the basic concepts and structure of Embedded systems	12	Understanding
CO2	Develop Programs for AVR Microcontrollers in C	19	Applying
CO3	Illustrate the interfacing of Microcontroller with external peripherals.	12	Applying
CO4	Explain the key concepts of Real Time Operating Systems.	15	Understanding
	Series Test	2	

CO – PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2						
CO2	3						
CO3	3						
CO4	2						

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

Course Outline

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	Explain the basic concepts and structure of Embedded systems		
M1.01	Explain the features of embedded systems.	3	Understanding.
M1.02	Illustrate the building blocks of embedded systems.	4	Understanding.
M1.03	Interpret the AVR architecture.	5	Understanding.
<p>Contents:</p> <p>Embedded Systems – Definition, Comparison with general purpose computers – Classify embedded systems with different criteria, Applications and Purpose.</p> <p>Building blocks of an Embedded Systems – Core of Embedded System, Classification of Memory, Memory selection for embedded systems, Role of Sensors, actuators, I/O subsystem, communication interface, Embedded Firmware and other components.</p> <p>Characteristics and Qualities of Embedded System – Characteristics, Quality Attributes,</p> <p>AVR Microcontroller Architecture - Factors to be considered in selection – Simplified view of AVR microcontroller, ATMega32 - Registers, Data Memory, AVR Status register, Program Counter and Program ROM space, I/O ports, Registers associated with I/O ports.</p>			
CO2	Develop Programs for AVR Microcontrollers in C		
M2.01	Examine C data types for the AVR microcontroller.	1	Understanding
M2.02	Develop C programs for time delay and I/O operations.	4	Applying
M2.03	Develop C programs for logic and arithmetic operations.	2	Applying

M2.04	Develop C programs for data conversion and data serialisation.	2	Applying
M2.05	Describe the Normal and CTC mode of Timers	2	Understanding
M2.06	Develop C Programs to generate time delays and count events using Timer/Counter.	4	Applying
M2.07	Explain Interrupts in AVR	1	Understanding
M2.08	Illustrate Interrupt Programming in C	3	Understanding
	Series Test – I	1	

Contents:

AVR Programming in C – data types, C programs to generate time delay, I/O Programming, logic and arithmetic operations, Data Conversion, Data Serialisation, Memory Allocation.

Timer and Counter: Timers and their associated registers, Normal and CTC mode, Programming Timers in C, Counter Programming in C.

Interrupts : AVR Interrupts, ISR, Steps executing an Interrupt, Sources of interrupts, Enabling and disabling Interrupts, Interrupt priority, Interrupt Programming in C.

CO3	Illustrate the interfacing of Microcontroller with external peripherals.		
M3.01	Illustrate the interfacing of Serial Port, LCD and Keyboard Interfacing.	6	Applying
M3.02	Illustrate the interfacing of ADC, DAC and Sensors.	6	Applying

Contents:

Interfacing: ATmega32 Connection to RS232, Serial Port Programming in C, LCD Interfacing, Keyboard Interfacing, ADC, DAC and Sensor interfacing and Programming in C.

CO4	Explain the key concepts of Real Time Operating Systems.		
M4.01	Explain the functions of an Operating System,	1	Understanding
M4.02	Summarize the features of different types of Operating Systems.	1	Understanding
M4.03	Outline key concepts of Task, Process and Threads.	3	Understanding
M4.04	Explain multiprocessing and multitasking.	1	Understanding
M4.05	Outline the key features of Task Scheduling algorithms.	3	Understanding
M4.06	Summaries the key concepts of Task Communication and Synchronization	4	Understanding

M4.07	Explain Device Drivers	1	Understanding
M4.08	List the functional and nonfunctional requirements in selecting a RTOS	1	Understanding
	Series Test – II	1	
<p>Contents: Real Time Operating Systems (RTOS) – OS Basics, Types of OS, Process, Task and Threads, Multiprocessing and Multitasking, Task Scheduling, Task Communication, Task Synchronization, Device Drivers, How to choose RTOS.</p>			

Text / Reference

T/R	Book Title/Author
T1	Shibu K.V, Introduction to Embedded Systems - Mc Graw Hill, First Edition
T2	Muhammad Ali Mazidi, Sarmad Naimi, & Sepehr Naimi, The AVR Microcontroller and Embedded Systems Using Assembly and C , Pearson Education
R1	Michael J. Pont, Embedded C , Pearson Education, Second Edition
R2	Raj Kamal, Embedded Systems , 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/