22ECPE614	EMBEDDED C		SEMESTER VII		
PREREQUISITE		**CATEGORY**	PE	Credit	3
1. C Programming		**Hours/Week**	L	T	P	TH
			3	0	0	3

Course Objectives:	
1	To write embedded programs using the C programming language.
2	To understand and build skills in writing circuit and assembly-level code.
3	To impact knowledge on programming for real time problems.

Unit I	**INTRODUCTION TO EMBEDDED SYSTEMS**	9	0	0	9

Introduction- Best Practices for Embedded Systems-Difference between C and Embedded C-Processor to use-Programming Language- Operating system- Develop embedded software. 8051 microcontroller- Introduction-external interface- Reset requirements- Clock-Memory-I/O pins and timers- Interrupts-Serial Interface & Power Consumption.

Unit II	**EMBEDDED PROGRAMMING**	9	0	0	9

Introduction - Installing the Keil software and loading the project-Configuring the simulator- Building the target – Running the simulation – Dissecting the program – Aside: Building the hardware - Reading switches : Introduction – Basic techniques for reading from port pins – Example : Reading and writing bytes – bits- The need for pull-up resistors – Examples: Dealing with switch bounce – Reading switch inputs- counting goats

Unit III	**REAL TIME PROGRAMMING**	9	0	0	9

Object oriented programming with C – The Project Header (Main.h)- The port header (Port h) – Example: Restructuring the 'Hello Embedded World' example – Restructuring the goat-counting example-Further examples- Meeting real- time constraints – Creating 'hardware delays' using Timer 0 and Timer 1- Example: Generating a precise 50 ms delay- Creating a portable hardware delay-Creating loop timeouts and hardware timeouts

Unit IV	**EMBEDDED OS**	9	0	0	9

Creating an embedded operating system-Basis of a simple embedded OS- Introducing sEOS- -Using Timer 0 or Timer 1– Alternative system architectures – Important design constraints when using sEOS- Example-Milk pasteurization - Multi state systems and function sequences- Introduction – Implementing a multi-state system (timed) - Example: Traffic light sequencing and Animatronic dinosaur– Implementing a multi-state system (Input / Timed) - Example: Controller for a washing machine.

Unit V	**INTERFACE AND CASE STUDY**	9	0	0	9

Using serial Interface- Introduction – RS-232- basic RS-232 protocol – Asynchronous data transmission and baud rates – Flow control – The software architecture – Using the on-chip UART for RS-232 communications- Memory-Example-Serial menu architecture-Example-Data acquisition and Remote – control robot. Case Study : Intruder alarm system

	Total(45L) =45 Periods

Text Books:	
1.	Michael J.Pont," Embedded C", Pearson Education, 2008.
2.	Stephen Oualline, "Bare Metal C Embedded Programming for the Real World" , No Starch Press,2022
Reference Books:	
1.	Mark Siegesmund, "Embedded C Programming Techniques and Applications of C and PIC MCUS", Elsevier Science, 2014.
2.	Michael Barr," Embedded C Coding Standard", Create Space Independent Publishing Platform, 2018.
3.	Michael Barr, Anthony Massa, "Programming Embedded Systems With C and GNU Development Tools", O'Reilly Media, 2006.
4.	LyLa B. Das, "Embedded Systems: An Integrated Approach", Pearson Education India, 2012.
E-References:	
1.	https://www.cranesvarsity.com/courses/embedded-c-course/
2.	https://www.udemy.com/course/embedded-c-programming-for-embedded-systems/

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand basics of embedded systems and 8051 microcontroller	L2
CO2	Develop basic embedded programs	L3
CO3	Develop advanced embedded programs	L3
CO4	Relate and write programs for embedded Operating System	L1
CO5	Analyse the case study problems	L4

COURSE ARTICULATION MATRIX

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1		1			2										
CO2	2	2	2	2	2							1	1		
CO3	2	2	2	2	2							1	1		
CO4	2	2	2	2	2						2	2	2		
CO5	2	2	2	2	2						2		2		2
Avg	1.6	1.8	1.6	1.6	2						0.8	0.8	1.2		0.4
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															