Microcontrollers and Embedded Systems

Course Code	22CS53	**Course type**	PCC	**Credits L-T-P**	**4 – 0 - 0**
Hours/week: L - T- P	**4 – 0 – 0**			**Total credits**	**4**
Total Contact Hours	**L = 50 Hrs; T = 0 Hrs; P = 0 Hrs** **Total = 50 Hrs**			**CIE Marks**	**100**
Flipped Classes content	**10 Hours**			**SEE Marks**	**100**

Course learning objectives	
1.	To equip students with a thorough understanding of microcontrollers, including their architecture, functionalities, and various applications in embedded systems.
2.	To guide students in mastering programming microcontrollers using Embedded ‘C’, ensuring they can write efficient and effective code for various applications.
3.	To teach students how to connect microcontrollers with a wide range of peripheral devices such as sensors, actuators, displays, and communication modules, enhancing their practical skills in system integration.
4.	To enable students to design and deploy embedded systems by instructing them on selecting appropriate hardware components and integrating them into functional and optimized systems.

Pre-requisites : Digital Electronics, ‘C’ Programming.

Unit – I	Contact Hours = 10 Hours
The 8051 Microcontrollers: Microcontrollers and Embedded Processors, A brief history of the 8051, Block Diagram of 8051 Microcontroller. 8051 Programming in ‘C’: Data Types and Time Delay in 8051 ‘C’, I/O Programming in ‘C’, Logic operations in 8051 ‘C’.	

Unit – II	Contact Hours = 10 Hours
8051 Programming in ‘C’: Data conversion programs in 8051 ‘C’, Accessing code ROM space in 8051 ‘C’, Data Serialization using 8051 ‘C’. 8051 Timer Programming in ‘C’: Programming Timers in Mode1 and Mode 2.	

Unit – III	Contact Hours = 10 Hours
8051 Counter Programming in ‘C’: Programming Counters in Mode1 and Mode 2. Serial Communication: Basics of Serial Communication, Serial Port Programming in ‘C’.	

Unit – IV	Contact Hours = 10 Hours
Interrupts Programming in ‘C’: 8051 interrupts, Interrupt Programming in ‘C’. Peripheral interfacing: Sensor, Actuator, LCD, ADC and DAC interfacing with 8051 Microcontroller.	

Unit – V	Contact Hours = 10 Hours
Embedded Computing: Introduction, Complex systems and microprocessors, embedding computers, Characteristics of embedded computing applications, why use microprocessors, Challenges in embedded computing system design, Performance of embedded computing systems. The Embedded System Design Process: Requirements, Specification, Architecture design, Designing hardware and software components, System integration.	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	2	2	2	2	2

Unit No.	**Self-Study Topics**
I	A brief history of the 8051
II	Data Serialization using 8051 'C'
III	Basics of Serial Communication
IV	8051 interrupts
V	Performance of embedded computing systems

Books	
	Text Books:
1.	Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Pearson, Second Edition onwards.
2.	Marilyn Wolf, Computers as Components Principles of Embedded Computing System Design, Morghan Kaufmann Elsevier, Third Edition onwards.
	Reference Books:
1.	David Calcutt, Frederick Cowan, and Hassan Parchizadeh, 8051 Microcontroller: An Applications Based Introduction
2.	Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, Private Limited, 2nd Edition.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://onlinecourses.nptel.ac.in/noc20_ee42/preview
2.	https://onlinecourses.nptel.ac.in/noc20_ee98/preview

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Assignment (OA)/ Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	4.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the action verb representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Explain the essential concepts governing microcontrollers and the architectural framework of embedded systems.	Un	1,2	1
2.	Apply programming concepts to effectively program microcontrollers using Embedded 'C'.	Ap	1,2,3,5	1,2
3.	Analyze various peripheral devices and determine suitable interfacing methods with microcontrollers.	An	1,2,3,5	1,2
4.	Develop embedded systems solutions by selecting appropriate hardware components and designing circuits.	Ap	1,2,3,5	1,2
5.	Analyze the requirements for a real world problem or a specification and develop a course project as the solution.	An	1,2,3,5, 9,10,11,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	**Addition of two IA tests**	**Open Assignments (OA)**	**Course project (CP)**	**Total Marks**
Marks	30 + 30 = 60 marks	10 + 10 = 20 marks	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	Minimum marks required in SEE to pass: Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains three parts A,B and C. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓	✓											✓		
2	✓	✓	✓		✓								✓	✓	
3	✓	✓	✓		✓								✓	✓	
4	✓	✓	✓		✓								✓	✓	
5	✓	✓	✓		✓				✓	✓	✓	✓	✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Programming Proficiency	Embedded System and IoT Application.	Embedded Engineers
2	Peripheral Interfacing		Embedded- IoT- Firmware Design Engineer
3	Hardware Design and Selection		