Course Code: **ECE 4082**	Course Title: **Advanced Embedded Systems**
Semester: **2025-26 (Odd)**	Date of Issue: 12-08-2025
Course Coordinator	Dr Vipan Kakkar
Co Faculty / Instructor	

Teaching & Evaluation Scheme

L	T	S/P	C	Midterm Duration	Major Duration	Assign ment	Quiz	Midterm Marks	Major Marks	Total Marks
3	0	0	3	1.5 Hours	3.0 Hours	20	20	20	40	100

Significance and Objectives of the Course:

This course aims to expose students to:

1. Learn the architecture and programming of Micro processor/controller.
2. Be familiar with the embedded computing platform design and analysis.
3. Be exposed to the basic concepts and overview of Hardware software codesign.
4. Learn partitioning and scheduling techniques
5. Learn specific protocols used in embedded system design

Course Outcomes:

After successful completion of this course, students shall be able to;

1. Acquire a basic knowledge about fundamentals of embedded systems with application Examples
2. Acquire knowledge of co-design, Communication synthesis, hardware and software synthesis, system architecture
3. Various Scheduling algorithms and embedded architectural aspects
4. Hardware and software for various applications.

COURSE CONTENTS

UNIT – I: EMBEDDED SYSTEM DESIGN TECHNIQUES: Design methodologies Design flows – Requirement Analysis – Specifications-System analysis and architecture design

UNIT- II: INTRODUCTION TO EMBEDDED COMPUTING AND PROCESSORS: Complex systems and micro processors– Embedded system design process –Design examples - Instruction sets preliminaries - Micro Processor and Microcontroller 8051 and ARM processor CPU: programming input and output- Coprocessors- Memory system mechanisms – CPU performance- CPU power consumption.

UNIT – III: EMBEDDED COMPUTING PLATFORM DESIGN: The CPU Bus-Memory devices and systems–Designing with computing platforms – Bus architecture – platform-level performance analysis - Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing

UNIT – IV: PROCESSES AND REALTIME SYSTEMS Introduction – Multiple tasks and multiple processes –Preemptive real-time operating systems Priority based scheduling- Interprocess communication mechanisms – Evaluating operating system performance- power optimization strategies for processes

UNIT – V: CASE STUDIES

NOTE:	End Term Evaluation (Major Exam) shall be carried out in three stages. Midterm (20 marks), and Major (40 marks) exams.
	Assignment Marks shall be awarded on students' work in the form of Case Study / Design problem / Presentation / Quiz, which shall be evaluated by the concerned faculty.

Recommended Books::

1. Embedded System Design by Peter Marwedel, Springer,

2. Computers as Components by Wayne Wolf, Morgan Kaufman
3. Readings in Hardware/Software Co-Design by G. De Micheli, Rolf Ernst, and Wayne Wolf, eds. Morgan Kaufmann, Systems-on-Silicon Series
4. Embedded System Design: A Unified Hardware/Software Introduction by Frank Vahid and Tony D. Givargis, Addison Wesley
5. Programming Embedded Systems in C and C++ by Michael Barr, O'Reilly,
6. An Embedded Software Primer by David E. Simon, Addison Wesley

LECTURE PLAN

	Unit / Topic / Lecture Contents
Week	**Lecture topic**
1st	Design methodologies Design flows introduction
2nd	Requirement Analysis – Specifications-System analysis and architecture design
3rd	Complex systems and micro processors– Embedded system design process – Design examples
4th	Design examples - Instruction sets preliminaries
5th	Micro Processor and Microcontroller 16/32 bit processor CPU:
6th	programming input and output- Coprocessors-Memory system mechanisms – CPU performance- CPU power consumption.
7th	Communication protocols, CAN, I2C, SPI, UART.
8th	Design problems for revision (ECG device)
9th	The CPU Bus-Memory devices and systems–Designing with computing platforms
10th	Bus architecture – platform-level performance analysis - Components for embedded programs
11th	Additional Design problems (Drone)
12th	**Midterm Exam**
13th	Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing
14th	Introduction – Multiple tasks and multiple processes
15th	Preemptive real-time operating systems Priority based scheduling- Interprocess communication mechanisms
16th	Additional Design problems (Smartphone and other application examples)
17th	Evaluating operating system performance- power optimization strategies for processes
18th	Case study
19^{th} & 20^{th}	**Major Exams**