SEMESTER S5

EMBEDDED SYSTEM DESIGN

Course Code	PBEVT504	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PBECT304, PBECT404	Course Type	Theory

Course Objectives:

1. To design an embedded electronic circuit and implement the same
2. To develop system using ARM processor and its peripherals
3. Implement and maintain applications written in Embedded C

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**1.1 Complex Systems and Microprocessors** Embedding Computers, Characteristics of Embedded Computing Applications, Application of Microprocessors, The Physics of Software, Challenges in Embedded Computing System, Characteristics and quality attributes of an embedded system, Performance in Embedded Computing **1.2 The Embedded System Design Process** Requirements, Specification, Architecture Design, Designing Hardware and Software Components, System Integration. **1.3 Formalisms for System Design** Structural Description, Behavioral Description, An embedded system design example. **1.4 Embedded product development cycle (EDLC)** Different phases of EDLC, EDLC models	**10**
2	**2.1 Communication devices** Serial Communication Standards and Devices - UART, HDLC and SPI. Serial Bus Protocols - I2C Bus, CAN Bus and USB Bus. Parallel communication standards ISA, PCI and PCI-X Bus.	**10**

	2.2 Memory Memory devices and systems – ROM-Flash, EEPROM,RAM-SRAM, DRAM, Cache memory, memory mapping and addresses, memory management unit– DMA . **2.3 Interrupts/Device Driver** Interrupts--Interrupt sources, recognizing an interrupt, ISR – Device drivers for handling ISR, Interrupt latency.	
3	**3.1 ARM Processor architecture** The Acorn RISC Machine, Architectural inheritance, The ARM programmer's model, ARM development tools. **3.2 ARM Assembly Language Programming** Data processing instructions, Data transfer instructions, Control flow instructions, writing simple assembly language programs. **3.3 ARM Organization and Implementation** Three stage pipeline ARM organization, five stage pipeline ARM organization, ARM instruction execution, ARM implementation, The ARM coprocessor interface	**10**
4	**4.1 Architectural Support for High-Level Languages** Abstraction in software design, Data types, Floating-point data types, The ARM floating-point architecture, Expressions, Conditional statements, Loops, Functions and procedures, Assembly and C language programming applications of embedded systems. **4.2 Architectural Support for System Development** The ARM memory interface, The Advanced Microcontroller Bus Architecture (AMBA). **4.3 Operating system basics** Functions of OS, Kernel, types of operating systems. **4.4Introduction to Real time operating systems** Tasks, process, threads, multiprocessing and multitasking, task scheduling, task communication, choosing an RTOS	**10**

Suggestion on Project Topics

1. Design and Implementation of ARM Cortex Based Motor Speed Control
2. ARM7 Processor based Auto Ignition control in automobiles
3. ARM Processor-based Real-time Car Theft Detection
4. Automated Irrigation system using ARM processor
5. ARM processor based Industrial Automation using GSM/Wi-Fi

Course Assessment Method
(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16 marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 6 marks. **(4x6 = 24 marks)**	**40**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the embedded system fundamentals and system design	**K1**
CO2	Understand the peripheral devices and their interfacing with the processor.	**K2**
CO3	Understand the ARM processor architecture and pipeline processor organization.	**K2**
CO4	Write programs in assembly and high-level languages for ARM processor.	**K3**
CO5	Understand the basics of real time operating systems and their use in embedded systems.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2		1						2	2
CO2	3	3	3		3				2			2
CO3	3	3		2	2		2		2			2
CO4	3	3		2	2		2					2
CO5	3	3	3	2	2		2		2			2

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Embedded Systems Architecture, Programming and Design	Raj kamal	TMH	2nd edition,2003
2	Introduction to Embedded Systems	K.V Shibu	McGraw Hill Education India	2nd edition,2016
3	Computers as Components: Principles of Embedded Computing System Design	Wayne Wolf	Morgan Kaufman Publishers - Elsevier	3rd edition,2008
4	ARM system-on-chip architecture	Steve Furber	Addison Wesley	2nd edition,2000

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	An Embedded Software Primer	David E. Simon	Pearson Education Asia	1st Edition,2000
2	Embedded Systems Design	Steve Heath	Newnes – Elsevier	2nd Edition,2002
3	Embedded Systems Architecture, A Comprehensive Guide for Engineers and Programmers	Tammy Noergaard,	Newnes – Elsevier	2nd Edition,2012

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/108/102/108102169/
2	https://onlinecourses.nptel.ac.in/noc22_cs93/preview
3	https://archive.nptel.ac.in/courses/108/102/108102169/
4	https://archive.nptel.ac.in/courses/106/105/106105172/

PBL Course Elements

L: Lecture (3 Hrs.)	**R: Project (1 Hr.), 2 Faculty Members**		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		**30**

1. **Project Planning and Proposal (5 Marks)**
    - Clarity and feasibility of the project plan
    - Research and background understanding
    - Defined objectives and methodology

2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**
    - Individual contribution to the presentation
    - Effectiveness in answering questions and handling feedback

3. **Involvement in the Project Work and Team Work (3 Marks)**
    - Active participation and individual contribution
    - Teamwork and collaboration

4. **Execution and Implementation (10 Marks)**
    - Adherence to the project timeline and milestones
    - Application of theoretical knowledge and problem-solving
    - Final Result

5. **Final Presentation (5 Marks)**
    - Quality and clarity of the overall presentation
    - Individual contribution to the presentation
    - Effectiveness in answering questions

6. **Project Quality, Innovation, and Creativity (3 Marks)**

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches