INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**EMBEDDED SYSTEMS DESIGN**		
Course Code	BESB01		
Programme	M.Tech		
Semester	I	ES	
Course Type	Core		
Regulation	IARE - R18		
Course Structure	**Theory**		
	Lectures	**Tutorials**	**Credits**
	3	-	3
Chief Coordinator	Ms. K Sravani, Assistant Professor		

I. COURSE OVERVIEW:

Embedded systems course is continuous of the Microprocessor and Microcontrollers, is intended to Designing, Implementation and Test of embedded applications. The topics covered are definition of embedded systems, history, classification, characteristics and major applications, Quality attributes of embedded systems, types of processors, ASICs, PLDs, COTS, Memory Interface, communication interface, embedded firmware design and development, RTC, RTOS, Task, task scheduling, threads, multitasking, Task communication, Task synchronization, techniques, device drivers. Understand need of microprocessors, microcontrollers in development of various projects and to know complete Operating Systems, RTOS.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEC016	VII	Embedded systems	3

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Embedded systems design	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	LCD / PPT	✓	Seminars	×	Mini Project	✓	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

Each theory course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIE during the semester, marks are awarded by taking average of two sessional examinations.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept
30 %	To test the analytical skill of the concept
20 %	To test the application skill of the concept

Continuous Internal Assessment (CIA):

For each theory course the CIA shall be conducted by the faculty/teacher handling the course as given in Table 1. CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Technical Seminar and Term Paper.

Table 1: **Assessment pattern for Theory Courses**

Component	**Theory**		**Total Marks**
Type of Assessment	**CIE Exam**	**Technical Seminar and Term Paper**	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part-A shall have five compulsory questions of one mark each. In part-B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Technical Seminar and Term Paper:

Two seminar presentations are conducted during I year I semester and II semester. For seminar, a student under the supervision of a concerned faculty member, shall identify a topic in each course

and prepare the term paper with overview of topic. The evaluation of Technical seminar and term paper is for maximum of 5 marks. Marks are awarded by taking average of marks scored in two Seminar Evaluations.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Lectures and problem solving
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Design Exercises and assignments
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	3	Lectures and Term paper
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	3	Lectures and Design Exercises
PO 9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	Seminar and Group discussions

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES:

The course should enable the students to:	
I	Introduce the difference between embedded systems and general purpose systems.
II	Optimize hardware designs of custom single-purpose processors.
III	Compare different approaches in optimizing general-purpose processors.
IV	Introduce different peripheral interfaces to embedded systems.

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Understand the basic concepts of embedded system and various applications and characteristics system design of embedded system design and Quality Attributes of Embedded Systems.	CLO 1	Demonstrate to understand the definition and comparison of embedded system with other systems
		CLO 2	Explain to understand the history embedded system, Classify the embedded systems.
		CLO 3	List out the application areas of embedded systems Understand the purpose of the embedded systems.
		CLO 4	Understand the concepts of the characteristics and quality attributes.
CO 2	Classify the different types of processors and compare them and remember the definitions of ASICs, PLDs, memory, memory interface. Communication Interface.	CLO 5	Classify the different types of processors and compare them and Remembering the definitions of ASICs, PLDs.
		CLO 6	Concept of COTS and Explain the memory shadowing, memory selection.
		CLO 7	Communication Interface: Onboard and External Communication Interfaces.
CO 3	Applying the blocks and different circuits and Embedded Firmware Design Approaches and Development Languages.	CLO 8	Applying the different blocks and different circuits.
		CLO 9	Applying the embedded firmware design approaches and development languages.
CO 4	Understand Operating System Basics, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.	CLO 10	Remembering the basics of operating system and types of operating systems.
		CLO 11	Understanding the definitions of task, threads
		CLO 12	Analyze the multiprocessing, multi tasking, task scheduling
CO 5	Understand Task Communication Synchronization Issues, Task Synchronization Techniques, Device Drivers, analyze RTOS.	CLO 13	Understanding Task Communication.
		CLO 14	Analyze the Task Synchronization, issues and techniques.
		CLO 15	Analyze Real Time Operating System and how to choose RTOS.

X. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BESB01.01	CLO 1	Demonstrate to understand the definition and comparison of embedded system with other systems	PO 1	3
BESB01.02	CLO 2	Explain to understand the history embedded system, Classify the embedded systems.	PO 2	3
BESB01.03	CLO 3	List out the application areas of embedded systems Understand the purpose of the embedded systems.	PO 1	3
BESB01.04	CLO 4	Understand the concepts of the characteristics and quality attributes.	PO 1,PO 2	3
BESB01.05	CLO 5	Classify the different types of processors and compare them and Remembering the definitions of ASICs, PLDs.	PO 2	3
BESB01.06	CLO 6	Concept of COTS and Explain the memory shadowing, memory selection.	PO 3	3
BESB01.07	CLO 7	Communication Interface: Onboard and External Communication Interfaces.	PO 3,PO 2	3
BESB01.08	CLO 8	Applying the different blocks and different circuits.	PO 3	3
BESB01.09	CLO 9	Applying the embedded firmware design approaches and development languages.	PO 3, PO5	3
BESB01.10	CLO 10	Remembering the basics of operating system and types of operating systems.	PO 3, PO5	3
BESB01.11	CLO 11	Understanding the definitions of task, threads	PO 3	3
BESB01.12	CLO 12	Analyze the multiprocessing, multi tasking, task scheduling	PO 5	3
BESB01.13	CLO 13	Understanding Task Communication.	PO 3, PO5	3
BESB01.14	CLO 14	Analyze the Task Synchronization, issues and techniques.	PO 9	2
BESB01.15	CLO 15	Analyze Real Time Operating System and how to choose RTOS.	PO 5	3

3= High; 2 = Medium; 1 = Low

XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes (COs)	Program Outcomes (PO)				
	PO1	PO2	PO3	PO5	PO9
CO 1	3	2			
CO 2		2	3		
CO 3			3	3	
CO 4			3	3	
CO 5			3	3	2

3 = High; 2 = Medium; 1 = Low

XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (PO)				
	PO1	PO2	PO3	PO5	PO9
CLO 1	3				
CLO 2		2			
CLO 3	3				
CLO 4	3	2			
CLO 5		2			
CLO 6			3		
CLO 7		2	3		
CLO 8			3		
CLO 9			3	3	
CLO 10			3	3	
CLO 11			3		
CLO 12				3	
CLO 13			3	3	
CLO 14					2
CLO 15				3	

3 = High; 2 = Medium; 1 = Low

XIII. ASSESSMENT METHODOLOGIES - DIRECT

CIE Exams	PO1,PO2, PO3	SEE Exams	PO1, PO2, PO3	Assignments	PO1,PO2, PO3	Seminars	PO1, PO2, PO3
Laboratory Practices	PO1, PO2, PO3	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO1, PO2, PO3						

XIV. ASSESSMENT METHODOLOGIES – INDIRECT

✔	Early Semester Feedback	✓	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS

Unit-I	**INTRODUCTION TO EMBEDDED SYSTEMS:**	**Classes:09**
Definition of Embedded System, Embedded Systems Vs 5General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.		
Unit-II	**TYPICAL EMBEDDED SYSTEM**	**Classes:09**
Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.		
Unit-III	**EMBEDDED FIRMWARE:**	**Classes:09**
Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer. Embedded Firmware Design Approaches and Development Languages.		
Unit-IV	**RTOS BASED EMBEDDED SYSTEM DESIGN**	**Classes:09**
Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.		
Unit-V	**TASK COMMUNICATION:**	**Classes:09**
Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.		
Text Books:		
1. Frank Vahid, Tony Givargis, "Embedded System Design", John Wiley Publications, 3rd Edition, 2006.		
Reference Books:		
1. Raj Kamal, "Embedded Systems", TMH, 2nd Edition, 2008. 2. Shibu K.V, "Introduction to Embedded Systems, McGraw Hill, 3rd Edition, 2012. 3. Lyla, "Embedded Systems", Pearson Education, 2nd Edition, 2013.		

XVI. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Demonstrate to understand the definition and comparison of embedded system with other systems	CLO 1	T1:Chapter 1.1 R2-Chapter 1.1,1.2
3-4	Explain to understand the history embedded system, Classify the embedded systems.	CLO 2	T1:Chapter 1.1 R2-Chapter 1.3,1.4
5-6	List out the application areas of embedded systems Understand the purpose of the embedded systems.	CLO 3	T1:Chapter 1.1 R2-Chapter 1.5,1.6
7-8	Understand the concepts of the characteristics and quality attributes.	CLO 4	T1:Chapter 1.1 R2-Chapter 3.1,3.2

9-10	Classify the different types of processors and compare them and Remembering the definitions of ASICs, PLDs.	CLO 5	T1:Chapter 1.3,1.4 R2-Chapter 2.1
11-12	Concept of COTS and Explain the memory shadowing, memory selection.	CLO 6	T1:Chapter 5.3 R2-Chapter 2.1
13-14	Communication Interface: Onboard and External Communication Interfaces.	CLO 7	T1:Chapter 6.1 R2-Chapter 2.4
15-16	Applying the different blocks and different circuits.	CLO 8	T1:Chapter 4.1 R2-Chapter 2.6
17-18	Applying the embedded firmware design approaches and development languages.	CLO 9	T1:Chapter 8.1 R2-Chapter 9.1,9.2
19-20	Remembering the basics of operating system and types of operating systems.	CLO 10	R2-Chapter 10.1
21-22	Understanding the definitions of task, process and threads.	CLO 11	R2-Chapter 10.3
23-24	Analyze the multiprocessing, multi tasking, task scheduling.	CLO 12	R2-Chapter 10.4
25-26	Understanding the Task Communication.	CLO 13	R2-Chapter 10.7
27-28	Analyze the Task Synchronization, issues and techniques.	CLO 14	R2-Chapter 10.8
29-30	Analyze Real Time Operating System and how to choose RTOS.	CLO 15	R2-Chapter 10.2

XVII. GAPS IN THE SYLLABUS-TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance with Pos
1	Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.	Seminars / NPTEL	PO 1, PO 2, PO 5
2	Embedded Firmware Design Approaches and Development Languages	Seminars / Guest Lectures / NPTEL	PO 2, PO 5

Prepared by:

Mrs. K. Sravani, Assistant Professor

HOD, ECE