INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

INFORMATION TECHNOLOGY

COURSE DESCRIPTOR

Course Title	**EMBEDDED SYSTEMS DESIGN**				
Course Code	AEC551				
Programme	B.Tech				
Semester	VI	IT			
Course Type	Open Elective-I				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	4	-	-
Chief Coordinator	Mr. N Nagaraju, Assistant Professor, ECE				
Course Faculty	Mr. N Nagaraju, Assistant Professor, ECE				

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, and major applications. Introduction to microcontroller and its interfacing, embedded firmware design and development, RTOS, task scheduling, threads, multitasking, task communication, task synchronization. Understand need of microcontrollers in development of various projects and to know operating systems and RTOS.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	ACS007	IV	Operating Systems	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Embedded Systems Design	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for SEE. Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

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" are drawn from each unit of the syllabus. 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 theoretical concepts and derivation capabilities.
50 %	To test the analytical and problem solving skills.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks of which 25 marks for problem solving and 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
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.

Quiz / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

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.	2	Lectures, 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.	2	Lectures, Assignments
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	One minute videos
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	3	Lectures

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** The ability to research, understand and implement computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient analysis and design of computer-based systems of varying complexity.	2	Seminars
PSO 2	**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.	-	-
PSO 3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths, to be an entrepreneur, and a zest for higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Imbibe knowledge about the basic functions, structure, concepts and applications of Embedded Systems.
II	Understand Real time operating system concepts.
III	Analyze different tools for development of embedded software.
IV	Understand the architecture of advanced processors.

IX. 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
AEC551.01	CLO 1	Understand basic concept of embedded systems.	PO 1, PO 3	3
AEC551.02	CLO 2	Understand and analyze the applications in various domains of embedded system.	PO 1, PO 3	2
AEC551.03	CLO 3	Develop embedded system development process and tools.	PO 5, PO 12	3
AEC551.04	CLO 4	Understand and remember what is microcontroller, and core of the embedded system.	PO1, PO 3	3
AEC551.05	CLO 5	Understand the memory interface and assembly language programming process.	PO 1, PO 3	2
AEC551.06	CLO 6	Understand the counters and timers of 8051 microcontroller.	PO 1, PO 3	3
AEC551.07	CLO 7	Understand the embedded C programming in Keil IDE, and compiling.	PO 5, PO 12	2
AEC551.08	CLO 8	Understand different concepts of display and keyboard interfacing using embedded C.	PO 5, PO 12	2
AEC551.09	CLO 9	Understand different concepts of serial communication using embedded C.	PO 5, PO 12	2
AEC551.10	CLO 10	Understand the RTOS concepts for firmware development.	PO 3, PO 5	3
AEC551.11	CLO 11	Develop host and target machines for linking to embedded software.	PO 3, PO 5	2
AEC551.12	CLO 12	Develop debugging techniques for testing on host machine.	PO 3, PO5	2
AEC551.13	CLO 13	Understand the advanced processors such as ARM and SHARC.	PO 3, PO 12	3
AEC551.14	CLO 14	Understand the bus protocols such as I2C and CAN bus.	PO 3, PO 12	2
AEC551.15	CLO 15	Design an application based on advanced technological changes.	PO 3, PO12	3

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

(CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3		3										2		
CLO 2	2		2										3		
CLO 3					3							3	2		
CLO 4	3		3												
CLO 5	2		2										1		
CLO 6	1		3										2		

(CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 7					3							2			
CLO 8					3							3			
CLO 9					2							2			
CLO 10			3		3										
CLO 11			2		2								1		
CLO 12			2		3								1		
CLO 13			3									3			
CLO 14			2									2	1		
CLO 15			2									3	3		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 3, PO 5, PO 12	SEE Exams	PO 1, PO 3, PO 5, PO 12	Assignments	PO 1, PO 3	Seminars	PSO 1
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

UNIT-I	EMBEDDED COMPUTING
Definition of embedded system, embedded systems vs. general computing systems, history of embedded systems, complex systems and microprocessor, classification, major application areas, the embedded system design process, , formalisms for system design, design examples.	
UNIT-II	**THE 8051 ARCHITECTURE**
Introduction, 8051 Micro controller Hardware, Input/output Ports and Circuits, External Memory, Counter and Timers, Serial data Input/output, Interrupts. The Assembly Language Programming Process, Instructions of 8051 Programming Tools and Techniques, Simple Programs.	
UNIT-III	**INTRODUCTION TO EMBEDDED C AND APPLICATIONS**
Embedded systems programming in C, binding and running embedded C program in Keil IDE, dissecting the program, building the hardware. Basic techniques for reading and writing from I/O port pins, LED interfacing, interfacing with keyboards,	

displays, D/A and A/D conversions, using embedded C interfacing.	
UNIT-IV	**INTRODUCTION TO REAL – TIME OPERATING SYSTEMS**
Tasks and Task States, Semaphores, and Shared Data; Message Queues, Mailboxes and Pipes, Timer Functions, Events, Semaphores and Queues, Hard Real-Time Scheduling Considerations, Interrupt Routines in an RTOS Environment. Embedded Software Development Tools: Host and Target machines, Linker/Locators for Embedded Software, Getting Embedded Software into the Target System; Debugging Techniques: Testing on Host Machine.	
UNIT-V	**INTRODUCTION TO ADVANCED ARCHITECTURES**
ARM and SHARC, Processor and memory organization and Instruction level parallelism; Networked embedded systems: Bus protocols, I2C bus and CAN bus.	
Text Books:	
1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill. 2. Wayne Wolf, "Principles of Embedded Computing System Design", Elseveir, 2nd Edition 2014. 3. Kenneth J.Ayala, "The 8051 Microcontroller", Thomson, 3rd Edition 2016. 4. Dr. K V K K Prasad, "Embedded / Real-Time Systems: Concepts, Design And Programming", Black Book , DreamTech Press.	
Reference Books:	
1. Embedding system building blocks, Labrosse, via CMP publishers. 2. Embedded Systems, Raj Kamal, TMH. 3. An Embedded Software Primer, David E. Simon, Pearson Education. 4. 8051 Microcontroller and Embedded Systems, by Muhammad Ali Mazadi,Janice Mazidi, Janice Gillispie Mazdi.	

XIV. 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	Definition of Embedded System, Embedded Systems Vs General Computing Systems	CLO 1	T1-1.1
3-4	History of Embedded Systems, complex systems and microprocessor	CLO 1	T1-1.2
5-6	Classification of Embedded Systems, Major Application Areas	CLO 2	T1-1.3
7	Embedded system design process	CLO 3	T2-1.4
8-9	Formalisms for system design	CLO 3	T2-1.5
10-12	Design examples	CLO 3	R2-1.2
13-14	Introduction, 8051 Micro controller	CLO 4	T3-1.3
15-16	Micro controller Hardware, Input/output Ports and Circuits	CLO 4	T3-2.4
17-18	External Memory, Counter and Timers	CLO 6	T3-2.5
19-20	Serial data Input/output, Interrupts	CLO 4	T3-2.6
21-22	The Assembly Language Programming Process	CLO 5	T3-2.7
23-24	Instructions of 8051 Programming Tools and Techniques	CLO 5	T3-2.8

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
25-26	Simple Programs	CLO 5	T3-2.9
27-28	Embedded systems programming in C	CLO 7	R2-3.1
29-30	Binding and running embedded C program in Keil IDE	CLO 7	R2-3.2
31-32	Dissecting the program, building the hardware	CLO 7	R2-3.3
33-34	Basic techniques for reading and writing from I/O port pins	CLO 8	R2-3.4
35-36	LED interfacing, interfacing with keyboards	CLO 8	R2-3.5
37-38	Displays, D/A and A/D conversions using embedded C interfacing	CLO 9	R2-3.6
39-40	Tasks and Task States, Shared Data	CLO 10	R3-3.7
41-42	Message Queues, Mailboxes and Pipes	CLO 10	R3-3.8
43-44	Timer Functions, Events, Semaphores and Queues	CLO 10	R3-4.1
45-46	Hard Real-Time Scheduling Considerations, Interrupt Routines in an RTOS Environment.	CLO 11	R3-4.2
47-48	Embedded Software Development Tools: Host and Target machines	CLO 11	R3-4.3
49-50	Linker/Locators for Embedded Software, Getting Embedded Software into the Target System	CLO 12	R3-4.4
51-52	Debugging Techniques: Testing on Host Machine	CLO 12	R3-4.5
53-54	ARM and SHARC	CLO 13	T2-8.1
55-56	Processor and memory organization and Instruction level parallelism	CLO 13	T2-8.2
57-58	Networked embedded systems: Bus protocols, I2C bus	CLO 14	T2-8.3
59-60	CAN bus.	CLO 14	T2-8.4

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

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Advanced embedded systems with real time examples.	Guest Lectures	PO 5	PSO 1
2	Real time operating system concepts which applicable to advanced systems.	Seminars / NPTEL	PO 1	PSO 1
3	Design of elevator controller.	NPTEL	PO 3	PSO 1

Prepared by:
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