



**SARVAJANIK UNIVERSITY**  
**Sarvajanik College of Engineering and Technology**  
**Bachelor of Technology**



**B. Tech. Semester VII**

**Subject Name:** Embedded System Design

**Subject Code:** BTEC13701

**Type of course:** PCC

**Prerequisite:** Microprocessor and Microcontroller

**Rationale:** This subject provides a practical introduction to the design of microprocessor-based electronic systems. The lectures and project work will expose students to the various stages in an engineering project that includes design, implementation, testing, documentation and a range of embedded system concepts.

**Teaching and Examination Scheme:**

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	0	2	4	60	25	15	30	20	150

**CA1:** Continuous Assessment (assignments/projects/open book tests/closed book tests) **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

**Content:**

Sr. no.	Topics	Teaching Hrs.	Module % Weightage
1.	<b>Embedded Systems Overview:</b> Features Of Embedded Systems And Applications, Abstraction Level And Design Challenges, Classification Of Embedded Systems, Hardware And Software Components Of Embedded Systems, Development Tools, Examples Of Embedded Systems, Embedded Programming Tools And Languages.	8	15
2.	<b>Introduction to OS and Real Time Operating System:</b> Overview of OS: Multirate Systems, Processes and Threads, Context Switching, Multi-tasking, Cooperative Multitasking, Pre-emptive Operating Systems structure, Operating system function, Timing requirements on processes, Features of an Operating System, Features of RTOS, Case studies: FreeRTOS. $\mu$ COS, RTx51 TinyOS, Benchmarking RTOS, VxWorks.	10	20
3.	<b>Inter-process Communication:</b> Multiple process in an application, Multiple Threads in an application, Task and Task state, Task and Data, Clear-cut Distinction between Functions, ISRS and Tasks by their Characteristics, Concept of Semaphores, Shared Data, Inter process Communication, Signal Function, Semaphore Functions, Message Queue Functions, Mailbox Functions, Pipe Functions, Socket Functions, RPC Functions.	7	20



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4.	<b>Device and Communication:</b> Bus for Devices Network IO Types and examples, Serial communication devices, Parallel Device ports, Sophisticated Interfacing Feature in Devices Ports, Wireless Devices, Timer and Counting Devices, Watchdog timer, Real time clock, Network Embedded Systems, Serial Bus Communication Protocols, parallel Bus Devices protocol Parallel communication Network using ISA, PCI, PCI-X and advanced buses, Internet Enabled Systems- Network protocols, Wireless and mobile system protocol.	8	20
5.	<b>Device Drivers and Interrupt Services Mechanism:</b> Programmed-I/O Busy-wait Approach without Interrupt Services Mechanism, ISR Concept, Interrupt Sources, Interrupt Servicing (Handling) Mechanism, Multiple Interrupts, Context and the Periods for Context Switching, Interrupt Latency and Deadline, Classification of Processor Interrupt Service Mechanism from Context-Saving Angle, Direct Memory Access, and Device Driver Programming.	6	15
6.	<b>Real Time Task Scheduling:</b> Requirements of Embedded Software, Interrupts- Basics, latency, Process state and scheduling, Clock driven and Event driven scheduling, Rate Monotonic Scheduling, Earliest-Deadline First Scheduling, Fault-Tolerant Scheduling, Round Robin, Round robin with interrupt, function queue scheduling.	6	10

**Suggested Specification table with Marks (Theory/Practical):**

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	10	25	15	20	20

**Legends:** R: Remembrance, U: Understanding; A: Application, N: Analyze, E: Evaluate C: Create and above Levels (**Revised Bloom’s Taxonomy**)

**Note:** This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Reference Text Books:**

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Embedded System: Architecture, Programming and Design.	Raj Kamal	TMH	2008	2 <sup>nd</sup>



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2.	Computer as Components: Principles of Embedded Computing System Design	Wayne Wolf	Morgan Kaufmann	2008	Latest
3.	Embedded Microcomputer Systems Real Time Interfacing	Jonathan W. Valvano	Cengage Learning	2000	1 <sup>st</sup>

**Course Outcome:**

Sr. No.	CO Statement After learning this subject students will be able to	Marks % weightage
CO-1	Explain the concepts of Embedded Systems	10
CO-2	Develop software and hardware components necessary in embedded system design	25
CO-3	Use interrupts service mechanism and handler.	15
CO-4	Describe Inter-process communication and synchronization of processes, Threads and Tasks	25
CO-5	Apply concepts of RTOS in real time embedded systems	25

**Mapping with POs:**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	-	2	2	2	2	-	-	2	2	1	2	2		
CO-2	3	2	-	2	3	-	-	-	-	3	2	1	2	3	2
CO-3	3	2	-	2	-	-	-	-	-	-	-	1	-	2	
CO-4	3	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO-5	3	2	2	2	2	-	-	-	-	-	-	2		2	-

**List of practical:**

- 1 Study various RTOS and perform Various linux commands
- 2 Write a C program to create and destroy various threads using Semaphores. simulate producer-consumer problem using Semaphores
- 3 To study POSIX thread & Write appropriate code in Linux using C/C++ for working with POSIX
- 4 Write a code in Linux using C/C++ to perform First come first serve scheduling
- 5 Write a code in Linux to perform Round Robin scheduling
- 6 Write a code in Linux to perform Priority Based scheduling
- 7 Write a code in Linux to perform Print parent process ID & child process ID using Fork()



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- 8 Write a C program to simulate the following contiguous memory allocation Techniques a) Worst fit b) Best fit c) First fit.
- 9 Simulate Bankers Algorithm for DeadLock Avoidance.
- 10 Simulate all file allocation strategies  
a) Sequential b) Indexed c) Linked.
- 11 Write appropriate the pseudo code for Pipe in Linux
- 12 Study of Dining Table philosophy problem and write appropriate pseudocode for the same
- 13 Mini Project

**Major Equipment:**

- PC equipped with Linux environment

**List of Open Source/learning website:**

- <https://nptel.ac.in/courses/106105172-Real Time Operating System>

**List of Open Source Software:**

- <https://www.freertos.org/>
- <https://ubuntu.com/>