MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING
(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

Model Question Paper

Seventh Semester BE Degree Examination

Embedded Systems

Time: 3 Hours (180 Minutes) **Max. Marks: 100**

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M: Marks, L: RBT (Revised Bloom's Taxonomy) level, C: Course outcomes.

		Module -1	**M**	**L**	**C**
Q1	a.	Explain the essential elements of an embedded system architecture with a neat block diagram.	08	L2	CO1
	b.	Illustrate the ZigBee communication protocol used in embedded systems.	08	L2	CO1
	c.	Explain the operation of a brown-out protection circuit used in an embedded system with a neat diagram.	04	L2	CO1
		OR			
Q2	a.	Explain the operational quality attributes of an embedded system.	08	L2	CO1
	b.	Explain the operation of the SPI bus interface for external communication in an embedded system with a neat diagram.	08	L2	CO1
	c.	Compare a general-purpose system and an embedded system with respect to their key characteristics.	04	L2	CO1
		Module- 2			
Q3	a.	A temperature sensor that provides data for every 10 ms, apply programmed I/O and interrupt-driven I/O techniques to design the data-acquisition mechanism. Calculate and compare the CPU utilization of both methods and justify the selection of the more efficient approach.	10	L3	CO3
	b.	A system has three devices generating interrupts: a keyboard, a timer, and a network card. Propose an interrupt handling scheme to manage multiple interrupts efficiently. Illustrate the sequence of ISR execution and how priority levels can be applied.	10	L3	CO3
		OR			
Q4	a.	During an ISR execution, the CPU must switch contexts between two processes. Calculate the total context switching time if saving/restoring a process state takes 120 μs, and the interrupt latency is 50 μs. Explain how these values impact the system's real-time deadlines.	10	L3	CO3
	b.	A high-speed ADC continuously generates data that must be transferred to a system memory buffer. Apply DMA concepts to design a suitable data transfer mechanism. Develop pseudo-code for initializing the DMA transfer, handling the transfer-completion interrupt, and updating the system buffer. Compare the CPU involvement with programmed I/O and justify how the DMA-based mechanism reduces CPU load.	10	L3	CO3
		Module - 3			
Q5	a.	Describe the Data Flow Graph computational model used in embedded system.	04	L2	CO4
	b.	Describe the process involved in translation from source file to object file in an embedded system.	06	L2	CO4

	c.	A beverage vending machine dispenses a selected beverage based on the amount of money inserted by the user. Apply the Finite State Machine (FSM) concept to represent the operation of the vending machine considering beverage selection, verification of the inserted amount, dispensing of the selected beverage when sufficient money is available, returning the excess amount, and handling insufficient payment or transaction cancellation. Explain the state transitions involved and indicate the conditions for returning the system to the idle state.	10	L3	CO4
OR					
Q6	a.	Describe the Control Data Flow Graph computational model used in embedded system.	04	L2	CO4
	b.	Describe the water fall model used in Embedded Design Life Cycle (EDLC) of a system.	06	L2	CO4
	c.	A healthcare company is developing a wearable health-monitoring device that continuously measures heart rate and body temperature. The device processes the sensor data and generates an alert when the measured values exceed predefined limits. Apply the EDLC to this application. Use FSM and CDFG models to represent the control and data-processing operations of the device and relate them to the prediction of system behavior before hardware implementation.	10	L3	CO4
Module - 4					
Q7	a.	Obtain a multithreaded application to print "Hello I'm in main thread" from the main thread and "Hello I'm in new thread" 5 times each, using the pthread_create() and pthread_join() POSIX primitives.	10	L3	CO5
	b.	Three processes P1, P2, and P3 enter the ready queue simultaneously with burst times of 10 ms, 5 ms, and 7 ms, and priorities 0, 3, and 2 respectively (where 0 indicates the highest priority and 3 indicates the lowest priority). Calculate the waiting time and turnaround time (TAT) for each process, and also determine the average waiting time and average turnaround time.	10	L3	CO5
OR					
Q8	a.	Apply the Round Robin (RR) scheduling algorithm with a time quantum of 2 ms to three processes P1, P2, and P3 having burst times of 6 ms, 4 ms, and 2 ms respectively, which enter the ready queue simultaneously in the order P1, P2, and P3. Determine the waiting time and turnaround time (TAT) for each process, and compute the average waiting time and average turnaround time, assuming there is no I/O waiting.	10	L3	CO5
	b.	Illustrate the Dining Philosophers' Problem by applying appropriate synchronization mechanisms and show how deadlock may occur when philosophers attempt to access shared resources concurrently. Suggest an effective method to avoid deadlock and explain its operation.	10	L3	CO5
Module – 5					
Q9	a.	Explain the role of an embedded system in a modern washing machine. How does it improve efficiency and automation compared to a traditional washing machine?	10	L2	CO2
	b.	Describe how embedded systems are used in Anti-lock Braking Systems (ABS).	10	L2	CO2
OR					
Q10	a.	Summarize the applications of embedded systems in industrial automation. How do they contribute to real-time monitoring, control, and efficiency in manufacturing processes?	10	L2	CO2
	b.	Explain the use of embedded systems in virtual instrumentation. How do embedded systems enhance data acquisition, communication, and portability in these devices?	10	L2	CO2

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