U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**

Branch: Medical Electronics Engineering **Duration: 3 hrs.**

Course Code: 19ML5PCESD **Max Marks: 100**

Course: Embedded System Design with ARM

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Discuss the role of Cache memory in embedded systems? How it is different from dynamic memory?	CO1	PO1	**06**
	b)	Explain how data can be transmitted bit by bit using the I2C bus. What is the disadvantage of I2C bus?	CO1	PO1	**09**
	c)	Discourse how power up reset is different from watchdog timer reset.	CO1	PO1	**05**
		OR			
2	a)	How embedded system is different from general purpose computing system?	CO1	PO1	**06**
	b)	What is SPI? Explain SPI master-slave topology. If it is required to connect multiple slaves, how can be slaves connected?	CO1	PO1	**09**
	c)	Design and explain the working of a hardware circuit for an embedded system to prevent the microntroller from unexpected program execution behavior when the supply voltage falls below a specified voltage.	CO1	PO1	**05**
		UNIT - II			
3	a)	What is an exception? Discuss the exceptions of ARM Cortex M3	CO2	PO2	**10**
	b)	What is the type of stack used in Cortex M3 architecture? Exemplify operation of PUSH and POP instructions used for data transfer.	CO2	PO2	**10**
		OR			
4	a)	How is mode and level switching carried out in ARM Cortex M3?	CO2	PO2	**10**
	b)	Elaborate the purpose of bit-banding memory region in Cortex-M3?	CO2	PO2	**10**

			UNIT - III			
	5	a)	Exemplify operation of the following instructions i) SBFX ii. BIC ii. TST	*CO2*	*PO2*	**10**
		b)	Develop an assembly language program for LPC 1768 to perform the following operations. 1. Assume that 4 words are stored in memory. Take second word, extract bit4 to bit8 and sign extend it. 2. Reverse this result to save it in memory in big endian format.	*CO2*	*PO2*	**10**
			OR			
	6	a)	Develop an embedded C program for Cortex M3 to perform the following operations. 1. P0.2 should function as ADC input, when Bits 5 and 4 of PINSEL0 are 10 respectively. 2. Then blink all hypothetical LEDs connected to port 2.	*CO2*	*PO2*	**05**
		b)	Develop an assembly language program for LPC 1768, to divide -8 by 2 and save the result in R3, then zero extend the byte from the result to save it in Big endian format in memory. Assume that the input data is available in a memory	*CO2*	*PO2*	**08**
		c)	Analyze the following sequence of instructions to identify the contents after execution of each instruction. Assume R5= 0x10000004 R6=0x02 C=1 LSL R3,R5,#02 MLA R0, R3, R6, R5 ASR R0,R0,#01	*CO2*	*PO2*	**07**
			UNIT - IV			
	7	a)	If the source code is written in embedded C, how is ROM image obtained in an embedded system design? Discuss.	*CO1*	*PO1*	**07**
		b)	Discuss any three operational quality attributes of an embedded system.	*CO1*	*PO1*	**06**
		c)	Develop and explain the finite state machine model for an automatic chocolate vending machine for the following requirements 1. The tea/coffee vending is initiated by user inserting a 5 rupee coin. 2. After inserting the coin, the user can either select 'Coffee' or 'Tea' OR 3. press 'Cancel' to cancel the order and take back the coin	*CO1*	*PO1*	**07**
			OR			
	8	a)	Discuss nonoperational quality attributes of an embedded system and exemplify their significance for medical embedded systems.	*CO1*	*PO1*	**10**

<table>
<tr><td></td><td></td><td>b)</td><td>Design a coin operated public telephone unit based on FSM model for the following requirements.
1. The calling process is initiated by lifting the receiver (off-hook) of the telephone unit. After lifting the phone the user needs to insert a 1 rupee coin to make the call. If the line is busy, the coin is returned on placing the receiver back on the hook (on-hook)
2. If the line is through, the user is allowed to talk till 60 seconds and at the end of 45th second, prompt for inserting another 1 rupee coin for continuing the call is initiated
3. If the user doesn't insert another 1 rupee coin, the call is terminated on completing the 60 seconds time slot.
4. The system is ready to accept new call request when the receiver is placed back on the hook
5. The system goes to the 'Out of Order' state when there is a line fault.</td><td>CO1</td><td>PO1</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - V</td><td></td><td></td><td></td></tr>
<tr><td></td><td>9</td><td>a)</td><td>In a manufacturing plant which involve many processes, discuss how an operating system can achieve ownership lock and signal mechanism.</td><td>CO3</td><td>PO3</td><td>05</td></tr>
<tr><td></td><td></td><td>b)</td><td>There are 7 processes in an embedded system. Execution of these processes is based on Preemptive Priority Scheduling. Their respective priorities, Arrival Times and Burst times are given in the table below.
<table><tr><th>Process Id</th><th>Priority</th><th>Arrival Time</th><th>Burst Time</th></tr><tr><td>1</td><td>2(L)</td><td>0</td><td>1</td></tr><tr><td>2</td><td>6</td><td>1</td><td>7</td></tr><tr><td>3</td><td>3</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>3</td><td>6</td></tr><tr><td>5</td><td>4</td><td>4</td><td>5</td></tr><tr><td>6</td><td>10(H)</td><td>5</td><td>15</td></tr><tr><td>7</td><td>9</td><td>15</td><td>8</td></tr></table>Represent Gantt chart and calculate waiting time, completion time and TAT for each process. Also calculate the average waiting time and average turnaround time</td><td>CO3</td><td>PO3</td><td>08</td></tr>
<tr><td></td><td></td><td>c)</td><td>Discuss the operation of Round Robin scheduling algorithm giving its advantages and disadvantages.</td><td>CO3</td><td>PO3</td><td>07</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>10</td><td>a)</td><td>Exemplify the various states of a task in RTOS.</td><td>CO3</td><td>PO3</td><td>07</td></tr>
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		b)	Consider CPU uses Round Robin scheduling with the 6 processes in an embedded system. Process arrival time and burst time are given in table below. If the with time quantum = 3ms, Represent Gantt chart to calculate waiting time , completion time and TAT for each process. Also calculate the average waiting time and average turn around time.	*CO3*	*PO3*	**08**
		c)	Discuss the various queues maintained by real time OS in association with CPU scheduling?	*CO3*	*PO3*	**05**

Process Id	Arrival Time	Burst Time
P1	5	5
P2	4	6
P3	3	7
P4	1	9
P5	2	2
P6	6	3

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