

INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Date: FN/AN Time: 3Hrs. Full marks: 100 No. of students: 72  
 End Spring Semester, 2009-2010 Deptt: Electronics & Elec. Comm. Engg. Sub No: EC 31006  
 3<sup>rd</sup> Year B.Tech(H) Sub Name: Microcontrollers and Embedded Systems

- Q1. (a) List down the sequence of actions that take place on occurrence of an interrupt. [5]  
 (b) Why are all interrupts of 8051 said to be vectored interrupts? [2]  
 (c) Enumerate two priority settings that are NOT possible in 8051. [4]  
 (d) Write a program to read the port P0 on occurrence of a level triggered interrupt on INT0 line. Compute the square of the number and store the values in memory locations 50H and 51H. [6]
- Q2. (a) Write a code fragment to read 150 data bytes from port P1 and store it in external RAM location 8000 onwards. Can we use port P0 instead of P1? [4+2]  
 (b) Suggest a mechanism by which more than 64K external memory can be interfaced with 8051. [3]  
 (c) Draw the circuit diagram to interface 4, 8-segment display modules with 8051. Number of port bits allowed for interfacing is at most 12. It is needed to continually display the string "1947" in the display. Assume that the display modules need the patterns 3FH, 67H, 66H and 07H for displaying the digits 1, 9, 4, and 7 respectively. Write down the corresponding code in the assembly language of 8051. [4+4]
- Q3. (a) Write a code fragment to generate a triangular waveform using a DAC with 8051. [8]  
 (b) Show a typical interface of an ADC with 8051. Write the code fragment to continually sample an analog signal in port P2 via an ADC interfaced there. [8]
- Q4. (a) What is meant by a system-call? How does a multi-threaded kernel differ from a single-threaded kernel in this respect? [2+3]  
 (b) Why SJF is called a theoretical algorithm? [2]  
 (c) Which scheduling algorithm is best suited for interactive environment? Name the corresponding scheduling criterion that is optimized here. [2]  
 (d) Consider the following set of simultaneous equations to be solved using an iterative approach that starts with a set of initial values and computes the new ones till the values converge. One equation is used to update one of the variables based upon the current values of remaining variables. Assume that each equation is realized by a separate process. Write the structure of processes with proper synchronization via semaphores. You should not forget to mention the initial values of the semaphores. Assume  $a_{ij}, c_i$  to be constants. [8]

$$\begin{aligned} a_{11}x + a_{12}y + a_{13}z &= c_1 \\ a_{21}x + a_{22}y + a_{23}z &= c_2 \\ a_{31}x + a_{32}y + a_{33}z &= c_3 \end{aligned}$$

- Q5. (a) State the necessary conditions of deadlock. [4]  
 (b) Consider the following snapshot of the system.

Process	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	0	0	1	2	0	0	1	2	1	5	2	0
P1	1	0	0	0	1	7	5	0				
P2	1	3	5	4	2	3	5	6				
P3	0	6	3	2	0	6	5	2				
P4	0	0	1	4	0	6	5	6				

Assuming Banker's Algorithm, what is the content of the Need matrix? Is the system in a safe state? If P1 requests for (0, 4, 2, 0) can it be granted immediately? [2+5+5]

- Q6. (a) For the following page reference string, compute the number of page faults assuming 4 memory frames for (i) Optimal, (ii) LRU policy.  
 1, 2, 3, 4, 5, 3, 4, 1, 6, 7, 8, 7, 8, 9, 7, 8, 9, 5, 4, 5, 4, 2. [3+3]  
 (b) Distinguish between soft, firm and hard real-time systems with examples. [6]  
 (c) Distinguish between RMS and EDF scheduling strategies. [3]  
 (d) Distinguish between a thread and a process. [2]