SARDAR PATEL INSTITUTE OF TECHNOLOGY

(Autonomous Institute Affiliated to University of Mumbai)

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058, India

BRANCH : COMP. ENGG.,DS,AIML

END SEMESTER EXAMINATION

CE206: Operating Systems

Max. Marks: 100 Time: 3 hours

Instructions

- Carefully read the question and the weight age given, and accordingly strategies your answers. *(Don't write things which are not asked)*
- Make suitable assumptions, if required. Mention those categorically.
- All Questions are Compulsory.
- New Question (not a sub-question) be solved from a new page.
- You may choose any sequence of questions while writing the answers, however, all sub questions must be written in a sequence.
- The last two columns are related to Outcome Based Education. (You don't bother)

Q. No		Questions	MM	BL	CO
Q.1	a	Explain the process of loading an executable program into memory using a loader in systems programming.	5	2	1
	b	How does Multitasking operating system differ from Time Sharing Operating System, and what are the key benefits of each?	5	2	1
	c	How does the process differ from thread? What are the differences between user level thread and kernel level thread? **OR** What are the different types of thread states? What are the benefits of multithreaded programming?	5	2	1
	d	Consider the set of 3 processes whose arrival time and burst time are given below-	5	3	2

Process No.	Arrival Time	Priority	Burst Time		
			CPU Burst	I/O Burst	CPU Burst
P1	0	2	1	5	3
P2	2	3	3	3	1
P3	3	1	2	3	1

		If the CPU scheduling policy is Priority Scheduling, calculate the average waiting time and average turn around time. (Lower number means higher priority)			

Q.2	a	What will be the output of the following code. Draw the tree representing various processes. Justify your answer.
		
		#include <stdio.h>
		#include <unistd.h>
		
		int main()
		{
		if (fork() && (!fork())) {
		if (fork() || fork()) {
		fork();
		}
		}
		printf("2 ");
		return 0;
		}
		
		OR
		
		Consider a process P that executes the fork system call twice. That is, it runs code like this:
		int ret1 = fork();
		int ret2 = fork();
		How many direct children of P (i.e., processes whose parent is P) and how many other descendants of P (i.e., processes who are not direct children of P, but whose grandparent or great grandparent or some such ancestor is P) are created by the above lines of code? Justify your answer.You may assume that all fork system calls succeed.
		(a) Two direct children of P are created.
		(b) Four direct children of P are created.
		(c) No other descendant of P is created.
		(d) One other descendant of P is created.
			5	4	1

	b	Consider a process P1 that forks P2, P2 forks P3, and P3 forks P4. P1 and P2 continue to execute while P3 terminates. Which process will be the parent of P4? Which of the following C library functions do NOT directly correspond to (similarly named) system calls? (a) fork, which creates a new child process. (b) exit, which terminates the current process. (c) strlen, which returns the length of a string.	2	2	1

<table>
<tr><td></td><td>c</td><td>A system with two dual-core processors has four processors available for scheduling. A CPU-intensive application (e.g., a program that spends most of its time on computation, not I/O or memory accesses) is running on this system. All input is performed at program start-up, when a single file must be opened and read sequentially. Similarly, all output is performed just before the program terminates, when the program results must be written sequentially to a single file. Between startup and termination, the program is entirely CPU-bound (e.g., only executing instructions). Your task is to improve the performance of this application by Multithreading. The system runs on OnetoOne threading model. Determine:
i) How many threads will you create to handle input and output? Briefly explain.
ii) How many threads will you create for the CPU-bound portion of the application? Briefly explain</td><td>8</td><td>3</td><td>1</td></tr>
<tr><td></td><td>d</td><td>Consider a logical address space of 32 pages of 2048 words mapped into 64 frames. What is the number of bits required for logical address?</td><td>5</td><td>3</td><td>4</td></tr>
<tr><td>Q.3</td><td>a</td><td>Consider the following solution to the producer-consumer synchronization problem. The shared buffer size is N. Three semaphores empty, full and mutex are defined with respective initial values of 0, N and 1. Semaphore empty denotes the number of available slots in the buffer, for the consumer to read from. Semaphore full denotes the number of available slots in the buffer, for the producer to write to. The placeholder variables, denoted by P, Q, R and S, in the code below can be assigned either empty or full. The valid semaphore operations are: wait() and signal().
<table>
<tr><th>Producer:</th><th>Consumer:</th></tr>
<tr><td>do {
wait (P);
wait (mutex);
//Add item to buffer
signal (mutex);
signal (Q);
}while (1);</td><td>do {
wait (R);
wait (mutex);
//consume item from buffer
signal (mutex);
signal (S);
}while (1);</td></tr>
</table>
What value of P,Q,R and S will yield the correct solution. Justify your answer</td><td>10</td><td>4</td><td>3</td></tr>
</table>

	b	Suppose S and Q are semaphores initialized to 1. P1 and P2 processes share the resources. Then what will be the output of the following code assuming P1 and P2 can perform context switch at any moment justify your answer. **P1** **P2** **Wait(S);** **Wait(Q);** **Wait(Q);** **Wait(S);** **CS1** **CS2** **Signal(S);** **Signal(Q);** **Signal(Q);** **Signal(S);**	5	4	3
	c	What is the critical section problem in Operating Systems? What are the requirements to solve the critical section problem explain in brief?	5	2	3
Q.4	a	What is external fragmentation? How do operating system take care of it? **OR** What is thrashing? Discuss different techniques to take care of thrashing.	4	4	4
	b	In a virtual memory system, the size of virtual address is 32-bit, size of physical address is 30-bit, page size is 4 Kbyte and size of each page table entry is 32-bit. The main memory is byte addressable. What is the maximum number of bits that can be used for storing protection and other information in each page table entry?	8	4	4
	c	Consider the following snapshot of a system. P0, P1, P2, P3, P4 are the processes and A, B, C, D are the resource types. The values in the table indicate the number of instances of a specific resource (for example: 3 3 2 1 under the last column indicates that there are 3 A-type, 3 B-type, 2 C-type and 1 D-type resources available after allocating the resources to all five processes).	8	3	3

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

Answer the following questions using banker's algorithm by providing all intermediate steps:

i. Compute the Need matrix for the given snapshot of a system.

		ii. Verify whether the snapshot of the present system is in a safe state by demonstrating an order in which the processes may complete. iii. If a request from process P1 arrives for (1,1,0,0), can the request be granted immediately? iv. If a request from process P4 arrives for (0,0,2,0), can the request be granted immediately?			
Q.5	a	Suppose the following disk request sequence (track numbers) for a disk with 100 tracks is given: 45, 20, 90, 10, 50, 60, 80, 25, 70. Assume that the initial position of the R/W head is on track 50. How much additional or less distance that will be traversed by the R/W head when the Shortest Seek Time First (SSTF) algorithm is used compared to the SCAN (Elevator) algorithm in tracks (assuming that SCAN algorithm moves towards 100 when it starts execution) ?	5	3	5
	b	A hard disk system has the following parameters: Number of tracks = 500 Number of sectors/track = 100 Number of bytes /sector = 500 Time taken by the head to move from one track to adjacent track = 1 ms Rotation speed = 600 rpm. What is the average time taken for transferring 250 bytes from the disk?	5	4	5
	c	A file system with 300 GByte uses a file descriptor with 8 direct block addresses. 1 indirect block address and 1 doubly indirect block address. The size of each disk block is 128 Bytes and the size of each disk block address is 8 Bytes. What is the maximum possible file size in this file system?	5	4	5
	d	Consider three processes, all arriving at time zero, with total execution time of 10, 20 and 30 units respectively. Each process spends the first 20% of execution time doing I/O, the next 70% of time doing computation, and the last 10% of time doing I/O again. The operating system uses a shortest remaining compute time first scheduling algorithm and schedules a new process either when the running process gets blocked on I/O or when the running process finishes its compute burst. Assume that all I/O operations can be overlapped as much as possible. For what percentage of the CPU remains idle? **OR** Three processes P1, P2 and P3 arrive at time zero. Their total execution time is 10ms, 15ms, and 20ms respectively. They spent the first 20% of their execution time in doing I/O, next 60% in CPU processing and the last 20% again doing I/O. For what percentage of time was the CPU free? Use Round robin algorithm with time quantum 5ms.	5	4	2

Good Luck !!