Roll Number:_____

Thapar Institute of Engineering & Technology, Patiala

Department of Electrical and Instrumentation Engineering

End Semester Test (EST)

B.E (EEC)-2nd Year-2223 EVENSEM	Course Code: UCS303
Date: May 17, 2023	Course Name: Operating Systems
M. Marks: 40	Name of Faculty: Dr. Alok Kumar Shukla

Note: Attempt all questions in a proper sequence with justification.
Assume missing data, if any suitably.

Q. 1 (a)	Consider a disk pack with 16 surfaces, 128 tracks per surface, 256 sectors per track, and 512 bytes of data stored in a bit serial manner in a sector. Answer the following queries: I. What is the capacity of the disk pack (**in KB only**)? II. What is the data transfer rate if the disk is rotating at 3600 RPM? III. If the disk system has a rotational speed of 3000 RPM, what is the average access time with a seek time of 11.5 msec?	(6)
1 (b)	Consider a file system that uses UNIX-like inodes to keep track of the sectors allocated to files. Assume that disk blocks are 1 KB in size, disk block addresses are 32 bits and the inode has space for 8 direct blocks, 1 singly indirect block, 1 doubly indirect block, and 1 triply indirect block. What is the largest disk drive that could be fully utilized by this system?	(4)
Q. 2 (a)	What is the purpose of paging in the page tables, explain with a neat diagram. Consider a computer system with a 32-bit logical address and 4-KB page size. The system supports up to 512 MB of physical memory. How many entries are there in a conventional single-level page table?	(2+2)
Q. 2 (b)	What are the causes of thrashing in computer memory management, explain with a neat diagram. How many page faults occur in Least Recently Used (LRU) page replacement algorithm for the given reference string: 7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1, with frame size is 3?	(2+3)
Q. 3 (a)	Consider the famous *dining philosophers'* problem. *N* philosophers are sitting around a table with *N* forks between them. Each philosopher must pick up both forks on her left and right before she can start eating. If each philosopher first picks the fork on her left (or right), then all will deadlock while waiting for the other fork. The goal is to come up with an algorithm that lets all philosophers eat, without deadlock or starvation. Write a solution to this problem using condition variables.	(3)
Q. 3 (b)	Write the pseudo-code of banker's algorithm. The banker's algorithm is being run in a system with m resource classes and n processes. In the limit of large m and n the number of operations that must be performed to check a state for safety is proportional to $m^a n^b$. What are the values of a and b.	(1.5+1.5)
Q. 4(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. Find the additional distance (in terms of tracks) that will be traversed by the R/W head when the Shortest Seek Time First algorithm is used compared to the Elevator algorithm (assuming that the Elevator algorithm moves towards 100 when it starts execution).	(5)
Q. 4(b)	Consider a process with a single CPU burst of 100-time units and a single disk I/O of 1000 time units at the end. If the timer interval is fifteen-time units and the process scheduling algorithm is round-robin, at most how many times would the process enter the ready queue before entering the terminated state? Assume that there is a sufficiently large number of processes of similar nature trying to run on the CPU.	(3)

Q. 5 (a)	Consider a parent process P that has forked a child process C in the program below.
	
	int a = 5;
	int fd = open(...)
	int ret = fork();
	if(ret >0) {
	close(fd);
	a = 6;
	...
	}
	else if(ret==0) {
	printf("a=%d\n", a);
	read(fd, OS);
	}
	
	After the new process is forked, suppose that the parent process is scheduled first, before the child process. Once the parent resumes after fork, it closes the file descriptor and changes the value of a variable as shown above. Assume that the child process is scheduled for the first time only after the parent completes these two changes.
	
	I. What is the value of the variable ***a*** as printed in the child process when it is scheduled next? With proper justification.
	II. Will the attempt to read from the file descriptor succeed in the child? With proper justification.
		(4)

Q. 5 (b)	Instructions related to accessing I/O devices are typically privileged instructions, that is, they can be executed in kernel mode but not in user mode. Give any **3** reasons why these instructions are privileged.	(3)

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Thapar Institute of Engineering & Technology, Patiala

(Deemed to be University)

End Semester Test

Subject: Operating Systems (UCS303) ***Faculty Name: Garima Singh***

Branch Code: MEC ***Date & Time: 17/05/2023 at 2pm***

Maximum Marks: 40 ***Maximum Time: 3 Hrs***

Note: All questions are compulsory assume missing data if any. Before starting the question paper please check your branch code and faculty name on question paper.

1.	a) Explain how operating system ensures access control using access matrix, also explain copy, owner and control rights of it.	3
	b) Provide an explanation of the different file access methods along with their respective advantages and disadvantages.	3
2.	a) Explain following terms i) Masquerading, ii) Trojan Horse, iii) Thrashing, iv) RACE condition	2
	b) Explain demand paging. Consider a main memory with five page frames and the following sequence of page references: 3, 8, 2, 3, 9, 1, 6, 3, 8, 9, 3, 6, 2, 1, 3. Find out total number of page faults if LRU and optimal page replacement method is used.	4
3.	a) A paging scheme uses a Translation Look-aside Buffer (TLB). A TLB-access takes 10 ns and a main memory access takes 50 ns. What is the effective access time (in ns) if the TLB hit ratio is 90% and there is no page-fault?	2
	b) Explain Peterson's solution with its limitations.	2
	c) Consider the methods used by processes P1 and P2 for accessing their critical sections whenever needed, as given below. The initial values of shared Boolean variables S1 and S2 are randomly assigned.	
	<table><tr><th>P1</th><th>P2</th></tr><tr><td>while (S1 == S2) ; Critical Section S1 = S2;</td><td>while (S1 == S2) ; Critical Section S1 = S2;</td></tr></table>	2
	Find out is it a valid solution for critical section problem or not with proper reasoning.	
4	a) Explain Dining-Philosophers problem and solve it using semaphore.	2
	b) Consider system is using static memory allocation and have five memory partitions of size 100 KB, 500 KB, 200 KB, 450 KB and 600 KB in same order. If sequence of requests for blocks of size 212 KB, 417 KB, 112 KB and 426 KB in same order come, then which of the	4

	partition allocation algorithm makes the efficient use of memory? Find out internal as well as external fragmentation.	
5	a) Discuss the paging technique, its distinctions from segmentation, and how it addresses external fragmentation problem, also acknowledge its limitations. b) What is virtual memory, and how does it enhance the efficiency and scalability of modern computer systems?	2 3
6	a) Explain belady's anomaly, further assume that the system has 3 page frames, initially all are empty. Consider the following page reference stream in the given order. **7, 0, 1, 2, 0, 3, 0, 4, 2, 3.** Find out the number of page faults occur using second chance algorithm. b) Explain significance of RAID (Redundant Array of Independent Disks) in a system, and what are the different RAID levels and their respective advantages and disadvantages?	3 2
7.	a) Consider a storage disk with 4 platters (numbered as 0, 1, 2 and 3), 200 cylinders (numbered as 0, 1, … , 199), and 256 sectors per track (numbered as 0, 1, … 255). The following 6 disk requests of the form [sector number, cylinder number, platter number] are received by the disk controller at the same time: [120, 72, 2], [180, 134, 1], [60, 20, 0], [212, 86, 3], [56, 116, 2], [118, 16, 1] Currently head is positioned at sector number 100 of cylinder 80, and is moving towards higher cylinder numbers. The average power dissipation in moving the head over 100 cylinders is 20 milliwatts and for reversing the direction of the head movement once is 15 milliwatts. Power dissipation associated with rotational latency and switching of head between different platters is negligible. Find out the total power consumption in milliwatts to satisfy all of the above disk requests using the Shortest Seek Time First disk scheduling algorithm. b) What are the different conditions that can contribute to the occurrence of deadlock in an operating system.	4 2