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B.TECH. V SEMESTER (NEW SCHEME)
MAIN/BACK EXAMINATION 2024-25

COMPUTER SCIENCE & ENGINEERING

5CS4–01 - Operating Systems

5AI4-01, 5AD4-01, 5AM4-01, 5CA4-01, 5CD4-01, 5DS4-01, 5IO4-01, 5IT4-01 5MC4-01, 5CM4-01, 5CY4-01, Common to CS, AI, AD, AM, CA, CD, DS, IO, IT, MC, CM, CY

Time : 3 Hours]

[Max. Marks : 70

[Min. Passing Marks :

Instructions to Candidates :

Part–A : Short Answer Type Questions (up to **25** words) 10 × 2 = 20 marks. All 10 questions are compulsory.

Part–B : Analytical/Problem Solving questions 5 × 4 = 20 marks. Candidates have to answer 5 questions out of 7.

Part–C : Descriptive/Analytical/Problem Solving questions 3 × 10 marks = 30 marks. Candidates have to answer 3 questions out of 5.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/ calculated must be stated clearly.

Use of the following supporting materials is permitted during examination. *(Mentioned in form no. 205).*

1_____Nil_____ 2_____Nil_____

Part–A

Q. 1. What is the difference between timesharing and multiprogramming systems ?

Q. 2. Give two reasons why caches are useful. What problems do they solve ? What problems do they cause ? If a cache can be made as large as the device for which it is caching, why not make it that large and eliminate the device ?

Q. 3. In what ways is the modular kernel approach similar to the layered approach ? In what ways does it differ from the layered approach ?

Q. 4. Describe the differences among short-term, medium-term, and long-term scheduling.

Q. 5. Discuss the strengths and weaknesses of implementing an access matrix using capabilities that are associated with domains.

Q. 6. What commonly used computer programs are prone to man-in-the-middle attacks ? Discuss solutions for preventing this form of attack.

Q. 7. What are the primary goals of the conflict-resolution mechanism used by the Linux kernel for loading kernel modules ?

Q. 8. Explain the difference between internal and external fragmentation. Why are segmentation and paging sometimes combined into one scheme ?

Q. 9. What is the cause of thrashing ? How does the system detect thrashing ? Once it detects thrashing, what can the system do to eliminate this problem ?

Q. 10. Show how to implement the wait() and signal() semaphore operations in multiprocessor environments using the TestAndSet () instruction. The solution should exhibit minimal busy waiting.

Part-B

Q. 1. Consider a multiprocessor system and a multithreaded program written using the many-to-many threading model. Let the number of user-level threads in the program be more than the number of processors in the system. Discuss the performance implications of the following scenarios.

(a) The number of kernel threads allocated to the program is less than the number of processors.

(b) The number of kernel threads allocated to the program is equal to the number of processors.

(c) The number of kernel threads allocated to the program is greater than the number of processors but less than the number of userlevel threads.

Q. 2. Consider a system running ten I/O-bound tasks and one CPU-bound task. Assume that the I/O-bound tasks issue an I/O operation once for every millisecond of CPU computing and that each I/O operation takes 10 milliseconds to complete. Also assume that the context-switching overhead is 0.1 millisecond and that all processes are long-running tasks. Describe the CPU utilization for a round-robin scheduler when:

(a) The time quantum is 1 millisecond

(b) The time quantum is 10 milliseconds

Q. 3. Given five memory partitions of 100 KB, 500 KB, 200 KB, 300 KB, and 600 KB (in order), how would the first-fit, best-fit, and worst-fit algorithms place processes of 212 KB, 417 KB, 112 KB, and 426 KB (in order) ? Which algorithm makes the most efficient use of memory ?

Q. 4. Explain the differences in how much the following scheduling algorithms discriminate in favor of short processes:

(a) FCFS

(b) RR

(c) Multilevel feedback queues

Q. 5. Consider the exponential average formula used to predict the length of the next CPU burst. What are the implications of assigning the following values to the parameters used by the algorithm ?

(a) $\alpha = 0$ and $\tau_0 = 100$ milliseconds

(b) $\alpha = 0.99$ and $\tau_0 = 10$ milliseconds

Q. 6. Discuss the tradeoff between fairness and throughput of operations in the readers-writers problem. Propose a method for solving the readers-writers problem without causing starvation.

Q. 7. Consider a system consisting of four resources of the same type that are shared by three processes, each of which needs at most two resources. Show that the system is deadlock free.

Part–C

Q. 1. Suppose that the following processes arrive for execution at the times indicated. Each process will run for the amount of time listed. In answering the questions, use non-preemptive scheduling, and base all decisions on the information you have at the time the decision must be made :

Process	Arrival Time	Burst Time
P_1	0.0	8
P_2	0.4	4
P_3	1.0	1

(a) What is the average turnaround time for these processes with the FCFS scheduling algorithm ?

(b) What is the average turnaround time for these processes with the SJF scheduling algorithm ?

(c) The SJF algorithm is supposed to improve performance, but notice that we chose to run process P_1 at time 0 because we did not know that two shorter processes would arrive soon. Compute what the average turnaround time will be if the CPU is left idle for the first 1 unit and then SJF scheduling is used. Remember that processes P_1 and P_2 are waiting during this idle time, so their waiting time may increase. This algorithm could be known as future-knowledge scheduling.

Q. 2. Consider the following state of a system :

Process	Allocation	Max	Available
	ABCD	ABCD	ABCD
P_0	0012	0012	1520
P_1	1000	1750	
P_2	1354	2356	
P_3	0632	0652	
P_4	0014	0656	

Answer the following questions using the banker's algorithm:

(a) What is the content of the matrix Need ?

(b) Is the system in a safe state ?

(c) If a request from process P_1 arrives for (0, 4, 2, 0), can the request be granted immediately ?

Q. 3. Consider a file system that uses I-nodes to represent files. Disk blocks are 8 KB in size, and a pointer to a disk block requires 4 bytes. This file system has 12 direct disk blocks, as well as single, double, and triple indirect disk blocks. What is the maximum size of a file that can be stored in this file system ?

Q. 4. Consider a demand-paging system with a paging disk that has an average access and transfer time of 20 milliseconds. Addresses are translated through a page table in main memory, with an access time of 1 microsecond per memory access. Thus, each memory reference through the page table takes two accesses. To improve this time, we have added an associative memory that reduces access time to one memory reference if the page-table entry is in the associative memory. Assume that 80 percent of the accesses are in the associative memory and that, of those remaining, 10 percent (or 2 percent of the total) cause page faults. What is the effective memory access time ?

Q. 5. Suppose that a disk drive has 5,000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order, is :

86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130

Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk-scheduling algorithms ?

(a) FCFS

(b) SSTF

(c) SCAN

(d) LOOK

(e) C-SCAN

(f) C-LOOK

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