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INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination, December 2025
BTech Backlog, 2025-26

CS1108: Operating Systems
Time: 2.5 hours

Max. Marks: 30

Ques 1: Answer the following questions with justifications wherever needed. (CO3)

a) Consider the following processes:

(6)

Process	Arrival Time	Burst Time	Priority
P1	3	16	3
P2	8	10	1
P3	0	18	4
P4	5	9	2
P5	1	17	5
P6	12	11	2
P7	10	19	1

Perform CPU scheduling using the following algorithms and draw the GANTT charts. Calculate the Average Turnaround Time, Average Waiting Time and Throughput for each of them.

- 1) First Come First Serve
- 2) Priority Scheduling (Non pre-emptive) (HINT: Consider the priorities as 1,2,3,4,5 respectively where *lower number = lower priority*)
- 3) Round Robin ($q = 4$)

Ques 2 Answer the following questions and show all the steps clearly: (6)
(CO3)

A system has 6 processes (P0, P1, P2, P3, P4, P5) and 4 resources (A, B, C, D). The current availability of A,B,C,D is 4, 6, 3 and 4 respectively. Assume the following table:

Process	Allocation (A B C D)	Maximum (A B C D)
P0	1 0 1 2	3 1 2 2
P1	2 1 0 1	4 2 1 3
P2	3 1 2 1	5 2 3 3
P3	2 1 1 2	3 2 1 4
P4	1 0 0 2	3 1 1 3
P5	0 1 1 0	2 2 2 1

(NOTE: If there are two or more processes whose request can be fulfilled at a time, give preference to the lower indexed process)

- a) Calculate the Need Matrix and check whether the system is in a safe state. If yes, give atleast one safe sequence. (2)
- b) A new process, P6 comes into the memory and requests 3, 5, 5, 6 instances of A, B, C, D respectively. Can the request of P6 be fulfilled? Justify your answer with proper reasoning. (2)
- c) In the context of semaphores, what is the difference between a counting semaphore and a binary semaphore? Give one use-case for each. (2)

OR

How does resource preemption help break a deadlock? Mention one advantage and one drawback of this. (2)

Ques 3. Answer the following questions: (CO4) (8)

- a) A system uses single-level paging with 32-bit logical addresses and a page size of 4 KB. The page table entry size is 4B. Calculate: (2)
 - i. Number of bits in the page offset
 - ii. Number of bits in the page number
 - iii. Number of pages in the logical address space
 - iv. Total size of the page table
- b) A process has the following page table. Page Size is 4 KB (2)

Page No.	Frame No.
P0	F9
P1	F3
P2	F7
P3	F11
P4	F5
P5	F12

Calculate the Physical Address for the following logical addresses:

1) (3, 1220)

2) (1, 1001)

(HINT: Physical Address = (Frame Number × Page Size) + offset)

c) Consider the following data values: (2)

TLB lookup time = 10 ns

Main Memory access time = 800 ns

Secondary Memory access time = 2500 ns

TLB hit ratio = 0.70, Main Memory Hit Ratio = 0.20.

Calculate the Effective Memory Access Time (EMAT) for a process. If the main memory hit ratio becomes 0.30, what would be the new EMAT?

d) Explain why paging eliminates external fragmentation but still causes internal fragmentation with an example. (2)

Ques 4. Answer the following questions: (CO 3, CO 4)

a) Consider the following sequence of page numbers requested by a process. Using LRU with 3 pages, calculate the total page faults. What are the final pages in the memory block? (2)

4, 1, 2, 4, 3, 2, 5, 1, 2, 6, 4, 3, 2, 1, 7, 5, 4, 2, 3, 1

b) Using the Optimal page replacement algorithm with 3 page frames, compute the total number of page faults for the following reference string. What are the final pages in the memory block? (2)

1, 2, 3, 4, 1, 2, 3, 4, 1, 2, 3, 4, 1, 2, 3, 4, 1, 2, 3, 4, 1

Ques 5. Short answer questions. Answer any SIX: (CO4, CO5) (6)

- a) Mention one condition that increases the chance of a deadlock forming in a system.
- b) State one situation in which a semaphore forces a process to wait.
- c) Identify one real-world scenario that behaves like a counting semaphore.
- d) Name one piece of information commonly stored in a file's metadata/inode.
- e) Mention one benefit of using a hierarchical directory structure.
- f) State one reason why page replacement algorithms are a necessity.
- g) Mention one reason why operating systems apply authentication before granting user access.
- h) Name one type of file commonly supported in Linux systems.

