

**2025**

**COMPUTER SCIENCE — MINOR**

**Paper : MN-4**

**(Operating System)**

**Full Marks : 75**

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

1. Answer **any five** questions :

2×5

- (a) What is the role of system calls in an operating system? Give two examples.
- (b) Differentiate between multiprocessing and multiprogramming.
- (c) What is internal fragmentation? How does it differ from external fragmentation?
- (d) Define medium-term scheduler. What is its role in process management?
- (e) Explain the concept of demand paging.
- (f) Distinguish between logical address and physical address with an example.
- (g) What are the key components of a Process Control Block (PCB)?
- (h) Name two preemptive and two non-preemptive scheduling algorithms.

**Section - A**

Answer **any three** questions.

2. Draw and explain the process state transition diagram, including all possible states and transitions. 5

3. A system uses 2 KB page size and has 8 KB of main memory. Given the reference string :

1, 3, 0, 2, 5, 6, 2, 3, 7, 1, 4

If the FIFO page replacement algorithm is used, determine which pages remain in memory at the end and calculate the number of page faults. 5

4. What are the four necessary conditions for deadlock? How does the 'circular wait' condition contribute to deadlock? Also, differentiate between deadlock prevention and deadlock avoidance. 3+2

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5. Consider the following segment table :

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580

Compute the physical address for the following logical addresses. Indicate if any result in a segmentation fault :

(i) (0, 430) (ii) (1, 11) (iii) (2, 125) (iv) (3, 420) 5

6. Explain the characteristics of a distributed operating system. Mention two real-world applications. 5

### Section - B

Answer *any five* questions.

7. (a) Define a file. List and explain three basic file operations.  
 (b) What is a binary semaphore? How is it different from a mutex? Explain how semaphores can solve the producer-consumer problem. (2+2)+(3+3)
8. (a) What is a thread? Differentiate between user-level and kernel-level threads.  
 (b) In a system using paging with TLB :  
 (i) Memory access time = 100 ns. What is the effective memory access time without TLB?  
 (ii) If TLB hit ratio = 85%, TLB access time = 10 ns, compute effective memory access time. (2+2)+(2+4)
9. Consider the following set of processes with their arrival times and burst times :

Process ID	Arrival Time	CPU Burst Time
P1	0 ms	4 ms
P2	2 ms	14 ms
P3	6 ms	10 ms
P4	8 ms	8 ms

Perform scheduling using :

- (a) First-Come-First-Serve Algorithm  
 (b) Round Robin Scheduling Algorithm

For each algorithm, draw the Gantt chart, find Average Turn-around Time and find Average Waiting Time. (1+2+2)+(1+2+2)

10. (a) State the task of a dispatcher.
- (b) Consider a memory of total size 1 MB that follows fixed memory partitioning scheme having partitions 150 KB, 252 KB, 330 KB, 170 KB and 122 KB. If sequence requests for blocks of sizes come in order 110 KB, 125 KB, 210 KB and 305 KB, draw the memory allocation diagram and find internal fragmentation for each of the following algorithms :
- (i) First Fit
- (ii) Best Fit
- (iii) Worst Fit. 1+(3+3+3)

11. (a) A system has 5 processes (P0-P4) and 3 resource types (A, B, C). The current allocation and maximum need are as follows :

Allocation			
	A	B	C
P0	0	1	0
P1	2	0	0
P2	3	0	2
P3	2	1	1
P4	0	0	2

Max			
	A	B	C
P0	7	5	3
P1	3	2	2
P2	9	0	2
P3	2	2	2
P4	1	3	3

Available = (3, 3, 2)

- (i) Compute the need matrix
- (ii) Use the Banker's algorithm to determine if the system is in a safe state.
- (b) How does a "wait-for-graph" help in detecting deadlocks in a system with single-instance resources? (2+5)+3
12. A disk has cylinders numbered 0 to 199. The current head position is at cylinder 53 and the previous request was at cylinder 47. The pending requests (in FIFO order) are :
- 98, 183, 37, 122, 14, 124, 65, 67

Calculate total head movement for :

2×5

- (a) FCFS
- (b) SSTF
- (c) SCAN (assume upward direction)
- (d) LOOK
- (e) C-SCAN.

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13. (a) What is the critical section problem? List its three essential requirements. 4+6  
(b) Write the complete Banker's safety algorithm in pseudocode.
14. Write short notes on *any two* of the following : 5×2  
(a) Interprocess Communication (IPC) mechanisms  
(b) Belady's Anomaly  
(c) File allocation methods (contiguous, linked, indexed)  
(d) Real-time scheduling algorithms.
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