OPERATING SYSTEMS
(MCAP 2104)

Time Allotted: 3 hrs **Full Marks: 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
Any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1= 10**

(i) In operating system, each process has its own
(a) address space and global variables (b) open files
(c) pending alarms, signals and signal handlers (d) all of these.

(ii) A computer system has 6 tape drives, with 'n' processes competing for them. Each process may need 3 tape drives. The maximum value of 'n' for which the system is guaranteed to be deadlock free is :
(a) 2 (b) 3 (c) 4 (d) 1.

(iii) The degree of multi-programming is
(a) the number of processes executed per unit time
(b) the number of processes in the ready queue
(c) the number of processes in the I/O queue
(d) the number of processes in memory.

(iv) Each process P_i, i = 0, 1, 2, 3, ……, 9 is coded as follows :

```
while(TRUE)
{
  P(mutex)
  Critical Section
  V(mutex)
}
```

The code for P_{10} is identical except that it uses V(mutex) instead of P(mutex). What is the maximum number of processes that can be inside the critical section at any instance of time (the mutex being initialized to 1)?
(a) 1 (b) 2 (c) 3 (d) none of these.

(v) Semaphore is a/an _____ to solve the critical section problem.
(a) hardware for a system (b) special program for a system
(c) integer variable (d) none of these.

(vi) A file is mapped using
(a) base address of file (b) access control matrix
(c) file name (d) file metadata.

(vii) Consider a system with 80% hit ratio, 50 nanoseconds time to search the associative registers, 750 nanoseconds time to access memory. The effective memory access time (in nanoseconds) is
(a) 800 (b) 950 (c) 1550 (d) 940.

(viii) An edge from process P_i to P_j in a wait for graph indicates that
(a) P_i is waiting for P_j to release a resource that P_i needs
(b) P_j is waiting for P_i to release a resource that P_j needs
(c) P_i is waiting for P_j to leave the system
(d) P_j is waiting for P_i to leave the system.

(ix) Dirty bit is used to show the
(a) page with corrupted data
(b) wrong page in the memory
(c) page that is modified after being loaded in memory
(d) page not in memory.

(x) Trojan-Horse programs
(a) are legitimate programs that allow unauthorized access
(b) are hacker programs that do not show up on the system
(c) usually are immediately discovered
(d) all of these.

Group - B

2. (a) What are the three main purposes of an operating system? Distinguish between the client–server and peer-to-peer models of distributed systems.

(b) What is the main advantage of the layered approach in system design? What are the disadvantages of using the layered approach?

(c) Provide three programming examples in which multithreading provides better performance than a single-threaded solution.

(3 + 2) + (2 + 2) + 3 = 12

3. (a) How can we predict the length of the next CPU burst in case of SJF algorithm?

(b) 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

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

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

(iii) 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 the average turnaround time, if the CPU is left idle for the first 1 unit and then SJF scheduling is used.

(c) What is the advantage of a multilevel queueing system which has different time-quantum at different leves?

2 + 8 + 2 = 12

Group - C

4. (a) What is race condition? Explain with an example.

(b) Describe the classical Dining Philosophers Problem. Write down a solution of it by using semaphore.

4 + 8 = 12

5. (a) Explain the concept of shared memory approach of inter process communication.

(b) Explain the Lamport's bakery algorithm for critical section problem.

(c) Define the synchronization tool Monitor.

3 + 6 + 3 = 12

Group - D

6. (a) How are deadlock prevention strategies different from deadlock avoidance approaches? Explain the necessary conditions for deadlock to occur.

(b) Consider a system with following processes (P_0, P_1, P_2, P_3 and P_4) and resources (A,B,C and D)

	Allocation	Max	Available
	A B C D	*A B C D*	*A B C D*
*P*0	0 0 1 2	0 0 1 2	1 5 2 0
*P*1	1 0 0 0	1 7 5 0	
*P*2	1 3 5 4	2 3 5 6	
*P*3	0 6 3 2	0 6 5 2	
*P*4	0 0 1 4	0 6 5 6	

Answer the following questions using the banker's algorithm:

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

(ii) Is the system in a safe state?

(iii) If a request from process *P*1 arrives for (0, 4, 2, 0), can the request be granted immediately?

(3 + 3) + (3 × 2) = 12

7. (a) Explain the difference between internal and external fragmentation.

(b) Consider a logical address space of 64 pages of 1,024 words each, mapped onto a physical memory of 32 frames.
(i) How many bits are there in the logical address?
(ii) How many bits are there in the physical address?

(c) Consider the following page reference during a given time interval for a memory consisting of 5 frames: y, c, z, c, d, a, y, a, e, a, y, f, d, e using the
(i) FIFO replacement strategy.
(ii) LRU replacement strategy.
Compare the results.

(d) Given a set of holes of memory sizes 700KB, 200KB, 900KB, 600KB and 300KB (in order) and processes of sizes 100KB, 100KB, 400KB, 200KB and 600KB (in order), draw diagrams showing First-Fit and Best-Fit allocation.

2 + 3 + 4 + 3 = 12

Group - E

8. (a) Suppose that a disk drive has 5000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 2150, and the previous request was at cylinder 1805. The queue of pending requests, in FIFO order, is:

2069, 1212, 2296, 2800, 544, 1618, 356, 1523, 4965, 3681

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?

(i) SSTF (ii) SCAN (iii) C-SCAN

(b) Briefly describe indexed file allocation technique. Compare with linked file allocation.

(3 × 2) + 6 = 12

9. (a) Explain the functioning of a DMA transfer with suitable diagram. What are the advantages of using DMA?

(b) What is an Access Control Matrix? What are the differences between implementing an ACM using Access List and Capability List?

(4 + 2) + (2 + 4) = 12