

**OPERATING SYSTEMS
(INFO 3103)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

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

Group - A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) The ready queue is generally stored as a _____
(a) Array (b) Linked List (c) Graph (d) Tree.
- (ii) The fundamental model(s) of IPC is/are
(i) Message Passing (ii) Independent
(iii) Cooperating (iv) Shared memory
(a) i, iii, iv (b) iii, iv (c) i, iv (d) all of them.
- (iii) A process which is copied from main memory to secondary memory on the basis of requirement is known as
(a) Demand Paging (b) Paging
(c) Segmentation (d) Starvation.
- (iv) The valid range for process id is
(a) any positive non-zero integer number (b) any positive non-zero real number
(c) any integer number (d) any real number.
- (v) A critical section is a program segment
(a) which should run in a certain specified amount of time
(b) which avoids deadlocks
(c) where shared resources are accessed
(d) which must be enclosed by a pair of semaphore operations, P and V.
- (vi) What does FAT mean?
(a) File Format Attribute (b) Font Allocation Tree
(c) File Allocation Table (d) Font Attribute Table.
- (vii) The FCFS algorithm is particularly troublesome for _____
(a) time sharing systems (b) multiprogramming systems
(c) multiprocessor systems (d) batch processing systems.

(viii) What should be the output of the following code?

```
int main(){
    int p,q;
    p=fork();
    if(p==0){
        q=fork();
        fork();
    }
    printf("hello world\n");
    return 0;
}
```

- (a) Once hello world will be printed (b) Twice hello world will be printed
(c) 5 times hello world will be printed (d) 8 times hello world will be printed.
- (ix) A multilevel page table is preferred in comparison to a single level page table for translating virtual address to physical address because _____
(a) it reduces the memory access time to read or write a memory location
(b) it helps to reduce the size of page table needed to implement the virtual address space of a process
(c) it is required by the translation lookaside buffer
(d) it helps to reduce the number of page faults in page replacement algorithms.
- (x) The idea of overlays is to _____
(a) data that are needed at any given time
(b) enable a process to be larger than the amount of memory allocated to it
(c) keep in memory only those instructions
(d) all of the mentioned.

Fill in the blanks with the correct word

- (xi) _____ section stores dynamically allocated memory to a process during its run time.
- (xii) A counting semaphore was initialized to 10. Then 6 P (wait) operations and 4 V (signal) operations were completed on this semaphore. The resulting value of the semaphore is _____.
- (xiii) Consider the following page reference string.
1 2 3 4 2 1 5 6 2 1 2 3 7 6 3 2 1 2 3 6
For Optimal page replacement algorithms with 3 frames, the number of page faults is _____.
- (xiv) Thrashing _____ the CPU utilization.
- (xv) When several processes access the same data concurrently and the outcome of the execution depends on the particular order in which the access takes place is called _____.

Group - B

2. (a) "Context switching incurs overhead to the system." - Justify this statement. [[CO3](Evaluate/HOCQ)]
(b) Compare between hard and soft real time operating systems. [[CO1](Analyse/IOCQ)]

- (c) With clear block diagram explain different types of schedulers and their utilities. [[CO3](Understand/LOCQ)]
3 + 3 + 6 = 12
3. (a) "Threads are called Light Weight Process" - Justify. [[CO3](Evaluate/HOCQ)]
 (b) Explain stepwise how RPC works with clear block diagram. [[CO3](Remember/LOCQ)]
 (c) Differentiate between micro and monolithic Kernel. [[CO2](Understand/LOCQ)]
3 + 6 + 3 = 12

Group - C

4. (a) What is convoy effect and when the system experiences it? [[CO3](Analyse/IOCQ)]
 (b) Consider the set of processes with arrival time (in milliseconds), CPU burst time (in milliseconds), and priority (0 is the highest priority) shown below. None of the processes have I/O burst time.

| Process | Arrival time | Burst Time | Priority |
|---------|--------------|------------|----------|
| P1 | 0 | 11 | 2 |
| P2 | 5 | 28 | 0 |
| P3 | 12 | 2 | 3 |
| P4 | 2 | 10 | 1 |
| P5 | 9 | 16 | 4 |

Find out the average waiting time (in milliseconds) of all the processes using pre-emptive priority scheduling algorithm. [[CO3](Apply/IOCQ)]

- (c) Design a solution for readers-writers problem using semaphore. [[CO3](Apply/IOCQ)]
2 + 5 + 5 = 12

5. (a) Consider the following system state. There are three resources and three processes.

| | | | | | |
|------------|----|----|------------|----|----|
| Resources: | | | Available: | | |
| R1 | R2 | R3 | R1 | R2 | R3 |
| 4 | 2 | 5 | 2 | 1 | 2 |

Claim matrix:

| | | | |
|----|----|----|----|
| | R1 | R2 | R3 |
| P1 | 2 | 1 | 2 |
| P2 | 3 | 2 | 4 |
| P3 | 4 | 2 | 1 |

Allocation matrix:

| | | | |
|----|----|----|----|
| | R1 | R2 | R3 |
| P1 | 1 | 0 | 1 |
| P2 | 0 | 0 | 1 |
| P3 | 1 | 1 | 1 |

The system is safe. What is the safe sequence? Consider each of the following requests and say if they can be granted.

- (i) P3 requests 1 0 0
- (ii) P2 requests 2 0 0
- (iii) P1 requests 0 1 0
- (iv) P2 requests 1 0 1.

[[CO3](Analyse/IOCQ)]

- (b) “Deadlock avoidance is better than deadlock prevention” - Justify this statement. [[CO3] (Evaluate/HOCQ)]
(1 + 8) + 3 = 12

Group - D

6. Compare efficiencies of FCFS, SSTF, SCAN, C-SCAN, LOOK and C-LOOK algorithms while the read write head is positioned at cylinder 93 initially on a hard disk having 300 cylinders and the requests are subsequently made from the cylinders 128, 134, 87, 225, 35, 50, 11, 68, 154, 230, 117. [[CO4](Analyse/IOCQ)]
12
7. (a) Consider the following page requests that arrived in a system driven with FIFO page replacement algorithm.
 1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5
 Compare the performance of FIFO algorithm with 3 page frames and 4 page frames respectively. Can you figure out any anomaly in the result? Discuss. [[CO4](Analyse/IOCQ)]
- (b) What are the different fragmentations? How can they be solved? [[CO4](Remember/LOCQ)]
(3 + 3 + 2) + 4 = 12

Group - E

8. (a) Compare between Memory Mapped IO and IO Mapped IO. [[CO5](Analyse/IOCQ)]
 (b) What is DMA? Explain with block diagram how it works? Explain different mode of operation of DMA? [[CO5] (Remember/LOCQ)]
3 + (2 + 3 + 4) = 12
9. (a) Describe PC bus structure with proper diagram. [[CO5](Remember/LOCQ)]
 (b) What is OTP? How it enhances security? [[CO6](Remember/LOCQ)]
 (c) Distinguish between the blocking and non-blocking IO. [[CO5](Remember/LOCQ)]
4 + (2 + 3) + 3 = 12

| Cognition Level | LOCQ | IOCQ | HOCQ |
|-------------------------|-------|-------|------|
| Percentage distribution | 41.67 | 48.96 | 9.37 |

Course Outcome (CO):

After the completion of the course students will be able to

1. Analyze and differentiate between different types of operating systems (namely, batch, multi programmed, time-sharing, real-time, distributed, parallel processing system) based on their application domains and evolution.
2. Demonstrate and describe system operations, internal structure of computer system and operating system.
3. Apply multiprocessing and multithreading architectures enabled with inter-process /thread communication and synchronization to improve the performance of the system.
4. Compare the different levels of memory (Primary memory, cache, virtual memory, secondary storage) and how they are correlated to improve the performance of the system.
5. Demonstrate the operations of IO devices and how they are governed by the operating system
6. Discuss the activity and impact of threat, virus, worm and how the system could be protected from them.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.