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Printed Page:-4 **Subject Code:-BMICSE0303A**
Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)
M.Tech Integrated
SEM: III - THEORY EXAMINATION (2025- 2026)
Subject: Operating Systems

Time: 2 Hours **Max. Marks: 50**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*
1. *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*
2. *Maximum marks for each question are indicated on right -hand side of each question.*
3. *Illustrate your answers with neat sketches wherever necessary.*
4. *Assume suitable data if necessary.*
5. *Preferably, write the answers in sequential order.*
6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION-A 15

1. Attempt all parts:-

1-a. The command in Linux that displays the current working directory is:(CO1,K2) 1

(a) cd
(b) ls
(c) pwd
(d) mkdir

1-b. Choose the CPU scheduling algorithm that yields the lowest average waiting time.(CO2,K2) 1

(a) FCFS
(b) SJF
(c) Round Robin
(d) Priority Scheduling

1-c. The primary purpose of the Banker's Algorithm is(CO3,K3) 1

(a) Preventing deadlocks
(b) Detecting deadlocks
(c) Recovering from deadlocks
(d) Process scheduling

1-d. The allocation strategy that allocates the first available block that fits is:(CO4,K3) 1

(a) Best Fit
(b) Worst Fit
(c) First Fit
(d) Next Fit

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1-e. File systems that use a separate block to store addresses of all data blocks use which allocation strategy?(CO5,K3) 1

(a) Linked
(b) Indexed
(c) Contiguous
(d) Segmented

2. Attempt all parts:-

2.a. Discuss the significance of the ls and ls-l command in Linux.(CO1,K3) 2

2.b. Compare pre-emptive and non-pre-emptive scheduling with an example of each.(CO2,K3) 2

2.c. List types of Semaphore along its definition.(CO3,K3) 2

2.d. Compare fixed partitioning and variable partitioning in memory allocation.(CO4,K3) 2

2.e. Define rotational latency and identify a key factor that influences it.(CO5,K2) 2

SECTION-B 15

3. Attempt all parts:-

3.a. Answer any one of the following:-

3.a.(i) Write a shell script that uses a function to calculate the factorial of a number entered by the user, but only if the number is prime. If the entered number is not prime, display an appropriate message.(CO1,K3) 3

3.a.(ii) Describe the architecture of a multiprocessor operating system. How does it enhance system performance compared to a single-processor system?(CO1,K2) 3

3.b. Answer any one of the following:-

3.b.(i) Use SJF (non-preemptive) to calculate for given process {P1, P2, P3, P4, P5} with their respective Arrival Times (AT) = {3, 1, 4, 0, 2} and Burst Times (BT) = {1, 4, 2, 6, 3}. Calculate for each process: 3
Completion Time
Turnaround Time
Waiting Time
Also calculate:
ATAT (Average Turnaround Time)
AWT (Average Waiting Time)
ACT (Average Completion Time) (CO2,K3)

3.b.(ii) Evaluate the Average turnaround time and Average waiting time using Round Robin scheduling with a time quantum of 3 ms for the following processes: {P1, P2, P3, P4, P5} with AT {0, 2, 4, 6, 8} and BT {7, 3, 5, 6, 2}. (CO2,K3) 3

3.c. Answer any one of the following:-

3.c.(i) Consider a traffic crossing between two roads, one in the east-west direction and the other in the north-south direction. Suppose the crossing is modelled as a shared data structure, and cars are modelled as processes that access the crossing in order to pass through it. Assume that cars only travel straight, without turning left or right. Two or more cars that are allowed to simultaneously pass through the crossing only if they are headed in the same or opposite directions (e.g., a north-bound and south-bound car), but east-west traffic and north-south traffic can never access the 3

crossings simultaneously. Devise a synchronization solution for the cars using semaphores. You should write two procedures east_west() and north_south() to show how cars travelling in the respective direction should behave.(CO3,K4)

3.c.(ii) P1 requests (1,0,2). Verify if request can be safely granted and determine safe/unsafe state. Available: 3, 3, 2 Allocation = [[1, 0, 0], # P0 [2, 2, 2], # P1 [3, 0, 2] # P2]Max = [[7, 5, 3], # P0 [3, 2, 2], # P1 [9, 0, 2] # P2] (CO3,K3) 3

3.d. Answer any <u>one</u> of the following:-

3.d.(i) Discuss the concept of virtual memory and explain how it allows the system to run processes that may not fit entirely into physical memory. What role does demand paging play in virtual memory management? How does demand paging optimize memory usage, and what factors contribute to its performance?(CO4,K3) 3

3.d.(ii) Consider the following reference string: 4 , 3, 2, 1, 4, 3, 5, 4, 3, 2, 1, 5, and a frame size of 3. Calculate the page fault rate using FIFO. Explain your solution step-by-step.(CO4,K3) 3

3.e. Answer any <u>one</u> of the following:-

3.e.(i) Explain shared memory in distributed systems. Then analyze the conditions under which race conditions may occur, and how to prevent them.(CO5,K2) 3

3.e.(ii) Describe virtualization in operating systems with an example.(CO5,K2) 3

<u>SECTION-C</u> 20

4. Answer any <u>one</u> of the following:-

4-a. Write a shell program to exchange the values of two variables (CO1,K2) 4

4-b. Write and explain the Linux commands to: 4
(a) Display the present working directory
(b) Create, view, and navigate directories
(c) Display system information (CO1,K3)

5. Answer any <u>one</u> of the following:-

5-a. Analyze the role of the operating system in process synchronization and communication between processes.(CO2,K2) 4

5-b. Illustrate the structure of a Process Control Block (PCB) and explain how it helps in context switching. (CO2,K2) 4

6. Answer any <u>one</u> of the following:-

6-a. A “barrier” is required for three processes such that each process must wait until all three have reached the barrier, and then all may proceed. A possible implementation uses a shared counter arrived = 0. All processes execute: P(mutex); 4
arrived++;
V(mutex);
while(arrived <3); Identify the major problem with this implementation. (CO3,K3)

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6-b.	Construct a Resource Allocation Graph (RAG) using two processes and two resources, showing at least one request edge and one allocation edge.(CO3,K3)	4

7. Answer any one of the following:-

7-a.	Compare FIFO with other page replacement algorithms (like LRU, LFU, and Optimal). Under what situations would FIFO be more efficient than other algorithms?(CO4,K4)	4
7-b.	A process of 180 KB is allocated to a 200 KB partition. What type of fragmentation occurs and how much?(CO4,K3)	4

8. Answer any one of the following:-

8-a.	"Using the Shortest Seek Time First (SSTF) disk scheduling algorithm, demonstrate the head movement for the following disk I/O request sequence: 40, 10, 22, 75, 95, 130 The disk head initially starts at track number 50. Show each step clearly and compute the total head movement."(CO5,K3)	4
8-b.	Illustrate how shared memory facilitates inter-process communication and compare it with message passing in terms of speed and complexity. (CO5,K2)	4