POSSESSION OF MOBILES IN EXAM IS UFM PRACTICE.

Name _____ **Enrollment No.** _____

Jaypee Institute of Information Technology, Noida
T2 Examination, 2024
B.Tech, 5th Semester

Course Title: Operating System and Systems Programming **Maximum Time: 1 Hr**
Course Code: 15B11CI412 **Maximum Marks: 20**

CO1	Explain the fundamental concepts along with the various components of operating system and systems programming.
CO2	Demonstrate various OS scheduling techniques and algorithms for processes and threads.
CO3	Build and apply the various resource management techniques of operating systems and their performance.
CO4	Apply the concept of IPC and describe various process synchronization techniques in OS.
CO5	Compare various disk scheduling algorithms and utilize IO management techniques.
CO6	Choose the appropriate OS design choices when building real-world systems.

Note: Attempt all the questions.

Q1) [CO3(Apply), 5M] A computer system uses a **36-bit physical** address space and pages that are **8 KB** each to store data. Every entry in the page table contains a frame number along with valid/invalid bit (1 bit), reference bit (1 bit), and read/write bit (1 bit).

i) What is the length of the virtual address space (in bytes) that the system can handle if the maximum size of the process page table is **32 GB**?

ii) What is the effective memory access time if the TLB access time is **20 nanoseconds** and memory access time is **100 nanoseconds**? Assume a TLB hit ratio of **95%**.

Q2) [CO3(Apply), 3M] The system uses **'Best-fit'** policy for memory management.

Request Number	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**
Request Size	2K	14K	3K	6K	6K	10K	7K	20K
Usage Time	4	10	2	8	4	1	8	6

Given the following details about the processes in the system, calculate the time at which **P7** completes execution.

Q3) [CO3(Apply), 4M] Consider the following snapshot of a system in which 4 resources X, Y, Z, and W are available. The system contains a total of 3 instances of X, 6 of resource Y, 4 of resource Z, and 3 of resource W.

	Allocation				**MAX**			
	X	**Y**	**Z**	**W**	**X**	**Y**	**Z**	**W**
P0	2	1	1	1	3	2	2	2
P1	1	2	0	1	2	3	2	2
P2	0	1	2	0	1	2	3	1
P3	1	0	1	2	2	1	2	2
P4	0	1	1	1	2	3	2	2

i) What is the content of the **Need Matrix**?

ii) Is the system in a **safe state**? If the system is safe, show how all the processes can complete their execution successfully. If it is unsafe, explain how a **deadlock** might occur.

iii) If a request from **P3** arrives for **(1, 1, 1, 0)**, can the request be granted immediately? Explain your answer and provide the sequence of steps.

Q4) [CO4(Apply), 3M] Consider three concurrently executing threads in the same process using two semaphores, **s1** and **s2**. Assume **s1** has been initialized to **1**, while **s2** has been initialized to **0**. What are the possible values of the global variable **y**, initialized to **5**, after all three threads have terminated?

/* thread A */ P(&s2); P(&s1); y = y + 4; V(&s1);

/* thread B */ P(&s1); y = y - 2; V(&s1);

/* thread C */ P(&s1); y = y * 3; V(&s2); V(&s1);

Describe the role of semaphores in this scenario and how they affect synchronization between the threads.

Q5) [CO4(Apply), 5M] Suppose there are **3 parallel running processes**: **P1, P2, and P3**. They all share a variable **Z**. Read-write operations are performed on **Z** as follows:

P1	P2	P3
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Z = Z + 30	Z = Z - 40	Z = Z + 20
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i) The processes are executed on a uniprocessor system running a time-shared operating system. If the minimum and maximum possible values of **Z** after the three processes have completed execution are **A** and **B** respectively, and if **Z** is initialized to **200**, then what is the value of **B - A** ?

ii) Suppose the processing environment is a multiprocessing system. Write a semaphore solution **(in pseudo code)** to ensure the execution order **P2, P1,** and **P3**. Define the appropriate variables and initialize them.