Jaypee Institute of Information Technology, Noida
T2 Examination 2022
Semester – 5th

Course Title: Operating System and Systems Programming **Max. Hours: 1Hr**
Course Code: 15B11CI412 **Max. Marks: 20**

After pursuing this course, the students will be able to:

C311.1 Describe and explain the fundamental components of operating systems and system programming.
C311.2 Apply and compare various policies of scheduling in processes and threads in OS.
C311.3 Describe and discuss various resource management techniques of operating systems and compare their performances.
C311.4 Understand the concept of IPC and describe various process synchronization techniques in OS.
C311.5 Discuss the working of IO management and apply various disk scheduling techniques.
C311.6 Analyse and report appropriate OS design choices when building real-world systems.

1. Suppose there are 3 parallel running processes. They all share a variable D. Read-write operation are performed on D. **[5 Marks] [CO-4]**

P1	P2	P3
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------	------	------
D=D +20	D=D - 50	D=D +10
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a. The processes are executed on a uniprocessor system running in time-shared operating system. If the minimum and maximum possible values of D after the three processes have completed execution are X and Y respectively, then the value of Y - X is _____. Write process execution order to calculate X and Y.(Initialize **D =100)**

b. Let the processing environment is multiprocessing then write a semaphore solution (pseudo code) to ensure the execution order P2, P1, and P3. Take the appropriate variable and initialized.

2. Consider the following snapshot of a system in which four resources *A*, *B*, *C*, and *D* are available. The system contains a total of 1 instance of *A*, 5 of resource *B*, 2 of resource *C*, and 2 of resource *D*.**[5 Marks] [CO-2]**

	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P_0	0	0	1	1	0	0	1	1	1	5	2	2
P_1	1	0	0	1	1	7	5	1				
P_2	1	3	5	1	2	3	5	2				
P_3	0	5	3	1	1	6	5	2				
P_4	0	0	1	1	5	6	5	1				

Answer the following question using Banker's algorithm.

1. What is the content of the need matrix?
2. Is the system in a safe state? If the system is safe, show how all the process could complete them execution successfully. If the system is unsafe, show how deadlock might occur. Explain.
3. If a request from P_1 arrives for (0,3,2,1), can the request be granted immediately? If yes or no write the sequence of step.

3. Consider the following scenario:**[2 Marks] [CO-2]**
Suppose there are four processes, P1, P2, P3 and P4 and three resources R1, R2 and R3.
   - P1 is requesting R3 and holding R1.
   - P2 is requesting R1 and holding R2.
   - P3 is requesting R2 and holding none.
   - P4 is requesting R2 and holding R3

   a. Construct Resource allocation graph (RAG) for the above scenario.
   b. Find out whether the given scenario is in deadlock or not?

4. A computer system uses 42-bit physical address space and pages that are 16 KB each to store data. Every entry in the page table has a page number along with valid or invalid (1 bit), dirty (2 bits), and read/write (1 bit). Answer the following questions: **[4Marks] [CO-3]**
   1. What is the length of the virtual address space (in bytes) that the system may handle if the maximum size of the process page table is 64 GB?
   2. What is the size of an inverted page table? (Assuming 30 bits for a process ID).
   3. What is the effective memory access time if TLB access time is 35 milliseconds and memory access time is 150 milliseconds (Assuming all pages are in TLB)?

5. Consider the following scenario. Counseling is being conducted in LT 2 of the JIIT Campus for the CSE branch (assuming that enough seats are available). LT 2 can hold N candidates. The number of candidates who wish to get admission are waiting in LT 3 having a seating capacity larger than N. The counseling being conducted in the following manner. Whenever the JIIT authority is ready for counselling, it opens the front door of LT 2 and waits for the candidates to fills completely. Once the candidate finishes with counselling, the backdoor of LT 2 is opened and the candidates are let out. Once all the candidate residing in LT 2 have exited, another batch of N candidate is admitted again through the front door. This process continues indefinitely.
We model the available branch seats and the JIIT as threads in a multithreaded program. The threads must be synchronized as follows. A candidate cannot allow for the counselling until the JIIT authority has opened its front door of LT 2. The JIIT cannot start the counselling service until N candidates have come in., The candidates cannot exit until the back door is open. The JIIT cannot close the backdoor and prepare for the next batch until all the candidates of the previous batch have left.
Note: You can only use the following variables and functions in your solution.
semaphore variables: mutex_enter, mutex_exit, enter_candidate, exit_candidate, enter_LT2, exit_LT2.
Counter variables: count_enter, count_exit.
[4 Marks] [CO-4]

CODE-1: Unsynchronized code for LT2:

```
OpenFrontDoor()
CloseFrontDoor()
Conduct_counselling()
OpenBackDoor()
CloseBackDoor()
```

CODE-2: Unsynchronized code for Choice Filling:

```
Computer_Allocation()
Choice_Filling()
Computer_Deallocation()
```

Solve the following :

a. Modify the CODE-1 for complete synchronization for LT-2.
b. Modify the CODE-2 for complete synchronized code for choice filling.