Course Code : CST 255 / CCT 205 / CDT 207 **QVRU/RS – 22 / 1160**

Fourth Semester B. Tech. (Computer Science and Engineering / Cyber Security / Data Science) Examination

OPERATING SYSTEMS

Time : 3 Hours] [Max. Marks : 60

Instructions to Candidates :—

(1) All questions are compulsory.
(2) Due credit will be given to neatness.
(3) Use appropriate diagrams and sketches wherever necessary.

1. (a) What are privileged instructions ? Assume the system is in user mode at t_0 and a privileged instruction is to be executed by the user program at time t_1, list the steps that need to be taken by the system. 5 (CO 1)

(b) How do clustered systems differ from multiprocessor systems ? What is required for two machines belonging to a cluster to cooperate to provide a highly available service ? 5 (CO 1)

2. (a) Eight processes arrive at time 0 (zero) and with bursts time as shown below (in milliseconds) :—

Process	CPU Burst Time	Process	CPU Burst Time
P1	16	P5	13
P2	20	P6	5
P3	10	P7	18
P4	4	P8	14

The scheduler has prior knowledge about the length of the CPU bursts and it decides the sequence of execution of processes at time t0 in the increasing order of process number. Time quantum : 10 milliseconds :

(i) Draw the Gantt chart for these eight processes using Round-Robin scheduler.

(ii) What is the average waiting time and average turnaround time (in milliseconds) for these eight processes ?

(iii) What are the throughputs at time 50 milliseconds and 90 milliseconds ?
6 (CO 2)

(b) What are the major 4 differences between a thread and a process ?
4 (CO 2)

3. (a) Observe the given pseudocode for Lock implementation.

```
AcquireLock(L)  {
while  (Fetch_And_Add(L,  1))
        L = 1 ;
}
ReleaseLock(L)  {
        L = 0 ;
}
```

Fetch_And_Add(X, i) is an atomic Read - Modify - Write instruction that reads the value of memory location X, increments it by the value 1 and returns the old value of X. It is used in the pseudo - code to implement a busy - wait lock. L is an unsigned integer shared variable initialized to 0. The value of 0 corresponds to the lock being available, while any non - zero value corresponds to the lock being not available.

Assertion **:** Above implementation fails as L can take on a non - zero value when the lock is actually available.

Identify a sequence of scenes (executions) to prove the above assertion.
6 (CO 3)

(b) In order to avoid deadlocks in semaphore, the Wait and Signal operations are required to be executed in the correct order. Justify the given statement with sample pseudo - code. 4 (CO 3)

4. (a) How does deadlock avoidance differ from deadlock prevention ? Write about the deadlock avoidance algorithm in detail. 5 (CO 3)

(b) Consider the following snapshot of the system at time t_0 :—

	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	2	0	0	1	4	2	1	2	3	3	2	1
P1	3	1	2	1	5	2	5	2				
P2	2	1	0	3	2	3	1	6				
P3	1	3	1	2	1	4	2	4				
P4	1	4	3	2	3	6	6	5				

Answer the following questions using the Bankers algorithm :—

(i) Illustrate that the system is in safe state by showing an order in which the processes may complete.

(ii) At time t_1, if a request from process P1 arrives for (1, 1, 0, 0). Can the request be granted immediately ? If yes, give safe sequence. 5 (CO 3)

5. (a) Let us assume the jobs and their memory requirements as follows :—

JOB	Memory Requirements
Job 1	90K
Job 2	20K
Job 3	50K
Job 4	200K

Let the free space memory allocation blocks (in Kilobytes) be of : 90, 50, 50, 200, 100 (in order).

Which memory allocation algorithm will result in minimum external fragmentation ? 4 (CO 4)

(b) A process has 7 logical pages and references them in the given order :

6, 1, 2, 3, 6, 4, 1, 2, 7, 6, 5, 1, 2, 7, 6, 3, 7, 4, 5, 7.

Find the number of page faults (including initial page faults) for the following page replacement algorithms for 3 frames and 4 frames respectively using FIFO, LRU and Optimal Page Replacement strategy. 6 (CO 4)

6. (a) The space of the deleted files should be used for the allocation of the new file as the memory space in the disk is limited. Explain various space management methods to achieve this reuse. 5 (CO 4)

(b) Suppose that the head of a moving-head disk with 200 tracks, numbered from 0 to 199, is currently serving the request at track 55 and has just finished a request at track 71. The queue of requests is kept in the FIFO order :

76, 155, 197, 23, 27, 145, 117, 28, 112, 111

What is the total number of tracks traversed by the head, needed to satisfy these requests for the following disk scheduling algorithms :—

(i) FCFS

(ii) SSTF

(iii) C-SCAN

Show the head movement and compute stepwise total number of tracks traversed by head. 5 (CO 4)