National Institute of Technology, Kurukshetra
B.Tech (Computer Engineering) IV Semester
End Sem Exam-May 2025
Operating Systems:ITPC-200(IT), AIPC-200(AI&ML), CSPC-200(M&C)

Time: 3 Hrs M.M: 50

Instructions: Attempt any five questions.

1. a) What are the differences between symmetric and asymmetric multiprocessor system? Discuss the factors that effects the multiprocessor scheduling. (6)

   b) Describe with an example how CPU-bound and I/O-bound processes are managed by different schedulers. (4)

2. a) How does the wait() system call help in process termination. (4)

   b) Consider three processes, all arriving at time zero, with total execution time of 10, 20 and 30 units, respectively. Each process spends the first 20% of execution time doing I/O, the next 70% of time doing CPU computation, and the last 10% of time doing I/O again. The operating system uses a shortest remaining compute time first scheduling algorithm and schedules a new process either when the running process gets blocked on I/O or when the running process finishes its compute burst. Assume that all I/O operations can be overlapped as much as possible.

   i)What is the scheduling sequence. (6)

   ii)For what percentage of time does the CPU remain idle?

3. a) Consider two processes, P1 and P2, where p1 = 50, t1 = 25, p2 = 75, and t2 = 30. Can these two processes be scheduled using rate-monotonic scheduling? Illustrate your answer using a Gantt chart. Illustrate the scheduling of these two processes using earliest deadline-first (EDF) scheduling. (4)

   b) A shared variable x, initialized to zero, is operated on by four concurrent processes W, X, Y, Z as follows. Semaphore S is initialized to two. What is the maximum possible value of x after all process's complete execution? (6)

Process W	Process X	Process Y	Process Z
Wait (S)	Wait (S)	Wait (S)	Wait (S)
Read (x)	Read (x)	Read (x)	Read (x)
x = x + 1;	x = x + 1;	x = x - 2;	x = x - 2;
Write (x)	Write (x)	Write (x)	Write (x)
Signal (S)	Signal (S)	Signal (S)	Signal (S)

4. a) A system has four processes and five allocatable resources. The current allocation and maximum needs are as follows:

	Allocated	Maximum	Available
Process A	1 0 2 1 1	1 1 2 1 2	0 0 x 1 1
Process B	2 0 1 1 0	2 2 2 1 0	
Process C	1 1 0 1 0	2 1 3 1 0	
Process D	1 1 1 1 0	1 1 2 2 1	

What is the smallest value of x for which this is a safe state? (6)

b) Analyze the dining philosophers problem. Show how semaphores help prevent deadlock and starvation. (4)

5. a) Discuss the working set model and the Page Fault Frequency (PFF) strategy to control thrashing. (5)

b) A certain computer system has the segmented paging architecture for virtual memory. The memory is byte addressable. Both virtual and physical address spaces contain 2^{16} bytes each. The virtual address space is divided into 8 non-overlapping equal size segments. The memory management unit (MMU) has a hardware segment table, each entry of which contains the physical address of the page table for the segment. Page tables are stored in the main memory and consists of 2 byte page table entries. What is the minimum page size in bytes so that the page table for a segment requires at most one page to store it? (5)

6. a) A demand paging system takes 100 time units to service page fault and 300 time units to replace a dirty page. Memory access time is 1 time unit. The probability of a page fault is p. In case of page fault, the probability of page being dirty is also p. It is observed that the average access time is 3 time units. Then what is the value of p? (5)

b) *Consider a disk system with 100 cylinders. The requests to access the cylinders occur in following sequence: 4, 34, 10, 7, 19, 73, 2, 15, 6, 20. Assuming that the head is currently at cylinder 50, what is the time taken to satisfy all requests if it takes 1ms to move from one cylinder to adjacent one and shortest seek time first policy is used?* (5)