

Note: Attempt any five questions selecting at least one question from each section.

Section A

- Q1. a) What are the key differences between batch processing and time sharing systems? (5)
 b) Why long term scheduler make a careful selection in terms of I/O bound and CPU bound processes? (5)
- Q2. a) Consider the set of processes with arrival time (in milliseconds), CPU burst time (in milliseconds), and priority (0 is the highest priority) shown below. Calculate the average waiting time for the instance of the problem using preemptive and non preemptive priority scheduling algorithm: (4)

Arrival time	0	5	12	2	9
CPU cycles	11	28	2	10	16
Priority	2	0	3	1	4

- b) Which job scheduling policy is starvation free? (2)
- c) Consider two processes P_1 and P_2 , where $p_1 = 50$, $t_1 = 25$, $p_2 = 75$, and $t_2 = 30$. Illustrate the scheduling of these two processes using earliest deadline-first (EDF) scheduling. (4)

Section B

- Q3. a) The following program consists of 3 concurrent processes and 3 binary semaphores. The semaphores are initialized as $S_0=1$, $S_1=0$, $S_2=0$. How many times will process P_0 print '0'? (5)

Process P_0	Process P_1	Process P_2
while (true) { wait (S_0); print (0); release (S_1); release (S_2); }	wait (S_1); Release (S_0);	wait (S_2); release (S_0);

- b) Write the solution using semaphore for the bounded buffer producer consumer synchronization problem. (5)

- Q4. a) Consider the following snapshot of a system:

	Allocation	Max	Available
	A B C D	A B C D	A B C D
P_0	0 0 1 2	0 0 1 2	6 7 12 12
P_1	2 0 0 0	2 7 5 0	
P_2	0 0 3 4	6 6 5 6	
P_3	2 3 5 4	4 3 5 6	
P_4	0 3 3 2	0 6 5 2	

Answer the following questions using the banker's algorithm:

- i. Illustrate that the system is in a safe state by demonstrating an order in which the processes may complete.
- ii. If a request from process P_3 arrives for $(0, 1, 0, 0)$, will it be correct to grant the request immediately? (6)
- b) Consider a system with 3 processes that share 4 instances of the same resource type. Each process can request a maximum of K instances. Resource instances can be requested and released only one at a time. What is the largest value of K that will always avoid deadlock? (4)

Section C

- Q5 a) Consider a process executing on an operating system that uses demand paging. The average time for a memory access in the system is M units if the corresponding memory page is available in memory and D units if the memory access causes a page fault. It has been experimentally measured that the average time taken for a memory access in the process is X units. What is the page fault rate experienced by the process? (5)
- b) What is the cause of thrashing? How does the system detect thrashing? Once it detects thrashing, what can the system do to eliminate this problem? (5)
- Q6. a) A computer has 32 bit virtual address space and 1024 byte page. A page table entry takes 4 bytes. A multilevel page table is used because each table must be contained with a page. How many levels are required? (4)
- b) Explain the linked list method of free space management? What are its pros and cons? How this can be improved further. (6)

Section D

- Q7 a) Assume that a main memory with only 4 pages, each of 16 bytes, is initially empty. The CPU generates the sequence of virtual addresses: 0, 4, 8, 20, 24, 36, 44, 12, 68, 72, 80, 84, 28, 32, 88, 92. How many page faults does this sequence cause if it uses Optimal, Least Recently Used (LRU) page replacement policy? What are the pages numbers of the pages present in the main memory at the end of the sequence? (5)
- b) Why is the average search time to find a record in a file less for an indexed sequential file than for a sequential file? (5)
- Q8. a) Consider the disk drive with 4000 cylinders from 0-3999 with following sequence of disk tracks requests 86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130. Assume that initially the head is at track 143 and previous request was served at 352. Compute the no. of tracks the head traverses using SSTF and elevator algorithms. (6)
- b) What are the advantages of using multithreading instead of multiple processes? (4)