Qn. Set Code-1

Semester: 4th
Programme: B.Tech
Branch: CSE, IT, CSCE, CSSE

SPRING END SEMESTER EXAMINATION-2023

4th Semester B.Tech

OPERATING SYSTEMS

CS 2002

(For 2022 (L.E), 2021 & Previous Admitted Batches)

Time: 3 Hours Full Marks: 50

Answer any SIX questions.
Question paper consists of four SECTIONS i.e. A, B, C and D.
Section A is compulsory.
Attempt minimum one question each from Sections B, C, D.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

SECTION-A

1. Answer the following questions. [1 × 10]

(a) *The Shortest Job First (SJF) process scheduling algorithm leads to the problem of starvation.* Discuss some of the ways to resolve this issue.

(b) There are some similarities between Semaphores and condition variables (of Monitor). What are the major differences between semaphores and condition variables?

(c) Explain the difference between the logical/virtual and physical address. What are the benefits of virtual memory?

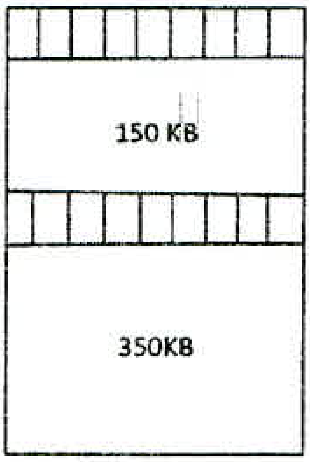
(d) The code for three concurrent processes P0, P1 and P2 is as follows.

Process P0	Process P1	Process P2

while (1)
{
P (S0);
print '0';
P (S1);
P (S2);
}
	V(S0);
	V(S1);
		V(S0);
		V(S2);

The binary semaphores S0, S1, and S2 in the above code are initialized to 1, 0, and 0 respectively. What is the maximum number of ***0s*** to be printed? Justify.

(e) If the memory requests from processes are in the order: 300K, 25K, 125K and 50K and the current memory availability is as shown below:



Then which approach, between "first fit" and "best fit", can satisfy all the above memory requests in dynamic partition memory allocation?

(f) Consider a process of size 13KB and page of size 4KB. How many pages will this process need? Calculate the % of unused space after allocation of the pages.

(g) A Resource Allocation Graph (RAG) contains a directed cycle. Then, under what circumstances is there a possibility of deadlock?

(h) When a detection algorithm determines a deadlock has occurred? What are some ways to recover the system from this deadlock?

(i) *Rotational latency = 0.5 X time to take one rotation-* true or false? – Justify your answer.

(j) Let a Hard Disk has 6 surfaces, each surface has 8 tracks, and each track has 16 sectors per track.

Find the Cylinder, head, and sector address of the logical block address 610.

SECTION-B

2. (a) Write the pseudo code for Peterson solution to the critical section problem. Explain the correctness of the solution which satisfies the 3 conditions for critical section problem. [4]

(b) [4]

Available			
R1	R2	R3	R4
2	1	0	0

	Current Allocation					Maximum Demand			
Process	R1	R2	R3	R4		R1	R2	R3	R4
P1	0	0	1	2		0	0	1	2
P2	2	0	0	0		2	7	5	0
P3	0	0	3	4		6	6	5	6
P4	2	3	5	4		4	3	5	6
P5	0	3	3	2		0	6	5	2

Consider the above snapshot of a system. There are no current outstanding queued unsatisfied requests.

i. Is this system currently in safe or unsafe state? Justify.

ii. If safe, then write the safe sequence. If unsafe, mention the processes in unsafe state.

iii. If a request from P3 arrives for (0,1,0,0), can the request be safely granted? In what state (deadlock, safe, unsafe) would immediately granting that whole request leave the system? Which processes (if any), are or may become deadlocked if this whole request is granted immediately?

3. (a) [4]

Process	Arrival Time	Execution Time
P1	0	12
P2	5	19
P3	8	21
P4	11	13

The above Table gives the snapshot of the processes in the system with arrival time and execution time in milliseconds. Draw a Gantt chart showing the scheduling of the processes using Round Robin scheduling algorithm. Find the waiting time of each of the processes. Calculate the average waiting time for all processes. (Given time quantum = 3 milliseconds)

(b) Explain the various stages of Process State Transition with a neat diagram. [4]

SECTION-C

4. (a) Consider the following page reference string: [4]

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

How many page faults would occur for the following page fault algorithms, assuming 3 and 4 available frames? Initially all the frames are empty.

i. Optimal replacement

ii. LRU replacement

(b) Implement Reader-Writer problem with reader dominance using Semaphore and Monitor. (Write the Pseudocode) [4]

5. (a) A system has three processes (P1,P2,P3) and three resource types (R1,R2,R3). There are two instances of R1 and R2 and one instance of R3. P1 holds one instance of R1 and is requesting one instance of R2. P2 holds one instance of R1 and one instance of R2 is requesting for one instance of R3. P3 holds one instance of R2 and one instance of R3 and is requesting one instance of R1. Draw the resource allocation graph for this situation. Does deadlock situation exist? Prove your answer using Banker's Algorithm. [4]

(b) Consider a file system with 5 direct disk blocks, 1 single indirect block and 1 double indirect block. Size of disk block in 512 bytes. 4 bytes are required to store one block number. If a process makes a request to access a byte at offset of 10000, find out which index block contain this byte information. [4]

6. (a) What do you mean by multilevel feedback scheduling? Briefly describe its characteristics, features, pros and cons of the scheduling algorithm. Explain the algorithm by using a neat diagram with a suitable example. [4]

(b) There is a memory with four partitions 4K, 8K, 20K, and 2K (in order). Total *eight* processes come at time *0 ms* with different request size and the execution time (ms) as given in the following table. [4]

Process no.	P1	P2	P3	P4	P5	P6	P7	P8
Req. size	2K	14K	3K	6K	6K	10K	7K	4K
Execution time	4	9	2	8	1	6	5	3

Calculate the time at which process P7 will be completed if *Best-Fit* method is used in fixed partition memory allocation. Explain with proper diagram.

SECTION-D

7. (a) Disk requests come into the disk driver for cylinders: 10,22,55,2,28,12,6,40 and 38 in that order. The disk drive has 60 cylinders numbered 0 to 59 and the current head position is 26. A seek takes 6 millisecond / cylinder moved. How much seek time is needed for: [4]

(A) FCFS (B) SSTF
(C) SCAN (D) LOOK

(b) A manufacturer wishes to design a hard disk with a capacity of 2^{10} GB. If the technology used to manufacture the disks allows 1KB sector size, 4K sectors per track, and having 2^{10}platters, then how many cylinders are required in the hard disk? [4]

8. (a) Suppose that pages in a virtual address space are referenced in the order:1 2 4 1 1 5 6 8 1 2 5 3 4 6 7 1 5. There are 3 empty frames available. Show the contents of frames after each memory reference and find the total number of page faults using "FIFO" and [4]

"LFU (Least Frequently Used)" page replacement algorithms. Also write the number of page faults for both the algorithms if the reference string is reversed.

(b) There are two kinds of threads, oxygen (O) and potassium (K). Your goal is to group these threads to form Potassium Oxide (K_2O) molecules. There is a barrier where each thread has to wait until a complete molecule can be formed. Potassium and oxygen threads will be given ***releasePotassium*** and ***releaseOxygen*** methods respectively, which will allow them to pass the barrier. These threads should pass the barrier in groups of three, and they must be able to immediately bond with each other to form a Potassium Oxide molecule. You must guarantee that all the threads from one molecule bond before any other threads from the next molecule do. [4]

In other words:

- If an oxygen thread arrives at the barrier when no potassium threads are present, it has to wait for two potassium threads.
- If a potassium thread arrives at the barrier when no other threads are present, it has to wait for an oxygen thread and another potassium thread.

We don't have to worry about matching the threads up explicitly; that is, the threads do not necessarily know which other threads they are paired up with. The key is just that threads pass the barrier in complete sets; thus, if we examine the sequence of threads that bond and divide them into groups of three, each group should contain one oxygen and two potassium threads.

Write the synchronization code for oxygen and potassium molecules that enforces these constraints.

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