


Final Assessment Test – November 2024

Course: BITE303L - Operating Systems

Class NBR(s): 3319 / 3339 / 3349

Slot: A2+TA2

Max. Marks: 100

Time: Three Hours

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

Answer ALL Questions
 (10 X 10 = 100 Marks)

1. A user program may disrupt the normal operation of the system by issuing illegal I/O instructions, by accessing memory locations within the operating system itself, or by refusing to relinquish the CPU. Analyse and illustrate the use of various mechanisms to ensure that such disruptions cannot take place in the system.
2. The following table gives the arrival times, execution times, and priority for some processes in a real-time system.

PROCESS	ARRIVAL TIME (ms)	EXECUTION TIME (ms)	PRIORITY
P ₁	0	8	2
P ₂	1	4	1
P ₃	3	5	4
P ₄	4	2	2
P ₅	5	1	3

Processes can be scheduled under three scheduling policies:

- a) Shortest job first without preemption
- b) Priority with preemption
- c) Round robin with preemption and a quantum of two-time units is used.

Apply the above scheduling policies and answer the following:

- i) Give the completion order of the processes under each of three scheduling policies with Gantt chart.
- ii) Identify the waiting time of each process under each of three scheduling policies.
- iii) Identify the turnaround time of each process under each of three scheduling policies.
- iv) Identify the average waiting time and average turnaround time. Identify which algorithm is the optimal algorithm.

3. An operating system uses the banker's algorithm for deadlock avoidance when managing the allocation of three resource types X, Y and Z to three processes P0, P1 and P2. The table given below presents the current system state. Here, the Allocation matrix shows the current number of resources of each type allocated to each process and the Max matrix shows the maximum number of resources of each type required by each process during its execution.

Process	Allocation			Max		
	X	Y	Z	X	Y	Z
P0	0	0	1	8	4	3
P1	3	2	0	6	2	0
P2	2	1	1	3	3	3

There are 3 units of type X, 2 units of type Y and 2 units of type Z still available. The system is currently in safe state. Consider the following independent requests for additional resources in the current state-

- REQUEST-1: P0 requests 0 units of X, 0 units of Y and 2 units of Z
- REQUEST-2: P1 requests 2 units of X, 0 units of Y and 0 units of Z

Determine which request can be permitted.

4. a) Construct a Resource Allocation Graph for the following situation: [5]

- The sets of Processes are $P = \{P_1, P_2, P_3\}$
- The set of Resources are $R = \{R_1, R_2, R_3, R_4\}$ with 1 instance for the resource types R_1 and R_3 , 2 instances for the resource type R_2 and 4 instances for the resource type R_4 .
- The sets of Edges are $E = \{P_1 \rightarrow R_1, P_2 \rightarrow R_3, P_3 \rightarrow R_2, R_1 \rightarrow P_2, R_3 \rightarrow P_3, R_2 \rightarrow P_1, R_2 \rightarrow P_2\}$

Determine if the system is in deadlock state or not.

- b) Define critical section problem. Discuss about three requirements that a solution to critical-section problem must satisfy. [5]

5. A data object (such as a file or record) is to be shared among several concurrent processes. Some of these processes may want only to read the content of the shared object, whereas others may want to update (that is, to read and write) the shared object. Apply the semaphore solution to solve the problem. Specify the required data structure and algorithm.

6. A system uses 3-page frames for storing process pages in main memory. Assume that all the page frames are initially empty. Identify the total number of page faults that will occur for the following page replacement policy
- First in First out (FIFO)
 - Least Recently Used (LRU) and
 - Optimal

while processing the page reference string given below-

5, 0, 1, 0, 2, 3, 0, 2, 4, 3, 3, 2, 0, 2, 1, 2, 7, 0, 1, 1, 0

7. Consider six memory partitions of size 200 KB, 400 KB, 600 KB, 500 KB, 300 KB and 250 KB. These partitions need to be allocated to four processes of sizes 357 KB, 210 KB, 468 KB and 491 KB in that order. Perform the allocation of processes using-
- First Fit Algorithm
 - Best Fit Algorithm
 - Worst Fit Algorithm
8. Consider a disk with 200 tracks and the queue has random requests from different processes in the order:

55, 58, 39, 18, 90, 160, 150, 38, 184

Initially arm is at 100. Find the Average Seek time using FIFO, SSTF, SCAN and C-SCAN algorithm.

- 9.a) The direct-access nature of disks allows us flexibility in the implementation of files. In almost every case, many files will be stored on the same disk. The main problem is how to allocate space to these files so that disk space is utilized effectively and files can be accessed quickly. Identify the three major methods of allocating disk space and specify their advantages and disadvantages.

OR

- 9.b) Illustrate how free-space allocation methods influence the efficiency of use of disk space, the performance of the file system, and the reliability of secondary storage.
- 10.a) Concurrent execution of cooperating processes requires mechanisms that allow processes to communicate with one another and to synchronize their actions. Illustrate how cooperating processes can communicate in a shared-memory environment and also via an interprocess communication (IPC) facility.

OR

- 10.b) Identify and illustrate some of the issues to consider with multithreaded programs.

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