Department of Computer Science and Engineering
Final Examination Fall 2023
CSE 321: Operating Systems

B

Duration: 1 Hour 45 Minutes **Total Marks:** 40

Answer the following questions.
Figures in the right margin indicate marks.

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1. CO4 **a)** In an office there are 10 employees. All the computers of the offices are connected to the internet by wired connectivity. But due to the limitation of bandwidth, office authorities allow only 5 devices to be connected with the wifi at the same time. On a particular day, 2 devices are already connected to the wifi and 6 more employees are trying to connect their devices to the wifi at the same time. **Explain** with proper logic, what issue has been raised in the above scenario and what will be the approach to provide proper synchronization to the issue according to the problem statement. [3]

b) For the upcoming PMCO finals team "xyz" has arranged training sessions for players. In a training session a player needs to use a set of headphones and a mobile device together. The team can only facilitate a set of headphones and a mobile device to players for training. In a particular session a 30 mins slot has been allotted for each player. 4 players of the team have arrived for the session and a queue has been fixed based on the ascending order of their arrival times. According to the criteria mentioned above the order of the players in the queue is Action, Top, Icy and Nirzed. But they were called for the training according to the following order: Nirzed, Icy, Top and Action. Therefore, after waiting for a long period Action left the training arena out of annoyance. **Logically explain** what issue has occurred in the above scenario. [2]

c) In a system, following conditions are present.

- There are 3 processes: P1, P2 and P3.
- There is a semaphore, s=2.
- Ready queue is in the following order, [P2, P3, P1].
- CPU allocation is managed by round robin scheduling algorithm with the time quantum of 9 ms.
- Each statement takes 3 ms to execute.
- Critical section contains 2 statements.
- Remainder section contains 3 statements.

The structure of process Pi in solution using Semaphore:

```
wait(s){
   while(s<=0)
     ;//busy wait
   s--;
}

signal(s){
   s++;
}
```

```
do{
   wait(s);
   //critical section
   signal(s);
   //remainder section
}while(true);
```

Complete the table given below for processes P1, P2 and P3 using semaphore. [5]

Process 1	Process 2	Process 3

2. CO4 **a)** We have various ways to overcome deadlock in a system. Among these approaches is the strategy of ignoring it and relying on system restarts to resolve the deadlock. Despite the need for restarting the system, this method remains popular. **Discuss** why this strategy is commonly employed and **mention** the type of system that may utilize this method [3]

b) Suppose, in a workplace, we have a set of resource types, R = {R1, R2, R3, R4} and a set of processes, P = {P1, P2, P3, P4}. **R1, R2, R3, and R4** have **2, 3, 2, and 3** instances respectively.

- P1 is holding 1 instance of R2
- P2 is holding 2 instances of R2
- P3 is holding 1 instance of R1
- P3 requests 1 instance of R2
- P4 holding 2 instances of R4
- P2 holding 1 instance of R1
- P1 requests 1 instance of R1
- P4 requests 1 instance of R3
- P3 holding 1 instance of R3
- P1 holding 1 instance of R3
- P3 holding 1 instance of R4

Construct a resource allocation graph for the above scenario and **identify the cycle (if any) and decide** whether there is a deadlock or not. [4]

3. CO5

a) Arrays are stored in contiguous memory locations to optimize access to array elements, yet allocating processes in contiguous memory locations is discouraged. **Explain** why this is not recommended in terms of space complexity. [3]

b) A system with an associative lookup time of 2ns, and memory access time of 72ns, what should be the approximate hit ratio to achieve Effective Access Time of 95ns? [3]

c) Assume that, page size of a process is **8 bytes** and size of the main memory is **72 bytes**. Logical memory and page table of the process are given below.

Logical Memory

Page #	Data
P0	ij
P1	jk
P2	kl
P3	lm
P4	mn
P5	no

PMT

Page #	Frame #
P0	5
P1	16
P2	7
P3	3
P4	6
P5	12

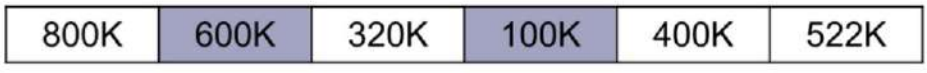
Main memory

i. **How** can the user's view of memory be mapped into the main memory? [1]

ii. **Find out** corresponding physical addresses of the following logical addresses – **25(11001), 37(100101) and 23(10111)** [3]

d) If the page size is **10 KB**, how many frames will be needed in Main memory for a process size of **31,110 Bytes**? Is there any internal fragmentation? - If yes, **calculate** the value. [1 KB = 1024 Bytes] [2]

e) In a particular time, the snapshot of Main memory given below for dynamic partitioning where gray portions of the memory are representing occupied spaces. Apply worst fit and first fit algorithms to place processes with the space requirement of **P1=600k, P2=400k, P3=298k, P4=292k, P5=200k, P6= 100k, P7=44k and P8=58k** (in order). Explain which algorithm makes the most effective use of memory? [5]



4. **a)** Consider a computer with a main memory that has 3 frames and page reference string of 0-7 page **[5, 5, 3, 1, 7, 3, 3, 5, 2, 0]**. The page reference string represents the order in which the pages are accessed by a program. **Apply LRU** & **OPT** algorithm to **simulate** the page replacement that occurs when the main memory can hold at most 3 pages at a time. **Record** the number of **page faults** and compare the result. **Mention** which algorithm performs better in this scenario. [6]

CO5