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

C

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 the research lab of a university there is a high-performing computer which can be used for research works on parallel computing. In a particular semester, four research groups are working on separate projects on parallel computing. One day four groups came together at the lab and were willing to use the high-performing computer at the same time. [3]

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.

b) In a certain match of PMCO two players from team "xyz" Action and Top started a debate over the sniping role of the team. Both of them are good in long range and in the match, Top found out a sniper weapon but he has no scopes. As a result, he is unable to use the sniper for the long range. On the contrary, Action has an 8x scope but he does not have any sniper weapon. Which means he is unable to use the scope. Both of them are willing to play as a sniper and for that Top is demanding the scope from Action and Action is demanding the sniper weapon from Top. But nobody is willing to make the compromise. Therefore, neither of them can play as a sniper. [2]

Logically explain what issue has occurred in the above scenario.

c) In a system, following conditions are present.

- There are 3 processes: P1, P2 and P3.
- There is a mutex lock, available=true.
- Ready queue is in the following order, [P3, P1, P2].
- CPU allocation is managed by round robin scheduling algorithm with the time quantum of 12 ms.
- Each statement takes 4 ms to execute.
- Critical section contains 3 statements.
- Remainder section contains 2 statements.

The structure of process Pi in solution using mutex lock:

```
acquire(){
   while(!available)
      ;//busy wait
   available=false;
}

release(){
   available=true;
}
```

```
do{
   acquire();
   //critical section
   release();
   //remainder section
}while(true);
```

Complete the table given below for processes P1, P2 and P3 using mutex lock. [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, P5}. **R1, R2, R3, and R4** have **3, 2, 4, and 2** instances respectively.

- P1 is holding 2 instances of R1
- P2 is holding 1 instance of R3
- P3 is holding 1 instance of R4
- P5 requests 2 instances of R3
- P4 is holding 1 instance of R4
- P3 requests 1 instance of R2
- P2 requests 1 instance of R1
- P2 is holding 1 instance of R2
- P1 is requesting 1 instance of R4
- P3 is holding 1 instance of R3
- P4 is holding 1 instance of R3
- P5 holding 1 instance of R2

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 5ns, and memory access time of 85ns, what should be the approximate hit ratio to achieve Effective Access Time of 146ns? [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	op
P1	pq
P2	qr
P3	rs
P4	st
P5	tu

PMT

Page #	Frame #
P0	10
P1	2
P2	4
P3	11
P4	8
P5	3

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 – **11(1011), 4(100) and 21(10101)** [3]

d) If the page size is **7 KB**, how many frames will be needed in Main memory for a process size of **93,600 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]

800K	600K	320K	100K	400K	522K

4. CO5 **a)** Consider a computer with a main memory that has 3 frames and page reference string of 0-7 page **[3, 5, 4, 6, 7, 4, 2, 6, 7, 6]**. 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]