



**Mahindra University Hyderabad**  
**École Centrale School of Engineering**  
**Minor-II**  
**Year: 3**

**Program: B. Tech.**

**Semester: 1**

**Subject: Operating Systems (CS/AI3102)**

**Date: 09 Nov 2023**  
**Time Duration: 1.5 hours**

**Start Time: 10:00 AM**  
**Max. Marks: 40**

**Instructions**

1. No marks will be given without proper justifications.
2. Do not use a pencil for writing your answers.

- Q1. a) Define a wait-for graph in the context of deadlock. What property should exist in the wait-for graph for a deadlock to be present? (2+1=3 marks)  
b) State whether the following statement is True or False. Justify your answer. (2 marks)  
"Cycle in resource allocation graph does not always imply the occurrence of deadlock."
- Q2. Consider 4 processes P1, P2, P3 and P4, all arriving in the ready queue in the same order at time 0. The burst time requirements of these processes are 4, 1, 8 and 1 respectively. Then what is the completion time of process P1. Use Round Robin scheduling with Time Quantum=1 unit. (5 marks)
- Q3. Answer the following questions using Banker's Algorithm. (1+2+2=5 marks)  
(i) What is 'Need' Matrix?  
(ii) Is the system in safe state? If yes, what is safe sequence?  
(iii) If a request arrives for (0, 4, 2, 0) from process P1 can the request be granted immediately?

Process	Current Allocation				Maximum Allocation				Available			
Resource	A	B	C	D	A	B	C	D	A	B	C	D
P0	0	0	1	2	0	0	1	2	1	5	2	0
P1	1	0	0	0	1	7	5	0				
P2	1	3	5	4	2	3	5	6				
P3	0	6	3	2	0	6	5	2				
P4	0	0	1	4	0	6	5	6				

Q4. Answer the following:

(5 marks)

- a) Consider the following pseudo code:
- ```
while (1)
{
    while (flag[i]);
    flag[i]=true;
    <CRITICAL SECTION>
    Flag[i]=false;
    <REMAINDER SECTION>
}
```

Which requirements for the critical section are met by the above software solution? Mutual exclusion, progress and bounded wait?

- b) What should be the binary semaphore operations on W, X, Y, Z so that the output string will print always  $01^n0$  or  $10^n1$  where n is odd. [Justify your answer].

(5 marks)

$P_1$   
while (true)  
{  
W: \_\_\_\_\_

print('0')  
print('0')  
X: \_\_\_\_\_  
}

$P_2$   
while (true)  
{  
Y: \_\_\_\_\_

print('1')  
print('1')  
Z: \_\_\_\_\_  
}

Q5. Answer the following questions with respect to threads and synchronization.

- a. What is a thread? How does it differ from a process? (2 marks)
- b. Differentiate between user-level and kernel-level threads? Under what circumstances is one type better than the other? What is the essential cause of the difference in cost between a context switch for kernel-level threads and a switch that occurs between user-level threads? (5 marks)
- c. Explain the wait and signal operations of semaphores with relevant pseudo-codes. Clearly explain how it guarantees- (2×4 =8 marks)
- Mutual exclusion
  - Progress
  - Bounded wait
-