JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATION- April-2023

COURSE CODE(CREDITS-3): 18B11CI411 MAX. MARKS: 25

COURSE NAME: Operating System

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MAX. TIME: 1.5 hrs

Note: *All questions are compulsory. Marks are indicated against each question in square brackets.*

Q1. Consider a system comprised of three processes with the following execution times and periods.

[CO3](1.5x4=06 marks)

Process T1: execution time - t1 = 1, period – T1 = 10

Process T2: execution time - t2 = 1, period – T2 = 2

Process T3: execution time - t3 = 2, period – T3 = 5

(a) Give a rate-monotonic (RMS) schedule i.e. Gantt Chart for the processes.

(b) Can the processes be scheduled in real-time using Rate-Monotonic Scheduling? Justify.

(c) Give an early-deadline-first (EDF) schedule i.e. Gantt Chart for the processes.

(d) Can the processes be scheduled in real-time using Early-Deadline-First Scheduling? Justify.

Q2. The following code shares the two variables (flag and x) among two threads (Thread1 and Thread2). Describe the behavior of multithreaded application with shared data on modern computer architecture.

```
boolean flag = false;
int x = 0;
```

where Thread 1 performs the statements

```
while (!flag)
   ;
print x;
```

and Thread 2 performs

```
x = 100;
flag = true;
```

[CO4] (03 marks)

Q3 A shared variable x, initialized to zero, is operated on by four concurrent processes W, X, Y, Z as follows. Each of the processes W and X reads x from memory, increments by one, stores it to memory, and then terminates. Each of the processes Y and Z reads x from memory, decrements by two, stores it to memory, and then terminates. Each process before reading x invokes the P operation (i.e., wait) on a counting semaphore S and invokes the V operation (i.e., signal) on the semaphore S after storing x to memory. Semaphore S is initialized to two. What is the maximum possible value of x after all processes complete execution? Justify your answer.

[CO4] (03 Marks)

Q4. There are two concurrent processes P and Q that uses binary semaphores S, T and U as follows. W, X, Y can be P(T) or P(U) or P(S) in the Process Q. **[CO4] (2x2 = 04 Marks)**

Process P:	**Process Q:**
P(S)	W:
P(T)	X:
P(U)	Y:
Print 'a'	Print 'a';
Print 'b'	Print 'b';
V(S)	A:
V(T)	B:
V(U)	C:

(a) What should be written at W to avoid deadlock?

(b) What should be written at X and Y for the above problem?

Q5. Two processes, P1 and P2, need to access a critical section of code. Here, wants1 and wants2 are shared variables, which are initialized to false. Consider the following synchronization construct used by the processes:

Find the following and provide appropriate explanation. **[CO4] (1x3=03 marks)**

(a) Mutual Exclusion

(b) Progress

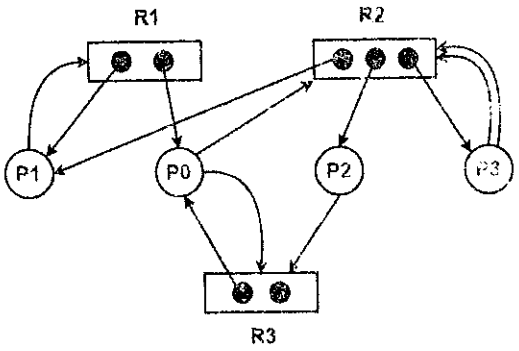
(c) Bounded-wait

Process P1	**Process P2**

`while (true) {`
`wants1 = true;`
`while (wants2 == true);`
`/* Critical Section */`
`wants1 = false;`
`}`
`/* Remainder section */`
	`while (true) {`
	`wants2 = true;`
	`while (wants1 == true);`
	`/* Critical Section */`
	`wants2=false;`
	`}`
	`/* Remainder section */`

Q6 (a) A system is having 3 user processes each requiring 2 units of resource R. What is the maximum number of units of R that ensures a deadlock? What is the minimum number of units of R that ensures no deadlock? **[CO5](02 marks)**

(b) Consider the resource allocation graph in the figure- [CO5] (04 Marks)



Find if the system is in a deadlock state otherwise find a safe sequence.