



NATIONAL INSTITUTE OF TECHNOLOGY GOA

Farmagudi, Ponda, Goa, 403401

Programme Name: B.Tech.

Mid Semester Examinations, October-2021

Course Name: Operating Systems

Course Code: CS300

Date: 4/10/2021

Time: 2:00 – 3:30 PM

Duration: 1 Hour 30 Minutes

Max. Marks: 50

ANSWER ALL QUESTIONS

- Q.1 a.** Differentiate kernel mode and user mode function in context of protection (security) system? How interrupt-driven system operation can be obtained using dual mode operation and system calls? **[04 Marks]**
- b.** A variable $V=0$ is shared by four concurrent processes A, B, C, D. The processes A and B reads V from memory and increments it by one, stores it to memory, and then terminates. The processes C and D reads V from memory and decrements it by two, stores it to memory, and then terminates. Before reading V, each process invokes the wait operation on a counting semaphore S and invokes the signal operation on the semaphore S after storing V to memory. Semaphore S is initialized to two. What is the maximum possible value of V after all processes complete execution? **[04 Marks]**
- c.** Consider, a faculty can contact maximum 30 students at any point in time. Once 30 students are contacted, a faculty will not accept another incoming contact request until an existing contact is released. Explain how semaphores can be used by a faculty to limit the number of concurrent contacts. **[04 Marks]**
- d.** Why spinlocks as a synchronization mechanism is appropriate only on multiprocessor systems and not on single-processor systems? Justify your answer. **[04 Marks]**
- e.** Consider three processes, which need 10, 20 and 30 CPU bursts and arrive at times 0, 2 and 6, respectively. How many context switches will occur, if an OS implements a shortest remaining time first scheduling algorithm? Context switches at time zero and at the end need not be counted. **[04 Marks]**
- Q.2 a.** Consider the cooperating processes A, B, and C, which are executing different code portions, which are accessing and updating some shared variables. Process A is executing the X operation (i.e., wait) on semaphores s1, s2 and s3; process B is executing the X operation on semaphores s2, s3 and s4; process C is executing the X operation on semaphores s3, s4, and s1 before entering the respective code portion. After completing the execution of its code portion, each process invokes the Y operation (i.e., signal) on its three semaphores. Consider all semaphores are binary semaphores initialized to one. Show a deadlock free order of invoking the X operations by the processes? Discuss your answer. **[08 Marks]**

- b. Consider a group of students are preparing for a CS 300 exam. The students can prepare for exam only while eating pizza. Each student runs the following loop: [12 Marks]

while (true) {pick up a piece of pizza; prepare for exam while eating the pizza}.

If a student finds that the pizza is gone, the student goes to sleep until another pizza arrives. When the first student finds that the group is out of pizza, he/she phones Dominos to order another pizza before going to sleep. Each pizza has S slices.

Write a pseudo code to synchronize the student threads and the pizza delivery thread. Your solution should avoid deadlock and phone (i.e., wake up the delivery thread) exactly once each time a pizza is exhausted. No piece of pizza may be consumed by more than one student.

- c. Consider 4 preemptive processes whose details are given in below table: [10 Marks]

Process	Arrival Time	Priority	Burst Time		
			CPU Burst	I/O Burst	CPU Burst
P1	0	2	1	5	3
P2	2	3	3	3	1
P3	3	1	2	3	1
P4	4	0	1	6	1

If the CPU scheduling policy is Priority Scheduling, calculate the average waiting time, average turn around time and % of CPU utilization.

-----ALL THE BEST-----