

## Operating Systems

### Part I: Write true if the statement is correct and false otherwise (1 pt each)

1. Peterson's solution works correctly for more than two processors.
2. Semaphores can provide the same functionality as mutex locks.
3. A binary semaphore is functionally equivalent to a mutex lock.
4. Preemptive scheduling may cause starvation.
5. A non-preemptive kernel is essentially free from race conditions in single processor systems.
6. Round robin is better than FCFS in terms of response time
7. Under preemptive scheduling, when a process switches from the running to the ready state, it may lose control of the CPU.
8. The multilevel feedback queue scheduling algorithm allows processes to migrate between different queues.

### Part II : Choose the best answer from the given alternatives (1pt each)

1. Which of the following components of program state are shared across threads in a multithreaded process? (you may choose more than 1 option)  
a. Register values b. Global variables c . Stack memory d. All
2. If a process is executing in its critical section, then no other processes can be executing in their critical section. This condition is called  
a) mutual exclusion      b) critical exclusion c) synchronous exclusion d) asynchronous exclusion
3. Which one of the following is a synchronization tool?  
a) thread      b) pipe      c) semaphore      d) socket
4. Binary semaphore is a shared integer variable  
a) that can not drop below zero      c) that can not drop below one  
b) that can not be more than zero      d) that can not be more than one
5. Mutual exclusion implies that:  
a) if a process is executing in its critical section, then no other process must be executing in their critical sections  
b) if a process is executing in its critical section, then other processes must be executing in their critical sections  
c) if a process is executing in its critical section, then all the resources of the system must be blocked until it finishes execution  
d) none of the mentioned
6. Round robin scheduling falls under the category of:  
a) Non preemptive scheduling      c) All of the mentioned  
b) Preemptive scheduling      d) None of the mentioned
7. The processes that are residing in main memory and are ready and waiting to execute are kept on a list called  
a) job queue      c) execution queue  
b) ready queue      d) process queue
8. The interval from the time of submission of a process to the time of completion is termed as

- a) waiting time
  - b) turnaround time
  - c) response time
  - d) throughput
9. Which scheduling algorithm allocates the CPU first to the process that requests the CPU first?
- a) first-come, first-served scheduling
  - b) shortest job scheduling
  - c) priority scheduling
  - d) none of the mentioned
10. In priority scheduling algorithm, when a process arrives at the ready queue, its priority is compared with the priority of
- a) all process
  - b) currently running process
  - c) parent process
  - d) init process
11. Time quantum is defined in
- a) shortest job scheduling algorithm
  - b) round robin scheduling algorithm
  - c) priority scheduling algorithm
  - d) multilevel queue scheduling algorithm
12. Process are classified into different groups in
- a) shortest job scheduling algorithm
  - b) round robin scheduling algorithm
  - c) priority scheduling algorithm
  - d) multilevel queue scheduling algorithm

### Part III Short answer Questions (2 points each)

1. Provide two programming examples in which multithreading provides better performance than a single-threaded solution.
2. Using Amdahl's Law, calculate the speedup gain of an application that has a 60 percent parallel component for (a) three processing cores and (b) four processing cores..
3. What is the term for describing the situation where shared data may be manipulated concurrently and the outcome of the execution depends upon the order of access?
4. What is the term used to describe the segment of code where shared data is accessed and possibly manipulated?
5. What are the three requirements a solution to the critical-section problem must satisfy?

*Consider the arrival times and execution times of the processes shown in the table below and answer questions numbered 5 to 8.*

Process	Burst time	Arrival time
P1	20	0
P2	25	15
P3	10	30
P4	15	45

6. What is the average waiting time if FCFS scheduling is used?
7. What is the average turn around time if shortest job first scheduling is used ?
8. What is the total waiting time for process P2 if an operating system uses Shortest Remaining Time First (SRTF) process scheduling algorithm?
9. How many context switches are needed if the operating system implements a preemptive priority based scheduling algorithm with priorities 2, 3, 1 and 4 for process P1 to P4 respectively? Do not count the context switches at time zero and at the end.

### Review questions on deadlock

1. List and explain the 4 different deadlock handling mechanisms.
2. List three examples of deadlocks that are not related to a computer system environment.
3. List the four conditions that must hold simultaneously in a system for deadlock to arise.

4. Suppose that a system is in an unsafe state. Show that it is possible for the processes to complete their execution without entering a deadlocked state.
5. Consider the following snapshot of a system:

	<b>Allocation</b>	<b>Max</b>	<b>Available</b>
	ABCD	ABCD	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	

**Answer the following questions using the banker's algorithm:**

- a) How many instances are there per each resource type?
- b) What is the content of the matrix Need?
- c) Is the system in a safe state? Support your answer with reason
- d) Can a (0,4,2,0) request from process p1 be granted immediately?