Mahindra University Hyderabad

École Centrale School of Engineering

Minor - II

Program: B. Tech. | **Year: 3rd** | **Semester: V**

Subject: Operating Systems | **Subject Code: CS3102** | **Date: 24 Oct, 2024**

Start Time: 02:00 PM | **Time Duration: 1.5 hours** | **Max. Marks: 30**

Instructions

1. No marks will be given without proper justifications.

Q1. Assess the validity (True/False) of these operating system-related statements, and offer justifications for your answers. $(5 \times 1 = 5\ marks)$

i) A program can only have one critical section.
ii) wait() and signal() operations of semaphores may result in a deadlock.
iii) A semaphore variable can only be initialized as 1 or 0.
iv) Blocking system call on user thread in Many-One threading model blocks all user threads.
v) Only the process which created a shared memory segment can delete it.

Q2. Answer the following questions:

a) Consider a banking system that maintains an account balance with two functions: deposit(amount) and withdraw(amount). These two functions are passed the amount that is to be deposited or withdrawn from the bank account balance. Assume that a husband and wife share a bank account. Concurrently, the husband calls the withdraw() function, and the wife calls deposit() function.

Describe a solution to the problem using semaphores. Give details of the semaphore, its usage in the problem above (how would you use semaphore in entry and exit sections), and the details of operations performed (wait and signal) on the semaphore to ensure data integrity. $(5\ marks)$

b) Consider the following pseudo code: $(5\ marks)$

```
while (1)
 {
      while (flag[i]);
      flag [i]=true;
      <CRITICAL SECTION>
      flag[i]=false;
      <REMAINDER SECTION>
 }
```

In the above case which among the following statement is true? (Justify your answer)

i) Mutual exclusion and bounded waiting are satisfied.
ii) Only mutual exclusion is satisfied.
iii) Mutual exclusion is violated.
iv) Mutual exclusion and progress are met.

Q3. Consider three processes, all arriving at time zero, with total execution time of 10, 20 and 30 units respectively. Each process spends the first 30% of execution time doing I/O, the next 60% of time doing computation, and the last 10% of time doing I/O again. The operating system uses a shortest remaining compute time first scheduling algorithm and schedules a new process either when the running process gets blocked on I/O or when the running process finishes its compute burst. Assume that all I/O operations can be overlapped as much as possible. For what percentage of time does the CPU remain idle? $(5\ marks)$

Q4. Answer the following questions:

a) What is Interprocess Communication (IPC)? Which categories of processes necessitate its implementation? Name the mechanisms employed to facilitate IPC. $(2 + 1 + 2 = 5\ marks)$

b) Consider a system with two tasks: one with Low priority and one with High priority. The Low-priority task is holding a lock on a resource that the High-priority task needs. Explain how priority inversion might occur in this situation. Explain how priority inheritance protocol works and how it can resolve the priority inversion problem.

$(2 + 3 = 5\ marks)$
