Motilal Nehru National Institute of Technology Allahabad
Department of Computer Science & Engineering
End Semester (Odd) Examination 2017-18

Subject- Operating Systems (CA 3301), MCA- III Semester

Duration- 3:00 hours **Max. Marks: 60**

All questions are compulsory. Assume if something missing.

1. List five services provided by an operating system. Explain how each provides convenience to the users. Explain also in which cases it would be impossible for user-level programs to provide these services. **(6)**

2. Consider the following definition of semaphores given as in Figure 2 (i) : **(6)**

```
void semWait(s)
{
      if (s.count > 0) {
        s.count--;
       }
else {
    place this process in s.queue;
       block;
    }
}
void semSignal (s)
{
  if (there is at least one process
          blocked on semaphore s) {
   remove a process P from s.queue;
   place process P on ready list;
  }
else
s.count++;
}
```

Figure 2 (i)

```
struct semaphore {
          int count;
          queueType queue;
};
void semWait (semaphore s)
{
     s.count--;
   if (s.count < 0) {
   /* place this process in s.queue */;
   /* block this process */;
    }
}
void semSignal (semaphore s)
{
    s.count++;
    if (s.count <= 0) {
/* remove a process P from s.queue */;
/* place process P on ready list */;
    }
        }
```

Figure 2 (ii)

Compare this set of definitions with definition as given in Figure 2 (ii). Note one difference: With the preceding definition, a semaphore can never take on a negative value. Is there any difference in the effect of the two sets of definitions when used in programs? That is, could you substitute one set for the other without altering the meaning of the program?

3. **(a)** List four characteristic of suspended process? What is the meaning of the term busy waiting? Can busy waiting be avoided altogether? Explain your answer. **(3)**
(b) Draw a neat labeled process state transition diagram with two suspended states. Explain the role of each transition in this state transition diagram. **(3)**

4. An operating system uses the Banker's algorithm for deadlock avoidance when managing the allocation of three resource types X, Y, and Z to three processes P0, P1, and P2. The table given below presents the current system state. Here, the Allocation matrix shows the current number of resources of each type allocated to each process and the Max matrix shows the maximum number of resources of each type required by each process during its execution. **(6)**

P.T.O

Process	Allocation			Max		
	X	Y	Z	X	Y	Z
P0	0	0	1	8	4	3
P1	3	2	0	6	2	0
P2	2	1	1	3	3	3

There are 3 units of type X, 2 units of type Y and 2 units of type Z still available. The system is currently in a safe state. Consider the following independent requests for additional resources in the current state:

REQ1: P0 requests 0 units of X, 0 units of Y and 2 units of Z

REQ2: P1 requests 2 units of X, 0 units of Y and 0 units of Z

Identify **REQ1** or **REQ2** is satisfied or not satisfied. Give proper explanation.

5. A process has been allocated 3 page frames. Assume that none of the pages of the process are available in the memory initially. The process makes the following sequence of page references (reference string): **4, 1, 2, 1, 1, 3, 7, 4, 5, 6, 3, 1,7, 4, 6, 3, 3,2 ,1**
If **OPTIMAL** and **Least Recently Used (LRU)** page replacement policy is used, how many page faults occur for the above reference string? **(3+3=6)**

6. **The Dinning –Philosophers Problem:** Consider five philosophers who spend their lives thinking and eating. The philosophers share a circular table surrounded by five chairs, each belonging to one philosopher. In the center of the table is a bowl of rice, and the table is laid with five single chopsticks. When a philosopher thinks, she does not interact with her colleagues. From time to time, a philosopher gets hungry and tries to pick up the two chopsticks that are closest to her (the chopsticks that are between her and her left and right neighbors). A philosopher may pick up only one chopstick at a time. Obviously, she cannot pick up a chopstick that is already in the hand of a neighbor. When a hungry philosopher has both her chopsticks at the same time, she eats without releasing her chopsticks. When she is finished eating, she puts down both of her chopsticks and starts thinking again. **(5+5=10)**
   a. Write a deadlock free solution to the above problem using monitor.
   b. It is noted that a deadlock-free solution does not necessarily eliminate the possibility of starvation. Write a solution, if possible, that is free from starvation.

7. **(a)** Consider a paging hardware with a TLB. Assume that the entire page table and all the pages are in the physical memory. It takes 10 milliseconds to search the TLB and 80 milliseconds to access the physical memory. If the TLB hit ratio is 0.6, find the effective memory access time (in ms). **(5)**

(b) Consider six memory partitions of size **200 KB, 400 KB, 600 KB, 500 KB, 300 KB**, and **250 KB**, where KB refers to kilobyte. These partitions need to be allotted to four processes of sizes **357 KB, 210 KB, 468 KB** and **491 KB** in that order. If the best fit algorithm is used, find out partitions that are NOT allotted to any process? **(5)**

8. Suppose that a disk drive has 5,000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order, is: **86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130**
Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk-scheduling algorithms? **(10)**
   a. SSTF
   b. SCAN
   c. LOOK
   d. C-SCAN