1. (10%)How does DMA increase system concurrency? How does it complicate the hardware and system design?

2. (10%)What problems could occur if a system allowed a file system to be mounted simultaneously at more than one location?

3. (10%)In the consumer-producer example program, a ring buffer queue is used to store the produced item that will be consumed by the consumer later. In what restricted conditions the program need not to use the lock synchronization primitive to support the correct operation?

4. (10%)The mutual exclusive algorithm for two concurrent processes is original from Dekker's algorithm (1965 Dijkstra). In 1981 Peterson discovered a much simple one as the following figures. (Modern Operating system)

```
#define FALSE 0
#define TRUE 1
#define N 2                                    /* number of processes */
int turn;
int interested[N];
void enter_region(int process);
{
    int other;
    other = 1 – process;
    interested[process] = TRUE;
    turn = process;
    while(turn == process && interested[other] == TRUE)
/*null statement*/ ;
/* critical section */
}

void leave_region(int process)
{
    interested[process] = FALSE;
}
```

Prove that the algorithm satisfies all three requirements for the critical section.

1.Mutual exclusion is preserved.

2.The progress requirement is satisfied.

3.The bounded-waiting requirement is met.

5. (10%)What is the cause of thrashing ? How does the system detect thrashing? Once it detects thrashing, what can the system do to eliminate this problem?

6. (20%) For the dining philosophers problem, assume it has reached the deadlock state that each philosopher, Pi, has acquired the chopstick on his right-hand side, Ci, where $1 \leq i \leq 5$. Please draw (a) the resource allocation graph and (b) the wait-for graph for the philosopher deadlock situation.
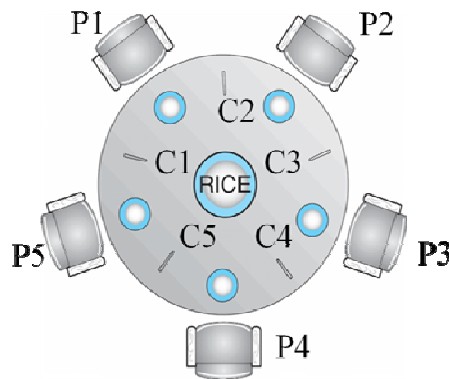
7. (20 %) Suppose that a scheduling algorithm (at the level of short-term CPU scheduling) favors those processes that have used the least processor time in the recent past. (a) Will this scheduling algorithm favor CPU-bound processes or I/O-bound processes? Why? (b) Please discuss if the starvation situation will permanently occur in this scheduling algorithm?

8. (10%) Are the following statements about IP addresses true or false? For each statement, you will get 2 points for correct answer, zero point for blank, or -1 point for incorrect answer.

   (a) The subnet mask for the subnet 200.23.16.0/23 is 255.255.255.0.
   (b) The subnet 200.23.16.0/23 could accommodate up to 256 hosts.
   (c) Domain Name Service (DNS) can be used to acquire IP addresses.
   (d) Address Resolution Protocol (ARP) can be used to acquire IP addresses.
   (e) Network Address Translation (NAT) is used to map MAC addresses to IP addresses.