1. What is dual-mode operation? Why an O.S. needs to implement memory/CPU protection? Explain how to implement the protection scheme.(10%)

2. Three process Pa, Pb, Pc arrive at the ready queue of a single processor system at 0, 3, 4(time unit). Their execution stat sequences are as follows:

   ■ Pa: CPU burst (5 time units) → I/O burst (5 time units) → CPU burst (4 time units)

   ■ Pb: CPU burst (6 time units)

   ■ Pc: CPU burst (3 time units) → I/O burst (2 time units) → CPU burst (2 time units) → I/O burst (4 time units) → CPU burst (3 time units)

   Assumed that there're sufficient I/O devices and processes re-enter the ready queue immediately after I/O execution.

   (1)Please draw the Gantt chart of the First-Come, First-Serve CPU scheduling algorithm.(5分)

   (2)Please draw the Gantt chart of the Round-Robin CPU scheduling algorithm(the time quantum = 4)(5分)

3. Consider the following program fragments. What are the values that x can take on during the execution of the following threads; assuming x is initialized to 0? (10%)

Thread 1: {for(i=0 ; i<10 ; i++) x=x+2;}

Thread 1: {for(j=0 ; j<10 ; j++) x=x-1;}

4. Consider a system consisting of four resources of the same type that are shared by three processes, each of which needs at most two resources. Show that the system is deadlock-free. (10%)

5. Assume for each memory reference, the TLB is first consulted. If the operation is failed, then the page table (one level) in memory is consulted. Access time for TLB and memory is 10ns and 100ns respectively. If the hit ratio for TLB is 80%, calculate the effective access time. (10%)

6(a). It is important that the process scheduler of an OS should distinguish the I/O-bound processes from the CPU-bound processes. Why is it important? (8%)

6(b). What method can be used by the process scheduler to distinguish between I/O-bound and CPU-bound processes? Give a method. (7%)

7. Suppose that the semaphore-processing operations, wait( ) and signal( ), are implemented with spin-lock in a multiprocessing computer system. What are the advantages and disadvantages for adopting the mechanism of spin-lock? (10%)

8(a). A sequence of memory-page reference is as shown below. If the working set window is 10, what are the working sets at time t_1 and t_2, respectively? (8%)

– 1 5 2 6 8 7 7 8 6 2 5 1 4 3 2 1 4 3 3 2 4 3 5 3 3 3 2 4 1 4 – .
$\overset{\uparrow}{t_1}$ ... $\overset{\uparrow}{t_2}$

8(b). What benefits can be obtained if an OS uses the working-set model? (7%)

9. Linked-allocation is one of disk-space allocation methods.
(a) What problems will be encountered when it is used by a file system? (5%)
(b) Give your solution to these problems. (5%)