[This question paper contains 6 printed pages.]

Sr. No. of Question Paper : 851   E   Your Roll No................

Unique Paper Code   : 234401

Name of the Course   : B.Sc. (H) Computer Science

Name of the Paper   : Operating Systems [CS–HT 408]

Semester   : IV

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. **Section A** is compulsory.

3. Attempt any **4** questions from **Section B.**

4. Parts of a question must be answered together.

SECTION – A

1. (i) In a multiprogramming and time-sharing environment, several users share the system simultaneously. This situation can result in various security problems.

    (a) What are two such problems ?

    (b) Can we ensure the same degree of security in a time-shared machine as in a dedicated machine ? Explain your answer.   (2+2)

    (ii) Describe a mechanism for enforcing memory protection in order to prevent a program from modifying the memory associated with other programs.   (2)

    (iii) List five services provided by an operating system that are designed to make it more convenient for users to use the computer system.   (3)

P.T.O.

(iv) Illustrate the concept of co-operating processes using the producer-consumer problem.   (4)

(v) Distinguish between the following terms :

    (a) Process and Program

    (b) Tree-structure and 2-level directory structure   (2+2)

(vi) Describe the actions taken by a kernel to context-switch between processes.   (2)

(vii) How does, the use of paired passwords avoid the problem of password sniffing ?   (2)

(viii) Why is it important for the scheduler to distinguish I/O-bound programs from CPU-bound programs ?   (3)

(ix) Can a multithreaded solution using multiple user-level threads achieve better performance on a multiprocessor system than on a single-processor system ?   (2)

(x) Consider a system that supports the strategies of contiguous, linked, and indexed allocation. What criteria should be used in deciding which strategy is best utilized for a particular file ?   (3)

(xi) Consider a logical address space of 64 pages of 1024 words each, mapped onto a physical memory of 32 frames.

    (a) How many bits are there in the logical address ?

    (b) How many bits are there in the physical address ?   (2)

(xii) A password may become known to other users in a variety of ways. Is there a simple method for detecting that such an event has occurred ? Explain your answer.   (2)

(xiii) Some systems provide file sharing by maintaining a single copy of a file; other systems maintain several copies, one for each of the users sharing the file. Discuss the relative merits of each approach.   (2)

SECTION – B

2. (a) Define the essential properties of the following types of operating systems :

    (i) Time sharing

    (ii) Real time   (3×2=6)

  (b) Which of the following scheduling algorithms could result in starvation ?

    (i) First-come, first-served

    (ii) Shortest job first

    (iii) Round robin

    (iv) Priority   (2)

  (c) What are the advantages of the variation of linked allocation that uses a FAT to chain together the blocks of a file ?   (2)

3. (a) Describe the differences among medium term and long term scheduling. (2)

  (b) Consider the following set of processes, with the length of the CPU burst times given in milliseconds:

Process	Burst Time	Priority
P1	7	2
P2	4	1
P3	3	3
P4	1	4
P5	3	2

The processes are assumed to have arrived in the order P1, P2, P3, P4, and P5 all at time t=0.

P.T.O.

(i) Draw four Gantt charts illustrating the execution of these processes using FCFS, SJF (equal burst length processes are scheduled in FCFS), a non-preemptive priority (small priority number means high priority, equal priority processes are scheduled in FCFS), and a RR (quantum=2) scheduling.

(ii) Calculate average waiting time and average turnaround time for all above mentioned scheduling algorithms. (4+4)

4. (a) The concurrent processes P1 and P2 execute the following code segments in a uniprocessor environment :

$$P1 : x = x + 1$$

$$P2 : x = x - 1$$

Where x is a shared variable ? What would be the problem of such concurrent execution ? (4)

(b) Suppose that a disk drive has 5000 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 ?

(i) FCFS

(ii) SSTF

(iii) SCAN (6)

5. (a) Assume we have a demand-paged memory. The page table is held in registers. It takes 8 milliseconds to service a page fault if an empty page is available or the replaced page is not modified, and 20 milliseconds if the replaced page is modified. Memory access time is 100 nanoseconds. Assume that the page to be replaced is modified 70 percent of the time. What is the maximum acceptable page-fault rate for an effective access time of no more than 200 nanoseconds ? (5)

(b) When do page faults occur ? Describe the actions taken by the operating system when a page fault occurs ? (5)

6. (a) Compare the main memory organization schemes of contiguous-memory allocation, pure segmentation, and pure paging with respect to the following issues :

(i) external fragmentation

(ii) internal fragmentation

(iii) ability to share code across processes (6)

(b) Which of the following components of program state are shared across threads in a multithreaded process ?

(i) Register values

(ii) Heap memory

(iii) Global variables

(iv) Stack memory (2)

(c) Explain the role of Long-term scheduler. (2)

7. (a) What is a Semaphore ? Explain its usage with the help of example. (4)

(b) Write short notes on following :

    (i) Tree Directory structure

    (ii) C-SCAN Disk Scheduling

    (iii) Segmentation   (2×3)