(ii) What is the turnaround time of processes P1 and P4 for each of the scheduling algorithms given in part (i)?

(iii) Which of the scheduling algorithms given in part (i) will result in the minimal average waiting time? (8)



[This question paper contains 12 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 5804** **K**

Unique Paper Code : 2342012302

Name of the Paper : Operating Systems

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

Semester : III

Duration : 3 Hours Maximum Marks : 90

**Instructions for Candidates**

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. The **first** question in **Section A** is compulsory; attempt any **four** questions from **Section B.**
3. Parts of a question must be answered together.

**Section – A**

1. (a) Give a one-word answer for the following : (1×6=6)

(i) Loading the pages of a process into memory only when they are needed is termed as _____.

(ii) The time needed for the disk to rotate the desired sector to the disk head is called _____ .

(iii) _____ CPU scheduler selects the processes from the secondary storage device.

(iv) _____ is a necessary condition for a deadlock according to which at least one resource is held in a non-sharable mode.

(v) _____ fragmentation occurs when there is enough space in main memory, but it is not contiguous.

(vi) The path name that begins at the root and follows a path down to the specified file is _____ .

(b) 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. Discuss the problem that can occur due to such concurrent execution. .

(3)



```
int a,b;
void *func();
int main()
{
    pthread_t tid;
    a = 10;
    b = 20;
    pthread_create(&tid, NULL, func, NULL);
    pthread_join(tid, NULL);
    printf("a = %d, b = %d\n", a, b);
}
void *func()
{
    int b;
    a = 50;
    b = 100;
}
```

(c) Consider the following set of processes, with the length of CPU burst time8 given in milliseconds:

| Process | Arrival Time | Burst Time | Priority |
|---|---|---|---|
| P1 | 0 | 3 | 2 |
| P2 | 2 | 5 | 1 (Highest) |
| P3 | 3 | 3 | 3 |
| P4 | 5 | 1 | 4 |

(i) Draw Gantt charts illustrating the execution of these processes using Preemptive Priority Scheduling and Shortest Job First scheduling algorithm.

P.T.O.

(i) Draw the resource allocation graph.

(ii) Is the system in a deadlock? If the answer is yes, then mention the processes in the deadlock; else, identify the sequence in which the processes can execute. (7)

(b) Consider a system with only two processes, P1 and P2. Write the structure of process PI to solve the critical section problem using Peterson's solution. Also, justify how this solution satisfies the necessary conditions required for correctly handling the critical-section problem. (8)

7. (a) Consider a demand paging system with the page table stored in memory. What should be the maximum page fault rate to achieve an effective access time of 200 ns if the time taken for a memory reference is 100 ns? Assume that a page fault is serviced in 10 ns. (3)

(b) What will be the output of the following code fragment? Justify your answer. (4)



(c) Consider the following code segment : (3)

```
int a = 10, p = fork () ;
    if (p == 0)
        a++ ;
    else {
        wait (NULL);
        a--;
    }
    cout << a << endl;
```

(i) What will be the output of the above code segment?

(ii) What are the possible outputs if the wait() statement is removed? Justify.

(d) Out of all disk-scheduling algorithms, FCFS scheduling is truly fair. Elaborate, giving a suitable example. (3)

(e) Discuss any three challenges faced in programming for multicore systems. (3)

P.T.O.

(f) Consider a 40-bit logical address. Find the number of bits required to represent the page number and page offset fields. It is given that the page size is 4 KB. (3)

(g) What system calls have to be executed by a command interpreter or shell in order to start a new process on a UNIX system? (3)

(h) Assume that you have a page-reference string for a process with m frames (initially all empty). The page-reference string has length p, and n distinct page numbers occur in it.

What is a lower bound on the number of page faults with respect to any page-replacement algorithm? What is an upper bound on the number of page faults? Justify your answer. (3)

(i) Mention any one limitation of each of the Monolithic and Microkernel approaches of operating system design. How can the Modular approach overcome each of these limitations? (3)



(c) Suppose there is a system with 128KB of memory, initially with no memory allocated. Given the following sequence of memory allocation and deallocation requests, show the memory layout after each step for both Best- Fit and Worst-Fit allocation algorithms. (6)

| Process Number | Nature of Request | Amount of Memory Requested (in KB) |
|---|---|---|
| P0 | Allocation | 20 |
| P1 | Allocation | 30 |
| P2 | Allocation | 22 |
| P0 | Deallocation | |
| P1 | Deallocation | |
| P3 | Allocation | 50 |
| P4 | Allocation | 20 |

6. (a) A system has 3 processes P1, P2 and P3, and 3 resources R1, R2 and R3. There are 2 instances each of R1 and R2, and one instance of R3.

Given the edge set E = {R1 → P1, R2 → P2, P1 → R3, R1 → P2, P3→ R1, R2 → P3, R3 → P3}

(c) Consider the following page reference string :

0, 3, 1, 4, 7, 6, 2, 7, 6, 2, 7, 1, 4, 7, 3, 2, 1, 2, 1

How many page faults would occur with FIFO and Optimal page replacement algorithms, assuming three frames in memory? All frames are initially empty. (6)

5. (a) On a system using round-robin scheduling, what would be the effect of including a specific process twice in the ready queue?

If there are n processes in the ready queue and the time quantum is q, then how long will any process wait to get the time quantum again? (4)

(b) Suppose a disk drive has 200 cylinders numbered from 0 to 199. The request for 62 is being serviced and is moving towards track 99, and the disk request queue contains read/write requests for the sectors on tracks 184, 55, 103, 96, and 197, respectively.

What is the total number of head movements needed to satisfy the requests in the queue using:

(i) FCFS

(ii) LOOK (5)



## Section – B

2. (a) Would it be appropriate to have a web server run as a single-threaded process? Why or why not? (3)

(b) For a paged system, the Translation Lookaside Buffer (TLB) hit ratio is 80%. Let the RAM access time be 120 ns, and the TLB access time be 40 ns. Find out :

(i) Effective memory access time with TLB

(ii) Effective memory access time without TLB (5)

(c) Discuss one advantage and one disadvantage of the Sequential and Direct access methods. Consider a file system on a disk that has both logical and physical block sizes of 1 KB. If we are currently at logical block 15 and want to access logical block 6, how many physical blocks must be read from the disk for the following access methods, and why?

(i) Sequential

(ii) Direct (7)

3. (a) Discuss Asynchronous and Synchronous threading strategies for creating multiple threads. (3)

(b) Consider the following Segment table : (4)

| Segment | Base | Length |
|---|---|---|
| 0 | 250 | 100 |
| 1 | 350 | 40 |
| 2 | 1345 | 350 |
| 3 | 1673 | 600 |

What are the Physical addresses for the following logical addresses?

(i) 0, 230

(ii) 1, 10

(iii) 2, 300

(iv) 3, 400

(c) A given operating system operates in the User and Kernel modes of operation. What is the mode of the system for the following scenarios? Justify your answer. (8)



(i) Boot time

(ii) When the printer generates "Out of paper" error.

(iii) When the operating system gains control.

(iv) When a user runs a text editor like Notepad or MS Word.

4. (a) Assume a program has just referenced an address in virtual memory. Which of the following scenarios can occur, and which cannot? Justify your answer :

(i) TLB hit and page fault

(ii) TLB miss with no page fault (3)

(b) For each of the following transitions between process states, indicate whether the listed transitions are possible. If it is possible, give an example of one event that would cause it. Justify your answer.

(i) Run → Ready

(ii) Run → Blocked

(iii) Blocked → Ready (6)