(5)

[This question paper contains 20 printed pages.]

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

Sr. No. of Question Paper : 1133 **I**

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. Question No. 1 (Section A) is compulsory.

3. Attempt any 4 (four) questions from Section B.

4. Parts of a question should be attempted together.

P.T.O.

Section A

1. (a) Differentiate between Orphan process and zombie process giving one difference each. (2)

(b) Explain the convoy effect exhibited by FCFS scheduling algorithm with an example. (2)

(c) What will be the output of the parent and child processes in the following (2)

code?

```
#include <stdio.h>

#include <sys/types.h>

#include <unistd.h>

#include <iostream>

using namespace std;
```

```
int main(int argc, char* argv[])

{

    int pid;

    cout<<"Hello\n";

    pid = fork();

    if (pid == 0)

    cout << "World\n";

  return 0;

  }
```

(d) Discuss the problem of cache coherency with an example. (2)

(e) Why page sizes in memory management scheme are always chosen as power of 2? (2)

(f) Give any one difference between Asymmetric multiprocessing and Symmetric multiprocessing. (2)

(g) Which of the following components of program state are shared across threads in a multithreaded process? Answer with yes or no. (2)

(i) Register values

(ii) Heap memory

(iii) Global variables

(iv) Stack memory

(h) Give an example for each of the following: (2)

(i) Privileged Instruction

(ii) Instruction that can be run in user mode

(i) Define data parallelism with suitable example. (2)

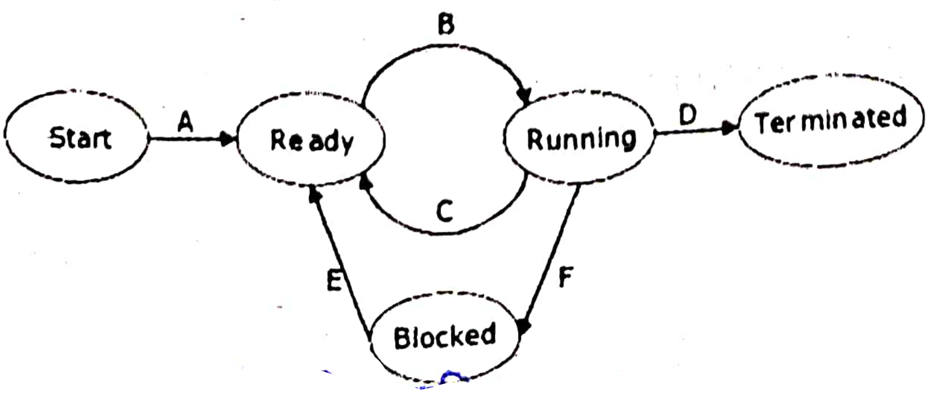
(j) Consider a process P1 with values of relocation and limit registers as 600 and 250 respectively. Assume that the process tries to reference the logical address 200. What will be the corresponding physical address and how is it computed? (2)

(k) Differentiate between Monolithic and Microkernel approach to operating system design. Give any one difference. (2)

(1) In the given process state transition diagram for a uniprocessor system, assume that there are always some processes in the ready state. Which of the following statements are true? Justify. (4)

(i) Termination of a process (Transition D) will result in invoking the long term scheduler to bring another process in the memory (Transition A).

(i) Consider a process P2 that is currently in the "Blocked state". Process P2 can make transition E to the ready state while another process P1 is in running state.



(m) Fill in the blanks. (4)

(i) ______________ Scheduler controls the degree of multi-programming.

(ii) Privileged instructions are executed in ______________ mode.

(iii) The time it takes disk head to reach the required cylinder during a disk access is termed as ______________ .

(iv) Switching the CPU to another process requires performing a state save of the current process and a state restore of a different process. This task is known as a ___________ .

Section B

2. (a) In a demand paging system with the page table stored in memory, if the memory reference time

is 200 nanoseconds and the page fault service time is 5 milliseconds, what should be the maximum page fault rate to achieve an effective access time of 350 nanoseconds? (4)

(b) Explain diagrammatically many-to-many multi-threaded model giving one advantage and disadvantage. (3)

(c) Consider the following set of processes, with the length of CPU burst time given in milliseconds as below: (4+2+2)

Process	Arrival Time	Burst Time	Priority
P1	0	6	3
P2	2	3	1 (Highest)
P3	4	2	2
P4	8	9	4 (Lowest)

Perform the following:

(i) Draw the Gantt Charts for priority scheduling (Pre-emptive), and Round Robin (Quantum = 3 ms) scheduling algorithms

(ii) Calculate waiting time for processes P1 and P3 in case of priority scheduling (Pre-emptive)

(iii) Calculate turnaround time for processes P2 and P4 in case of Round Robin (Quantum = 3 ms) scheduling algorithm.

3. (a) Consider the program given below. Assume that the actual PIDs of the parent and child processes are 1500 and 1567 respectively. (4)

Identify the output of the lines A, B, C, and D.

```
#include <sys/types.h>
```

1133

```
#include <stdio.h>

#include <unistd.h>

int main()

{

    pid_t pid;

    pid=fork();

    if (pid==0)

    {

        cout<<pid;          //Line A

        cout<<getppid();    //Line B

    }
```

```
else if (pid>0)

{

    cout<<pid;              //Line C

    cout<<getpid();         //Line D

}

}
```

(b) Consider the following processes P1 and P2.

(2+3)

P1: counter ++

P2: counter —

Assume that the initial value of counter is 10. Show how P1 and P2 can exhibit race condition while executing concurrently. State three requirements that a solution to critical-section problem must satisfy.

(c) For the given sets P (processes), R (resources) and E (edges) (3+3)

P= {P1, P2, P3, P4}

R={R1, R2}

E= {P1→R1, R1→P2, R1→P3, P3→R2, R2→P1, R2→P4}

There are two instances each of resources R1 and R2.

(i) Draw Resource allocation graph.

(ii) Is the given system in deadlock state? Justify your answer.

4. (a) Consider a system with logical address space comprising of 256 pages having 1024 bytes each, mapped to physical address space of 128 frames. (4)

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

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

   (b) Name any two operations which can be performed on a directory. List any one disadvantage of Two-level directory structure. How can this disadvantage be overcome using Tree Structured directory structure? (5)

   (c) Consider the following page reference string: (6)

   9, 5, 3, 6, 5, 8, 2, 1, 9, 9, 0, 7

5. (a) In case of demand paging, assuming four frames, how many page faults would occur for following page replacement algorithms: (4)

(i) FIFO replacement

(ii) Optimal replacement

The program shown below uses the Pthreads API. What would be the output from the program at LINE X and LINE Y respectively? Justify your answer.

```
#include <pthread.h>

#include <stdio.h>

#include <types.h>

int value = 10;

void *printing (void *param);
```

```
int main(int argc, char *argv[])

{

    pthread t tid;

    pthread_attr_t  attr;

    pthread_attr_init(&attr);

    pthread_create (&tid, &attr, printing,
    NULL);

    pthread_join(tid, NULL);

    cout<<value;                    // LINE X

}

void printing (void *param)

{
```

```
int value = 20;

value +=10;

cout<< value;                    // LINE Y

}
```

(b) Define external fragmentation? Does paging suffer from external fragmentation? Justify your answer. (2+1+2)

(c) Consider a disk drive of 2000 cylinders, numbered from 0 to 1999. Drive is currently serving a request at cylinder 500, and the previous request was at cylinder 250. The queue of pending request is 150, 1500, 900, 1700, 800, 1900. Starting at current head position, show the head movement and calculate the total distance in cylinders that the disk arm moves to satisfy all pending requests for each of following disk scheduling algorithms: (6)

(i) Shortest Seek Time First

(ii) LOOK Scheduling

6. (a) Consider the following segment table (4)

Segment	Base	Length
0	519	500
1	1800	95
2	170	300
3	1920	780
4	1860	50

What are the physical addresses for the following logical addresses?

(i) 0,240

(ii) 2,320

(iii) 3,670

(iv) 4,10

(b) For a paged system, Translation Look aside Buffer (TLB) hit ratio is 80%. Let memory access time be 150 ns and TLB buffer access time be 10 ns. Calculate the following: (2+3)

(i) Effective memory access time without TLB

(ii) Effective memory access time with TLB

(c) Consider the following: (6)

(i) TLB miss with no page fault

(ii) TLB miss and page fault

(iii) TLB hit

For each of the above cases, state the situation in which they occur. Also show how the frame number is determined in each case.

7. (a) Assuming a 2-KB page size, what are the page numbers and offsets for the following address references (provided as decimal numbers): (4)

(i) 3085

(ii) 42095

(b) Describe Belady's anomaly in context of Demand paging. Which of the following algorithms suffer from Belady's anomaly: (3+2)

(i) FIFO

(ii) Least Recently Used algorithm

(c) Given six memory partitions of 300 KB, 600 KB, 350 KB, 200 KB, 750 KB, and 125 KB (in order). How would the following scheduling algorithms place processes of size 115 KB, 500 KB and 375 KB (in order)? (6)

(i) First-fit algorithm

(ii) Best-fit algorithm