Course	**: B.Sc.(H) Computer Science**
Semester	**: III**
Paper Title	**: Operating Systems**
Unique Paper Code	**: 32341302**
Admission Year	**: 2019 onwards**
Max. Marks	**: 75**
Time	**: 3 hours**

Instructions for students:

- **Attempt any 4 questions.**
- **All questions carry equal marks.**

Q1.	Suppose that a disk drive has 6,000 cylinders, numbered 0 to 5999. The drive is currently serving a request at cylinder 2350, and the previous request was at cylinder 1800. The queue of pending requests, in FIFO order, is: 2069, 1212, 3296, 2800, 244, 1618, 3856, 1523, 965, 3681 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 SCAN and C-SCAN disk-scheduling algorithms? Show all the intermediate steps.	8
	Consider a disk drive with 10,000 cylinders. Suppose that 50 percent of the disk access requests are for a small set of cylinders between 100 and 800. Which of the following algorithms will take greater advantage of the given situation? Justify your answer. a) Shortest Seek Time First (SSTF) b) First Come First Serve (FCFS)	6
	Which of the following instructions should be privileged? Give reasons. a) Modify entries in the open-file table. b) Read the clock. c) Access I/O device.	4.75

Q2

A given operating system operates in the user and kernel mode of operation. What is the mode of the system at the following points? Justify your answer. **6**

a) Boot time
b) When the printer generates "Out of paper" error
c) When the operating system gains control

Consider a process (id= 2256) creates a child process (id = 2257) and child process further creates a child process (id= 2258). What will be output at statement (1), (2) and (3) along with the process generating this output, for the code given below: **5**

```
int main()
{
   int id1= fork();
   cout<<id1;        //  (1)
   if (id1==0)
   {
       int id2;
        id2= fork();
       cout<< id2;   // (2)
   }
   cout<<id1;        //   (3)
   }
```

A computer system with a 32-bit logical address and 4-KB page size supports up to 512 MB of physical memory. Consider a user process that accesses the entire physical memory. How many entries will be there in a conventional single-level page table. How many entries can exist in a two-level hierarchical page table? Justify your answer. **4**

A process P is allocated n frames in the memory (initially all empty). The process page-reference string has length q; n distinct page numbers occur in it. What is the lower bound on the number of page faults? What is an upper bound on the number of page faults? Justify your answer. **3.75**

Q3

As a process executes, it changes its state. The state of a process is defined in part by the current activity of that process. Draw a process state diagram. **4.75**

A process P changes its state as mentioned in the table below. Perform the following-

a) Identify each state of the process P (S. No. 1-5)
b) In the process diagram, mark each state of the Process P (S.No. 1-5).

S. No	Current Activity
1	P arrives in main memory
2	P starts execution
3	Process Q preempts P
4	P resumes execution
5	P needs to accept some input from user

Consider the following code, for creating a child process using fork( ) system call. Mention the value of 'a' printed by each process at statement (1), (2) and (3). Explain your answer with the help of a parent-child tree diagram. 4

```
void main( )
{
   int a = 7;
   int pid1 = fork();
   if ( pid1 == 0 )
     {
       a++;
      cout<< "value of a is" <<a<<endl;    // (1)
      }
   else
      {
       int pid2= fork();
       if (pid2==0)
           {
             a--;
             cout<<"value of a is"<<a<<endl;    // (2)
             exit(0);
            }
        }
    cout<< "value of a is" <<a<<endl;        // (3)
 }
```

	Consider the following set of processes with the burst time given in milliseconds.	10

Process	Arrival Time	Burst Time
P1	0	30
P2	5	22
P3	10	15
P4	15	5

a) Draw a Gantt chart for SRTF (shortest remaining time first and Round Robin (time quantum q= 10 ms) based CPU scheduling algorithms.

b) Calculate average turnaround time and average waiting time for each algorithm.

Q4

Find the number of unique threads created at statements (1), (2) and (3) each, as specified in the code given below. Additionally in each case mention the process which is creating the thread. Justify your answer. 4.75

```
int main( )
 {
    int x;
    thread_create(...);  // (1)
    x= fork();
    thread_create(...);  // (2)
    if (x==0)
      fork();
    thread_create(...);  // (3)
    return 0;
 }
```

State True or False: 2

a) The child process is known as a zombie process when its parent terminates before it.

b) init() is the parent of those processes who do not have a parent.

Consider a printing resource having 5 non-shareable instances which may be required by many processes simultaneously. Synchronize the usage of this resource with the help of a semaphore S. **6**

a) What type of semaphore will be required for this purpose?

b) How will the synchronization be achieved if six processes want to use this resource simultaneously?

Consider a system with 4 types of resources R1 (2 units), R2 (2 units), R3 (2 units), R4 (2 units). A non-preemptive resource allocation policy is used. Three processes P1, P2, P3 request and hold the resources as follows: **6**

Process	**Requesting**	**Holding**
P1	1 unit of R1	1 unit of R3, 1 unit of R4, 1 unit of R2
P2	1 unit of R2	1 Units of R1, 1 unit of R3
P3	1 unit of R3	1 unit of R1, 1 unit of R2, 1 unit of R4

Draw a resource allocation graph and identify the possibility of any deadlock in the system. Give reasons.

5 Given memory partitions of 150 KB, 400 KB, 250KB, 300 KB and 650 KB (in order), how would each of the first-fit, best-fit and worst-fit algorithms place processes of 224 KB, 405 KB, 98 KB and 500 KB (in that order)? Which algorithm results in least external fragmentation? **9+1**

Assuming a 2-KB page size, what are the page numbers and offsets for the following address references (provided as decimal numbers) **5**

a) 3089
b) 32095
c) 235201

	Consider a paging system with the page table stored in memory. a) If a memory reference takes 150 nanoseconds how long does a paged memory reference take? b) If we add a TLB and 77 percent of all page-table references are TLB hits, what is the effective memory reference time? (Assume that finding a page-table entry in the TLB takes zero time, if the entry is there.)	3.75
6	Consider the following page-reference string: 1, 2, 3, 4, 5, 1, 5, 6, 7, 1, 2, 4, 7, 6, 3, 4, 1, 2, 3, 6 How many page faults would occur for the following replacement algorithms, assuming three frames? Remember that all frames are initially empty, so your first unique pages will all cost one fault each. a) FIFO replacement. b) Optimal replacement.	5+5
	Consider the following segment table: **Segment** | **Base** | **Length** 0 | 200 | 446 1 | 2122 | 15 2 | 88 | 222 Compute the physical addresses for the following logical addresses? a) 0, 336 b) 1, 11 c) 2, 400	5
	Consider a virtual address space of four pages with 1024 bytes each, mapped onto a physical memory of 64 frames. a) How many bits are used in the virtual address? b) How many bits are used in the physical address?	3.75