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

Instructions for students:

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

Q1 For memory protection, each process has a base and a limit register. A process is not allowed to access memory outside the range of its base and limit registers. Can a user change its base register or limit register value, justify your answer? How does operating system ensures protection of system data?

Although the system data is not directly accessible to the user but they are able to access the hardware resources, so how are user processes able to access these resources, explain?

RAM is volatile in nature but when a computer is switched on , operating system is up and running. How is the operating system code brought in the main memory, explain?

A company wants to launch a mobile phone (handheld device). Suggest the features to be included in the operating system comparing them with features of operating system of laptop/ desktop.

Q2 Find the number of unique threads created at statements 1 to 4 each, as specified in the code given below, additionally in each case mention the process which is creating the thread. Justify your answer.

```
int main( )
{
int x;
thread_create(...);          // (1)
x= fork();
thread_create(...);          // (2)
if (x==0)
{
   thread_create(...);       // (3)
   fork();
}
thread_create(...);          // (4)
return 0;
}
```

In a system having multiple processes contending for resources simultaneously deadlock can occur. Consider a system with 4 processes(P1, P2, P3, P4) and 3 non shareable resources (R1, R2, R3) having single instance for R1 and R2 each and two instances for R3, with resource allocation state as given below:

- P1 is holding R2 and waiting for R1.
- P3 is waiting for R2 and holding R3
- P2 is using R3
- P4 is using R1 and waiting for R3

Draw the resource allocation graph. Does any deadlock occur in the system, justify your answer? Explain how four conditions necessary for deadlock apply in context of given scenario.

Q3

P1	P2
Use A;	Use A;
Use B;	Use B

Consider a system having two processes P1 and P2 as shown above, needing to use two non shareable resources A and B in the following sequence.

P2 --> A .....(1)
P1 --> A .....(2)
P1 --> B .....(3)
P2 --> B .....(4)

How many semaphores will ensure the above sequence of resource usage, show the working?

Multiple processes may be ready to execute at the same time but in single processor systems CPU can be allocated to one at a time. Consider the following set of processes with the length of CPU burst given in milliseconds

Process	Arrival Time	Burst Time	Priority
P1	0	5	4
P2	2	6	1
P3	3	4	5
P4	5	8	3
P5	6	3	3

Assuming that low value indicate high priority, draw Gantt chart for SRTF(shortest remaining time first) and non pre-emptive priority based CPU scheduling algorithms. Calculate average turnaround time and average waiting time for each algorithm.

Q4 Consider a process of size 435 bytes stored in a 2 KB physical memory divided into fixed size frames of 32 bytes each. How many pages will be there in this process? How much and what type of wastage of space is in this allocation, if any? Calculate the number of bits required to represent the page number, frame number and complete logical and physical addresses. How many more pages this process can have without increasing the number of bits for the page number and why?

Assume a process with 8 pages of size, each of size 1 KB stored in main memory of 16

frames as per the details given in the page table below:

	Frame no.
0	2
1	14
2	0
3	5
4	A
5	7
6	3
7	1

Assume any value for A (from 0-15 and not already in use) and mention in your answer.
What will be the frame number and offset (in decimal) for the logical addresses given below.
Additionally calculate the physical address for each.
a) 6748
b) 2874
c) 1387
d) 5235

Q5 Consider the following sequence of logical memory address references (in decimal) for a process divided into pages (page size is 100 bytes).

28, 251, 75, 145, 568, 40, 392, 199, 485, 278, 653, 745

Give the memory reference string for the process. Find the number of page faults for the reference string using LRU and FIFO page replacement algorithm, if 3 frames are allocated to the process. Give one advantage of each.

Extending the philosophy of demand paging and considering the fact that many child processes execute exec() system call after their creation, is it necessary to create a copy of parent's address space for the child immediately after its creation? Which technique is used to handle this issue? How?

Q6 The two simplest disk-scheduling algorithms are FCFS (First come first serve) and SSTF (shortest seek time first) algorithms. Using these algorithms, find the total head movements, for the following sequence of disk track requests for a disk having 300 cylinders numbered from 0 to 299.

27, 129, 110, 186, 147, 41, 10, 64, X.

Where X can be any number in the range 100 to 200. Mention the value of X in your answer.
Assume that the disk head is initially positioned over track 120.
Find out which algorithm has more head movement and by how much.

There is a disk which can store 2048 bytes per sector and has 100 sectors per track, 120 tracks per surface and has 4 usable surfaces. If we want to store 30,000 logical records which are of 512 bytes each, how much disk space is needed? Calculate in terms of sectors and tracks. Ignore any file header(s) or indices. Assume that records cannot span two sectors.