OPERATING SYSTEMS
(CSEN 2203)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) System calls are usually invoked by using
(a) Software interrupt (b) Polling
(c) An indirect jump (d) A privileged instruction.

(ii) A systematic procedure for allocating the CPU to a new process is known as
(a) Synchronization (b) Deadlock
(c) Starvation (d) Context Switching.

(iii) Which system call returns the process identifier of a terminated child?
(a) wait() (b) exit() (c) fork() (d) get()

(iv) Which of the following state transitions is not possible?
(a) Blocked to running (b) Ready to running
(c) Blocked to ready (d) Running to blocked.

(v) In UNIX, which system call creates a new process?
(a) fork (b) create
(c) new (d) None of (a), (b) & (c).

(vi) Run time mapping from virtual to physical address is done by
(a) MMU (b) CPU (c) PCI (d) LRU

(vii) Consider three processes (P1, and P2, and P3), all arriving at time zero, with 35, 15, and 25 time units of execution respectively, then the average turnaround time and average waiting time of the system using SJF algorithm is.
(a) 18.33,40 (b) 40,18.33
(c) 53.3,28.33 (d) None of (a), (b) & (c)

(viii) The time spent by a process in the ready queue is called?
(a) Waiting Time (b) Turnaround Time
(c) Throughput (d) None of these

(ix) How many times the following C program prints Operating System?

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main() {
 fork(); fork(); printf(" \n Operating System "); }
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(a) Once (b) Twice (c) Four times (d) Eight times.

(x) Dirty bit for a page in a page table
(a) helps avoid unnecessary writes on paging device (b) helps maintain LRU information
(c) allows only read on a page (d) none of (a), (b) or (c).

Fill in the blanks with the correct word

(xi) The address of the next instruction to be executed by the current process is provided by the _____.

(xii) Several processes access and manipulate the same data concurrently and the outcome of the execution depends on the particular order in which the access takes place, is called a _____.

(xiii) A system has 10 identical resources and N processes competing for them. Each process can request at most 2 resources. The minimum value of N for which the system may lead to deadlock is _____.

(xiv) For Round Robin CPU scheduling algorithm if there are n no of processes and "t" is the length of time slice, then every process will get the CPU after maximum _____ unit of time.

(xv) If a process has 24 KB of logical address space and the page size is 4096 bytes, the number of pages in the process are _____.

Group - B

2. (a) Show and explain the 7 state process model with the help of a diagram. *[(CSEN2203.2)(Explain/LOCQ)]*
   (b) Write Short Notes on: (i) Access Matrix (ii) System Threats. *[(CSEN2203.6)(Summarize/LOCQ)]*
   6 + 6 = 12

3. (a) Differentiate between: (i) Multiprogramming OS and Time Sharing OS (ii) Process and Threads. *[(CSEN2203.1)(Recall/LOCQ)]*
   (b) What are the 4 levels at which a system must be protected?
   State and explain any 2 Program Threats. *[(CSEN2203.6)(Recall/LOCQ)]*
   (c) How a worm is different from virus? *[(CO6)(Analyze/IOCQ)]*
   6 + 4 + 2 = 12

Group - C

4. (a) Consider a system that has the following resource types A(6), B(7), C(12), D(12). The numbers in the brackets indicate the instances of each type. Given the following snapshot of the system:

Process	Allocation	Max
	A B C D	A B C D
P1	0 0 1 2	0 0 1 2
P2	2 0 0 0	2 7 5 0
P3	0 0 3 4	6 6 5 6
P4	2 3 5 4	4 3 5 6
P5	0 3 3 2	0 6 5 2

   (i) How many instances of each resource are currently available? What is the content of Need matrix? Is the system in a safe state? Justify your answer.
   (ii) If a request from process P3 arrives for (0,1,0,0), can it be granted immediately? *[(CSEN2203.2)(Estimate/HOCQ)]*
   (b) Compare and Contrast Peterson's and Dekker's solutions for Two Process Synchronization. Write the algorithms for both to justify your arguments. *[(CSEN2203.3)(Compare/LOCQ)]*
   8 + 4 = 12

5. (a) Consider following three concurrent processes P0 and P1 and P2 and three semaphore variables S0,S1,S2. The semaphores are initialized as S0=1, S1=0, S2=0. Use wait( ) and signal( ) operations on the semaphore variables in the processes such that the following string will be printed. 002211002211.....
   Justify your solution.

P0	P1	P2

do{
printf("0");
printf("0");
}while(1);
	do{
	printf("2");
	printf("2");
	}while(1);
		do{
		printf("1");
		printf("1");
		}while(1);

   [(CO3)(Apply/HOCQ)]
   (b) Consider three processes (P1, and P2, and P3), all arriving at time zero, with 10, 20, and 30 time units of execution respectively. P1 spends the first 50% of execution time doing I/O, the next 30% of time doing computation, and the last 20% of time doing I/O again, but P2 and P3 spend the first 20% of execution time doing I/O, the next 70% of time doing computation, and the last 10% of time doing I/O again. The operating system uses a shortest remaining compute time first scheduling and schedules a new process either when the running process finishes its compute burst or when the running process gets blocked on I/O. Assume that all I/O operations can be overlapped. For what percentage of time does the CPU remain idle? *[(CO3)(Apply/HOCQ)]*
   (c) Consider the set of 5 processes whose arrival time and burst time given below.

Process id	Arrival Time	Burst time
P0	0	3
P1	1	5
P2	2	1
P3	2	4
P4	4	5

   If the CPU scheduling policy is FCFS and context switching time is 1 time unit, then
   (i) Find the CPU utilization.
   (ii) If the CPU scheduling policy is RR with time quantum 2 time units and context switching time is 1 time unit, then find the CPU utilization.
   (Hint: CPU Utilization is the percentage of time the CPU is busy in execution) *[(CO3)(Apply/HOCQ)]*
   4 + 4 + 4 = 12

Group - D

6. (a) Consider the following reference string
   7, 0, 1, 2, 0, 4, 2, 3, 0, 7

If there are four empty frames initially, then find the number of Page Faults with (i) FIFO (ii) LRU
And hence state which algorithm performs better.
Explain Belady's Anomaly with an example. *[(CSEN2203.4)(Solve/IOCQ)]*

(b) Consider a system with physical address 256MB, Logical address space 4GB, frame size is 4KB and each page table entry is 2B and there is a 4-entry TLB. TLB access time is 10ns and memory access time is 100 ns, TLB hit ratio is 0.4
(i) How many levels of paging are required?
(ii) How many bits are required for page offset?
(iii) How much memory in bytes is required for outer and inner page table?
(iv) What is the average memory access time? *[(CSEN2203.4)(Estimate/HOCQ)]*

(4 + 2) + 6 = 12

7. (a) Given six memory partitions of 100 MB, 170 MB, 40 MB, 205 MB, 300 MB, and 185 MB (in order), how would the first-fit, best-fit, and worst-fit algorithms place processes of size 200 MB, 15 MB, 185 MB, 75 MB, 175 MB, and 80 MB (in order)? Indicate which, if any, requests cannot be satisfied. *[(CO4)(Understand/LOCQ)]*

(b) Explain Internal Fragmentation and External Fragmentation with the help of an example. *[(CSEN2203.4)(Explain/LOCQ)]*

(c) What is Thrashing? What is the cause of Thrashing? How does the system detect Thrashing? What can the system do to eliminate this problem? *[(CO3)(Understand/LOCQ)]*

6 + 3 + 3 = 12

Group - E

8. (a) Write Short Notes on the following, providing suitable diagrams wherever necessary:
(i) Programmed I/O vs Interrupt driven I/O
(ii) File Attributes & File Operations. *[(CSEN2203.5)(Summarize/LOCQ)]*

(b) State the difference between blocking and non blocking IO. *[(CSEN2203.5)(Summarize/LOCQ)]*

(c) Consider a disk with a rotational rate of 10,000 RPM, an average seek time of 8 ms, and an average of 500 sectors per track. Estimate the average time to read a random sector from disk. Do this by summing the estimates of the seek time, rotational latency, and transfer time. *[(CSEN2203.5)(Solve/IOCQ)]*

6 + 3 + 3 = 12

9. (a) A disk drive has 200 cylinders, numbered 0 to 199. The drive is currently serving a request at cylinder 143 and has just finished a request at track 125. The queue of pending requests, in FIFO order, is
89, 193, 27, 112, 4, 134, 56, 76.
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) SSTF (ii) C-SCAN *[(CSEN2203.5)(Solve/IOCQ)]*

(b) What are the advantages and disadvantages of a two-level verses tree-structured directories?
Explain the mechanism of Spooling. *[(CSEN2203.5)(Summarize/LOCQ)]*

(3 + 4) + (3 + 2) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	54.17	18.75	27.08

Course Outcome (CO):

After the completion of the course students will be able to

CSEN2203.1. Develop knowledge about the importance of computer system resources and the role of operating system in their management policies and algorithms.
CSEN2203.2. Understand processes and its management policies and scheduling of processes by CPU.
CSEN2203.3. Acquire an understanding of the need of process synchronization, evaluate the requirement for process synchronization and coordination handled by operating system.
CSEN2203.4. Analyze the memory management and its allocation policies and compare different memory management approaches.
CSEN2203.5. Understand the impact and co-relation of different scheduling algorithm in secondary storage and different structure of file system and able to design the system with improved performance.
CSEN2203.6. Identify the different activities and impact of threat, virus, worm and able to protect system from them.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*