FUNDAMENTAL OF OPERATING SYSTEMS
(CSEN 4121)

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

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 4 (four)</u> from Group B to E, taking <u>one</u> 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)   Which is not the state of the process?
           (a) Running   (b) Ready   (c) Privileged   (d) Blocked.

    (ii)   The total time taken by a process to complete the execution (arrival to termination) is known as
           (a) waiting time   (b) response time
           (c) turnaround time   (d) execution time.

    (iii) What is a Process Control Block?
           (a) Process type variable   (b) Data Structure
           (c) A secondary storage section   (d) A Block in memory.

    (iv)   If a process has 32k bytes logical address space and the page size is 2048 bytes then the number of frames of that process is
           (a) 4   (b) 16   (c) 8   (d) 32.

    (v)   A semaphore is a shared integer
           (a) that can not drop below zero   (b) that can not be more than zero
           (c) that can not drop below one   (d) that can not be more than one.

    (vi)   Round robin scheduling is essentially the pre-emptive version of _____.
           (a) Longest job first   (b) Shortest job first
           (c) Shortest remaining time   (d) FIFO

    (vii) 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 the above.

(viii) If the record sizes are same, which file access method is suitable to update a record?
    (a) Sequential   (b) Indexed sequential
    (c) Direct   (d) Hashed.

(ix) In which of the following cases Banker's algorithm is used?
    (a) Deadlock Avoidance   (b) Deadlock Prevention
    (c) Deadlock Recovery   (d) Mutual Exclusion.

(x) A solution to the problem of external fragmentation
    (a) compaction   (b) larger memory space
    (c) smaller memory space   (d) none of (a), (b) & (c).

Fill in the blanks with the correct word

(xi) To access the services of the operating system, the interface is provided by the _____.

(xii) The number of processes completed per unit time is known as _____.

(xiii) In a time-sharing operating system, when the time slot given to a process is completed, the process goes from the running state to the _____.

(xiv) If the resources are always preempted from the same process _____ can occur.

(xv) The address generated by the CPU is referred to as _____.

Group - B

2. (a) Define operating system. What are the functions of operating system?
[(CO4)(Remember/LOCQ)]
   (b) What do you mean by system calls? What are various types of system calls?
[(CO5)(Understand/LOCQ)]
   (c) Describe briefly the microkernel architecture of an operating system. What are its benefits?   *[(CO4,CO5)(Remember/LOCQ)]*

(2 + 2) + (2 + 1) + (3 + 2) = 12

3. (a) Name one essential property of the following types of operating systems: (i)Interactive, (ii) Time-sharing, (iii) Real time, (iv) Network. *[(CO5)(Understand/LOCQ)]*
   (b) What are the advantages of using Virtual Machine Architecture?
[(CO4,CO5)(Understand/LOCQ)]
   (c) Explain the batch processing and multiprogramming operating system.
[(CO4)(Remember)/IOCQ)]

4 + 4 + 4 = 12

Group - C

4. (a) Differentiate between process and thread.   *[(CO3)(Analyse/HOCQ)]*
   (b) What is the role of long-term and short term schedule? What are the CPU scheduling criteria? Explain.   *[(CO4)(Remember/LOCQ)]*

(c)   Explain different 5 process states with the help of a diagram.   [(CO3)(Remember/LOCQ)]

3 + (2 + 4) + 3 = 12

5.   Consider the snapshot for the set of processes

Process	Arrival Time	Burst Time in ns
P1	0	3
P2	1	5
P3	3	2
P4	9	5
P5	12	5

Draw the Gnatt charts for illustrating the execution of these processes and calculate the average waiting time, average turnaround time, average response time, average completion time using the following scheduling algorithms.
(i) SJF   (ii) RR(Time quantum=2)   (iii) SRT.   [(CO3)(Understand/Apply/LOCQ)]

4 + 4 + 4 = 12

Group - D

6.   (a)   What is readers-writer problem? Write an algorithm to solve readers-writer problem using semaphore.   [(CO3)(Remember/LOCQ)]
      (b)   At a particular time of computation the value of a counting semaphore is 5. Then 15 P   operations and 10 V operations were completed on this semaphore. Find out the resulting value of the semaphore.   [(CO3)(Understand/IOCQ)]
      (c)   Compare various recovery schemes for a system in deadlock.   [(CO3)(Remember/LOCQ)]

6 + 3 + 3 = 12

7.   (a)   Consider the following snapshot of a system and answer the following questions using Banker's Algorithm.

Process	Allocation				Max				Available			
	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4
									1	5	2	0
P1	0	0	1	2	0	0	1	2				
P2	1	0	0	0	1	7	5	0				
P3	1	3	5	4	2	3	5	6				
P4	0	6	3	2	0	6	5	2				
P5	0	0	1	4	0	6	5	6				

(i) What is the content of the matrix need?
(ii) Is the system in a safe state? Justify your answer.
(iii) If a request from process P2 arrives for(0, 4, 2, 0), can the request be granted immediately? Explain your answer.   [(CO3)(Apply/IOCQ)]
      (b)   What are the necessary conditions for deadlock?   [(CO3)(Remember/LOCQ)]

(2 + 4 + 3) + 3 = 12

Group - E

8.   (a)   Why page sizes are always power of 2?   [(CO3)(Analyse/HOCQ)]

(b)   Consider a logical address space of sixteen pages of 1024 words each. If the physical memory has 32 page frames, then,
(i) How many bits are there in the physical address space?
(ii) How many bits are there in the logical address space?   *[(CO2)(Apply/IOCQ)]*

(c)   Consider the following memory references have been generated by a program:
0100, 0432, 0101, 0612, 0102, 0103, 0104, 0101, 0611, 0102, 0103, 0104, 0101, 0610, 0102, 0103, 0104, 0101, 0609, 0102, 0105
At 100 bytes per page, determine the number of page faults in each of the following page replacement policies assuming 3 frames are available.
Also assume that initially none of the pages are in main memory. What will be the number of page faults if we use the following page replacement policy?
(i) LRU (ii) Optimal.   *[(CO6)(Apply/IOCQ)]*

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

9. (a)   Explain the difference between internal and external fragmentation. Which one occurs in paging system? How the problem of external fragmentation be solved?
[(CO2)(Remember/LOCQ)]

(b)   How would each of the first fit, best fit and worst fit algorithms place processes of 212KB, 417KB, 112KB and 426KB (in order). Which algorithm makes the most efficient use of memory?   *[(CO2)(Analyze/IOCQ)]*

(c)   What is 'thrashing'? What is the effect of it on page fault frequency?
[(CO2)(Analyze/IOCQ)]

(2 + 1 + 3) + 3 + 3 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	61.46	33.33	5.21

Course Outcome (CO):

After the completion of the course students will be able to:
1. Apply knowledge of mathematics, science and engineering in the areas of process management, memory management and storage management.
2. Understand the underlying technologies and features of memory management and storage management. 3. Understand the various design issues in process management.
4. Learn operating system operation, structures.
5. Be familiar with various types of operating systems.
6. Identify the concepts learned here which are used in their own field of work.

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