FUNDAMENTALS OF OPERATING SYSTEMS
(CSEN 4121)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) A thread is a
(a) process (b) task (c) program (d) light weight process.

(ii) The Need matrix is given by the formula
(a) Need = Max – Allocation (b) Need = Max + Allocation
(c) Need = Max * Allocation (d) Need = Max.

(iii) Scheduling a process from ready queue to CPU is done by
(a) short term scheduler (b) middle term scheduler
(c) long term scheduler (d) dispatcher.

(iv) Bakery algorithm provides
(a) two process solution for process synchronization
(b) multiple process solution for process synchronization
(c) solution for deadlock avoidance
(d) solution for demand paging.

(v) A state is safe, if
(a) the system does not crash due to deadlock occurrence
(b) the system can allocate resources to each process in some orderand still avoid a deadlock
(c) the state keeps the system protected and safe
(d) all of these.

(vi) Thrashing
(a) reduces page I/O (b) decreases the degree of multiprogramming
(c) implies excessive page I/O (d) improves the system performance.

(vii) The time to move the disk arm to the desired sector in a hard disk is known as
(a) rotational latency (b) positioning time
(c) seek time (d) hashed time.

(viii) Which of the following page replacement algorithms suffers from Belady's anomaly?
(a) Optimal Replacement (b) LRU
(c) FIFO (d) both (a) and (b).

(ix) If a process has 24 K byte of logical address space and the page size is 4096 bytes, the number of pages in the process are
(a) 12 (b) 6 (c) 16 (d) 8.

(x) What is the purpose of resource allocation graph?
(a) To represent deadlock (b) To detect deadlock
(c) To avoid deadlock (d) To prevent deadlock.

Group- B

2. (a) What is multiprocessor or tightly coupled system? In which situations would you prefer a multiprocessor system. [(CO5)(Analyze/HOCQ)]
(b) Explain how multiprogramming operating system increases CPU utilization. [(CO1)(Analyze/HOCQ)]
(c) What is the main advantage of the microkernel approach to system design? How do user programs and system services interact in a microkernel architecture? [(CO1,CO4)(Understand/IOCQ)]

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

3. (a) What is Spooling ? [(CO2) (Remember/LOCQ)]
(b) Draw the Microkernel and Layered architecture of Operating System and explain botharchitectures. [(CO4) (Understand/IOCQ)]
(c) What is the advantage of using Virtual Machine Architecture? [(CO4)(Understand/LOCQ)]

2 + 6 + 4 = 12

Group - C

4. (a) Draw and Explain 7-state model of process state diagram. Write the difference between suspended and blocked state of the process. [(CO2,CO3)(Remember/LOCQ)]
(b) What do you mean by direct and indirect communication in terms of IPC? And what are the properties of communication link in both cases. [(CO2) (Understand /LOCQ)]

6 + (3 + 3) =12

5. (a) Consider the following set of processes, with given CPU burst time and arrival time

Process	CPU Burst	Arrival Time
P_0	10	3
P_1	2	1
P_2	4	2
P_3	1	4
P_4	5	2

Draw Gnatt chart illustrating execution of these processes using FCFS and SJF Scheduling. Find out average turned around time and waiting time for both scheduling algorithm. [(CO1,CO3)(Understand/IOCQ)]
(b) With an example explain FCFS scheduling suffers from convoy effect. [(CO6)(Analyze/IOCQ)]

(c) Under what conditions the following state transition occurs with respect to a process?

(i) Run to Ready,

(ii) Blocked (or wait) to Ready. [(CO1)(Analyze/IOCQ)]

(4 + 2) + 3 + 3 = 12

Group - D

6. (a) Explain deadlock detection mechanism in case of single instance of each resource type. What is indefinite postponement? [(CO4)(Remember/LOCQ)]

(b) Consider the following snapshot of a system.

Process	Allocation	Max	Available
P0	0 0 1 2	0 0 1 2	1 5 2 0
P1	1 0 0 0	1 7 5 0	
P2	1 3 5 4	2 3 5 6	
P3	0 6 3 2	0 6 5 2	
P4	0 0 1 4	0 6 5 6	

(i) Is the system in a safe state? Justify your answer.

(ii) If a request from process P1 arrives for(0,4,2,0), can it be granted immediately? [(CO1,CO6)(Analyze/HOCQ)]

(4 + 2) + 6 = 12

7. (a) "All unsafe state may not lead to deadlock.". Justify this statement with an example. [(CO6)(Analyze/IOCQ)]

(b) Explain how Peterson's solution solves mutual exclusion and progress for two processes. [(CO2, CO6)(Apply/HOCQ)]

(c) State the differences between deadlock and indefinite postpone. What is aging? [(CO3)(Understand/LOCQ)]

4 + 4 + (2 + 2) = 12

Group - E

8. (a) 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? [(CO3)(Understand/IOCQ)]

(b) In a paged segmented system, a virtual address consists of 32 bits, of which 12 bits are used for offset, 11 bits are segment number and 9 bits are a page number. Calculate

(i) page size

(ii) maximum number of pages

(iii) maximum segment size

(iv) maximum number of segments. [(CO1,CO2)(Understand/IOCQ)]

(c) What is the difference between internal and external fragmentation? [(CO2)(Understand/LOCQ)]

(3 + 1) + 6 + 2 = 12

9. (a) Consider a logical address space of eight pages of 1024 words each, mapped onto a physical memory of 32 page frames. Answer the following:
   (i) How many bits are there in the logical address?
   (ii) How many bits are there in the physical address? [(CO6)(Apply/IOCQ)]
   (b) Describe how a file directory system can be organized into a tree-structure and explain advantages of such arrangement. [(CO2)(Understand/LOCQ)]
   (c) How the problem of external fragmentation be solved? How logical address is converted in physical address in paging? [(CO2)(Understand/LOCQ)]

3 + 5 + (2 + 2) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	40.63	46.87	12.5

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