

**OPERATING SYSTEM  
(CSEN 3103)**

**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) Banker's algorithm with resource allocation deals with
    - (a) deadlock prevention
    - (b) deadlock avoidance
    - (c) deadlock recovery
    - (d) mutual exclusion.
  - (iii) In UNIX, the return value for the fork system call is \_\_\_\_ for the child process and \_\_\_\_ for the parent process.
    - (a) a negative integer, zero
    - (b) zero, a negative integer
    - (c) zero, a nonzero integer
    - (d) a nonzero integer, zero.
  - (iv) 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.
  - (v) If a process is executing in its critical section, then no other process can be executing in their critical section. This condition is called
    - (a) mutual exclusion
    - (b) critical exclusion
    - (c) synchronous exclusion
    - (d) asynchronous exclusion.
  - (vi) A monitor is a module that encapsulates
    - (a) shared data structures
    - (b) procedures that operate on shared data structure
    - (c) synchronization between concurrent procedure invocation
    - (d) all of the mentioned.

- (vii) 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 order and still avoid a deadlock
  - (c) the state keeps the system protected and safe
  - (d) all of these.
- (viii) Thrashing
  - (a) reduces page I/O
  - (b) decreases the degree of multiprogramming
  - (c) implies excessive page I/O
  - (d) improves the system performance.
- (ix) Addresses generated by CPU is referred to as
  - (a) logical address
  - (b) physical address
  - (c) relational address
  - (d) virtual address.
- (x) CPU fetches the instruction from memory according to the value of
  - (a) program counter
  - (b) status register
  - (c) instruction register
  - (d) program status word.

**Group - B**

2. (a) Name one essential property of the following types of operating systems:  
(i) Batch, (ii) Interactive, (iii) Time-sharing, (iv) Real time, (v) Network.
- (b) What are the differences between a trap and an interrupt? What is the use of each function?
- (c) What is the purpose of the command interpreter? Why is it usually separate from the kernel?
- 5 + 5 + 2 = 12**
3. (a) Define operating system. What are the functions of operating system.
- (b) What do you mean by system calls? What are various types of system calls?
- (c) Discuss about layered approach of operating system. What is microkernel and what are the advantages of this approach?

**(2 + 2) + (1 + 2) + (2 + 1 + 2) = 12**

**Group - C**

4. (a) A system contains 10 units of resource  $R_k$ . The resource requirements

of three processes P1, P2 and P3 are as follows:

	P1	P2	P3
Maximum Requirements	8	7	5
Current Allocation	3	1	3

Show that the system is deadlock free.

- (b) Let P1, P2 and P3 be three processes that have become ready at the same time and need 24, 3 and 3 ms respectively to complete their executions. Based on FCFS scheduling algorithm, draw the Gantt chart of CPU allocation to processes and compute average waiting time.
- (c) Based on pre-emptive and non-pre-emptive SJF scheduling policies, draw Gantt charts and average waiting times for the following processes:

Process	Arrival Time	Burst Time
P <sub>1</sub>	0.0	7
P <sub>2</sub>	2.0	4
P <sub>3</sub>	4.0	1
P <sub>4</sub>	5.0	4

$$3 + 4 + 5 = 12$$

- 5. (a) Differentiate between user level thread and kernel level thread.
- (b) What is dining philosopher problem? Write an algorithm to solve dining philosopher problem using semaphore.
- (c) Consider the following set of processes, with the length of the CPU burst time is given in millisecond.

Process	Burst time	Arrival time	Priority
P1	4	0	2
P2	2	1	4
P3	3	2	6
P4	5	3	10
P5	1	4	8
P6	4	5	12
P7	6	6	9

- (i) Draw a Gantt chart. Illustrate the execution of these process in pre-emptive priority (higher number implies a higher priority) scheduling.
- (ii) Find the completion time and response time.
- (iii) Find the average waiting time and average turn around time.

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

**Group - D**

- 6. (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?
- (b) Given references to the following pages by a program.  
7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2, 1, 2, 0, 1, 7, 0, 1  
How many page faults would occur for the following page replacement algorithms?  
(i) FIFO  
(ii) Optimal  
(Assume 3 frames available and initially none of page is in main memory).

- (c) Explain Belady's anomaly with example.

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

- 7. (a) Explain the difference between internal and external fragmentation. Which one occurs in paging system? How the problem of external fragmentation be solved?
- (b) Suppose a disk drive has 300 cylinders, numbered 0 to 299. The current head position of the disk is at 90. The queue of pending requests in FIFO order is 36, 79, 15, 120, 199, 270, 89, 170. Calculate average cylinder movements for the following algorithms.  
(i) SSTF  
(ii) SCAN  
(iii) C-SCAN

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

**Group - E**

- 8. (a) Discuss the strengths and weaknesses of implementing an access matrix using access lists that are associated with objects.
- (b) What is the need-to-know principle? Why is it important for a protection system to adhere to this principle?
- (c) A password may become known to other users in a variety of ways. Is there a simple method for detecting that such an event has occurred? Explain your answer.
- (d) What commonly used computer programs are prone to man-in-the-middle attacks? Discuss solutions for preventing this form of attack.

$$3 + 3 + 3 + 3 = 12$$

9. (a) What are two advantages of encrypting data stored in the computer system?
- (b) Discuss how the asymmetric encryption algorithm can be used to achieve the following goals.
- (i) Authentication: the receiver knows that only the sender could have generated the message.
  - (ii) Secrecy: only the receiver can decrypt the message.
  - (iii) Authentication and secrecy: only the receiver can decrypt the message, and the receiver knows that only the sender could have generated the message.
- (c) How are the access-matrix facility and the role-based access-control facility similar? How do they differ?

$$2 + (2 + 2 + 2) + (2 + 2) = 12$$