

**FUNDAMENTALS OF OPERATING SYSTEMS  
(CSE3121)**

**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) To access the services of operating system the interface is provided by the?  
(a) System call (b) Application Program  
(c) API (d) Assembly Instructions
- (ii) Which of the following is not an operating system?  
(a) Windows (b) Oracle (c) Unix (d) Linux
- (iii) The process by which a storage disk can be divided into some storage drive sectors is called  
(a) tracking (b) Partitioning (c) Formatting (d) Allotting
- (iv) Which of the following is not a condition that causes deadlock?  
(a) Mutual Exclusion (b) Pre-emption  
(c) Hold and wait (d) Circular wait
- (v) Which of the following are two types of atomic operations performed by semaphores?  
(a) wait and post (b) wait and signal  
(c) signal and stop (d) wait and stop
- (vi) If fork is called n times successfully, how many child processes are executed simultaneously?  
(a) n (b)  $(2^n) - 1$  (c)  $2^n$  (d) n-1
- (vii) The term used for the mapping of logical addresses to physical addresses is:  
(a) Address resolution (b) Address translation  
(c) Memory mapping (d) Paging
- (viii) What does a page fault indicate?  
(a) The page is already in memory (b) The page needs to be fetched from disk  
(c) The memory is full (d) A logical address is invalid.

- (ix) What is the use of a directory structure in the operating system?  
 (a) The directory structure is used to solve the problem of network connection in the OS  
 (b) It is used to store the folders and files hierarchically  
 (c) It is used to store the program in a file format  
 (d) All of these

- (x) In C-scan, C stands for  
 (a) Common      (b) Circular      (c) Control      (d) Commit

*Fill in the blanks with the correct word*

- (xi) A program is a \_\_\_ entity but process is an \_\_\_ entity.  
 (xii) Resource Allocation Graph is a useful tool to represent a \_\_\_ in a system.  
 (xiii) If the time quantum is too short, Round Robin scheduling suffers from \_\_\_\_.  
 (xiv) The \_\_\_ is the address used by the CPU to access a particular memory location, while the \_\_\_ is the actual location in physical memory.  
 (xv) The \_\_\_\_\_ page replacement algorithm replaces the least recently used page in memory.

### Group - B

2. (a) Explain a symmetric multiprocessor system with a labelled diagram. [[CO2](Understand/IOCQ)]  
 (b) What is the speed-up ratio? "The speed-up ratio with N processors is not N; however, it is less than N". Please explain the statement. [[CO2](Understand/LOCQ)]  
 (c) Write the three features of the timesharing (multitasking) system. [[CO1](Understand/LOCQ)]  
**(2 + 3) + (2 + 2) + 3 = 12**
3. (a) Arrange the following according to the size and the access time in ns. Registers, cache, main memory, solid-state disk, and magnetic disk [[CO1](Understand/LOCQ)]  
 (b) What is cache coherency? Write the three Memory management components of I/O with a one-line description of each. [[CO1](Understand/IOCQ)]  
 (c) Protection is a mechanism for controlling the access of processes or users to resources defined by the OS. Provide three example mechanisms that the OS defines to provide protection. What is security? [[CO1](Understand/IOCQ)]  
**2 + (2 + 3) + (3 + 2) = 12**

### Group - C

4. (a) Define multiple parts of a Process. [[CO2](Understand/LOCQ)]  
 (b) Give one example justifying that one program can be several processes. [[CO2](Understand/LOCQ)]

- (c) Draw the 5-state model of the process state diagram with proper labelling. Explain each state.

[[CO2](Understand/IOCQ)]

$$5 + 2 + (2 \times 2.5) = 12$$

5. (a)	Process Arrival Time	Burst Time
	P1	16
	P2	3
	P3	5
	P4	2

What will be the average waiting time and total turnaround time if we use the shortest job first CPU scheduling algorithm? Draw the scheduling chart and calculate.

[[CO3](Apply/IOCQ)]

- (b) What is the convoy effect in the domain of CPU scheduling? Give an example scenario where you can experience this effect. How could you solve the problem?

[[CO4](Analyze/IOCQ)]

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

### Group - D

6. (a) Define deadlock.

Draw the Resource Allocation Graph (RAG) for the following requirements and state if it will create a deadlock. Give a reason for your answer.

There are two threads T1 and T2 and two types of resources R1 and R2. There exists one instance of resource type R1 and one instance of resource type R2. Thread T1 is holding an instance of resource type R2 and is waiting for an instance of resource type R1. Thread T2 is holding an instance of R1 and waiting for an instance of R2.

[[CO5](Judge/IOCQ)]

- (b) What is starvation?

[[CO4](Analyze/LOCQ)]

- (c) Define the Readers-Writers problem. To address the critical section problem of this problem, which semaphores would you use?

[[CO4](Analyze/IOCQ)]

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

7. (a) What is a safe state?

[[CO5](Judge/LOCQ)]

- (b) What is the wait-for graph in the deadlock detection algorithm? When should we invoke the detection algorithm?

[[CO5](Judge/LOCQ)]

- (c) Solve the following using Bankers' Algorithm:

$P_n$	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				

What is the content of the need matrix? Is the system in a safe state? Find the safety sequence.

[[CO3](Apply/HOCQ)]

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

## Group - E

8. (a) Find the size of the memory if its address consists of 22 bits. Assume the memory is 2-byte addressable. *[[CO3](Apply/LOCQ)]*
- (b) Consider a single-level paging scheme. The virtual address space is 256 MB, and the page table entry size is 4 bytes. What is the minimum page size possible such that the entire page table fits well in one page? *[[CO3](Apply/IOCQ)]*
- (c) Compare and contrast fixed partitioning and variable partitioning in contiguous memory allocation. *[[CO3](Apply/IOCQ)]*
- 4 + 4 + 4 = 12**
9. (a) Consider the following sequence of memory references generated by a single program in a pure paging system:  
10, 11, 104, 104, 170, 173, 177, 309, 245, 246, 247, 458, 364.  
Determine the number of page faults for each of the following page replacement policies, assuming 3(three) page frames are available and all are initially empty. The size of a page is 100 words:
- (i) LRU
- (ii) FIFO
- (iii) Optimal Page Replacement. *[[CO3](Apply/HOCQ)]*
- (b) Is Segmentation possible without paging? Justify your answer.? *[[CO4](Analyse/IOCQ)]*
- 7 + 5 = 12**

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	29.17	57.29	13.54