Indian Institute of Information Technology Chittoor, Sri City

Name of the Exam: **Distributed Computing** Duration: **1½** Hours Total Marks: 40

Roll No.:_____ Room No.: _____ Seat No.: _____

Name: _____ Invigilator's Signature: _____

Instructions:

1. Read all questions carefully and answer them in the space provided (**Strictly within the box**).
2. Answer all questions compulsorily (no choice, unless otherwise mentioned) within the given box. **Answers must be written inside the box only** and no rough work should be done inside the box. Use your space insider the answer box efficiently and avoid useless explanations.
3. Two empty sheets are provided at the end of this booklet for rough work. No additional sheet would be provided.
4. **Calculators / Electronic gadgets** are **NOT** permitted during the examination.
5. Most importantly, **NO answer should be written in Pencil**. Pencils are allowed for rough work but the final answers should be written using either a **BALL - POINT** pen or **INK** pen.
6. We already provided two empty sheets for rough work. Use pencil to do the rough work so that you could reuse these extra pages.
7. Exchanging of stationary items is prohibited inside the hall. Bring your own stationary items.

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1. [4 Marks] Define a distributed system. Also state and briefly describe the essential characteristics of a distributed system. How is a distributed system different from a parallel system?

Definition:

Characteristics:

1)

2)

3)

Parallel vs. Distributed system:

2. [2 marks] State two examples (other than distributed sorting) that need real-time distributed systems and justify the critical task in these examples that need distributed processing.

1)

2)

3. [2 marks] Assume that the communication channel is bi-directional and we focus on 4 different interconnection networks: line, ring, mesh and, tree network. There are n processes in each network and any process can inject a message m into the network. Now compare the total number of message exchanges required (in the best and, the worst cases) for the message m to return to its source process for the first time since it has been injected into the network.
[For specifying the complexity, please use big-O notation like O(n), O(log n), and so on]

	Best case	Worst case	Which data structure will you assume for the underlying network and why?
Line Network			
Ring Network			
Mesh Network			
Tree Network			

4. [2 marks] Formally define Concurrent Events and what is the necessary and sufficient condition for a pair of events to be concurrent?

Definition:

Condition(s):

5. [2 Marks] Compare odd-even transposition sorting with Sasaki's time-optimal distributed sorting algorithm and state at least 4 unique differences between these two algorithms:

Odd–Even Transposition Sort Sorting	**Sasaki's Time–Optimal Distributed**
1) 2) 3) 4)	

6. [3 Marks] State different processing models of Flynn's taxonomy each with an example.

7. [2 Marks] Assume any two messages in a distributed system. How will you define causal ordering between these two messages?

8. [2 Marks] Mathematically define a consistent global state of a distributed system.

9. [5 marks] Briefly describe Lamport's Logical clock approach and illustrate the correction of clocks with an example. Also mention at least 2 limitations of Lamport's logical clock approach.

Approach:

Illustration:

Limitations:

1)

2)

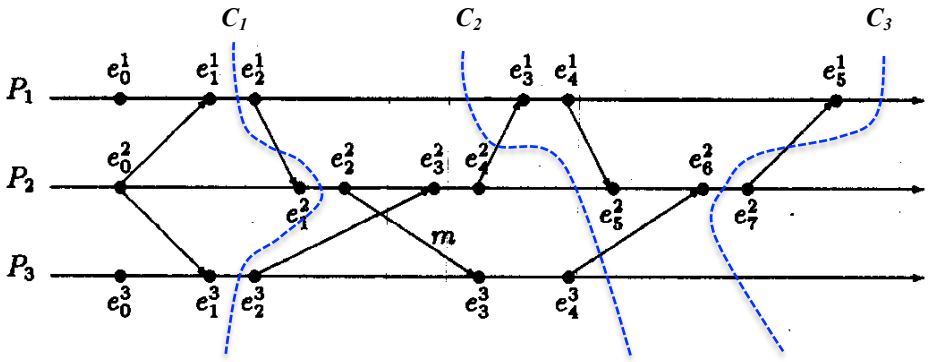
10. [6 marks] Describe Chandy and Lamport's global snapshot recording algorithm and illustrate it with a pair of processes and a set of variables: x_i, y_i and z_i (Initially all set to 0) at each P_i.

Chandy – Lamport's Algorithm:

Illustration:

11. [2 marks] State the condition for termination detection of a distributed computation.

12. [8 marks] Carefully look at the state – time diagram of 3 processes in a distributed system.



Let the local state LS_x^i denote the state of P_i after occurrence of the event e_x^i and before the occurrence of the event $e_{(x+1)}^i$. Here superscript denotes the process ID and subscript denotes the event ID. Now answer the following questions:

a) [2 marks] Find and List any two events in such a way that one event does not casually affect the other and justify your choice of events with "happened before" concept.

b) [2 marks] State whether the cuts C_1, C_2 and, C_3 are consistent or not? Justify your answer.

1) C_1 is _____ why? _____

_____

2) C_2 is _____ why? _____

_____

3) C_3 is _____ why? _____

c) [2 marks] Identify and list any 4 concurrent events from the above space-time diagram:

i.

ii.

iii.

iv.

d) [2 marks] State whether the given global state is consistent or not?

i. $GS_1 = \{LS_2^1, LS_0^2, LS_0^3\}$ is _____

ii. $GS_2 = \{LS_0^1, LS_2^2, LS_2^3\}$ is _____

iii. $GS_3 = \{LS_1^1, LS_4^2, LS_2^3\}$ is _____

iv. $GS_4 = \{LS_4^1 , LS_5^2 , LS_4^3 \}$ is _____

Space for ROUGH WORK

Space for ROUGH WORK