INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, NAGPUR
Department of Computer Science and Engineering
End Semester Examination (Descriptive): January – June 2020
Distributed Computing Systems (CSL423)
Course coordinator: Dr. U.A. Deshpande (9822698329)/
Dr. Milind Penurkar (9552559528).

Duration: 2 Hours and 30 Minutes **Max. Marks: 30**

***Important Instructions*:**
1) Write the following at the start of 1st page of your answer sheet:

End Semester Examination: January – June 2020

Name:	**Enrollment Number:**
Branch:	**Semester:**
Course Title:	**Course Code:**
Date:	**Number of sheets used:**
Signature of student:	

2) Write page number on each page of your answer sheet
3) After completion of writing all the answers, scan the complete document as a single PDF file and upload it. All pages in the scanned document should be thoroughly checked to ensure all pages are clearly scanned and are readable.
4) In case of any issue during examination, contact the course coordinator immediately.
5) Retain the hardcopy of your answer sheet as it needs to be submitted to the course coordinator once the institute resumes.

Important Instructions from the Course Coordinator:
- This question paper comprises total **8** questions for **5** marks each.
- Solve any **6** questions.

Q1 Briefly explain how the Franklin's algorithm for leader election achieves O(nlogn) message complexity, where there are n nodes in the ring. In the algorithm, when does a node begin a new round?

Q2 Give an informal proof that Ricart-Agarwala algorithm for distributed mutual exclusion is correct. Explain how to determine its performance measures. Can it work when the links do not support in-order delivery of messages?

Q3 Explain what problems might occur if Lamport's algorithm for global state collection is deployed in a network where the links do not support in-order delivery of messages.

Q4 Why is the Byzantine Agreement Problem not solvable using oral messages when the total number of nodes in the system is three and there is one faulty node? Show how the problem can be solved if there are four nodes and one faulty node.

Q5 With an example, show how does an uncoordinated checkpointing and rollback scheme rolls back to a consistent global state after the recovery of a crashed node. What is the maximum number of iterations required for the termination of the algorithm?

Q6 (a) In the dynamic voting scheme for fault tolerance, with an example, explain why should a node get a majority of votes when it wants to increase the number of votes after it detects a failure of some other node?

(b) In this scheme, what actions must a node perform when it recovers from a failure and wants to integrate with the rest of the system?

(c) How can the initial votes of a node be decided?

Q7 Explain how the Request Sets can be constructed when using Maekawa's algorithm for mutual exclusion, when there are nine nodes in the system. Why can a deadlock occur and how is it handled in Maekawa's algorithm?

Q8 Consider the algorithm by Chandy-Misra-Haas for detecting a *communication deadlock (OR model)*. In the following wait-for-graph, does a communication deadlock exist? If not, give reasons. If yes, briefly trace the steps explaining how node 0 detects a communication deadlock.