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- (e) Explain the Bully algorithm.
 - (f) What are vector clocks? What are the advantages of vector clock over Lamport clock?

2 Attempt any **two** parts : **10×2=20**

- (a) What are Phantom Deadlocks? Explain the algorithm which could detect phantom deadlocks?
- (b) Construct a solution to reliable, totally ordered multicast in a synchronous system, using a reliable multicast and a solution to the consensus problem.
- (c) What are Agreement Protocols? What are Agreement and validity objectives of Byzantine Agreement Problems?

3 Attempt any **two** parts : **10×2=20**

- (a) What do you mean by the Distributed object model ? Write a short note on Remote method invocations.
- (b) What do you mean by Digital Signature ? Explain the different methods for generating and verifying signatures.
- (c) What is the difference between a file service using the upload/download model and one using the remote access model? What is the difference between tree structured directory system from a general graph structured system?

4 Attempt any **two** parts : **10×2=20**

- (a) Describe how a non-recoverable situation could arise if write locks are released after the last operation of a transaction but before its commitment.

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- (b) What are the advantages and drawbacks of multiversion timestamp ordering in comparison with the ordering timestamp ordering.
 - (c) Explain the difference between linearizability and sequential consistency, and why the latter is more practical to implement, in general ?

5 Attempt any **two** parts : **10×2=20**

- (a) What is Routing? What is Destination based routing?
- (b) What is Election Algorithm? Suppose that two processes detect the demise of the coordinator simultaneously and both decide to hold an election using the bully algorithm. What happens?
- (c) Write short notes on :
 - (i) ARP problem
 - (ii) Deadlock free Packet Switching.