Course Code : CST 401 **ITSJ/RW – 17 / 1098**

Seventh Semester B. E. (Computer Science and Engineering) Examination

DISTRIBUTED SYSTEMS

Time : 3 Hours] [Max. Marks : 60

Instructions to Candidates :—

(1) All questions carry marks as indicated against them.
(2) Number your answers properly.
(3) Assume suitable data and illustrate answers with neat sketches wherever necessary.

1. (a) Three computers (A, B and C) communicate using a protocol that implements the idea of Lamport clocks (they include their clock time stamp in messages). At the beginning of time, all three computers begin with their logical clock set at zero

Later, the following sequence of events occurs :

- A sends message M1 to B : "hi"
- After sending M1, A sends message M2 to C : "hi"
- After receiving M1, B sends message M3 to C : "A told me hi".
- After receiving M3 first and then M2, C sends message M4 to A : "B is studying"

(i) Draw appropriate space time diagram for the above scenario

(ii) Indicate the time included with the messages as they are sent at each step.

(iii) Write out the vector time representation with the following messages as they are sent at each step.

(iv) Mention concurrent events in the space time diagram. 5 (CO 1)

(b) State the rules of Huang's termination detection algorithm.
Implement the algorithm for the following scenario.
Computation starts at process P1 (which acts as the controlling agent).

(a) P1 asks P2 to do some computation.

(b) P2 requests P3 to do part of its computation.

(c) P3 passes on part of its job to P4.

(d) After some time, P2 uses P5 to carry out another part of its computation.

Draw a process – tree diagram and mention the weights assigned to each process.
Now, the computation completes in the following sequence :

(a) P5 completes and hands over the results to P2 ;

(b) after that, P4 hands over the results to P3 ;

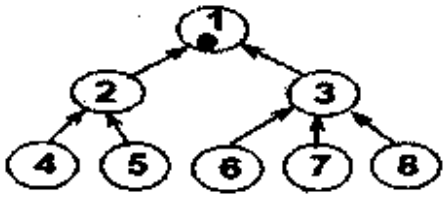
(c) then, P3 passes the results to P2 ;

(d) Finally, P2 hands over to P1..

assigned / returned by each process. 5 (CO 1)

2. (a) List and describe the characteristics that a solution to a synchronization (mutual exclusion) problem must have. 2 (CO 2)

(b) Simulate the working of Raymond's Tree based algorithm for the following scenario.



Process 1 is initially the token holder. If even takes place in the following order :

- P8 makes a request,
- P2 makes a request,
- P6 makes a request,
- P1 exit critical section and releases the token
- P1 passes token to P3
- P3 passes token to P8

- P8 exit critical section
- P7 makes a request.

(i) Show in diagram how each process updates its queue and how the token is being passed until all the requests have been served.

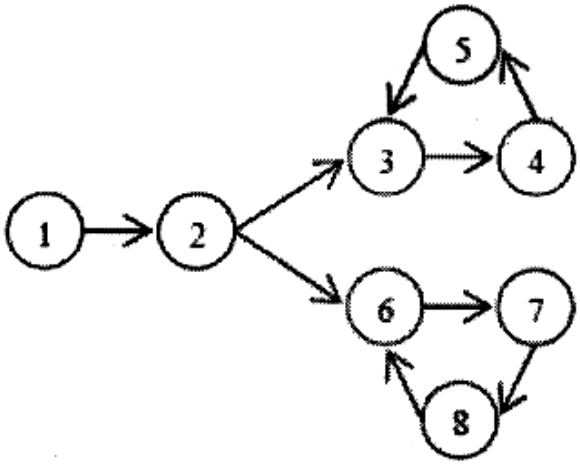
(ii) Compute the number of messages required for CS invocation in this case. 5 (CO 2)

(c) For deadlock handling, does Maekawa's algorithm access the critical section according to the increasing order of timestamps ? Justify the answer with example. 3 (CO 2)

OR

(d) Show that in the Lamport algorithm, the critical section is accessed according to the increasing order of timestamps. 3 (CO 2)

3. (a) In the following wait for graph, detect a distributed deadlock if any, viewing the model as an OR model and using Chandy et al's algorithm. Show all the messages that will flow over the edges to detect the deadlock. Assume node 1 is the initiator.

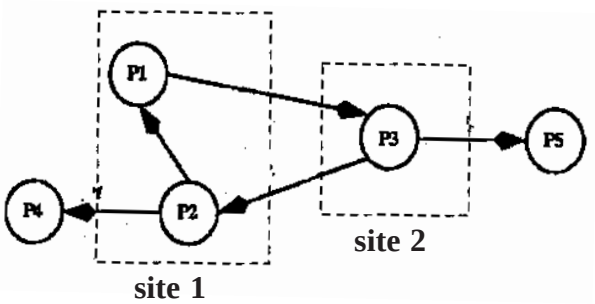


5 (CO 2)

OR

(b) Find out Cycles and Knots in the following wait for graph. Trace the steps for the following WFG if node P1 initiates using Chandy Misra Hass

edge – chasing algorithm.



5 (CO 2)

(c) Compare consensus problem, byzantine problem and interactive consistecy problem in terms of three basic requirements i. e. Termination, Agreement and Validity. 5 (CO 2)

4. (a) What is strict consistency and why is it not possible to achieve it in a distributed system ?
Is the following sequence of events allowed with a sequentially — consistent data store ?

P1 :	W (x) a			W (x) c	
P2 :		R (x) a	W (x) b		
P3 :		R (x) a		R (x) c	R (x) b
P4 :		R (x) a		R (x) b	R (x) c

4 (CO 3)

OR

(b) Discuss cache coherence in PLUS system with neat sketch. 4 (CO 3)

(c) Cache consistency is most desirable and essential property for any file system. Sun NFS and Sprite File System use their own consistency models. Differentiate between both implementations. Also, specify difficulties in using strong consistency model at all the times. 3 (CO 3)

(d) A stateful file server records state information for its clients. What problems are associated with this type of file server ? Give scenario where it might be necessary to use stateful file server. 3 (CO 3)

5. (a) Compare load balancing and load sharing policies for load distribution. 2 (CO 3)

(b) What is processor thrashing ? Give the scenario of processor thrashing using single threshold policy. 2 (CO 3)

(c) Describe the components of a load distributing algorithm. Compare the threshold location policy with shortest location policy of Sendor – initiated load sharing algorithm. Mention drawbacks of sender initiated algorithm. 6 (CO 3)

OR

(d) Differentiate between preemptive and non preemptive task migration. What are the drawbacks of above average algorithm ? Discuss how these drawbacks are removed in stable symmetrically initiated algorithm. 6 (CO 3)

6. (a) Consider a distributed transaction involving the participation of two processes, A and B. Each process runs on a different machine installed with a database. The transaction is split amongest A and B and cannot be committed until both A and B have committed their parts of the transcation.
Now, A and B successfully execute their parts and send the coordinator a VOTE_COMMIT message implying that each is ready to locally commit its part. In return, the coordinator initiates a GLOBAL_COMMIT message affirming to proce ed with the commit. While A receives the GLOBAl_COMMIT message and performs the commit, just before the GLOBAL_COMMIT message arrives at B, it crashes. Answer the following questions precisely and concisely :—

(i) When B revives, which stage in the 2PC protocol does B resume from ? Explain.

(ii) Once B has resumed its current stage, does it perform the usual sequence of operations in that stage ? Explain.

(iii) Does B ever learn about the GLOBAL_COMMIT message sent by the coordinator ? Explain.

(iv) Mention drawbacks of two phase commit protocol. 6 (CO 4)

(b) Explain problem of livelocks and domino effect with a suitable example. 4 (CO 4)

OR

(c) Explain the Bell–Lapadula model. Highlight information flow and access control. 4 (CO 4)