Ref. No.: EX/IT/T/323/2017

B.E. INFORMATION TECHNOLOGY 3RD YEAR 2ND SEMESTER EXAMINATION-2017

Subject: Distributed Systems: Algorithms

Time: 3 Hours **Full Marks: 100**

Note: Attempt *Q.1* and any *five* from the rest

Q.1 Answer any *ten questions.*

a) Explain the role of marker message in Chandy-Lamport 'snapshot' algorithm.
b) Write at least *four* fallacies for designing distributed systems w.r.t. underlying network.
c) Discuss the consequence(s) of the "absence of shared memory" in distributed system.
d) What is the role of middleware in a distributed system?
e) How can a distributed algorithm be distinguished from a centralized algorithm?
f) Why is it not always a good idea to aim at implementing the highest degree of transparency possible?
g) "If a system supports replication transparency that generally supports location transparency", Explain with suitable examples
h) When does a resource request model behave as unrestricted model?
i) Under which condition(s) an anonymous network will be deterministic and/or probabilistic?
j) "If a system supports relocation transparency it will also support migration transparency", Explain with suitable examples.
k) How a leader is elected in arbitrary network?
l) Write the advantage and disadvantage of Matrix clock over Vector clock in distributed system

2x10

Q.2

a) Discuss the following issues of distributed system: i) Openness and ii) Dimensions of scalability.
b) Write the similarity and dissimilarity of replication and caching. Why the masking failure is one of the hardest issues in failure transparency of distributed system?
c) Explain with suitable example(s), i) Centralized services are sometimes unavoidable and ii) Trade-off in between degree of transparency and performance of distributed system.
d) Update the clock-value after each event occurred at the processes, P_0 to P_4 (in Figure 1) using rules of Matrix Clock.

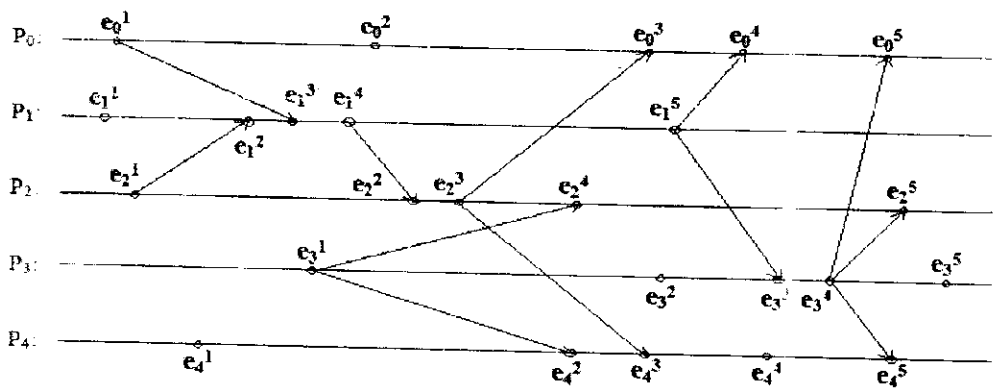

Figure 1

Q.3

2x2+2x2+2x2+4

a) Prove that, presence of knot in OR model indicates a deadlock.
b) State the different features of p-out-of-q model as resource request model. Hence, deduce AND, OR, and single resource model.
c) Write the advantage(s) and disadvantage(s) of path pushing, edge-chasing and diffusion-computation class of algorithms.
d) "Asynchronous distributed system is more realistic than synchronous" – Explain.

3+(2+3)+(2x3)+2

Q.4

a) "Causality of events can only be captured by Vector clock & Matrix clock" – Explain.

b) Give the internal meaning of the followings w.r.t. physical clock: clock skew, clock drift rate, external synchronization and internal synchronization.

c) How many average number of messages will be transmitted in electing a coordinator among 13 numbers of processes (including present coordinator which is currently down) for Bully and Ring algorithms?

d) Establish the rules for causally-ordered multicasting of messages by Matrix clock. Hence, update the clock value for each $MC_i(?)$, i = 0, 1 and 2 in Figure 2.

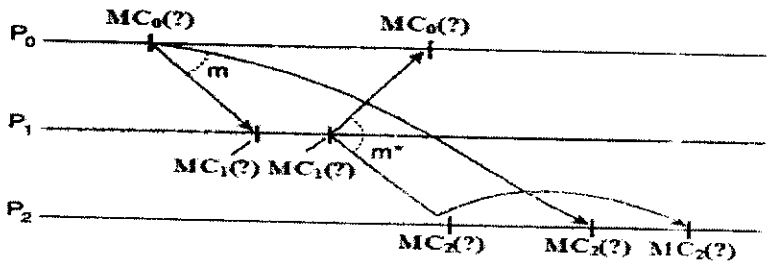

Figure 2

2+4+2x2+(2+4)

Q.5

a) How will a distributed-computation terminate using 'snapshot'algorithm, DONE and CONTINUE messages for any others and monitor process?

b) Define with suitable examples (if required): Run, Linearization, Frontier and Global history.

c) Explain with suitable example(s), i) "Any subset of the global history can not be a cut" and ii) "Not all runs are linearization".

d) Establish a reachability relation among observed, initial and final global states. Draw as maximum as possible number of cuts in *Figure 1* which will indicate the execution of a distributed system as a series of global states.

3+4+2x2+(2+3)

Q.6

a) Write down at least *eight* different types of software failure in distributed systems.

b) Consider a distributed system with three processes (P_i, $i \in [1, 3]$), three incoming FIFO channels (C_j, $j \in [1, 3]$) and two messages (m_k, $k \in [1, 2]$), where each process is associated with one incoming channel, satisfying the condition $\{P_i, C_j\} x \{m_k\} \rightarrow \{Active, Passive\}$. Under which probable conditions the system will: i) be eligible for termination and ii) not be eligible for termination?

c) Describe the followings w.r.t. distributed system: i) balanced sliding window protocol and ii) dead lock free packet switching.

d) What action will be taken by a process when more than one marker message is received, sent by different monitors/initiators?

4+4+(3+3)+2

Q.7 Write short notes on any *four*.

a) Net change algorithm

b) Election in chordal rings

c) Archimedean assumption

d) Korach-Kutten-Moran Algorithm

e) Computing network size

f) Hypercube computing and its application(s)

4x4