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MAIN EXAMINATION

JANUARY – APRIL 2020 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF COMPUTER AND LIBRARY SCIENCE

REGULAR PROGRAMME

CMT 308: DISTRIBUTED SYSTEMS

Date: APRIL 2020	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and any other TWO Questions	

Q1. a) Define the following terms:

i) Software Redundancy **(1 Mark)**

ii) Middleware **(1 Mark)**

iii) Heterogeneity **(1 Mark)**

iv) Openness **(1 Mark)**

b) Identify and briefly describe five important requirements in the design of distributed systems. **(10 marks)**

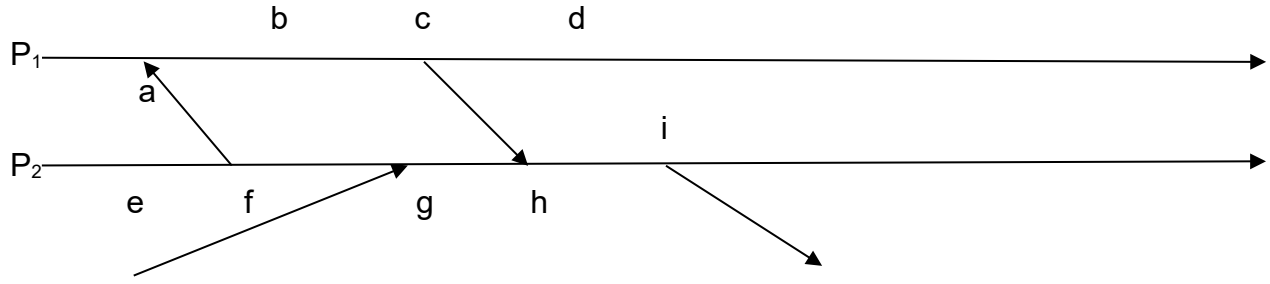
c) Distinguish the following terms:

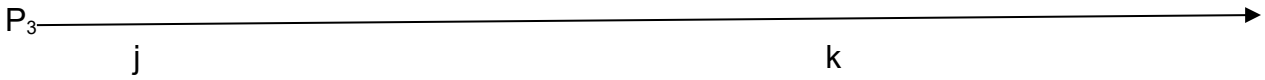
i) Intermittent and transient fault **(2 marks)**

ii) Backward and forward recovery **(2 marks)**

iii) Mobile code and mobile agent **(2marks)**

d) Consider the following set of events:





Assign the missing vector clock values to the events. **(10 marks)**

Q2. a) Consider a bully election with six processes, P1 – P8. P8 (the current coordinator) fails and P4 starts the election. Illustrate the messages exchanged (use figures).

(8 Marks)

b) How many processors do you need in order to achieve k fault tolerance with byzantine faults.

i) For agreement **(2 marks)**

ii) With a majority voting scheme **(2 marks)**

c) Explain two benefits of replication. **(2 marks)**

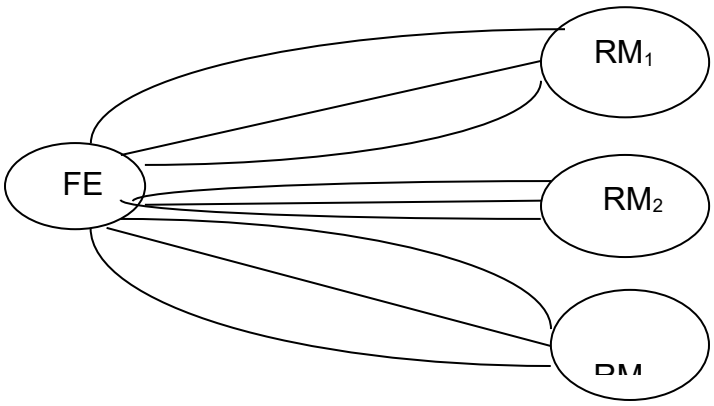
d) Security goals of a distributed system are decided by security policies. Explain three policies that would guarantee appropriate use of resources by different users.

(6 marks)

Q3. a) i) What are the potential problems found in client server systems? **(2 marks)**

ii) How are they solved with peer-to-peer systems? **(2 marks)**

b) Consider total ordering based on distributed agreement (no central sequencer); consider one front end and several replication managers as illustrated below.



Three messages have to be exchanged by the Front End (FE) with each Replica Manager (RM). Explain the reason why these messages have to be exchanged and what the messages contain. **(6 marks)**

c) Trace the way of a request and of a reply from the client to a remote server and back in Remote Method Invocation. Illustrate with a figure. **(10 marks)**

Q4. a) Explain five mechanisms that Transport Control Protocol (TCP) implements on top of internet protocol (IP) in order to meet reliability guarantees. **(10 marks)**

b) Describe two problems with Lamport's logical clocks. **(2 marks)**

c) Identify and briefly describe two requirements for a mutual exclusion mechanism. **(4 marks)**

d) Define the following types of redundancy.

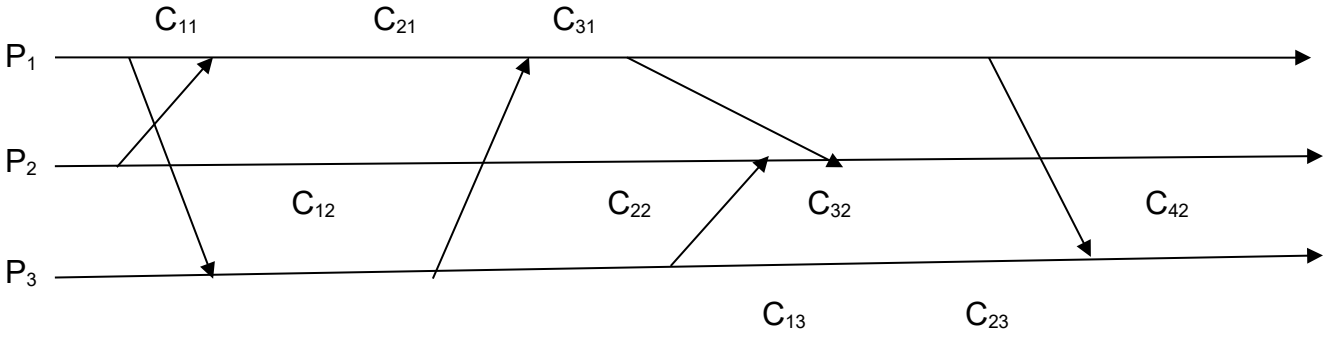
i) Time redundancy (1 mark)

ii) Hardware redundancy (1 mark)

iii) Software redundancy (1 mark)

iv) Information redundancy (1 mark)

Q5. a) Consider the following snapshot.



Determine for each of the following cuts if it is inconsistent, consistent or strongly consistent:

$\{C_{21}, C_{12}\}$, $\{C_{31}, C_{42}\}$, $\{C_{22}, C_{13}\}$, $\{C_{32}, C_{23}\}$, $\{C_{23}, C_{42}\}$, $\{C_{11}, C_{12}\}$ **(6 marks)**

b) Different copies of identical software always produce the same behavior for identical inputs thereby making software redundancy difficult to implement. Outline five approaches that you can employ to mitigate against this occurrences. **(5 marks)**

c) Identify and describe two ways in which mobile devices explore their environment. **(4 marks)**

d) Briefly describe five features found in real time systems. **(5 marks)**

END