Ref. No.: Ex/PG/DMC/T/1210B/2019

M.TECH DISTRIBUTED AND MOBILE COMPUTING FIRST YEAR SECOND SEMESTER 2019

DISTRIBUTED OPERATING SYSTEMS

Time: Three hours **Full Marks:** 100

Answer any ***five*** from the following questions. Each question carries twenty marks.
Make your answer brief and to-the-point.

1. a) What is ***distributed operating system*** **(DOS)?** Name various kinds of **DOS** that exist in literature and compare them with respect to **degree of transparency**, **underlying hardware** (homogeneous or heterogeneous), **number of OS**, **basis for communication** and **scalability**.
   b) Write down the advantages and disadvantages of ***distributed systems*** **(DS)** over the **centralized systems**. What is the difference between a ***multiprocessor*** and a ***multicomputer***?
   c) A bus-based **multiprocessor** uses **snoopy caches** to achieve a coherent memory. Will ***semaphore*** work on this machine?
   (2+6) + (6+3) + 3

2. a) Describe the **Lamport's** algorithm for achieving total ordering of various events in a ***distributed system*** **(DS)**. Are the time values assigned to events necessarily close to actual **physical time**? Justify your answer.
   b) What is ***mutual exclusion***? Describe the **Ricart and Agrawala's** algorithm for achieving mutual exclusion in a **DS**.
   c) A **DS** may have multiple, independent ***critical regions*** **(CR)**. Imagine that *process 0* wants to enter **CR** *A* and *process 1* wants to enter **CR** *B*. Can **Ricart and Agrawala's** algorithm lead to deadlocks? Explain your answer.
   (5+2) + (1+8) + 4

3. a) How a transaction is represented and executed in a distributed system?
   b) Define ***well-formed*** transaction and ***two-phase*** transaction. Consider the following transaction **T1** and define it in well-formed two-phase form.

```
T1:begin_transaction
        read(x); read(y); write(x-5); write(y+5);
   end_transaction.
```

   c) Prove that if **{ T1, T2, ..., Tm}** is a set of well-formed and two-phase transactions, then any legal schedule is equivalent to a serial schedule.
   3 + (2+3) + 12

4. a) Describe a distributed periodic deadlock detection algorithm. Prove that global deadlock will be detected by some site if that distributed periodic deadlock detection is followed.
   b) What is ***phantom deadlock***? Illustrate it with an example. How it can be prevented to occur?

   (8+4) + (5+3)

5. a) "The choice of lockable object or granularity of the database, presents a trade off between increased concurrency and system overhead" – explain. Define three different ***intention locking modes*** that are introduced to increase concurrency in a distributed system and also show compatibility among these three locking modes.
   b)Describe the ***two-phase commit*** protocol. What happens if **COMMIT Coordinator** crashes after successful write of a COMMIT record but before writing a COMPLETE record?

   (3+3+2) + (10+2)

6. a) Specify one major limitation of bus-based **multiprocessor**? What alternative system design has been proposed in literature to overcome it?
   b) Describe the cache consistency protocol adopted by ***Dash***. A **Dash** system has B bytes of memory divided over m clusters. Each cluster has n processors in it. The cache block size is c bytes. Give a formula for the total amount of memory devoted to directories (excluding the two state bits per directory entry).
   c) Write down the differences between **UMA** multiprocessor and **NUMA** multiprocessor.

   (1+4) + (8+4) + 3

7. a) What are the advantages of a***distributed shared memory*** (**DSM**) system over a **distributed system**? Write down the basic design principle of page-based **DSM**.
   b) Although use of **replicated pages** among the processors can improve the performances of the page-based **DSMs**, but if a process attempts to write on a **replicated page**, a potential consistency problem arises - explain it. Describe a suitable **protocol** to overcome this consistency problem.
   c) Write down the page replacement algorithm followed by **DSM** systems.

   (2+4) + (3+6) + 5