Ref. No.: **Ex/PG/DMC/T/1210B/2018**

M.TECH DISTRIBUTED AND MOBILE COMPUTING FIRST YEAR SECOND SEMESTER EXAM 2018

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.
Use illustrative diagrams wherever necessary.

1. a) What is ***distributed system*** **(DS)**? Describe the classification of distributed systems based on how multiple CPUs are interconnected and how they communicate.
   b) Explain in your own word the concept of ***access transparency*** and ***parallelism transparency***.
   c) Compare between ***monolithic kernel*** and ***microkernel***.
   d) An experimental file server is up 3/4 of the time and down 1/4 of the time, due to bugs. How many times does this file server have to be replicated to give an availability of at least 99 percent?

   (1+5) + (2+2) +6+ 4

2. a) Show how the **name server (NS)** can be used for **addressing** in a **distributed system.** Specify the benefits and also the negativity of using **NS** for addressing in a **DS**.

   b) If the communication primitives in a ***client-server*** system are ***nonblocking***, a call to ***send*** will complete before the message has actually been sent. To reduce overhead, some systems do not copy the data to the kernel, but transmit it directly from user space. For such a system, devise two ways in which the sender can be told that the transmission has been completed and the ***buffer*** can be reused.

   c) Discuss different approaches to implementing ***reliable communication*** between the client and the server in case the **communication channel** between them is **unreliable**, i. e., messages may get lost.

   (4+2) + 6 + 8

3. a) What is **distributed mutual exclusion** problem? Specify the **necessary** as well as **desirable conditions** for solving the **distributed mutual exclusion** problem.

   b) Describe the ***distributed mutual exclusion algorithm*** proposed by **Maekawa**. Explain its performance and show that it achieves ***optimal performance***.

   (2+6) + (8+4)

4. a) Describe the ***happened-before relation*** which is used for ordering different events in a **distributed system** without using any physical clock. Show that ***happened-before relation*** is transitive in nature.
b) Can ***happened-before relation*** implement the total ordering of all the events within a **distributed system** (**DS**)? If not, then how ***total ordering*** on all the events within a **DS** can be induced without using any physical clock.
c) Define ***well-formed*** and ***strong two phase*** transaction.

(6+2) + (2+6) + (2+2)

5. a) Prove that if [$S_1, S_2 \ldots S_n$] are node schedules for a set of transactions denoted by {T_1 T_2 .... T_m }, then there is a global schedule S such that
   i. T_i and S_i are subsequences of S and
   ii. if each S_i is legal, then S is legal.

   b) Describe a ***distributed deadlock detection*** algorithm by considering
   i. a site where the deadlock detection message is initiated and
   ii. a site where such a message is received. Here, consider two sub-cases:
      A. the receiving site is not the originating site of the message, and
      B. the receiving site is the originating site of the message.

10 + 10

6. a) What is **hierarchical system of locks**? Define the notions of ***compatible locking modes*** and ***intention modes***.

   b) Discuss different **hierarchical locks** that have been introduced to allow greater **concurrency** in a **database system**. State the rules that a transaction must obey in order to prevent acquisition of access to a resource without prior acquisition of proper access to an **ancestor component**.

   c) What is ***atomic action*** and State the possible outcome of an ***atomic action***? What is ***recoverable transaction*** and how such **transactions** can be realized?

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

7. a) Describe cache consistency protocol ***write once***.
   b) What are the limitations of ***bus based multiprocessor***? Describe the architecture of a ***switched multiprocessor*** system.
   c) What is the difference between *UMA* and *NUMA*?

8 + (2+7) + 3