Dept. Math. & Comp. Sc.	**Distributed Systems**
Vrije Universiteit	**06.06.2001**

Part I

This part covers the same material as the midterm exam.

1a Explain the principle of a page-based distributed shared memory (DSM) system. *5pt*

1b Consider a distributed operating system that supports memory-mapped files. Outline an implementation for a DSM system using files instead of pages. *10pt*

1c In either a page-based or file-based DSM system, what do you consider as the major common scalability problem. Explain your answer. *5pt*

2a Give a simple solution for synchronizing clocks in a local-area distributed system. *5pt*

2b Explain how Lamport timestamps work, and what they achieve. *5pt*

2c Consider a group of three communicating processes using vector timestamps. If process P_1 receives a message *m* with timestamp $[3,2,4]$ from process P_3, what does this mean? When will P_1 deliver *m* if it is required to maintain causality? *5pt*

2d Suppose a process P_i timestamps its messages with a matrix M_i, where $M_i[j,k] = n$ indicates that P_i knows that P_j has received *n* messages from P_k. Give an application of such a timestamp. *10pt*

Part II

3a Explain the principle of anti-entropy as used in epidemic protocols. *5pt*

3b What is the problem with removing data in epidemic protocols, and how can it be solved? *5pt*

3c For an electronic bulletin board, explain how Write-Follows-Read consistency guarantees that you never see a response before the original posting. *5pt*

4a Large-scale reliable multicasting introduces a feedback problem. Give a solution and discuss that solution's main advantages and disadvantages. *10pt*

4b What is meant by a virtually synchronous reliable muticast? *5pt*

5a Consider a distributed system that supports only synchronous method invocations to remote objects. Outline the implementation of a client-side-only extension that will allow a client to perform CORBA's deferred synchronous invocations. *10pt*

5b DCOM uses only local interface pointers as references to remote objects. Explain how object references are passed between different processes in such a system. *5pt*

Final grade: *(1) Add, per part, the total points. (2) Let T denote the total points for the midterm exam ($0 \leq T \leq 45$); $D1$ the total points for part I; $D2$ the total points for part II. The final number of points E is equal to* $\max\{T, D1\} + D2 + 10$.