

W249/403

DUBLIN INSTITUTE OF TECHNOLOGY  
KEVIN STREET, DUBLIN 8.

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# **BSc Information Systems / Information Technology**

**Stage 4**

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**WINTER EXAMINATIONS 2008**

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**DISTRIBUTED SYSTEMS**

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2 HOURS

ATTEMPT 3 QUESTIONS

ALL QUESTIONS CARRY EQUAL MARKS

1. (a) Provide a clear description of distributed systems, and discuss the relevance of at least five *features* of distributed systems.

**(8 marks)**

- (b) Describe the importance of and demonstrate the operation of *locking* in nested transactions.

**(10 marks)**

- (c) Describe the operation of the *two-phase commit protocol*.

Provide a design for a commit protocol with more than two phases, and support your design with a discussion of the improvements that can be made because of the inclusion of a third phase.

State all assumptions you make and complete a PMI on the design of your system (i.e. identify the positive, negative and interesting aspects of your design).

**(15 marks)**

2. (a) Describe the means by which processes are given globally unique addresses on the modern Internet. Describe in detail each component of process addressing.

**(8 marks)**

- (b) Clearly describe the differences between the operation of a well known *connection-oriented* transport protocol and a well known *connectionless* transport protocol as used in the Internet. For each, give a brief outline of the important Java classes required for the implementation of systems using each protocol.

**(10 marks)**

- (c) The *sliding window protocol* provides for management of flow and reliability among two communicating processes using a connection-oriented communications protocol.

Provide a design for a parameterised protocol for managing flow and reliability for communicating processes that are willing to tolerate some degree of unreliability (i.e. dropped packets).

Consider real time systems that don't want completely connectionless communication, but don't want a single dropped packet to halt all communication.

Your design should identify the handshaking methods to be used to reach agreement before communication, and the headers that are used while data is being communicated.

State all assumptions you make and complete a PMI on the design of your system (i.e. identify the positive, negative and interesting aspects of your design).

**(15 marks)**

3. (a) Using an example of your choice, demonstrate the operation of standard logical clocks, and identify their shortcomings. **(8 marks)**
- (b) Expand your example from part (a) to demonstrate the operation of vector clocks, and discuss the means by which they address some or all of the shortcomings identified in part (a). **(10 marks)**
- (c) A set of processes  $p_{1..N}$  are required to reach agreement on which process should play the role of coordinator. The coordinator should be a process with a low load, but not necessarily the lowest load. In the event of two processes wanting to become coordinator, the process that sought permission first should win.

State all assumptions you make and complete a PMI on the design of your system (i.e. identify the positive, negative and interesting aspects of your design). **(15 marks)**

4. (a) In relation to distributed objects, clearly distinguish between three different types of *invocation semantics* for a remote method, and comment on the burden each semantic places on client and server. **(8 marks)**
- (b) Using a simple example, demonstrate how a client-server system could be implemented using either the *Java RMI* or *CORBA* approaches to distributed object systems. You must use sample code in your answer and clearly describe each of the components of the system and their roles. **(10 marks)**
- (c) Provide a design for a distributed object system for a *share price service*. Clients should be able to register their interest in a particular share price and should then be informed when the share price changes.

You do not need to provide sample code, but you should use diagrams and you may wish to use pseudocode.

Complete a PMI on the design of your system (i.e. identify the positive, negative and interesting aspects of your design). **(15 marks)**