

DUBLIN INSTITUTE OF TECHNOLOGY  
KEVIN STREET, DUBLIN 8

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BSC IN APPLIED SCIENCES

YEAR 4

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**SUMMER EXAMINATIONS 2002**

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COMPUTER NETWORKS AND DISTRIBUTED SYSTEMS

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WEDNESDAY, 1<sup>ST</sup> MAY 2002, 2:30 – 6:00

Answer **FOUR** questions, **TWO** from each section.

## Section A

1. (a) Discuss the following challenges for distributed systems
  - Heterogeneity
  - Openness
  - Security
  - Scalability
  - Failure Handling
  - Concurrency

**(6 marks)**
- (b) What is meant by the term *transparency* in terms of distributed systems? List and explain six different types of transparency.

**(6 marks)**
- (c) What is meant by the *architectural model* of a distributed system? Compare and contrast the *mobile code* model with the *client server* model. Give situations where each might be preferred over the other.

**(8 marks)**
- (d) What potential threats are posed by downloading Java applets? How are these problems avoided? What is a *signed applet*?

**(5 marks)**
2. (a) Discuss the structure of IPv4 addresses.

**(4 marks)**
- (b) One of the main problems with IPv4 addressing was bad allocation of addresses. One solution for this problem was CIDR. Discuss how CIDR overcame the allocation problem in IPv4 addressing.

**(7 marks)**
- (c) Discuss the differences between IPv4 and IPv6 under the following headings
  - Address space
  - Multicast and Anycast
  - Header Fields
  - Security

**(8 marks)**
- (d) What is the purpose of *Mobile IP*? Outline its operation discussing in detail the roles of the *home agent*, *foreign agent* and *care-of-address*.

**(6 marks)**

3. (a) Explain, using a diagram and sample code, how Java synchronises thread access to methods in an object. **(6 marks)**
- (b) What is meant by the terms *starvation* and *deadlock*. Explain with reference to the example you provided in part (a) above. **(3 marks)**
- (c) TCP and UDP are both protocols at the transport layer in the OSI reference model. Explain how the two protocols differ from each other, by outlining what extra they provide over and above the service provided by IP. Give example applications where each protocol would be preferred over the other. **(6 marks)**
- (d) Provide Java code to send a UDP message from a client to a server. **(5 marks)**
- (e) Provide Java code to multicast a UDP message from a client to a group. **(5 marks)**
4. (a) The RSA algorithm is used to encrypt messages using asymmetric cryptography. Explain the algorithm used to generate the keys to be used, and the algorithm used to encrypt and decrypt messages. You should use an example. **(8 marks)**
- (b) Give one method you could use to attempt to decrypt a message encrypted using RSA, without having the decryption key. What would make this difficult? **(4 marks)**
- (b) MD5 is an algorithm used to generate a *secure digest*. Discuss what a secure digest is, what it is used for and what properties it should have. **(5 marks)**
- (c) SSL is comprised of two main protocols, the *SSL Record Protocol*, and the *SSL Handshake Protocol*. Give an overview of SSL, and explain in detail the operation of each of these sub-protocols. **(8 marks)**

## Section B

5. (a) How does a Java *interface* differ from an *abstract class*? Why does Java require interfaces while other object oriented languages such as C++ do not? What information does an interface provide that is required for a client in Java RMI?  
(4 marks)
- (b) “An employee database is located on a server. Users need to query the database for two separate pieces of information. Firstly, if users provide an employee ID, they should be returned the age of the employee. Secondly, if users provide a surname, they should be returned an array of all possible first names.”
- “Users will create queries using a client application written in Java. A Java object will be located on the server, which will handle communication with the database. The client application needs to be able to communicate with this Java object on the server in order to query the database.”
- Describe in detail what would be needed to create a solution to this problem using Java RMI. Discuss **all** the components used, and the role that they play. You must use diagrams and Java code segments in your answer.  
(15 marks)
- (c) Java objects and messages that are passed between processes must be represented in a certain format and reconstructed on the receiving side. Discuss what is meant by *serialization* and *reflection* and how they relate to calling methods and passing parameters in Java RMI.  
(6 marks)
6. (a) List and discuss *three* different remote method invocation semantics. In what situations would each be suitable.  
(6 marks)
- (b) Explain what is meant by the term *garbage collection*. Why is this difficult in a distributed system? Explain in detail the operation of a distributed garbage collection algorithm based on reference counting. Explain how it handles failures.  
(10 marks)
- (c) Describe and discuss *distributed event based systems*. In your answer you should refer to the different participants and their roles. You may wish to use an example application.  
(9 marks)

7. (a) Discuss what is meant by the term *web service*. What advantages/disadvantages do web services have when compared to Java RMI. **(4 marks)**
- (b) You are required to implement a web service to provide flight information. The client will pass a time, a source city and a destination city to the service and the service will return flight details.
- Discuss in detail how such a web service would be implemented. In your answer you should describe the role played by the following standards/protocols: XML, HTTP, SOAP, UDDI, WSDL. **(15 marks)**
- (c) Describe the *semantic web*. Discuss the benefits the semantic web could offer web services? **(6 marks)**
8. (a) What is a *name service*? What is a *directory service*? How does it differ from a *name service*? **(3 marks)**
- (b) Discuss, using examples from DNS, the main design issues for a name service. **(10 marks)**
- (d) Discuss in detail the X.500 directory service. **(12 marks)**