



**DUBLIN INSTITUTE OF TECHNOLOGY**

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**DT211C BSc. (Honours) Degree in Computer Science  
(Infrastructure)**

**DT228 BSc. (Honours) Degree in Computer Science**

**DT282 BSc. (Honours) Degree in Computer Science  
(International)**

**Year 4**

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**WINTER EXAMINATIONS 2018/2019**

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**DISTRIBUTED SYSTEMS [CMPU4021]**

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TUESDAY 15<sup>TH</sup> JANUARY

9.30 A.M. – 11.30 A.M.

TWO HOURS

ATTEMPT **3 QUESTIONS.**

ALL QUESTIONS CARRY **EQUAL MARKS.**

ONE COMPLIMENTARY MARK IS AVAILABLE.

1. (a) Discuss the difference between *peer-to-peer* and *client-server* software architectures and give examples of systems they are suitable for.

(8 marks)

- (b) The code shown below is a partial implementation of a server that takes a message from the user and sends it to a *group* of clients.

Complete the Java implementation of this code, and write a client that can receive the message. Note that several client processes should be able to run concurrently, with *all* of them receiving the message.

```
import java.net.*;
import java.io.*;
public class Q1b{

    public static void main(String[] args) {

        try {
            int port = 22211;
            BufferedReader inputStr = new BufferedReader(new
                InputStreamReader(System.in));
            DatagramSocket socket = new DatagramSocket();

            InetAddress group = // WRITE THE MISSING CODE

            while(true) {
                System.out.print("Enter message :/> ");
                String message = inputStr.readLine();
                socket.send(new DatagramPacket(
                    message.getBytes(),
                    message.length(),
                    group, port));
            } catch (Exception e) {}
        }
    }
}
```

(12 marks)

- (c) Describe the main usage of *indirect communication* and discuss *group* communication as an example of an indirect communication paradigm.

(13 marks)

2. (a) Describe *serial equivalence* in terms of concurrent transactions.

(8 marks)

- (b) Explain the term *transparency* in relation to distributed systems, and using as examples *four* different types of transparency, show how they *are* or *are not* provided for by some distributed applications.

(12 marks)

- (c) Consider a system offering a *football-score-service* that provides scores to client applications in real time, as scores change.

Present a design for a distributed object system for such a service and illustrate the role of remote objects and proxy objects. Evaluate the strengths and weaknesses of your design.

(13 marks)

3. (a) Describe the states that a *thread* can be in while running inside a process in a Java Virtual Machine (JVM).

(8 marks)

- (b) Write the code for the multi-threaded Java program described below.

- The main thread starts off three threads to run concurrently.
- Each thread is responsible for doing the following inside its `run()` method:
  - Adding up all the numbers from 1 to some specific number.
  - Printing out the result of the addition.
  - The first thread must add all numbers from 1 to 500; the second must add all numbers from 1 to 50; the third must add all numbers from 1 to 5.

You must ensure that while the three threads run concurrently, the first thread **MUST** be the first to finish and the second thread **MUST** be the second to finish i.e. the threads must wait for each other.

(12 marks)

- (c) Compare and contrast *web services* and the *distributed object model*. Use examples where necessary.

(13 marks)

4. (a) A distributed World Health Organisation (WHO) statistics application has statistic objects available to connecting clients. These remote objects allow a client to get:

- The main language of a country
- The population of a country
- The capital city of a country

Define the *interface* to the WHO statistics service in *Java Remote Method Invocation (RMI)*.

(8 marks)

- (b) With the help of a diagram and examples, explain the Message Oriented Middleware (MOM) paradigm and discuss its advantages and disadvantages.

(12 marks)

- (c) Discuss the *three* different types of RMI *invocation semantics*.

(13 marks)