

**TECHNOLOGICAL UNIVERSITY DUBLIN**  
**CITY CAMPUS**

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BSc. (Honours) Degree in Computer Science  
BSc. (Honours) Degree in Computer Science (Infrastructure)  
BSc. (Honours) Degree in Computer Science (International)

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**Year 4**

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SEMESTER 1 EXAMINATIONS 2021/22

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**Distributed Systems**

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Ms. Sanita Tifentale – TU856  
Ms. Pauline Martin - TU857  
Ms. Pamela O'Brien - TU858

Duration: 2 hours  
Date:

Attempt **3 questions**  
All questions carry **equal** marks  
One complimentary mark is available

1. (a) IP provides a *multicast* facility. Explain what this means, then discuss the scenarios where multicast is used.

(8 marks)

- (b) A server program written in one language (for example C++) provides the implementation of an object that is intended to be accessed by clients that may be written in a different language (for example Java). The client and server computers may have different hardware, but all of them are attached to an internet.

Discuss the issues due to the *four* aspects of *heterogeneity* that need to be solved to make it possible for a client object to invoke a method on the server object.

(12 marks)

- (c) Provide Java code to multicast a message from a client to a group.

(13 marks)

2. (a) Explain the characteristics of a *peer-to-peer* systems and give examples of *peer-to-peer* *middleware* platforms.

(8 marks)

- (b) Discuss and compare the *three* alternative approaches to *external data representation* and marshalling.

(12 marks)

- (c) Provide sample Java code to show how to create a TCP server that uses *Java serialisation* to receive a Java object of type *Person* where the *Person* class has *name*, *address* and *personID* attributes.

(13 marks)

3. (a) Group communication is an important building block for reliable distributed systems. Describe key areas of application of group communication.

(8 marks)

- (b) Suggest a design for a *notification mailbox* service that is intended to store notifications on behalf of multiple subscribers, allowing subscribers to specify when they require notifications to be delivered. Explain how subscribers that are not always active can make use of the service you designed.

How will the service deal with subscribers that crash while they have delivery turned on?

(12 marks)

- (c) Describe *four* key characteristics and basic operations of what are known as RESTful architectures. Compare it with competing approaches. Give an example how RESTful can work in practice.

(13 marks)

4. (a) Failures in distributed systems are mostly partial failures which can make failure handling more difficult.

Describe and illustrate with examples *four* main techniques for dealing with failures.

(8 marks)

- (b) Discuss *security* as one of the challenges for all distributed systems. Describe how the security of a distributed system can be achieved. Give an example of a *protocol* currently employed by web clients and servers to provide secure communication.

(12 marks)

- (c) Managing a *distributed transaction* involves many transaction managers and is made difficult because the state of one system can change suddenly, unknown to the other participants in the transaction.

Using examples and diagrams *show* how the *two phase commit* protocol addresses the problem outlined here.

(13 marks)