SCHOOL OF SCIENCE

GMIT EXAMINATIONS

SESSION: WINTER 2014/2015

PROGRAMME: **B.SC (HONS) IN SOFTWARE DEVELOPMENT**

YEAR/STAGE: 4

MODULE: **DISTRIBUTED SYSTEMS**

Date: Fri. 19th Dec.
Time: 9.30 a.m.

INTERNAL EXAMINER(S):   **Dr. John Healy**

EXTERNAL EXAMINER(S):   **Dr. Michael Schukat**
Mr. Tom Davis

TIME ALLOWED: **2 HOURS**

INSTRUCTIONS TO CANDIDATES:

ATTEMPT ANY 4 QUESTIONS

Attachments:	Yes	No	X	If yes, please list details:
Special Requirements:	Yes	No	X	If yes, please list details:
Calculators Permitted:	Yes	No		Not applicable X

1. (a) Explain, using diagrams and examples where appropriate, the following terms as they apply to distributed systems:

- Heterogeneity **(3 Marks)**
- Openness **(3 Marks)**
- Transparency **(3 Marks)**

(b) Using a fully labelled diagram, describe the different components of the ***n*-tier client-server architecture** and discuss how the principles of heterogeneity, openness and transparency can be incorporated into the design of distributed systems. Your diagram should clearly illustrate how the different layers of the architecture interact with each other.

(16 Marks)

2. *"Both horizontal and vertical scalability are essential attributes of distributed, enterprise systems."*

Discuss this statement. Your answer should address the different forms of scalability and contrast the use of **synchronous** and **asynchronous** architectures in the design of distributed systems. Include diagrams in your answer where appropriate.

(25 Marks)

3. *"The flexibility and power of the Java Remote Method Invocation (RMI) architecture is due to the wide application of the proxy pattern in the framework design."*

Discuss this statement. You answer should include a fully labelled diagram and address the following:

- The role that **proxies** play in the RMI framework.

- How **remote object references** can be used as method parameters and return types.

- The **distributed garbage collection** mechanism used in RMI.

(25 Marks)

B.Sc (Hons) in Software Development
Distributed Systems

4.   The LAMP system architecture depicted in **Figure 1** below is used by a company to enable customers to order and pay for pizzas deliveries.
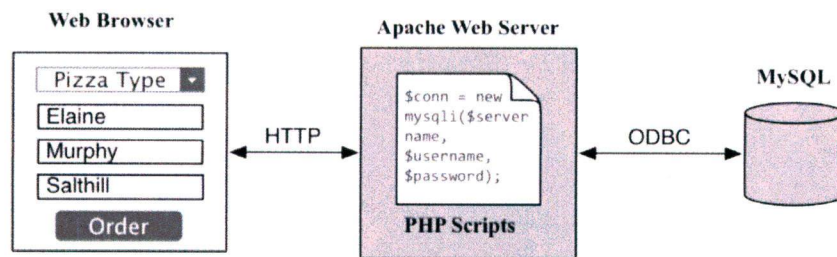

Figure 1

You are required to provide a re-design of the system that provides the following:

a) The system should be **highly scalable**. The performance of the current implementation degrades significantly as the number of concurrent users increases.

b) The system should support a **diverse range of Tier 1 client types**, including Android, iPhone, Windows Mobile and different desktop operating systems. The system should also be capable of supporting a **variety of different database models** at Tier 3.

c) The system should be flexible enough to enable **peer-to-peer communication** at Tier 2, by exposing APIs that are remotely accessible from applications written in different programming languages.

d) Where possible, open or *de facto* **standards** should be used to increase system flexibility and extensibility.

(25 Marks)

5. (a)   Discuss, citing examples, the difference between **homogeneous** and **heterogeneous** distributed database systems.

(8 Marks)

(b)   Describe how the **two-phase-commit protocol** can be used to implement a distributed atomic transaction.

(8 Marks)

(c)   Discuss how a ***hash-ring*** can be used in a distributed tuple store as a mechanism for promoting high availability and scalability. Include in your answer a diagram showing how a hash ring can be used to partition and locate database nodes.

(9 Marks)

B.Sc (Hons) in Software Development
Distributed Systems

6. (a) Using a fully labelled diagram, describe the various components of an **Object Request Broker (ORB)** and discuss their role in the CORBA architecture. Your answer should clearly illustrate how client invocations are dispatched to target remote objects.

(11 Marks)

(b) Explain what is meant by the term CORBA **Common Object Services**. Discuss the extent to which similar services are available in J2EE containers.

(9 Marks)

(c) Describe how objects deployed in a J2EE container can communicate directly with a remote CORBA orb.

(5 Marks)