TECHNOLOGICAL UNIVERSITY DUBLIN
TALLAGHT CAMPUS

Bachelor of Science (Honours)

Bachelor of Science

IT Management

Computing

Full Time and ACCS

Semester Five : January 2019

Big Data Technologies (Advanced Databases)

Internal Examiners
Mr. Seán McHugh

External Examiners
Mr. Thomas Davis
Mr. David Power
Ms. Natasha Kelly

Day **Monday**
Date **7th January 2019**
Time **15:30 - 17:30**

Instructions to Candidates

Please answer any three out of four questions on the paper. Note Question 1 carries 34 marks. All other questions carry 33 marks.

Please start each question on a new page.

Question 1 (34 Marks)

a) With the aid of examples, briefly explain the TWO options in Oracle to make Object Types persistent in the database.

(8 Marks)

b) It has been decided to rationalise the relational tables below. The Project table is to be removed (maximum 10 projects per project manager at any one time) and data is to be stored as a column in the Project Manager table. Briefly explain the object relational **collection type** options available discussing their similarities and differences. Which one is the most suitable for this situation? Justify your answer.

(10 Marks)

ProjectManager(id, mgrName, location, emailAddress, contactNumber)

Project(projectName, projectType, duration, budget)

c) The Oracle Database provides object relational features. Explain what REF in Oracle is and why one would use it. Explain with examples TWO methods to **dereference** a REF value. When would you use one over the other?

(9 Marks)

d) What is a Dangling REF? Giving an example, show how a DANGLING REF can occur. How can you test for this condition?

(7 Marks)

Question 2 (33 Marks)

"In Relational Database Management Systems transactions are **a**tomic, **c**onsistent, **i**solated and **d**urable"

a) Discuss the statement above. Give examples to demonstrate your answer. Outline how well these properties are supported in **noSQL** databases?

(11 Marks)

b) Locking is a common technique used to enforce concurrency control in databases. Explain the basic rules of locking with reference to the 2 Phase Locking (2PL) protocol.

(10 Marks)

c) Explain the **"Uncommitted Dependency"** problem. Using an example, outline how the 2PL protocol can prevent the "Uncommitted Dependency" problem.

(8 Marks)

d) Briefly explain the difference between a Fuzzy Read (Unrepeatable Read) and a "Phantom Read".

(4 Marks)

Question 3 (33 Marks)

"Sharding and **Replication** of data are commonly supported features in NoSQL distributed database environments".

a) Using a diagram to demonstrate your answer, discuss **Sharding** as it applies to NoSQL databases. As part of your answer comment on the use of a shard key.

(8 Marks)

b) Briefly explain **Master/Slave replication**. Provide a relevant diagram to demonstrate your answer. As part of your answer, highlight its advantages and disadvantages.

(9 Marks)

c) Using an example, briefly explain the reasons why Domain Driven Design using Aggregates is suited to NoSQL environments. Discuss ONE potential drawback to using aggregates as a unit of storage.

(8 Marks)

d) Discuss the types of Consistency supported in a NoSQL database. Give examples to demonstrate your answer. How does this compare to the Consistency provided in a Relational DBMS?

(8 Marks)

Question 4 (33 Marks)

Data warehouse data can be described as **subject-oriented**, **integrated**, **time-variant**, and a **non-volatile** collection of data in support of management's decision-making process (Inmon,1993).

a) Briefly explain the characteristics of data in a data warehouse as defined in the above description. Contrast them with the characteristics of data in an OLTP system.

(8 Marks)

b) Dimensional modelling is a logical design technique used to design Star and derivative schemas.

i Differentiate between Star and Snowflake schemas explaining when you would use one over the other. Use diagrams to support your answer. Explain with justification an advantage of each schema.

(10 Marks)

ii Describe a **Fact Constellation.** What design decisions must you make to ensure you achieve this design? Use a diagram to support your answer.

(6 Marks)

c) Explain **three** types of Slowly Changing Dimensions (SCDs) identifying the circumstances in which one would use each one. Support your answers with examples.

(9 Marks)