



**Strathmore**  
UNIVERSITY

**SCHOOL OF COMPUTING AND ENGINEERING SCIENCES**

**BACHELOR OF BUSINESS INFORMATION TECHNOLOGY & COMPUTER**

**NETWORKS AND CYBER SECURITY**

**END OF SEMESTER EXAMINATION**

**CNS/BBT1201: DATABASE SYSTEMS**

**DATE: 18<sup>th</sup> March 2022**

**Time: 2 Hours**

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**Instructions**

1. This examination consists of **FIVE** questions.
2. Answer **Question ONE (COMPULSORY)** and any other **TWO** questions.

**QUESTION ONE (20 Marks)**

- a) Describe the approach taken to the handling of data in the early file-based systems. Discuss any **TWO** the disadvantages of this approach. **(4 Marks)**
- b) Discuss any **TWO** the properties of a relation. **(2 Marks)**
- c) Discuss the concept of data independence and explain its importance in a database environment. **(3 Marks)**
- d) In the context of Entity-Relationship Modelling we define an entity, an entity type, and an entity set. Explain the differences among the three terms. **(3 Marks)**
- e) Consider a relation  $R(A, B, C, D, E, F, G, H)$  with the following dependencies:

$CH \rightarrow G$

$A \rightarrow BC$

$B \rightarrow CFH$

$E \rightarrow A$

$F \rightarrow EG$

f) Determine the candidate keys in the relation. Show your workings **(4 Marks)**

f) Draw a state diagram and discuss the typical states that a transaction goes through during

execution. **(4 Marks)**

## QUESTION TWO (20 Marks)

You are a database designer and a car race company approaches you to help them build a database from design to implementation.

### **Requirements:**

- We have cars, for each car we keep its VIN number (unique ID), engine type, color, make, and model
- We have drivers, for each driver we keep ID (unique), name, DoB, and age (derived attribute)
- Drivers use cars to enter races, each race has some attributes such as the race number (unique ID), race type, the number of rounds, and date.
- Each driver can enter many races and can use the same car or different one in each race. Thus the same car can participate in many races.
- In the design, we want to capture which car is used by which driver and in which race.
- We also need to capture the winner of each race (the driver who won the race) and the winning time (the time taken to finish and win the race).

### **Required:**

- i) What do you understand by the term Entity as used in database design? **(2 Marks)**
- ii) From the requirements narrative above, identify **ALL** the entities as well as attributes for each of the entities **(4 Marks)**
- iii) Select any two entities and explain the **TYPE** or relationship between them. Write down your assumption if any. **(3 Marks)**
- iv) Using the entities and attributes identified in (ii) above, draw a ER- Diagram to clearly capture the requirements in the narrative above. Write down your assumptions and indicate all entity relationship cardinality. (Use Crow's foot notation). **(6 Marks)**
- v) Generate schema relations/tables from the ER-Diagram you just drew in (iv) above. Indicate clearly your primary and foreign keys. **(5 Marks)**

**QUESTION THREE (20 Marks)**

**SECTION A:**

Branch	( <u>branchNo</u> , street, city, postcode)
Staff	( <u>staffNo</u> , fName, lName, position, sex, DOB, salary, branchNo)
PropertyForRent	( <u>propertyNo</u> , street, city, postcode, type, rooms, rent, ownerNo, staffNo, branchNo)
Client	( <u>clientNo</u> , fName, lName, telNo, prefType, maxRent)
PrivateOwner	( <u>ownerNo</u> , fName, lName, address, telNo)
Viewing	( <u>clientNo</u> , propertyNo, viewDate, comment)

Using the Relations above, write SQL scripts to achieve the following:

- a) List the addresses of all branch offices in London or Glasgow. **(2 Marks)**
- b) List all staff with a salary between £20,000 and £30,000. **(2 Marks)**
- c) Produce a list of **monthly** salaries for all staff, showing the staff number, the first and last names, and the salary details. **(2 Marks)**
- d) List the details of all viewings on property PG4 where a comment has not been supplied. **(2 Marks)**
- e) List all managers and supervisors. **(2 Marks)**
- f) List the staff who work in the branch at '163 Main St'. **(2 Marks)**

**SECTION B:**

Student			Course		
<u>Sno</u>	Sname	Age	Sno	Cname	Fees
S1	n1	21	S1	C1	1000
S2	n2	22	S3	C3	3000
S3	n3	23	S5	C5	5000
S4	n4	24			

- a) Using the relations **COURSE** and **STUDENT** above, carry out the following operations using **SQL**:
  - i). Natural Join **(2 Marks)**
  - ii). Left Outer Join **(2 Marks)**
  - iii). Right Outer Join **(2 Marks)**
  - iv). Full-outer Join **(2 Marks)**

**QUESTION FOUR (20 Marks)**

An agency called *Instant Cover* supplies part-time/temporary staff to hotels within Scotland. The table shown below displays sample data, which lists the time spent by agency staff working at various hotels. The National Insurance Number (NIN) is unique for every member of staff.

**Assumption: The Nominated key for the relation is (NIN, contractNo)**

NIN	contractNo	hoursPerWeek	eName	hotelNo	hotelLocation
113567WD	C1024	16	John Smith	H25	Edinburgh
234111XA	C1024	24	Diane Hocine	H25	Edinburgh
712670YD	C1025	28	Sarah White	H4	Glasgow
113567WD	C1025	16	John Smith	H4	Glasgow

Figure 1: Employees of Instant Cover and their contracts to work at hotels

a) The Table (Figure 1) is susceptible to update anomalies. Using the table, provide examples of insertion, deletion, and modification anomalies. **(6 Marks)**

b) First Normal Form (1NF) calls for atomicity and that a relation should not have any repeating fields/groups.

i) What do you understand by the term *Repeating field/groups*? **(2 Marks)**

ii) Is the Table (Figure 1) in 1NF? Explain your answer **(3 Marks)**

c) Second Normal Form (2NF) requires that all non-key attributes to depend on the key-attribute and that there should be no partial dependency.

i) What is the meaning of partial dependency as used in databases? **(2 Marks)**

ii) Normalize the table in b(ii) above, showing how you progress from 1NF through 2NF to a set of 3NF named relations. At each stage show the primary key and any foreign keys of each relation and state assumptions that you make about any of the relationships between the columns of data. Give your relations meaningful names. **(7 Marks)**

**Question FIVE (20 Marks)**

a) Discuss the atomicity, durability, isolation, and consistency preservation properties of a database transaction. **(4 Marks)**

b) There mainly three transaction anomalies, namely the lost update problem, the dirty read/reading uncommitted data problem and the inconsistent analysis problem. With relevant examples, describe each of these. **(6 Marks)**

c) Consider the following information and use it to answer the questions that follow;

A customer owning account 801 is transferring Ksh. 139,500 from his account to an account 998 belonging to one of his business partners. The business partner (owner of account 998) is also trying to settle a debt of raw materials supplied by one of his suppliers by issuing a cheque of 150,000. Assume that cheques are debited (credited) immediately after being deposited. Assume the bank has a rule that minimum balances cannot go below zero.

Time (t)	Transaction 4567	Transaction 4568	Acc 801 (Balances)	Acc 998 (Balances)
t1	Begin Transaction		322,850	96,675
t2	Read Bal Acc 801		322,850	96,675
t3	Bal Acc 801 = Bal Acc 801 - 139, 500		322,850	96,675
t4	Bal Acc 998 = Bal Acc 998 + 139, 500	Begin Transaction	322,850	96,675
t5	Write Bal Acc 801, write Bal Acc 998	Read Bal Acc 998	183,350	235,175
t6		Bal Acc 998 = Bal Acc 998 - 150, 000	183,350	235,175
t7	Roll Back	Write Bal Acc 998	322,850	85,175
t8		Commit	322,850	85,175

From the above case, answer the following questions.

i) What property or properties have been contravened in the above schedule? **(2 Marks)**

ii) What anomaly might have occurred? Why so? **(2 Marks)**

iii) How would serializability have help to avert the anomaly noted in (ii) above? **(2 Marks)**

iv) What might have caused Transaction 1228 to roll back? **(1 Mark)**

v) Rewrite the schedule correctly. **(3 Marks)**