

CARDIFF UNIVERSITY EXAMINATION PAPER

Academic Year: 2017-2018
Examination Period: AUTUMN
Examination Paper Number: CM2102
Examination Paper Title: Database Systems
Duration: TWO hours

Do not turn this page over until instructed to do so by the Senior Invigilator.

Structure of Examination Paper:

There are **FIVE** pages.
There are **FOUR** questions in total.

There are no appendices.

The maximum mark for the examination paper is **60 MARKS** and the mark obtainable for a question or part of a question is shown in brackets alongside the question.

Students to be provided with:

The following item of stationery is to be provided:
ONE answer book.

Instructions to Students:

Answer **ANY THREE** questions.

Important note: if you answer more than the number of questions instructed, then answers will be marked in the order they appear only until the above instruction is met. Extra answers will be ignored. Clearly cancel any answers not intended for marking. Write clearly on the front of the answer book the numbers of the answers to be marked.

The use of a translation dictionary between English or Welsh and another language, provided that it bears an appropriate school stamp, is permitted in this examination.

1. (a) What is *normalisation* in the context of relational database design? Explain whether it is always desirable to normalise relations into Third Normal Form. [3]
- (b) The following is an example of an order placed by a customer with a self-explanatory order form:

Order No	102369			
Order Date	17/03/2010			
Customer ID	103423			
Customer Name	John Smith			
Delivery Address	123 Main Road, Cardiff, CF12 3AB			
Item No	Description	Item Price (£)	Quantity	Cost (£)
1023-01	A4 Paper	1.20	6	7.20
2137-12	DVD-R Disk	0.70	30	21.00
7387-45	Batteries	2.30	10	23.00
Total Amount	£51.20			

Using this form

- derive a single First Normal Form relation (only the schema is required and the primary key should be underlined); [2]
 - identify the functional dependencies that you would expect to hold among the attributes in your First Normal Form relation and express them in a functional dependency diagram (state any assumptions you make); [7]
 - normalise your First Normal Form relation into a set of Third Normal Form tables (primary keys should be underlined). [5]
- (c) Assume that we have a relation with three attributes: $R(A, B, C)$, and $A \rightarrow B$ and $B \rightarrow C$ (functional dependencies) hold in R . Use Armstrong rules to show that $A \rightarrow BC$ also holds. [3]

2. (a) Briefly explain how transaction deadlocks may be detected, resolved and prevented. [6]

(b) Explain in English what each of the following code fragments does:

i. GRANT select, insert ON Student TO scm233
WITH GRANT OPTION; [2]

```

ii. tttitle center 'Current Stock Value' skip 2 left -
    'prepared by ' &Officer right -
        &Todays_Date skip 4;
    btitle center format 999 SQL.PNO;

```

[2]

```

iii. CREATE VIEW ComputingModule
AS SELECT *
    FROM Module
    WHERE Department = 'Computing'
WITH CHECK OPTION;

```

[3]

iv. The **Stocks** table used in this query records which supplier (**SupplierCode**) supplies to which store (**StoreCode**).

```
SELECT    SupplierCode
FROM      Stocks stk
GROUP BY  SupplierCode
HAVING    COUNT(DISTINCT stk.StoreCode) =
          (SELECT COUNT(str.StoreCode)
           FROM Stores str);
```

[3]

```
v. CREATE TABLE Enrollment
    (Student#    char(6),
     Module#     char(6),
     Mark        Number(3) CHECK (Mark <= 100),
     CONSTRAINT en_pk PRIMARY KEY (Student#, Module#),
     CONSTRAINT en_fk1 FOREIGN KEY (Student#)
                REFERENCES Student(Student#)
                ON DELETE CASCADE,
     CONSTRAINT en_fk2 FOREIGN KEY (Module#)
                REFERENCES Module(Module#));
```

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3. (a) Explain why indexing helps enhance the performance of a database system. [4]
- (b) What is a B-Tree of order M ? Insert the following key values: 23, 43, 10, 5, 98, 50, 12, 20, 30, in the order given, into an initially empty B-Tree of order 1. [6]
- (c) Suppose that we have the following Student table

S#	Sex	Scheme	Module	Marks
S60	M	BSc	Graphics	Distinction
S70	F	BSc	Database	Distinction
S80	F	BEng	Database	Merit
S90	M	BSc	Java	Merit
S100	F	BSc	Graphics	Pass
S110	F	BEng	Graphics	Distinction
S120	M	BEng	Java	Merit
S130	F	BSc	Java	Merit
S140	M	BSc	Database	Pass
S150	F	BEng	Java	Pass

Show how bitmap indexes may be used to answer the following query efficiently:

```
SELECT COUNT(*)
FROM Student
WHERE Module = 'Java'
OR (Scheme = 'BSc' AND Marks <> 'Distinction');
```

[6]

- (d) Briefly explain why cost-based optimisation may not actually out-perform rule-based optimisation in executing a given query in terms of response time. [4]

4. (a) Briefly explain what a *Trigger* is. [4]

(b) The following relations form part of a relational database (the relations are self-explanatory):

CUSTOMER(Cust#, CName, CAddress, Ctown, Balance)

ORDER(Order#, Date, Cust#)

ORDERLINE(Order#, Part#, Amount-Ordered)

PART(Part#, Desc, Stock, Item-Class, Unit-Price)

With reference to this relational schema, write SQL statements for the following queries:

i. List the name of the customer who has placed Order 123 (i.e. Order# = 123). [4]

ii. List the names of customers who are in Cardiff and have ordered Part 456 (i.e. Part# = 456). [4]

iii. List the order numbers (Order#) for orders that contain at least 3 parts and the amount ordered for each part is at least 10. [4]

iv. List the description (Desc) of those parts for which the average amount ordered is greater than the amount ordered for Part 456 (Part# = 456) in Order 123 (Order# = 123). [4]