

# UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

*DEPARTMENT OF COMPUTER SCIENCE*

**MAIN EXAMINATION, MAY 2010**

Title of Paper : **Databases and their Design II**  
Course Number : **CS 346**  
Time Allowed : **Three (3) Hours**  
Instruction : Answer **ANY FIVE** questions

This paper should not be opened until permission has been granted by the invigilator.

### Question 1

- (a) Discuss the concept of functional dependency. [3]
- (b) When is a table in 2NF? When is it in 3NF? [5]
- (c) What is partial dependency? What form is it associated with? [4]
- (d) What is a surrogate key, and when should you use one? [3]
- (e) Discuss the execution of a view in SQL with reference to an example. [5]

### Question 2

Given the following relations:

Employee(Fname, Minit, Lname, EmplPin, Bdate, Address, Sex, Salary, Super\_Pin, Dnum)  
Department(Dname, Dnum, Mgr\_Pin, Mgr\_start\_date) Dep\_Loc (Dnum, Dloc)  
Project (Pname, Pnum, Ploc, Dnum) Works\_On (Pin, Pnum, Hours)  
Dependent (EmplPin, Dependent\_name, Sex, Bdate)

Specify the following queries on the given database in SQL. [8]

- a) For each department whose average employee salary is more than 30000, retrieve the department name and the number of employees working for that department.
- b) Suppose that we want the number of male employees in each department rather than all employees as in a) above – can we specify this query in SQL? How or Why not?

Consider the following view, EMPL\_SUMM, defined on the same database by the SQL query:

```
CREATE VIEW      EMPL_SUMM (D, C, Total_s, Average_s)
AS SELECT       Dnum, COUNT (*), SUM(Salary), AVG(Salary)
FROM            EMPLOYEE
GROUP BY       Dno
```

State which of the following queries and updates would be allowed on the view. If the query or update would be allowed, show the corresponding actual query or update that will be executed.

- c) 

```
SELECT      D, C
FROM        EMPL_SUMM
WHERE       Total_s > 100000;
```
- d) 

```
SELECT      D, Average_s
FROM        EMPL_SUMM
WHERE       C > (SELECT C FROM EMPL_SUMM WHERE D=4);
```
- e) 

```
UPDATE      EMPL_SUMM
SET         D=3
WHERE       D=4;
```

**Question 3**

Assume your Inkhundla wishes to design a database for their community library. Initial analysis has determined the following data.

Each library book has a call number, a title, an author, a publisher, and edition. The library may have more than one copy of the same book. Each copy of a book has a copy number, a purchase date and the price. Users of the library are issued library cards. Each user has a card number, name and address. There are two types of library users: *adults* and *children*. Every child has exactly one adult sponsor who must also be a library user. For each student the school and grade must be recorded. Library users may borrow books and for every loan the due date is recorded.

- (a) Draw an ER diagram to illustrate the structure of the above database. [10]
- (b) Break down the above ER diagram into tables, stating the normal form of each table. For those tables not in 3NF, normalize them to 3NF. [10]

**Question 4**

Suppose you have the following table structure and sample data shown here. The data reflect that a lecturer can have more than one advisee, can serve on multiple committees and can edit more than one journal.

Col Name	Sample Data	Sample Data	Sample Data	Sample Data
Empl Num	123	104	118	
Lect Rank	Prof	Asst Lecturer	Lecturer	Lecturer
Empl Name	G	R	O	S
Dept Code	CIS	Chem	CIS	Eng
Dept Name	Comp Inf Syst	Chemistry	Compt Inf Sys	English
Office	S567	S119	S562	S345
Advisee	1215, 2312, 3233, 2218, 2098	3102, 2782, 3311, 2008, 2876, 2222, 3745, 1783, 2378	2134, 2789, 3456, 2002, 2046, 2018, 2764	2873, 2765, 2238, 2908, 2308
Comm Code	Promo, Traf, Appl, Dev	Dev	SPR, TRAF	Promo, SPR, Dev
Journal Code	JMIS, QED, JMGT		JCIS, JMGT	

- a) Draw the dependency diagram. [7]
- b) Normalize these tables into table structures in 3NF. [8]
- c) Draw the ER diagram to reflect the connections of the resulting 3NF tables. [5]

**Question 5**

- a) Draw a dependency diagram for a table with the following dependencies.  
 $A, B \twoheadrightarrow C, D, E, F, G$   
 $A \twoheadrightarrow D$   
 $C \twoheadrightarrow B$   
 $E \twoheadrightarrow G$

Normalize this table into tables in 3NF [10]

- b) Normalize the following table to 3NF, stating all assumptions (especially functional dependencies) [10]

**STUDENT** (Stud\_Numb, Stud\_Name, Proj\_Supervisor\_Numb, Proj\_Supervisor\_Name, Dept\_Numb, Dept\_Name, Crse\_Code, Crse\_Name, Crse\_Desc, Crse\_Sem, Crse\_grade)

**Question 6**

Consider the following relation:

Car\_Sale(car\_num, date\_sold, salesman\_num, commission%, discount\_amnt)

Assume that a car may be sold by multiple salesman, and hence {car\_num, salesman\_num} is the primary key. Additional dependencies are:

date\_sold  $\twoheadrightarrow$  discount\_amnt  
 salesman\_num  $\twoheadrightarrow$  commission%

- a) Is this relation in 1NF or 2NF? Explain your answer. [3]
- b) Normalise the relation to 3NF. [7]

Consider the following relation for published books

Book(Book\_title, AuthorName, BookType, ListPrice, AuthorAffil, Publisher)

The AuthorAffil refers to the affiliation of the author. Suppose the following dependencies exist:

Book\_title  $\twoheadrightarrow$  Publisher, BookType  
 BookType  $\twoheadrightarrow$  ListPrice  
 AuthorName  $\twoheadrightarrow$  AuthorAffil

- c) What normal form is the relation in? Explain your answer. [3]
- d) Apply normalisation until you cannot decompose the relation further. State the reasons behind each decomposition. [7]