UNIVERSITY OF GHANA

B.SC INFORMATION TECHNOLOGY – FIRST SEMESTER

EXAMINATION 2015/2016
CSIT 207: DATABASE FUNDAMENTALS   (3 CREDITS)

INSTRUCTION:
Answer Question One (1) and any other three (3) Questions
TIME ALLOWED:
TWO AND A HALF (2½) HOURS

QUESTION 1   [Short Answer questions]   [25 marks]

Write answers to this question clearly in your answer booklet.

1. In an E-R diagram a dashed line between entities indicate ------------
2. A relation is not in ----------- if a non-key attribute is dependent on another non-key attribute.
3. One relational algebra operation that does not require the participating tables to be

union-compatible is ---------------

4. When R S = ϕ , then R   S is the same as -----------
5. Tree structures are used to store data in ------------- model
6. The rule that a value of a foreign key must appear as a value of some specific table is called a -------------- ⋈
7. The clause in SQL that specifies that the query result should be sorted in descending order based on the values of attribute A is --------------
8. In 2NF, no -------------------- functional dependencies exist.
9. An M:N relationship is broken into two 1:M relationships using a --------- entity.
10. If two relations R and S are joined, then the non-matching tuples of both R and S are ignored in -------------------- join.
11. The keyword to eliminate duplicate rows from the query result in SQL is -------------
12. Which of the following aggregate functions does not ignore nulls in its results? --------

COUNT, COUNT (*), MAX, MIN

1. Consider the join of relation R with a relation S. If R has m tuples and A attributes and S has n tuples and B attributes, then the maximum size of the join is ------------ tuples and ----------- attributes.
2. The common column is eliminated in --------------- join
3. The values of the attributes in a row describes a particular ---------------
4. The clause alter table in SQL can be used to --------------------
5. The data models defined by ANSI/SPARC architecture are ---------   ---------   ---------
6. A table can have only one ------------ key
7. According to the levels of abstraction, the schema at intermediate level is called -------
8. A ----------- occurs when two keys hash to the same address.
9. Two different methods for collision resolution are: -------------- ------------
10. A table is in ---------- normal form when it is in ------------ and there are no transitive dependencies.

QUESTION 2   **[25 marks]**

a) Discuss the roles of the database administrator (DBA)   **[8 marks]**

a) What are the requirements that two relations must satisfy in order to be considered union-compatible?   **[2 marks]**

a) i. The rules for normalization can be summed up in a single phrase. What is this phrase?   **[2 marks]**

ii Identify and explain four anomalies associated with this schema: **[8 marks]**
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III. Normalise this schema into third normal form (3NF), showing intermediate stages.   **[5 marks]**

QUESTION 3   **[25 marks]**

a) i. Name three (3) security threats to databases.   **[9 marks]**

ii. Briefly explain three (3) kinds of countermeasures that can be implemented to protect

databases against these types of threats

a) Draw a Crow's Foot ER diagram that captures the following information. Describe each relationship in terms of connectivity, cardinality, relationship strength and participation   A lso show primary key, any foreign keys and a minimum of three attributes per entity.   **[16marks]**

A company database needs to store information about employees (identified by SSN, with SALARY and PHONE as attributes), departments (identified by DNO, with DNAME and BUDGET as attributes), and children of employees (with NAME and AGE as attributes).
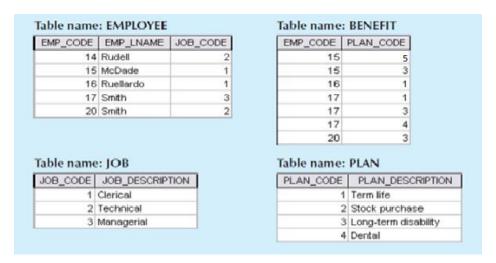
Employees work in departments. Each department is managed by an employee, a child must be identified uniquely by name when the parent (who is an employee, assume that only one parent works for the company) is known. We are not interested in information about a child once the parent leaves the company.

QUESTION 4 [25 marks]

Use the following database to answer the questions below. The database is composed of four tables that reflect these relationships:

- An EMPLOYEE has only one JOB_CODE, but a JOB_CODE can be held by many EMPLOYEEs.

- An EMPLOYEE can participate in many PLANs, and any PLAN can be assigned to many EMPLOYEEs.

Note also that the BENEFIT table serves as a composite or bridge entity.

Table name: EMPLOYEE

EMP_CODE	EMP_LNAME	JOB_CODE
14	Rudell	2
15	McDade	1
16	Ruellardo	1
17	Smith	3
20	Smith	2

Table name: BENEFIT

EMP_CODE	PLAN_CODE
15	5
15	3
16	1
17	1
17	3
17	4
20	3

Table name: JOB

JOB_CODE	JOB_DESCRIPTION
1	Clerical
2	Technical
3	Managerial

Table name: PLAN

PLAN_CODE	PLAN_DESCRIPTION
1	Term life
2	Stock purchase
3	Long-term disability
4	Dental

a) For each table, identify the primary key and the foreign key(s). **[7 marks]**

a) i. Explain entity integrity and referential integrity using any tables in this database as examples. **[4 marks]**

ii. How do you specify these constraints in SQL. Give examples from this database.

[4 marks]

a) Create a Crow's Foot ERD to show connectivity, relationship participation and relationship strength between EMPLOYEE, BENEFIT, JOB, and PLAN.   **[10marks]**

QUESTION 5   [25 marks]

a) What is a recursive relationship? Give three examples, showing the 3 types of connectivity in a recursive relationship.   **[8 marks]**

a) Use a diagram to explain data independence and the three levels of data abstraction in a data model   **[7 marks]**

a) Use the tables in question 4 to answer this question
Evaluate the following Relational Algebra expressions, showing relevant intermediate stages:

I. ($\prod$_{Emp_Code, Job_Code}(**Employee**)) **Benefit**   **[2 marks]**
II. Employee   Job   **[3 marks]**
III. Benefit =X= Plan   **[3 marks]**

IV. $\prod$ _{Emp_Name} $\bowtie$ (σ_{Job_Code <> 2} (**Employee**))   **[2 marks]**

QUESTION 6 [25 marks]

Table - Shipment

ID	Sender	Sender Address	Price	Receiver	Receiver Address
1	Toyota Car Co.	Tokyo	K127,000.00	Boroko Motors	P O Box 221, Boroko
2	Kiwi Fruit Ltd.	Wellington	K47,400.00	Steamships	P O Box 3384, POM
3	Oscar Mueller	21 Kleingasse, Bonn	K6,200.00	Oscar Mueller	P O Box 107, University
4	Malanda Dairy	Malanda	K77,000.00	Steamships	P O Box 3384, POM
5	Caravana Wines	Sydney	K191,000.00	Stop 'n Shop	P O Box 220, Waigani
6	Alaska Fishery	Anchorage, AL	K21,000.00	Boroko Foodworld	P O Box 1011, Boroko
7	Johnson's Pharmacy	Darwin, NT	K9,930.00	Johnson's Pharmacy	P O Box 25, Boroko
8	Datec	Sydney	K1,405,000.00	Datec	P O Box 399, POM
9	Peter Noel	21, Short St., London	K2,700.00	Peter Noel	P O Box 320, University
10	International Carriers	Christchurch	K32,500.00	Kocarski Lodge	Private Mail Bag, POM
11	Cheese Inc.	Munchen	K73,050.00	Caroline Lynn	P O Box 12, Waigani
12	Andrew Love	Bogota	K54,000.00	Andrew Love	P O Box 44, Boroko
13	Singapore Computers	3 Orchard Rd, Singapore	K198,000.00	Datec	P O Box 399, POM
14	Nissan	Osaka	K969,000.00	Boroko Motors	P O Box 221, Boroko
:	:	:	:	:	:

A shipping company keeps a database on its shipments in the database table **Shipment** above.

Write SQL statements that answer the following questions:

   a) What is the average price of a shipment in the database? **[2 marks]**

   b) Which shipment is the most expensive? Display the ID and the sender's and receivers'

names. **[3 marks]**

   c) List all receivers and how many shipments they are currently expecting. **[2 marks]**

   d) Which shipments have the same sender and receiver? Display ID's and Sender names.

[2 marks]

   e) The custom authorities are looking for a shipment that may contain narcotics. A

witness said that there were the letters "CAR" in the name but could not say if they were in the

sender's or the receiver's name. List all suspicious shipments.   **[3 marks]**

    f) Draw the resulting table that will be generated by your Query in question (e), given

the instance above.   **[2 marks]**

    g) How many senders have dispatched more than one shipment?   **[3 marks]**

    h) Increase Price value by 13% for all shipments to Steamships.   **[3 marks]**

    i) Insert a new text field 'Grade of Shipment' into the table.   **[2 marks]**

    j) Create database table Shipment. Identify the primary key and the constraint that every

shipment price must be greater than K20,000.   **[3 marks]**