



Chancellor College

Department of Computer Science

End of First Semester Examination

Examination Code: **COM411**
Examination Title: **Database Systems**
Duration: **Three Hours**
Date: **23rd May 2016**
Time: **8:30 am**

Instructions

- a) **DO NOT** turnover the paper until you are told to do so
- b) This paper contains **five** pages (including this cover page), please check.
- c) This paper contains **six** questions. You are required to answer **all** the questions.
- d) The maximum marks attainable from each question are shown in brackets to the right of each question.
- e) Answer each question in the answer sheet provided.
- f) Show your calculation or reasoning. Unsupported answers will lead to loss of marks

1. Database Management Systems.

- a. What is a database? (2)
- b. How many distinct tuples are in a relation instance with cardinality 1004? (2)
- c. Define full functional dependency. (2)
- d. Describe two major components of SQL. (4)
- e. Explain the order of execution of the following SQL statement. (5)

SELECT [DISTINCT] select-list
FROM from-list
WHERE qualification
GROUP BY group-by-list
HAVING group-qualification
ORDER BY order-list

- f. What is the difference between the WHERE and HAVING clauses in SQL? (2)
- g. Discuss the general characteristics of advanced database applications like Computer-aided design (CAD), GIS, CASE etc. (10)
- h. Distributed databases.
 - i. Explain the motivation to provide distributed databases over ordinary databases. (3)
 - ii. Compare and contrast a distributed DBMS with a parallel DBMS. (4)
 - iii. Explain any three advantages of distributed databases. (6)

2. Consider a relation $R(a, b)$ that contains r tuples, and a relation $S(b, c)$ that contains s tuples. Make no assumptions about keys.

- a. Which of the three expressions below are equivalent (i.e., produce the same answer on all databases). Show your working. (5)

i. $\Pi_{a,c}(R \bowtie \sigma_{b=1} S)$

ii. $\Pi_a(\sigma_{b=1} R) \times \Pi_c(\sigma_{b=1} S)$

iii. $\Pi_{a,c}(\Pi_a R \times \sigma_{b=1} S)$

- b. Assuming $r > 0$ and $s > 0$. State in terms of r and s the minimum and maximum number of tuples that could be in the result of the following expression. Show your working.

$$\Pi_b R - (\Pi_b R - \Pi_b S) \quad (5)$$

3. In the schema below, the primary key for each relation is denoted by the underlined attribute, and **c-name**, **p-name** and **m-name** represent company, person and manager names respectively:

lives(p-name, street, city)
works(p-name, c-name, salary)
located-in(c-name, city)
manages(p-name, m-name)

Provide relational algebra expressions for the following queries:

- Find the name, street and city of all employees who work for National Bank and earn more than MK10,000. (4)
- Find all persons who do not work for National Bank. (3)

4. Given the following relations where the underlined attributes form the primary keys.

Hotel (hotelNo, hotelName, city)
Room (roomNo, hotelNo, type, price)
Booking (hotelNo, guestNo, dateFrom, dateTo, roomNo)
Guest (guestNo, guestName, guestAddress)

- Describe the relations that would be produced by the following relational algebra operations (2)

$\Pi_{\text{hotelName}} (\text{Hotel} \bowtie \sigma_{\text{Hotel.hotelNo} = \text{Room.hotelNo}} (\sigma_{\text{price} > 50} (\text{Room})))$ (2)

- Describe the relations that would be produced by the following relational calculus operations (2)

$\{H.\text{hotelName} \mid H \in \text{Hotel} \wedge (\exists R) (R \in \text{Room} \wedge H.\text{hotelNo} = R.\text{hotelNo} \wedge R.\text{price} > 50)\}$ (2)

- Provide the relational calculus to list the hotel names where the guest named Takondwa has a booking. (7)

5. Study the entity relationship diagram of the learner with disability management system (Figure 1) and answer the questions that follow.

- Study the table "performance"

i. What is the primary key of this table and what does it imply? (4)

ii. Define, in SQL, the foreign key constraints necessary for this table. (4)

- Write an SQL statement to list all **needs** a learner with disability has. Assume you know the last name of the learner. (4)

- If you were to delete a **need** in the *need* table what potential impact would this have on the database? (4)

- Write an SQL statement to find the first, last name, and date of birth of the youngest learner with disability. (4)

- Write an SQL statement to list name and category of disabilities without a disability level. (5)

6. Study the information provided below. Assume that $Act[a, b, \underline{c(FK)}, (d, e)]$ represents a schema "Act" where a, b, \dots, e are attributes, (d, e) represent a repeating group, \underline{c} represent primary key and (FK) indicates attribute c is a foreign key.

Pet Id	Pet Name	Pet Type	Pet Age	Owner	Visit Date	Procedure	Doctor
246	Popi	DOG	12	SAM LOYA	JAN 13/2014	01 - RABIES VACCINATION	06 - Banda
					MAR 27/2014	10 - EXAMINE and TREAT WOUND	08 - Chikoti
298	Tiger	DOG	2	TITANI KUNJE	APR 02/2014	05 - HEART WORM TEST	03 - Kathe
					JAN 21/2014	08 - TETANUS VACCINATION	01 - Lungu
341	Fluffy	CAT	4	SAM LOYA	MAR 10/2014	05 - HEART WORM TEST	04 - Kajombo
					JAN 23/2013	01 - RABIES VACCINATION	06 - Banda
519	Bruno	RABBIT	2	TITANI KUNJE	JAN 13/2014	01 - RABIES VACCINATION	08 - Chikoti
					APR 30/2014	20 - ANNUAL CHECK UP	03 - Kathe
					APR 30/2014	12 - EYE WASH	04 - Kajombo

- Provide the un-normalised schema of this information. (3)
- Reduce the schema in a. into first normal form. State any assumptions made. (4)
- Reduce the schema in b. into second normal form. (7)
- Reduce the schema in c. into third normal form. (2)

