



Undergraduate Programme
Department of Computer Science and Mathematics
Semester 2 Year 2018

FINAL EXAMINATION PAPER

ITC104 DATABASE SYSTEMS

Important Instructions to Students:

1. Read the questions, instructions carefully and answer the questions.
2. You are allowed an **extra 10 minutes reading time** (during this time, you are not allowed to write with pen) and **180 minutes (3 Hours)** to complete this paper.
3. Silent, non-programmable calculators are allowed, but not supplied.
4. Write all your answers in the answer booklet provided. If you need extra sheets, please ask from the supervisor. Write your name, course code and student identification number in the answer booklet and in the attendance sheet.
5. **This Final Course Examination Paper is worth 100 marks contributes 50% of the total course assessments.**
6. This paper contains one (1) section, A. All questions are compulsory to answer.
7. Write all your answers legibly. The marker has the right to award zero for answers that are not legible.
8. This is a **Closed Book Examination**. The University views plagiarism, cheating and dishonest practice as serious offences and if found, offenders are penalized.

Examination Paper Content (Format):

<u>Section</u>	<u>Question</u>	<u>Content</u>	<u>Marks</u>	<u>Suggested Time</u>
A	1-10	Short Answer Questions	100	180 minutes
		TOTAL	100	180 Minutes

SECTION A: SHORT ANSWER QUESTIONS**[100 Marks]****Question 1: Database Introduction and Database Characteristics****[10 Marks]**

- A. List and explain the **three (3)** characteristics of a database. [3 Marks]
- B. List and describe the features of **three (3)** product variations of a Database Management Systems (DBMS). What features are common to the product variations? [3 Mark]
- C. What is the major difference between procedural access and non-procedural language. List and explain **three (3)** reasons for combining procedural language with non-procedural access [2 Marks]
- D. List the **three (3)** levels of the decision-making hierarchy. Give an example of a typical decision that is made at each level. [2 Marks]

Question 2: Relational Data Model and CREATE TABLE Statement**[10 Marks]**

- A. Explain the use of *Entity Integrity* and *Referential Integrity* in a relational database. [2 Marks]

Student		Offering	
StdNo	StdLastName	OfferNo	CourseNo
123-45-6789	WELLS	1234	IS320
124-56-7890	KENDALL	4321	IS320
234-56-7890	NORBERT		
--	JONES		

Enrollment	
StdNo	OfferNo
123-45-6789	1234
234-56-7890	1234
123-45-6789	4321
124-56-7890	4321
234-56-7890	6789
--	4321

Figure 1: Integrity rule violations

- B. Identify **three (3)** integrity rule violations in Figure 1. [1.5 Marks]

- C. List **five (5)** different constraints that can be applied in a SQL CREATE query. What the two (2) placement options for the constraints inside a SQL CREATE query?

[3.5 Marks]

Table 1: Sample customer table

custno	custname	address	Internal	contact	phone	city	state	zip
C100	Football	Box 352200	Y	Mary Manager	6857100	Boulder	CO	80309
C101	Men's Basketball	Box 352400	Y	Sally Supervisor	5431700	Boulder	CO	80309
C103	Baseball	Box 352020	Y	Bill Baseball	5431234	Boulder	CO	80309
C104	Women's Softball	Box 351200	Y	Sue Softball	5434321	Boulder	CO	80309
C105	High School Football	123 AnyStreet	N	Coach Bob	4441234	Louisville	CO	80027

- D. Write a CREATE TABLE statement for the *Customer* table shown in Table 1. Choose data types appropriate for the DBMS used in your course. All columns are required (not null).

[3 Marks]

Question 3: Basic Query formulation with SQL

[10 Marks]

- A. Explain the major weakness of the SQL standards.

[1 Mark]

- B. Rewrite the following query using the Join Operator Style.

```
SELECT OfferNo, CourseNo, FacFirstName, FacLastName
FROM Offering, Faculty
WHERE OffTerm = 'FALL' AND OffYear = 2012
AND FacRank = 'ASST' AND CourseNo LIKE 'IS%'
AND Faculty.FacNo = Offering.FacNo;
```

[1 Mark]

- C. Write a SQL SELECT statements for the following problems:

(You have to make up names of tables and attributes based on the problem definition)

1. List the customer number, the name, the phone number, and the city of customers.

[1 Mark]

2. List all columns of the *EventRequest* table for events costing more than \$4000. Order the result by the event date (*DateHeld*).

[2 Marks]

3. List the event number, the event date (*DateHeld*), and the estimated audience number with approved status and audience greater than 9000 or with pending status and audience greater than 7000. Table name is *EventRequest*.

[2 Marks]

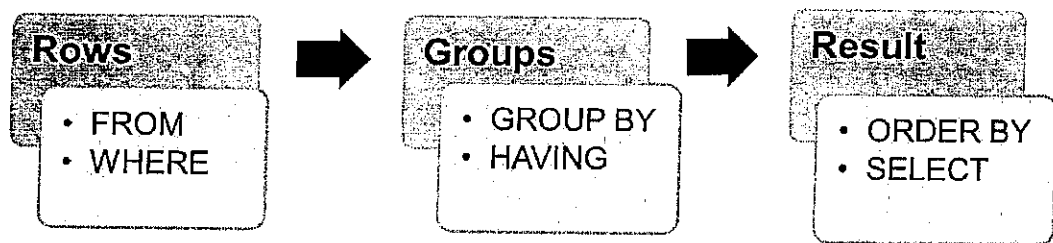


Figure 2: SELECT Query clause evaluation order

D. Explain the steps of execution in a SELECT query with the help of Figure 2.

[3 Marks]

Question 4: Extended Query Formulation with SQL

[10 Marks]

A. List the **three (3)** critical questions that need to be answered when formulating a SELECT query. Identify **two (2)** factors that need to be considered for each question listed.

[3 Marks]

B. List **four (4)** ways to reduce redundancy in a SELECT query?

[2 Marks]

C. Complete the GROUP BY clause of the following query:

```

SELECT Enrollment.OfferNo, CourseNo, FacFirstName, FacLastName, AVG(StdGPA) AS AvgGPA
FROM Offering, Enrollment, Student, Faculty
WHERE Offering.OfferNo = Enrollment.OfferNo
AND Student.StdNo = Enrollment.StdNo
AND Faculty.FacNo = Offering.FacNo
AND OffYear = 2012 AND OffTerm = 'FALL'
GROUP BY _____
HAVING AVG(StdGPA) > 3.0;
  
```

[1 Mark]

D. List and explain the use of the three (3) traditional set operators used by Microsoft SQL.

[1.5 Marks]

E. Complete the following SELECT query:

```

SELECT      Offering.OfferNo, Offering.CourseNo, OffDays, OffLocation, OffTime,
            CrsUnits, FacFirstName, FacLastName
FROM
WHERE      Faculty.FacNo = Offering.FacNo
AND        Offering.OfferNo = Enrollment.OfferNo
AND        Student.StdNo = Enrollment.StdNo
AND        Offering.CourseNo = Course.CourseNo
AND        OffYear = 2013 AND OffTerm = 'SPRING'
AND        StdFirstName = 'BOB'
AND        StdLastName = 'NORBERT';
  
```

[1 Mark]

E. What type of join is used in question 4(E) above.

[0.5 Mark]

F. What are the requirements for using the traditional set operators on tables and data.

[1 Mark]

Question 5: Notation for Entity Relationship Diagrams

[9 Marks]

A. Match the following Classifications with its correct Cardinality Restrictions:

Classification	Cardinality Restrictions
1. Mandatory	i. Minimum cardinality = 1
2. Optional	ii. Maximum cardinality = 1 in one direction; maximum cardinality > 1 in the other direction
3. Functional or single-valued	iii. Minimum cardinality = 0
4. 1-M	iv. Maximum cardinality = 1 in both directions
5. M-N	v. Minimum cardinality ≥ 1
6. 1-1	vi. Maximum cardinality > 1 in both directions

[3 Marks]

B. Draw an ERD containing *Student* and *Paper* entity types connected by a 1-M relationship. The *Student* entity type should have attributes for *StdNo* (primary key), *StdFirstName*, *StdLastName*, *StdAdmitSemester*, *StdAdmitYear*, and *StdEnrollStatus* (full or part-time). The *Paper* entity type should have attributes for *PaperNo* (primary key), *PaperTitle*, *PaperSubmitDate*, *PaperAccepted* (yes or no), and *PaperType* (first, second, proposal, or dissertation). Add a 1-M relationship from *Student* to *Paper*.

[2 Marks]

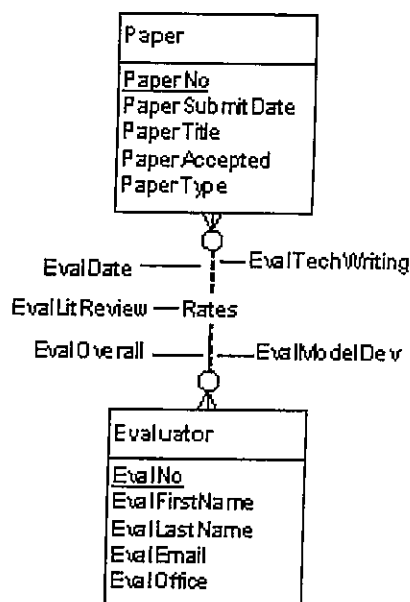


Figure 3: Basic ERD Diagram

C. List and briefly explain the four (4) broad goals of database development.

[2 Marks]

D. Transform the M-N relationship from Figure 3 into an associative entity type and identifying relationships.

[2 Marks]

Question 6: ERD Rules and Problem Solving

[11 Marks]

A. Draw an ERD containing the Order and Customer entity types connected by a 1-M relationship from Customer to Order. Choose an appropriate relationship name using your common knowledge of interactions between customers and orders. Define minimum cardinalities so that an order is optional for a customer and a customer is mandatory for an order. For the Customer entity type, add attributes CustNo (primary key), CustFirstName, CustLastName, CustStreet, CustCity, CustState, CustZip, and CustBal (balance). For the Order entity type, add attributes for the OrdNo (primary key), OrdDate, OrdName, OrdStreet, OrdCity, OrdState, and OrdZip.

[3 Marks]

B. List and explain the four (4) Entity Relationship Diagram (ERD) completeness rules.

[2 Marks]

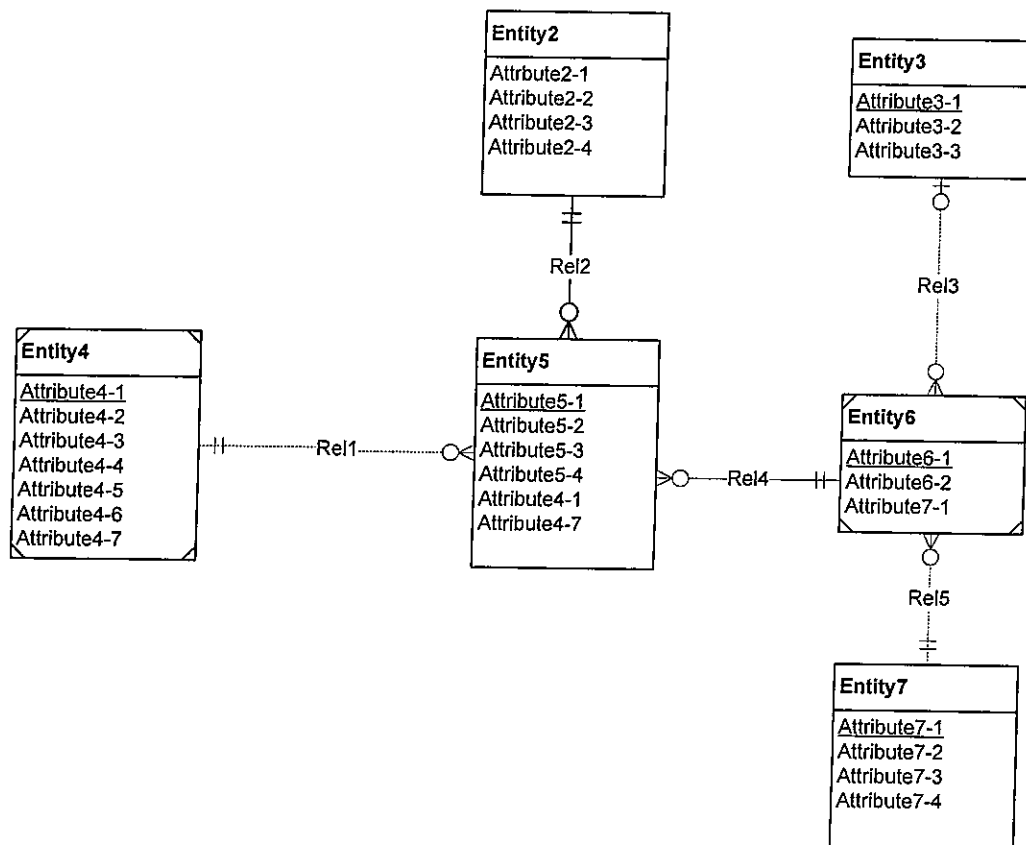


Figure 4: ERD with diagram rules

- C. Identify **six (6)** consistency rule violations in Figure 4 and suggest possible resolutions of the error. The ERD has generic names so that you will concentrate on finding diagram errors rather than focusing on the meaning of the diagram.

[6 Marks]

Question 7: Developing Business Data Models

[10 Marks]

- A. Explain the **three (3)** steps of Narrative Problem Analysis.

[3 Marks]

- B. Define an ERD for the following narrative. The database should track homes and owners. A home has a unique home identifier, a street address, a city, a state, a zip, a number of bedrooms, a number of bathrooms, and square feet. A home is either owner occupied or rented. An owner has a unique owner number, a Social Security number (used for government reporting requirements), a name, an optional spouse name, a profession, an optional spouse profession, and an optional spouse Social Security number. An owner can possess one or more homes. Each home has only one owner.

[3 Marks]

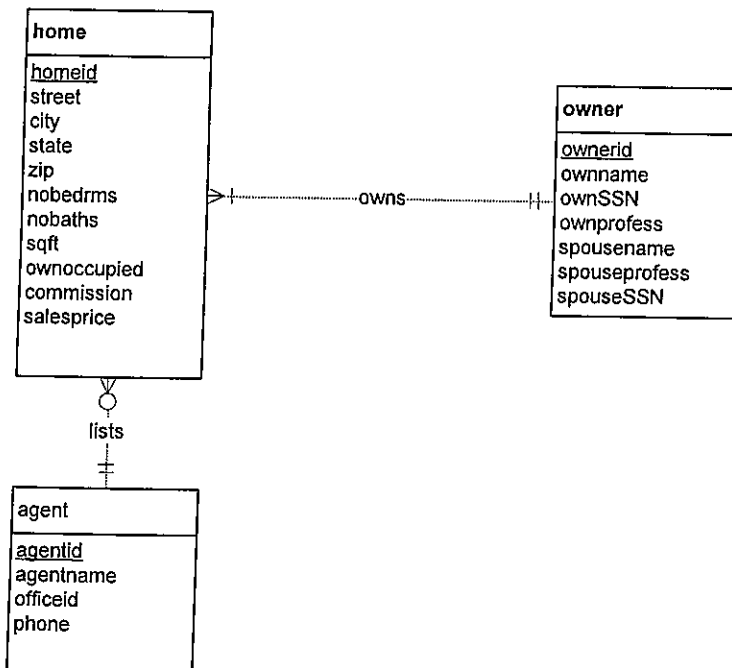


Figure 5: Attribute Expansion

- C. Consider the ERD in Figure 5 and transform the attribute, officeid, into an entity type. Data about an office include the phone number, the manager name, and the address. Add appropriate relationships and cardinalities.

[2 Marks]

- D. Design an ERD to represent a credit card statement. The statement has two parts: a heading containing the unique statement number, the account number of the credit card holder, and the statement date; and a detail section containing a list of zero or more transactions for which the balance is due. Each detail line contains a line number, a transaction date, a merchant name, and the amount of the transaction. The line number is unique within a statement.

[2 Marks]

- A. For the following problem, define an ERD for the initial requirements and then revise the ERD for the new requirements. Your solution should have an initial ERD and a revised ERD.

The database supports the placement office of a leading graduate school of business. The primary purpose of the database is to schedule interviews and facilitate searches by students and companies. Consider the following requirements in your initial ERD:

- Student data include a unique student identifier, a name, a phone number, an e-mail address, a web address, a major, a minor, and a GPA.
- The placement office maintains a standard list of positions based on the Labor Department's list of occupations. Position data include a unique position identifier and a position description. Because the position list is standardized, multiple companies may interview for the same position.
- Company data include a unique company identifier, a company name, and a list of positions and interviewers. Each company must map its positions into the position list maintained by the placement office. For each available position, the company lists the cities in which positions are available.
- Interviewer data include a unique interviewer identifier, a name, a phone, an e-mail address, and a web address. Each interviewer works for one company.
- An interview includes a unique interview identifier, a date, a time, a location (building and room), an interviewer, and a student. An interviewer may conduct multiple interviews.

[7 Marks]

After reviewing your initial design, the placement office decides to revise the requirements. Make a separate ERD to show your refinements. Refine your original ERD to support the following new requirements:

- Allow companies to use their own language to describe positions. The placement office will not maintain a list of standard positions.
- Allow companies to indicate availability dates and number of openings for positions.
- Allow companies to reserve blocks of interview time. The interview blocks will not specify times for individual interviews. Rather a company will request a block of X hours during a specified week. Companies reserve interview blocks before the placement office schedules individual interviews. Thus, the placement office needs to store interviews as well as interview blocks.
- Allow students to submit bids for interview blocks. Students receive a set amount of bid dollars that they can allocate among bids. The bid mechanism is a pseudo-market approach to allocating interviews, a scarce resource. A bid contains a unique bid identifier, a bid amount, and a company. A student can submit many bids and an interview block can receive many bids.

[4 Marks]

Question 9: Schema Conversion

[9 Marks]

- A. Illustrate the application of the *four (4)* conversion rules used to convert an ERD into a logical database. Explain the order and operations that are performed when applying the conversion rules.

[4 Marks]

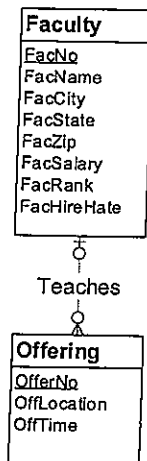


Figure 6: Application of 1-M relationship

- B. Outline and explain the four (4) steps of logical database design.

[4 Marks]

- C. Which of the following is the correct application of a 1-M relationship depicted in Figure 6?
(Write down the letter of your choice)

- CREATE TABLE Faculty(..., PRIMARY KEY (FacNo), FOREIGN KEY (OfferNo) REFERENCES Offering, ...)
- CREATE TABLE Faculty(..., PRIMARY KEY (FacNo), FOREIGN KEY (OfferNo) REFERENCES Faculty, ...)
- CREATE TABLE Offering (... , PRIMARY KEY (OfferNo), FOREIGN KEY (FacNo) REFERENCES Faculty, ...)
- CREATE TABLE Offering (... , PRIMARY KEY (OfferNo), FOREIGN KEY (FacNo) REFERENCES Offering, ...)

[1 Mark]

Question 10: Normalization Concepts and Practice

[10 Marks]

- A. For Table 2, list Functional dependencies (FD) with the column StdCity as the determinant that are not true due to the sample data. For each FD, you should identify one falsification example or indicate that no falsification example exists in the sample rows. Remember that it takes two rows to falsify an FD in which the Left-Hand Side is the same in both rows but the Right-Hand Side is different.

Table 2: Sample Data for the Big University Database Table

StdNo	StdCity	StdClass	OfferNo	OffTerm	OffYear	EnrGrade	CourseNo	CrsDesc
S1	SEATTLE	JUN	O1	FALL	2013	3.5	C1	DB
S1	SEATTLE	JUN	O2	FALL	2013	3.3	C2	VB
S2	BOTHELL	JUN	O3	SPRING	2014	3.1	C3	OO
S2	BOTHELL	JUN	O2	FALL	2013	3.4	C2	VB

- B. Apply the simple BCNF procedure to the following list of FDs. Show the result of each step. In the final list of tables, you should show the primary keys, foreign keys, and unique constraints. You do not need to write CREATE TABLE statements.

AuthNo $\rightarrow$ AuthName
AuthEmail $\rightarrow$ AuthNo
PaperNo $\rightarrow$ Primary-AuthNo
AuthNo $\rightarrow$ AuthAddress
AuthNo $\rightarrow$ AuthEmail
PaperNo $\rightarrow$ PapTitle
PaperNo $\rightarrow$ PapAbstract
PaperNo $\rightarrow$ PapStatus
RevNo $\rightarrow$ RevName
RevNo $\rightarrow$ RevEmail
RevEmail $\rightarrow$ RevNo
RevNo, PaperNo $\rightarrow$ Auth-Comm
RevNo, PaperNo $\rightarrow$ Prog-Comm
RevNo, PaperNo $\rightarrow$ RevDate
RevNo, PaperNo $\rightarrow$ Rating
RevNo $\rightarrow$ RevAddress

THE END