



# MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

## FACULTY OF ENGINEERING, APPLIED SCIENCES AND TECHNOLOGY

DEPARTMENT: COMPUTER SCIENCE AND INFORMATION SYSTEMS

MODULE: DATABASE SYSTEMS

CODE: INSY122

SESSIONAL EXAMINATIONS  
OCTOBER 2023

DURATION: 3 HOURS

EXAMINER: MS C KATSANDE

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### INSTRUCTIONS

1. Answer *ALL questions* in Section A
2. Answer Any *three (3) questions* in Section B
3. Each question carries 25 marks
4. Start a new question on a fresh page
5. Total marks 100

*Additional material(s): None*

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## **SECTION A**

### **Question 1**

Manicaland State University needs to develop an online registration and examination system to keep student information and their registration details. The university comprises several departments, each of which belongs to a faculty. Each department has a name, phone extension, and specific mailing address. Additionally, each department offers at least one programme, which belongs to only one department at a time. A program is identified by its code, name, programme type (full-time or part-time), and duration. A student can only be enrolled in one programme at a given time and has a registration number, name, gender, date of birth, and address. Moreover, a student may register for more than one course, and each course belongs to a department. A course has a title, credits, and prerequisites. Each department has at least one instructor who is assigned more than one course to teach. An instructor belongs to only one department and has a name, employee number, and title. At the end of the semester, course instructors award grades to students in each course they are enrolled in.

a) Design an Entity Relationship Diagram (ERD) to capture the above requirements.

Make sure cardinalities and primary keys are clear.

**15 Marks**

b) Map the ERD diagram in a) above to create the relational model corresponding to the described application. Clearly define the primary keys and foreign keys.

**10 Marks**

## SECTION B

### Question 2

a) Outline any five (5) features of a Database Management System (DBMS) and explain how they contribute to the effectiveness and efficiency of data management.

**10 Marks**

b) Provide any five threats to database security faced by organizations and propose mitigation strategies for each of these threats to enhance database security.

**15 Marks**

### Question 3

Given the following relation:

StudentID	S_name	CourseID	C_name	Faculty	F_phone	Final_Result
1	Student A	INSY122	Database	Applied Sciences	1111	A
1	Student A	ACCT123	Financial Accounting	Agribusiness	3333	B
2	Student B	INSY122	Database	Applied Sciences	1111	A
3	Student C	INSY122	Database	Applied Sciences	1111	B
4	Student D	ACCT123	Financial Accounting	Agribusiness	3333	A
4	Student D	INSY122	Database	Applied Sciences	1111	B

a) Identify and explain three data anomalies you have observed.

**9 Marks**

b) Normalize the relation into 3NF. Show all the normalized tables at each stage of the normalisation.

**12 Marks**

c) Explore any two limitations of normalisation.

**4 Marks**

#### **Question 4**

- a) Outline the four (4) main properties of a transaction in a database management system. **4 Marks**
- b) Explain how the two-phase locking technique can address the issue of poor concurrency in a database. **6 Marks**
- c) Differentiate between replication and fragmentation, and provide suitable examples. **6 Marks**
- d) ‘The CAP theorem states that when a network partition occurs, a distributed database system must choose between consistency and availability’. Justify? **9 Marks**

#### **Question 5**

Explain how the following models increase database security:

- i. Authentication. **3 Marks**
- ii. Authorisation. **3 Marks**
- iii. Encryption. **3 Marks**
- a) Explain two ways that views can be used to implement data security. **4 Marks**
- b) You are a Database Administrator (DBA) for a large organization that handles sensitive customer data. One day, a server crash occurs, and you need to restore the database as soon as possible to minimize the impact on the organization. You have three backup options available: full, differential, and incremental backups. The last full backup was performed a week ago, and differential backups are performed every day at midnight. Incremental backups are performed every hour. Based on the scenario above, which backup type would you choose to restore the database, and why? In your response, you should also highlight the advantages and limitations of each backup type, and explain why it is the best choice for the given scenario. **12 Marks**

**END OF EXAMINATION**