SOUTH EASTERN UNIVERSITY OF SRI LANKA

DEPARTMENT OF INFORMATION & COMMUNICATION TECHNOLOGY
FIRST EXAMINATION IN BICT - 2021/2022
SEMESTER I – APRIL / MAY 2024
CIS-11022 DATABASE DESIGN

Answer **ALL** Questions — Time allowed: **TWO (02)** Hou

1 a) Define the following terms:
   a. Data
   b. Data independency
   c. Data Model
   d. Information (20 Marks

b) Explain followings with suitable examples:
   i. Levels of abstraction
   ii. Database instance (20 Marks

c) i. What are the benefits of a database management system over a manual system? Provide three (03) examples.
   ii. What are the five (05) disadvantages of file processing system. (30 Marks

d) Explain the three-tier architecture of DBMS along with followings:
Levels, schema, and mappings. You are advised to explain with the illustration. (30 Marks

[Total 100 Marks

2 a) Define the following terms:
   a. Attribute
   b. Weak entity
   c. Entity set
   d. Null values (20 Marks

b) You are tasked with designing a database system for a library. Using your knowledge of Entity-Relationship (ER) diagrams and database design principles, create an ER diagram for the library database system. The database should include entities for books, authors, borrowers, and transactions. Each book has a unique ISBN, title, publication year, and may have multiple authors. Authors are identified by their names and may have written multiple books. Borrowers are library members who can borrow books. Include attributes such as borrower ID, name, address, and contact information. Transactions represent the borrowing and returning of books by borrowers. Each transaction should include the book borrowed, the borrower, the date borrowed, and the due date.

- Define appropriate relationships between these entities, ensuring data integrity and consistency.
- Your ER diagram should clearly illustrate: Entities, Attributes, Relationships, and Primary Keys.

Provide a brief explanation of your design choices and any assumptions made during the process. (80 Marks

[Total 100 Marks

3 a) Define the following terms:
   a. Relation schema
   b. Functional dependency
   c. Non-key attribute
   d. Referential integrity (20 Marks)

b) Explain the distinctions among the terms primary key, candidate key, and super key. (15 Marks)

c) 1. Define normalization and explain its significance in database design
   2. Discuss the concept of partial dependency and how it relates to achieving second normal form (2NF). (20 Marks)

d) Answer the followings;
   a. Given a relation R(A, B, C, D) and Functional Dependency set FD = { AB → CD, B → C }, determine whether the given R is in 2NF? If not convert it into 2 NF.
   b. Given a relation R(P, Q, R, S, T, U, V, W, X, Y) and Functional Dependency set FD = { PQ → R, PS → VW, QS → TU, P → X, W → Y }, determine whether the given R is in 2NF? If not convert it into 2 NF.
   c. The following relations R = (A, B, C, D, E) is given below with following functional dependencies {BCE → ADE , D → B }
      i. Find all candidate keys.
      ii. Identify the best normal form that R satisfies (1NF, 2NF, 3NF or BCNF? Explain your answer in detail. (45 Marks)

[Total 100 Marks]

4 a) Answer the following questions using SQL statements by referring the following relations.

Employees (employee_id, name, department_id, salary)
Departments (department_id, department_name, manager_id)
Projects (project_id, project_name, department_id, start_date, end_date)
Tasks (task_id, project_id, employee_id, task_description, start_date, end_date)

i. Retrieve all employee names and their respective departments
ii. Find the project names along with their start dates
iii. List all employees who are not assigned to any project
iv. Find the employee(s) with the highest salary within each department
v. Calculate the average duration of tasks across all projects (50 Marks)

b) Consider the following relations and answer the questions given below using relational algebraic notations.

- Employees (Emp_ID, Name, Department_ID)
  Departments (Department_ID, Department_Name, Manager_ID)
  Projects (Project_ID, Project_Name, Department_ID)
  Work_hours (Emp_ID, Project_ID, Hours)
  Salaries (Emp_ID, Salary)

  i. List all employees' names and their corresponding department names
  ii. Find the names of employees who work on the project named "XYZ"
  iii. Retrieve the names of employees who have not worked on any project
  iv. List the names of employees who work more than 40 hours a week
  v. Retrieve the names of employees who work on projects managed by their own department.

(50 Marks

[Total 100 Marks