

Course Code: CS 203	Course Name: Database Systems
Instructor Name: Dr. Zulfiqar Ali Memon / Mr. Shoaib Rauf / Ms. Anam Qureshi	
Student Roll No:	Section:

Instructions:

- Return the question paper. Don't write anything on question paper, except your Roll # & Section #.
- Read each question completely before answering it. There are **6 questions and 3 pages**.
- In case of any ambiguity, you may make assumptions. But your assumptions should not contradict any statement in the question paper.
- This paper is subjective. Write the answers only on answer sheet.

Time: 180 minutes.

Max Marks: 50

Question 1: Students can lease university flats and some of the details of leases held by students for places in university flats are shown below in table. A place number (placeNo) uniquely identifies each single room in all flats and is used when leasing a room to a student. BannerID is used to uniquely identify a student. [7 marks]

leaseNo	bannerID	placeNo	fName	lName	startDate	finishDate	flatNo	flatAddress
10003	B017706	78	Jane	Watt	01/09/2010	30/06/2011	F56	34 High Street, Paisley
10259	B017706	88	Jane	Watt	01/09/2011	30/06/2012	F78	111 Storrie Road, Paisley
10364	B013399	89	Tom	Jones	01/09/2011	30/06/2012	F78	111 Storrie Road, Paisley
10566	B012124	102	Karen	Black	01/09/2011	30/06/2012	F79	120 Lady Lane, Paisley
11067	B034511	88	Steven	Smith	01/09/2012	30/06/2013	F78	111 Storrie Road, Paisley
11169	B013399	78	Tom	Jones	01/09/2012	30/06/2013	F56	34 High Street, Paisley

- The table shown above is susceptible to update anomalies. Provide examples of insertion, deletion, and update anomalies.
- Describe and illustrate the process of normalizing the table shown above to 3NF, by identifying the functional dependencies represented by the attributes. State any assumptions you make about the data shown in the table.

Question 2: Generate the relational algebra expressions for the following queries, using the schema given below: [5 marks]

Branch	(branchNo, street, city, postcode)
Staff	(staffNo, fName, lName, position, sex, DOB, salary, branchNo)
PropertyForRent	(propertyNo, street, city, postcode, type, rooms, rent, ownerNo, staffNo, branchNo)
Client	(clientNo, fName, lName, telNo, prefType, maxRent, eMail)
PrivateOwner	(ownerNo, fName, lName, address, telNo, eMail, password)
Viewing	(clientNo, propertyNo, viewDate, comment)
Registration	(clientNo, branchNo, staffNo, dateJoined)

- How many properties cost more than £350 per month to rent?
- Identify all clients who have viewed all properties with three rooms.
- List the names and comments of all clients who have viewed a property for rent.
- List all cities where there is either a branch office or a property for rent situated.
- List all cities where there is a branch office but no properties for rent.

Question 3:

[8 marks]

You are required to create a conceptual data model of the data requirements for a company that specializes in IT training. The Company has 30 instructors and can handle up to 100 trainees per training session. The Company offers five advanced technology courses, each of which is taught by a teaching team of two or more instructors. Each instructor is assigned to a maximum of two teaching teams or may be assigned to do research. Each trainee undertakes one advanced technology course per training session.

Represent the data requirements of the company as a single ER diagram, by identifying:

- the main entity types & the attributes associated to those entity types,
- the relationship types between the entity types,
- the multiplicity/structural constraints for each relationship
- the primary & foreign key attributes

Questions 4: Produce a wait-for-graph (WFG) for the following transaction scenario and determine whether deadlock exists. [5 marks]

Transaction	Data items locked by transaction	Data items transaction is waiting for
T ₁	X ₂	X ₁ , X ₃
T ₂	X ₃ , X ₁₀	X ₇ , X ₈
T ₃	X ₈	X ₄ , X ₅
T ₄	X ₇	X ₁
T ₅	X ₁ , X ₅	X ₃
T ₆	X ₄ , X ₉	X ₆
T ₇	X ₆	X ₅

Question 5: Consider the two transactions T1 and T2 given below, with their order of operations: (‘‘R1’’ means Read of T1, ‘‘W2 means Write of T2’’, etc) [15 marks]

(a)	<div>T₁</div> <div>R1 (X) W1 (X) R1 (Y) W1 (Y)</div>	(b)	<div>T₂</div> <div>R2 (X) W2 (X)</div>
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Following are the possible different schedules of the operations for the transactions shown above. Determine which among these are; conflict serializable; not conflict serializable and which are serial.

- S 1 :** R 1 (X); W 1 (X); R 1 (Y); W 1 (Y); R 2 (X); W 2 (X);
S 2 : R 2 (X); R 1 (X); W 2 (X); W 1 (X); R 1 (Y); W 1 (Y);
S 3 : R 1 (X); W 1 (X); R 1 (Y); R 2 (X); W 1 (Y); W 2 (X);
S 4 : R 2 (X); R 1 (X); W 1 (X); R 1 (Y); W 1 (Y); W 2 (X);
S 5 : R 1 (X); W 1 (X); R 1 (Y); R 2 (X); W 2 (X); W 1 (Y);
S 6 : R 1 (X); W 1 (X); R 2 (X); R 1 (Y); W 2 (X); W 1 (Y);
S 7 : R 2 (X); R 1 (X); W 1 (X); R 1 (Y); W 2 (X); W 1 (Y);
S 8 : R 1 (X); W 1 (X); R 2 (X); W 2 (X); R 1 (Y); W 1 (Y);
S 9 : R 1 (X); R 2 (X); W 1 (X); R 1 (Y); W 1 (Y); W 2 (X);
S 10 : R 1 (X); R 2 (X); W 1 (X); R 1 (Y); W 2 (X); W 1 (Y);
S 11 : R 1 (X); R 2 (X); W 1 (X); W 2 (X); R 1 (Y); W 1 (Y);
S 12 : R 1 (X); W 1 (X); R 2 (X); R 1 (Y); W 1 (Y); W 2 (X);
S 13 : R 1 (X); R 2 (X); W 2 (X); W 1 (X); R 1 (Y); W 1 (Y);
S 14 : R 2 (X); R 1 (X); W 1 (X); W 2 (X); R 1 (Y); W 1 (Y);
S 15 : R 2 (X); W 2 (X); R 1 (X); W 1 (X); R 1 (Y); W 1 (Y);

Question 6:*[10 marks]*

You are designing a database for KW Humane Society. The result is the following set of relations where the type of each relations attribute is given following the attribute (e.g., ID: integer):

Animals(ID: integer, Name: string, PrevOwner: string, DateAdmitted: date, Type: string)

Adopter(SIN: integer, Name: string, Address: string, OtherAnimals: integer)

Adoption(AnimalID: integer, SIN: integer, AdoptDate: date, chipNo: integer)

where

-) The primary keys are underlined.
-) Animals stores information about the animals currently at the Humane Society. Each is given an ID, and their names together with the SIN of their previous owners (attribute PrevOwner), and their date of admission is recorded. Type refers to the type of animal (dog, cat, etc).
-) Adopter is the relation that holds information about animal adopters. The attributes are self-descriptive, except OtherAnimals which records the number of other animals that the adopter currently has at home.
-) AnimalID in Adoption refers to the ID of Animals. Similarly, SIN in Adoption refers to the SIN of Adopter. Attribute chipNo stores the number on the microchip that is implanted on the animal for tracking. Owner in Animals refers to the SIN of Adopter (in this case the previous adopter).

Formulate the following queries in SQL;

- (a) Retrieve the total number of dogs that were brought to the Humane Society on 18 April 2000.
- (b) List the name of the adopter who has adopted every type of animal.
- (c) For each animal type, list the animal type and total number of adoptions on 14 June 1999.
- (d) List the types of animals who have not had any adoptions.
- (e) For each adopter who has made at least two adoptions, list their names and addresses.

Good Luck