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National University of Computer and Emerging Sciences, Lahore Campus

Course:	**Database Systems**	**Course Code:**	**CS203**
Program:	**BS(Computer Science)**	**Semester:**	**Spring 2018**
Duration:	**60 Minutes**	**Total Marks:**	**40**
Paper Date:	**12-Apr-18**	**Weight**	**15%**
Section:	**ALL**	**Page(s):**	**5**
Exam:	**Midterm-2**		

Instruction/Notes: Scratch sheet can be used for rough work however, all the questions and steps are to be shown on question paper. No extra/rough sheets should be submitted with question paper.
You will not get any credit if you do not show proper working, reasoning and steps as asked in question statements.

Q1. *(10 points)* Consider a relation with schema *R(A, B,C,D)*, with FDs *F = {BC → A, AD → B, CD → B, AC → D}*.
Assume possible keys of this relation are *{BC}, {CD},* and *{AC}*. Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer. If R is not in BCNF, decompose it into a set of BCNF relations and show your steps. Indicate which dependencies if any are not preserved by the BCNF decomposition.

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Q2. *(4+6= 10 points)* Consider the relation schema *R(A, B, C, D)*, with FDs *F = {AC → B, B → A, BD → C, D → A}*.

a) Which of the following FDs may or may not hold over schema *R*? Justify your answer.

i) *CD → B* **ii)** *AC → D* **iii)** *BD → B* **iv)** *A → B*

b) Find all the candidate keys for this relation *R* (You do not need to list superkeys that are not keys). Provide proper reason.

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Q3. *(10 points)* Consider the relation schema *R(A, B, C, D),* with FDs *F = {AB →CD, C →A, AD→C, CD →AB, D →B}*. Find a minimal cover of *F* (i.e. F_c).

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Q4. ONLY FOR SECTION (A, B, E, F) *(3+3+4= 10 points)*

a) Given these transactions, find a cascade-free but not strict schedule, if possible (your schedule must be non-serial).
T1: r1(A), r1(B), w1(B), w1(A), c1. **T2:** r2(B), w2(B), c2. **T3:** w3(B), c3.

b) Consider the following schedule of three transactions T1, T2, and T3.
S: w3(X), r2(X), w1(Y), r2(Y), r2(Z), r1(Z), c3, c2, c1.

Draw the serializability (precedence) graph for this schedule. State whether this schedule is (conflict) serializable or not. If the schedule is serializable, write down the equivalent serial schedule(s) otherwise explain why it is not.

c) What are checkpoints, and why are they important? What are transaction commit points, and why are they important?

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Q4. ONLY FOR SECTION (C, D) *(10 points)*

Represent the following requirements as ER model also specify the constraints using **min-max notation**.

Each bank can have multiple branches, and *each branch* have multiple *types of accounts* and offers diverse types of l*oans*. A bank is registered with its name and have a unique nine-digit code. The different branches of a bank have branch number that is unique within a bank. Most of the branches are recognized by their location (i.e. town, city, state). To open an account a customer must provide name, CNIC, mobile number and home phone, resident and permanent address and birthdate. A customer must know the unique account number issued by the bank to perform the basic transactions. For each account bank record the account type and balance. The account number consists of 3-digit bank code followed by 7-digit number. Same is the case with loan number. The bank also records the loan type and amount.

Every customer must have at least one account but is restricted to at most two loans at a time, and a bank branch cannot have more than 5000 loans. The customer can access the details of their accounts and loans online. The bank keeps track of the date when the customer last access their account.