Roll No. _____ Name _____ Section ____

National University of Computer and Emerging Sciences, Lahore Campus

Course:	**Database Systems**	**Course Code:**	**CS219/CS203**
Program:	**BS (Computer Science)**	**Semester:**	**Spring 2020**
Duration:	**3 Hours**	**Total Marks:**	**50**
Paper Date:	**Mon 29-Jun-2020**	**Weight**	**50%**
Section:	**BCS-4A, BCS-4B, BCS-6A**	**Page(s):**	**2**
Exam:	**Final Exam**	**Questions:**	**6**

NOTES:

HOW TO SUBMIT ANSWER SHEET/SOLUTION *(DON'T SEND INDIVIDUAL/SEGMENTS OF SOLUTIONS and MULTIPLE COPIES)*:

1. Prepare a single *PDF file* (merge individual answer sheets into a single pdf file *in order* and with *correct numbering*).
2. Mention your *Full Name*, *Roll Number,* and *Section* clearly on each document; *any anonymous document will not be marked at all*.
3. You will be given **an extra 30 minutes** to complete this submission process in two mediums (i) Through **Slate or Google Classroom, or both** (ii) Using following **email** address: ishaq.raza@nu.edu.pk; add your file name to email subject line.

   IMPORTANT:
   Your **file name** should contain *Course Abbreviation Name* (DB), your *Section* (BCS-4A), and *Roll No*, (**For example: *DB_BCS-4A_18L-1234.pdf***).
4. *Late solutions received will NOT be considered.*

You will not get full credit if you do not show proper working, reasoning and steps as asked in question statements.

The current pandemic has unprecedented effects on the people and governments. The government of Pakistan wants the researchers to team up and develop systems that can detect disease outbreak and other medical conditions. It has invited the researchers to submit research proposals for funding. Your task is to develop a database for storing all the proposal and related details like researchers that will participate in it and the resources that are requested.

Proposal (ID, name, duration, teamID)
Team (teamID, teamName)
Researcher (resrID, name, email, DOB, position, university)
ResearchersInTeam (teamID, resrID, resrRole, remuneration)
Resource (ID, name, price, description)
ProposalResources (proposalID, resourceID, quantity)

The proposal duration is given in years.
The attribute Position in researcher table can be Professor, Assistant Professor, Lecturer, Instructor, Student etc.
The attribute resrRole indicates the role of the researcher which can be PI (Principle investigator), COPI (co - principle investigator) or team member. Attribute remuneration indicates the amount of money that will be given to each researcher.

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Q1. *(16 points)*
Write query in <u>Relational algebra (RA) and SQL</u> to solve the following:

a. Print the ID and name of the teams in which every researcher is under the age of 40.
b. Find the pair of teams that have exactly same members. Print the IDs of such teams.
c. Print the name and id of the proposal that demands maximum funds. The funds required by the proposal includes the remuneration of all the researchers working on it and the price of all the resources required.
d. List the names of the team that have PI as well as COPI.

Q2. (4 points)
It is required that a team do not submit more than two proposals. Write a SQL query or trigger or view to solve this issue?

Q3. *(1+1+2+2+4= 10 points)*
Consider a relation schema *R (A, B, C, D, E)*, with FDs *F = {C→AB, A→E, D→E, BD→C, CD→B}*.
Show all steps, working, and reasoning to answer the following questions.

a. Determine all possible keys. Prove it.
b. Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer.
c. Decompose the relation R into a 2NF schema, if it is not in 2NF. *(<u>Remove 2NF violations only, in this part</u>)*
d. Check whether your answer to part **(c)** is in 3NF. If not, decompose it into a 3NF schema. List clearly complete set of 3NF schema relations with all keys and FDs.
e. Check whether your answer to part **(d)** is in BCNF. If not, decompose it into a BCNF schema. List clearly complete set of BCNF schema relations with all keys and FDs and also indicate which dependencies if any are not preserved.

Q4. *(10 points)*
Identify the data requirements of FAST Computer Lab Management system. The FAST consists of various computer labs for conducting lab sessions, research, fyp, and have general purpose labs too. Make sure that it has **at least** 5 regular entity types, 4 relationship types, a weak entity type, an n-ary (n>2) relationship type, and a specialization.
Design and Draw an EER diagram (using notation discussed in lectures) for a database of a FAST Computer Lab Management system. Specify all constraints that should hold on the database.

Q5. *(5 points)*
Consider the EER diagram in Question 4. Map the EER schema into a relational schema. Specify all constraints that should hold on the database. Justify your choice of mapping options, if any. State any assumptions you make.

Q6. *(5 points)*
Consider the relational schema designed in Question 5. Identify five functional dependencies that should hold in the system.