INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

EXAMINATION (Mid Semester)	SEMESTER (Spring)

Roll Number									Section		Name	

Subject Number	C	S	3	0	2	0	2	Subject Name	*Database Management Systems*

Department / Center of the Student		Additional sheets	

Important Instructions and Guidelines for Students

1. You must occupy your seat as per the Examination Schedule/Sitting Plan.

2. Do not keep mobile phones or any similar electronic gadgets with you even in the switched off mode.

3. Loose papers, class notes, books or any such materials must not be in your possession, even if they are irrelevant to the subject you are taking examination.

4. Data book, codes, graph papers, relevant standard tables/charts or any other materials are allowed only when instructed by the paper-setter.

5. Use of instrument box, pencil box and non-programmable calculator is allowed during the examination. However, exchange of these items or any other papers (including question papers) is not permitted.

6. Write on both sides of the answer script and do not tear off any page. **Use last page(s) of the answer script for rough work.** Report to the invigilator if the answer script has torn or distorted page(s).

7. It is your responsibility to ensure that you have signed the Attendance Sheet. Keep your Admit Card/Identity Card on the desk for checking by the invigilator.

8. You may leave the examination hall for wash room or for drinking water for a very short period. Record your absence from the Examination Hall in the register provided. Smoking and the consumption of any kind of beverages are strictly prohibited inside the Examination Hall.

9. Do not leave the Examination Hall without submitting your answer script to the invigilator. **In any case, you are not allowed to take away the answer script with you.** After the completion of the examination, do not leave the seat until the invigilators collect all the answer scripts.

10. During the examination, either inside or outside the Examination Hall, gathering information from any kind of sources or exchanging information with others or any such attempt will be treated as **'unfair means'.** Do not adopt unfair means and do not indulge in unseemly behavior.

Violation of any of the above instructions may lead to severe punishment.

Signature of the Student

To be filled in by the examiner

Question Number	1	2	3	4	5	6	7	8	9	10	Total
Marks Obtained											

Marks obtained (in words)	Signature of the Examiner	Signature of the Scrutineer

Instructions: Answer all THREE questions. Time = 2hrs. Total marks = 3x20 = 60. Write your answers only in the space provided. <u>Show the solution steps</u>. Answers without explanation will be penalised. The question paper has total 16 pages.

ROUGH WORK

1.(a). Draw an ER diagram, with mapping and cardinality constraints, to represent the following information: A student with a unique roll number appears for exams. An exam is held on exactly one date. A student may take any number of exams, and every exam is taken by at least one student. An exam is uniquely identified by a combination of a course and a semester. Every exam has at least one invigilator. An invigilator is uniquely identified by the exam and invigilator name. There is at least one question for an exam. A particular question is given for at most one exam. A question may be answered by any number of students and a student may answer multiple questions in an exam. **[10]**

(b) Define what a foreign key (FK) is. How it is specified using SQL data description language? How the integrity constraints related to FK are specified and mention various options related to it. **[5]**

(c) Consider the following tables R1 and R2. **[5]**

R1

A	B
2	2
3	8
7	3
5	8
6	9
8	5
9	8

R2

C	D
2	2
8	3
3	2
9	7
5	7
7	2

In table R1, A is the primary key and B is the foreign key referencing C in table R2 with on delete cascade and on-update cascade. In table R2, C is the primary key and D is the foreign key referencing A in table R1 on-delete set NULL and on-update cascade. In order to delete record <3, 8> from table R1, the additional records that need to be deleted from (a) table R1, and (b) R2 are -

R1 :

R2 :

2.(a). Name the primitive operators of relational algebra? Describe their operations.   [4]

(b) A table with name *Bank_Balance* is given below. What is the output of the following SQL query?   [4]

Customer	Manager	Amount
Rajat	Sujay	10000
Swagata	Rahim	5000
Mainak	Sujay	7000

SELECT count(*)

FROM(

(SELECT Customer. Manager FROM Bank_Balance) AS S

NATURAL JOIN

(SELECT Manager, Amount FROM Bank_Balance) AS T

);

(c) Consider the following table *Top_Scorer*. What are the tuples are returned by the SQL query - [4]

player	country	runs
Kohli	India	160
Robin	Bangladesh	150
Mahi	India	140
Forte	France	130
Palash	Bangladesh	120
Kumble	India	110
Kurt	Holland	110
Bradman	Australia	100
Cyrus	Portugal	100
Lazzaras	Poland	100
Labusgne	England	100
Tendulkar	India	100
Rohit	India	100

SELECT ta.player FROM Top _Scorer AS ta

WHERE ta.runs > ALL (SELECT tb.runs

FROM Top_Scorer AS tb

WHERE tb.country = 'Nepal')

AND ta.runs > ANY (SELECT tc.runs

FROM Top_ Scorer AS tc

WHERE tc.country = 'India')

(d) Let R and S be two relations with the following schema: $R(P, Q, R1, R2, R3)$, $S(P, Q, S1, S2)$. Where, $\{P, Q\}$ is the key for both relations. Which of the following queries are always equivalent? [4]

I. $\Pi_P (R \bowtie S)$

II. $\Pi_P (R) \bowtie \Pi_P (S)$

III. $\Pi_P \left(\Pi_{P,Q} (R) \cap \Pi_{P,Q} (S)\right)$

IV. $\Pi_P \left(\Pi_{P,Q} (R) - \left(\Pi_{P,Q} (R) - \Pi_{P,Q} (S)\right)\right)$

(e) One of the following four expressions of relational algebra is not equivalent to the other three. They are all based on the relations $R(A,B)$ and $S(B,C)$. Indicate which is not equivalent to the others. [4]

I. $\pi_{AB} (R \bowtie S)$

II. $R \bowtie \pi_B(S)$

III. $R \cap (\pi_A(R) \times \pi_B(S))$

IV. $\pi_{A,R.B}(R \times S)$

3.(a). Why some relations require decomposition? What is a lossless decomposition? What are the conditions for a decomposition being lossless? [5]

(b) How do you check a given relation schema R (with the set F of functional dependencies) is in (i) BCNF, (ii) 3NF? Mention the advantages and disadvantages of BCNF and 3NF.

[5]

(c) Consider the schema R = (A, B, C, D, E, G) and the set F of functional dependencies:
AB → CD, ADE → GDE, B → GC and G → DE

(i) Determine the list of candidate keys for the above schema R.
(ii) Determine the canonical cover for F, along with the explanation of the steps for its generation.
(iii) Check whether the given schema R is in 3 NF?
(iv) If the schema R is not in 3NF, use 3NF decomposition algorithm to generate a 3NF decomposition.   [10]