PDPM IIITDM JABALPUR
CS203 DATABASE DESIGN AND MANAGEMENT
Mid Semester Examination (February 25, 2017)

MaxMarks 60 **Time 2 hours**

1. [1] Management policy changes are difficult to implement in a file based system because **relating data in different files is difficult**.

2. [5] State whether these statements are True or False:
   (a). Every minimal key is superkey. **T**
   (b). One objective of DBMS is to ensure data redundancy. **F**
   (c). By data independence we mean that application programs may be developed without knowing the organization of data. **T**
   (d). A conceptual record is same as an external record. **F**
   (e). Every entity in a superclass is a member of some subclass. **F**

3. [4] Fill in the blanks:
   (a). **Generalization** and **specialization** concepts are additionally added in the EER model.
   (b). Complete description of database which is described in design phase and is changed rarely is called **conceptual schema**.
   (c). Consistent data values are maintained through **data integrity**.
   (d). When an entity instance must be a member of only one subtype, it is **disjoint** with **total** specialization.
   (e). A subclass with more than one superclass is an example of **multiple inheritance**.
   (f). **Canned transaction** is formed by linking of the object codes of both DML commands and host language commands.

4. [2] Given a relation R with five attributes (say, A, B, C, D, and E), find out the possibilities for what its primary key could be (e.g., ACE)?

   Answer: $2^5-1 = 31$ (null set is excluded)

   or ${}^5C_1 + {}^5C_2 + {}^5C_3 + {}^5C_4 + {}^5C_5 = 5+10+10+5+1 = 31$

5. [2] Consider relations R1(A,B,C) and R2(D,E,F) where, D is foreign key in R2 referring R1. Is it possible to reduce number of tables to store this information? How?

   Answer: Yes, R(A,B,C,E,F)

6. [2+3] Consider the table T(X, Y) with instances given below (Delete policy is cascade):
T(X, Y) = {<5,4>,<8,18>,<9,15>,<12,5>,<15,9>,<18,5>,<20,8>}
Assume one is primary key and other one is Foreign Key referring to the same table. Identify and explain which of the set the primary key is and which of the set is foreign key? Also, show the content of the table after deletion of tuple (5,4).

Answer:
Here X is the PRIMARY KEY because X follows all the properties of primary key. That is,

1) X does not contain any null values.
2) All the values in X are distinct. So X is Primary key.

However, Y cannot be foreign key referring to the same table because of the presence of tuple <5, 4>, as value 4 does not exist for attribute X.

If Y is not a foreign key referring X, then deletion of <5, 4> will not cause any other deletion propagation.

[In case Y would have been foreign key referring X, then the tuples (12,5), (18,5), (8, 18) and (20, 8) will also be deleted.]

7. [2] Consider a database table R containing two columns X and Y each of type integer. After the creation of the table, one record (X=1, Y=1) is inserted in the table. Let MX and MY denote the respective maximum values of X and Y among all records in the table at any point in time. Using MX and MY, new records are inserted in the table 128 times with X and Y values being 2*MX+2, MY+1, respectively. It may be noted that each time after the insertion, values of MX and MY change. What will be the output of the following SQL query after the steps mentioned above are carried out:

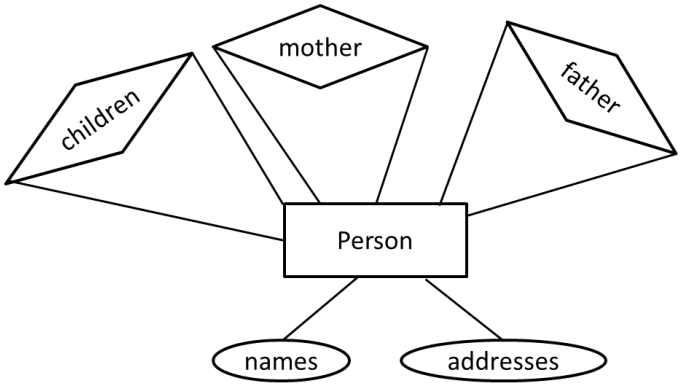
SELECT X FROM R WHERE Y=8;

Answer: 382

X	Y
1	1
4	2
10	3
22	4
46	5
94	6
188	7
382	8
.....	
.....	

8. [4] Give an E-R diagram for a "database of persons" giving their "names", "addresses", "mother", "father" and "children". Person should be the only entity set in this design.

Answer:



9. [4] Consider the following relation schemas with their instances
R(A,B)= {<a,b>,<a,c>,<c,d>,<b,e>}
T(B,C)= {<b,e>,<d,h>,<b,f>,<a,d>,<a,e>}
Compute the result of the following relational algebra expression:

$\pi_{A,C}(R \bowtie T)$

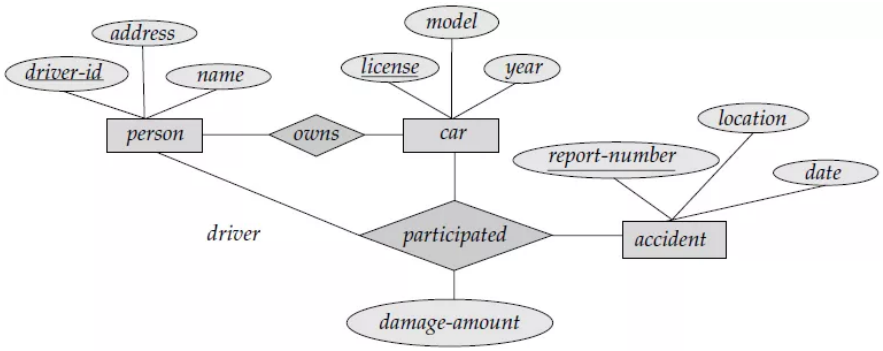
Answer:
(join before projection) =

A	B	B	C
a	b	b	e
a	b	b	f
a	c	Null	Null
c	d	d	h
b	e	Null	Null

after projection:

A	C
a	e
a	f
c	h
a	Null
b	Null

10. [5] Consider the following E-R diagram for a car-insurance company whose customers own one or more cars each. Each car has associated with it zero to any number of recorded accidents. Convert this ER model to relational model.



E-R diagram for a Car-insurance company.

Answer: Car insurance tables:
person (driver-id, name, address)

car (license, model, year, driver-id)

accident (report-number, date, location)

participated(driver-id, license, report-number, damage-amount)

** Although it is not recommended and not a good choice but if you include "license" attribute in Table "person" to represent "owns" relationship, then both "driver-id and license" will be key of "person" table.

OR

person (driver-id, name, address)

car (license, model, year)

owns (driver-id, license)

accident (report-number, date, location)

participated(driver-id, license, report-number, damage-amount)

11. [5] Consider the following relations X, Y, Z. How many tuples does the result of the following relational algebra expression contain? Assume that the schema of XUY is the same as that of X.

$$X \cup Y \bowtie_{X.ID=Z.IDD} Z$$

Table X			Table Y			Table Z		
Id	Name	Age	Id	Name	Age	Idd	Phone	Area
15	Neema	70	25	Savita	20	10	2500	02
25	Savita	20	30	Shami	50	40	2100	01
40	Biplav	10	35	Biplav	10			
			40	Biplav	10			

Answer: one
Result of XUY will be the following table:

Id	Name	Age
15	Neema	70
25	Savita	20
40	Biplav	10
30	Shami	50
35	Biplav	10

The result of given relational algebra expression will be:

Id	Name	Age	Idd	Phone	Area
40	Biplav	10	40	2100	01

(marks are given on the steps shown and correctly showing the single result row.)

12. [12+5+4] Consider the following database schema, where attribute names are self-explanatory. NULL values are allowed and date format is 'dd-mm-yyyy'.

Doctor(SSN, FirstName, LastName, Specialty, YearsOfExperience, PhoneNum)

Patient(SSN, FirstName, LastName, Address, DOB, PrimaryDoctorSSN)

Medicine(TradeName, UnitPrice, GenericFlag)

Prescription(Id, Date, DoctorSSN, PatientSSN)

PrescriptionMedicine(PrescriptionId, TradeName, NumOfUnits)

I. Write the following queries in relational algebra expressions:

(a) List the first and last name of patients whose primary doctor name is 'Ravi Gupta'.

$R1 \leftarrow \Pi_{ssn}(\sigma_{FirstName='Ravi' \text{and } LastName='gupta'}(doctor))$
$Result \leftarrow \Pi_{FirstName.LastName}(R1 \bowtie_{R1.ssn=PrimaryDoctorSSN} (patient))$

(b) List the first and last name of doctors who are not primary doctors to any patient.

$R1(SSN) \leftarrow \Pi_{PrimaryDoctorSSN}(Patient)$
$R2 \leftarrow \Pi_{SSN}(Doctor) - R1$
$Result \leftarrow \Pi_{FirstName,LastName}(Doctor * R2)$

(c) For medicines written in more than 20 prescriptions, report the trade name and the total number of units prescribed.

$R1(TradeName,count1,sum1) \leftarrow {}_{Tradename}\mathcal{F}_{count(PrescriptionID),sum(NumofUnits)}(Prescription\_Medicine)$
$Result \leftarrow \Pi_{TradeName,sum1}(\sigma_{count1>20}(R1))$

II. Write the following queries in SQL:

(a) List the trade name of generic medicine with unit price less than Rs. 100/-

```
Select TradeName
From Medicine
Where UnitPrice<100 and GenericFlag=True
```

(b) List the doctors whose last name not ends at "a", have phone and have experience ranging from 8 years to 10 years.

```
Select SSN
From Doctor
Where lastName not like '%a'
And PhoneNum is not NULL
And YearsOfExperience between 8 and 10
```

III. Based on the information given, write the statement to create table 'Prescription' where minimum and maximum number of a medicine units allowed to be written in each prescription are 1 and 10, respectively.

```
CREATE TABLE Prescription
( ID INT,
  Date date),
  DoctorSSN CHAR(10),
  PatientSSN CHAR(10),
  PRIMARY KEY (ID),
  FOREIGN KEY (DoctorSSN) REFERENCES Doctor.SSN,
  FOREIGN KEY (PatientSSN) REFERENCES Patient.SSN)
);
```

It is not possible to put this constraint while creating this table, as table 'Prescription' does not contain any such attribute.
However, marks have been given if you have included this attribute in the table and written check constraint.