National University of Computer and Emerging Sciences, Lahore Campus

Course:	Database Systems	Course Code:	CS203
Program:	BS(Computer Science)	Semester:	Fall 2016
Duration:	180 min	Total Marks:	70
Paper Date:	26-Dec-2016	Weight	50%
Section:	All	Page(s):	7
Exam:	Final	RegNo. (Section)	----------( )

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.**
Write your Roll no on every sheet.
You will not get any credit if you do not show proper working, reasoning and steps as asked in question statements.

Question 1: SQL and RA
Note: Your queries should not have hard coded values and should work for every instance of database.
Consider the following database of a Car showroom. (FK are self-explanatory)

Sales

ID	SalesPersonID	CarID	CustomerID	SalesDate
1009	10	A20	1	12/12/2016
1010	10	A30	2	1/12/2016
1011	12	H20	3	8/12/2016
1012	12	H20	4	8/11/2016
1013	13	H30	3	5/12/2016
1014	13	H30	4	10/10/2016
1015	13	H20	1	3/3/2016

* dates are in dd/mm/yyyy format

Employees

ID	Name	Type	Hiring Date
10	Hassan	SalesPerson	1/12/2003
11	Ayesha	Manager	1/9/2004
12	Kamal	SalesPerson	1/5/2004
13	Javaid	SalesPerson	5/5/2015

Cars

ID	Model	Make
A20	RDX	Acura
A30	MDX	Acura
H20	Civic	Honda
H30	Accord	Honda

Customers

ID	Name	ContactNo
1	Ali	51356468
2	Zarea	58975131
3	Fahad	56891646
4	Salman	89894646

Part a (10 points). At the start of each Month the Car Showroom selects a **Star Salesperson,** and displays his name on its website. The Star Salesperson is selected based on last month's performance, the Salesperson who made maximum sales in last month is selected as Start Employee. However, only the salespersons that have been working in showroom for the whole previous month qualify to be Star Employee.
You have to write a View (in SQL) the will give the name of Star Salesperson of Current Month. You view should be generic and work for every month, without a need to make any changes in query.
Who will be the star employee if current month was Jan 2017, according to your query?

```
select name from (
select top 1 E.ID,E.Name ,COUNT(S.ID) TotalSales
from Employees E inner join Sales S
on S.SalesPersonID=E.ID
where E.[Hiring Date]<= DATEADD(MM,-1,GETDATE())
and E.Type='SalesPerson'
and datepart(mm,SalesDate)= datepart(mm,DATEADD(MM,-1,GETDATE()))
and datepart(yy,SalesDate)= datepart(yy,DATEADD(MM,-1,GETDATE()))
group by E.ID, E.Name
order by 3 desc
      ) as A
```

(9 mark)

Note that student don't have to use these exact date functions, but they should at least write generic query, using getdate() or similar function.

Star employee of Jan 2017 Hassan (1 mark)

9 Marks for query. Marks are deducted according to the mistakes. -1 for each mistakes in query.

Part b (5 points). Write a query in RA that will give names of all the employees that have sold cars of make Acura Make but no Car of make Honda. Write the Results of YOUR query as well.

R1 ← ($\pi_{ID,name}$ Employees) join $_{ID=SalespersonID}$ Sales join $_{CarID=ID}$ ($\sigma_{Make='Acura'}$ Car)

R2 ← ($\pi_{ID,name}$ Employees) join $_{ID=SalespersonID}$ Sales join $_{CarID=ID}$ ($\sigma_{Make=honda}$ Car)

Final Result ← π_{name} R1-R2 (4 mark)

Result: Hassan (1 mark)

Part c (5 points). Explain in one sentence what this query is doing, and write the result for given state of Database.

```
SELECT Name
FROM Employees E
WHERE NOT EXISTS ( ( SELECT ID
                     FROM Cars
                     WHERE Make='Honda')
                     EXCEPT ( SELECT CarID
                              FROM Sales
                              WHERE E.ID=Sales.SalesPersonID) );
```

Lists all the employees that have sold all the cars with make Acura. (3 mark)

Result: (2 mark if explanation is correct)

Name

Javaid

Question 2: Functional Dependencies and Normalization.

Part a (10 points). Given two sets of Functional Dependencies, F and G, on attributes {V, W, X, Y, Z}. Find if F and G are equivalent or not. Show all the steps.

F: {Z → YXW, XY → WZ, VW→ X} and G: {Z→YW, XY→ Z, W→ X, V→X}

F+ = {Z+ → XYWZ
XY+→ XYWZ
VW+→VWX
W+→W
V→V
X→X
Y→Y
}
(4 mark)

G+= {Z+→ YWXZ
XY+→ ZYWX
VW+→VWX
W+→WX
V+→VX, X+→ X, Y+→Y
} (4 mark)
G and F are not equivalent aas W→X and V→X does not hold in F (2 mark)

Part b (10 points). Find the candidate key of Relation R, when F_1 is the set of functional Dependencies that hold on R, and A, B, C, D, E are attributes of R. Also find the highest normal form, if it's not in BCNF then normalize till BCNF. Show all steps.
F_1= {B→AC, DC→B, E→D, A→E}

Finding keys A+→ AED, B+→ ACEDB, C+→C, D+→ D, E+→ED, AC+→ACEDB, DC+→DCBAE, EC+→EDCBA so AC , DC, EC and B are the candidate keys, and let B be the primary key (5 mark with proper step)
Prime attributes A, B, C, D, E non-prime: none
1NF: it is in 1 NF as there is one key (1 mark)
2NF it is also in 2NF as there is no non-prime attribute partially dependent on partial key (1 mark)
3NF: It is also in 3NF as no non-prime attribute determines non-prime attribute (1 mark)
BCNF: E→D and A→E violate BCNF as A and E are not super keys.
There for the highest normal form of given R is 3NF (1 mark)
Converting to BCNF:
One possible decomposition is
R1: AED R2: BCD
B→A is not preserved
Another possible decomposition is
R1: ED R2: ABCD
Now A→E is not preserved. (BCNF 1 mark)

Question3 (10 Points). S is schedule of four Transactions T1, T2, T3 and T4. Find if S is conflict serializable or not, using precedency graph. If yes show its equivalent serial schedule/s. Show all the steps.

S: r2 (Z); r1 (X); r3 (X); w2 (Z); r1 (Z); r2 (Y); r3 (Y); w2 (Y) w1 (X); c1; w3 (Y); c3; c2;

T1	T2	T3
	r2 (Z)	
r1 (X);		
		r3 (X)
	w2 (Z)	
r1 (Z)		
	r2 (Y)	
		r3 (Y)
	w2 (Y)	
w1 (X)		
		w3 (Y)

(10 mark if graph and explanation is correct, if explanation is incorrect then only 2 marks for graph, -1 if mistakes in graph.)

The schedule is not serializable as the is a cycle between t2 and t3

Question 4: ER, EER Diagram

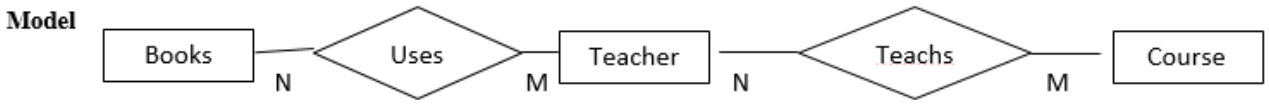
Part a (2+3 points).
i). Are the following models, A and B, equivalent to each other? Give brief reason of your choice

Not equivalent (1 mark). In Model B, Antibiotic U Painkiller = Medicine,

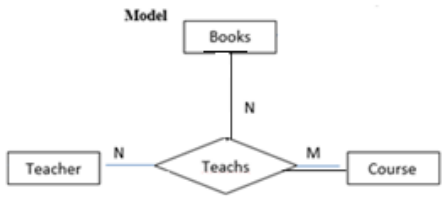
Where as in model A Medicine <subset> Antibiotic U Painkiller (1 mark)

ii). Consider the following ER models the given statement. You have to find if Model is correct or not according the functionality. If yes give reason if no give reason and correct model. For the model, assume that all the required attributes are present.

Statement: Each course is taught by one or more teachers and each teacher uses one or many books while teaching that specific course he is teaching.

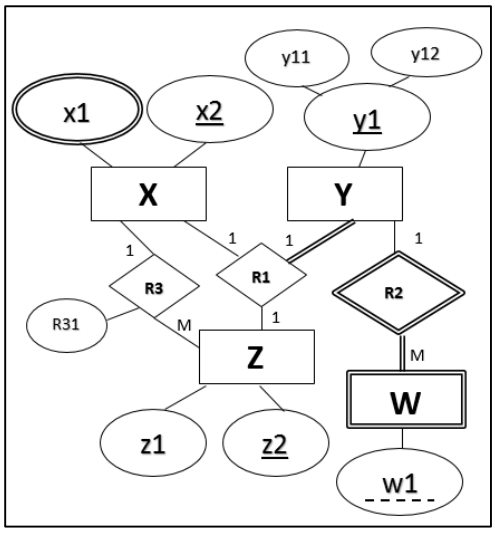


The relationship should be ternary and participation of books and course should be full



(1 mark for total participation and 2 for ternary relation)

Part b (5 points). Consider the following ER-EER diagram. Map it to Relational Schema, showing all the keys and foreign keys.

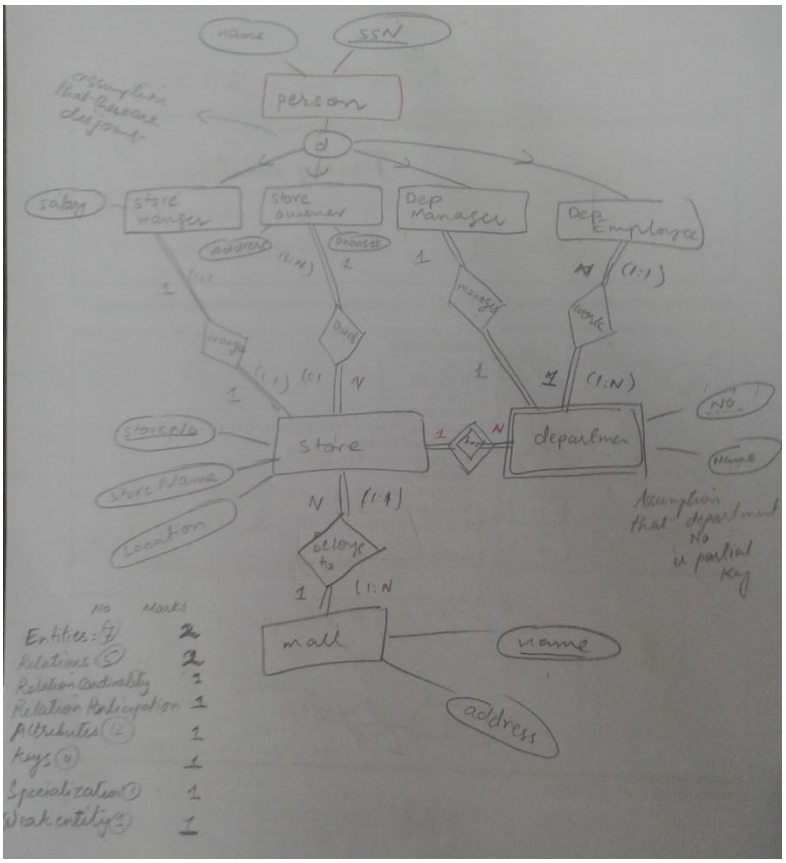


Simple entities
X: x2 (0.5 mark)
Y: y11, y12 (0.5 mark)
Z: z2, z1 (0.5 mark)
Weak entities
W: w1, y11 (FK refers Y.y11), y12 (FK refers Y.y12) (0.5 mark)
Multivalued entities
X1_X: x2 (FK refers X.x2), x1 (0.5 mark)
Relation ships
R1: x1 (FK refers X.x1), y1 (FK refers Y.y1), z1 (FK refers Z.z1) (0.5 mark)
Modifying Z for mapping R3 (0.5 mark)
Z: z2, z1, x2 (FK refers X.x2), R31 (0.5 mark)
FK and PK (1.5 mark)

Question 5 (10 points).

Create an EER diagram of the following case study:

A new mall, Emporium Mall, just had its grand opening few months ago in Lahore, Pakistan. This new mall is attracting a lot of customers and stores. Emporium Mall, which is part of a series of malls owned by a parent company, now needs a database to keep track of the management of the mall in terms of keeping track of all its stores as well as the owners and workers of the stores. Before we build a database for this system of malls, the first step will be to design an EER diagram for the mall owner. We gathered the following initial user specifications about the malls, with which we can start creating the EER diagram:
We need to record information about the mall and each store in the mall. We will need to record the mall's name and
Address. A mall, at any point in time, must contain one or more stores.
For each store, we will need to keep the following information: store number (which will be unique), the name of the store, the location of the store (room number), departments, the owner of the store, and manager of the store. Each store will have only one store manager. Each store is owned by only one owner. Each store is located in one and only one mall.
A store manager can manage only one store. We have to record information on the store manager: the name, social security number, which store he or she is working for, and salary. The store owner is a person. We have to record information about the store owner, such as name, social security number, address, and office phone number. A store owner has to own at least one store, and may own more than one store.
A store must have one or more departments. A department will not exist without a store. For each department we will store the department name, department number, and department manager. Each department has at least one employee working for it.
For each employee in a store, we will have to keep an employee's name, social security number, and the department in which that the employee works. Employees must work in one and only one department.



Marks distribution:

Entities: 1 mark

Relations: 1 marks

Cardinality: 1 mark

Participation 1 mark

Keys: 1 mark

Specialization: 1 mark

Weak entity: 1 mark

-1 for adding unnecessary objects.