## Question 1 (ER/EER Diagram) – 25 marks

"Start Small Credit Union" is planning to automate its data processing facility, which is currently operated manually.

The credit union may have several customers who will maintain one or more accounts. In case of joint accounts, a maximum of 2 customers will have shared access to a single account. Currently, the credit union offers two types of accounts namely regular account and fixed deposit account.

A customer is identified by an ID number. Other information about a customer such as name, address and phone number is also held. An account holds information such as account number, account type, balance and interest rate. For regular account, the maximum number of daily withdrawal is stored and for fixed deposit, the deposit term/duration is stored.

An account is created by a staff member who has the privilege to create accounts. Information about staff members like ID, name, address, base salary and remarks is also stored. Junior staff can only create regular account, while the senior staff can create both account types. For senior staff, the service bonus information is also stored.

An account may participate in many transactions like deposits and withdrawals. A transaction ID uniquely identifies a transaction. Information like the date and the time of the transaction, the amount which is deposited or withdrawn and the type of the transaction (whether it is a deposit or a withdrawal) is also held for each transaction.

Every transaction is recorded on a ledger, usually in the end of the day. The credit union may have several such ledgers which will be identified by a unique ledger code. The date and the time when the transaction is entered into the ledger will be stored in the ledger.

Develop an **EER model** for the above description. The EER should contain necessary information such as entities, attributes, primary keys, relationships, cardinalities, and participation. Note that you may need to make up some of the attributes for your model. **Any assumption should also be stated**.

[25 marks]

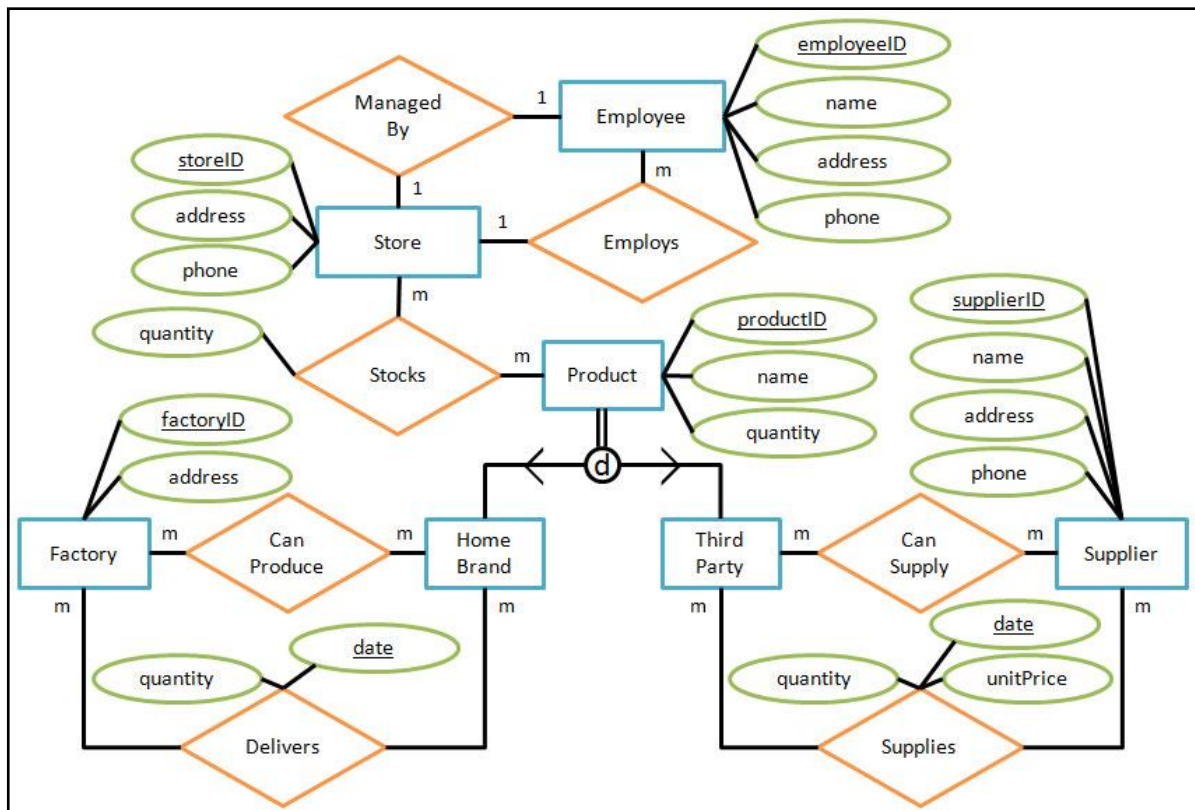## Question 2 (Transformation to Relational Tables) – 20 marks

The following EER diagram models the database for a supermarket. You need to do these following tasks:

a) Perform the transformation of the EER model into the **relational tables**. For specialization relationship, you need to apply option 8A (multiple tables for superclass and sub classes).

[15 marks]

b) Technically, can you apply transformation rules options 8B or 8C for specialization relationships of this EER model? What are the implications of applying these two options to your database?

[5 marks]

## Question 3 (Normalisation) – 30 marks

a) Consider the following dependencies and the description of FINANCIAL-PLAN data item.

```
CustomerId --> CustomerName, CustomerAddress
InvestmentId --> Type, Description
BranchNum --> BranchName, BranchAddress, RegionCode
RegionCode --> RegionName
CustomerId, InvestmentId, BranchNum --> Balance
```

The **UNF** of the above relationships is described as follows:

```
FINANCIAL-PLAN(CustomerId, CustomerName, CustomerAddress,
    (BranchNum, BranchName, BranchAddress, RegionCode,
    RegionName, (InvestmentId, Type, Description, Balance)))
```

i) Normalize the above **FINANCIAL-PLAN** Un-Normalized Form to arrive at a suitable database design which satisfies the BCNF, clearly show the stages 1NF, 2NF, 3NF, and BCNF.

ii) If you leave the tables in 2NF, describe the insertion, update and delete anomalies that might happen during database operation.

[15 marks]

b) Nip and Tuck Construction Company maintains timesheet for their employees using a sample form shown below. Using normalization technique, identify the database tables for this form. All tables must be at least in BCNF.

**Nip and Tuck Construction Company: Time Sheet**

**Employee No**: 124298      **Name**: Smithers, Thomas      **Title (Mr, Mrs, Mss, Ms)**: Mr
**Department**: Electrics      **Telephone Extension**: 5890

**Bank Account No**: 12312-45683-58

| Date | Job No | Operation | Time Start | Time Finish | Time (Hrs) Worked |
|------|--------|-----------|------------|-------------|-------------------|
| 01/08/12 | 3421 | Cabling | 8.00 | 12.00 | 4 |
| 02/08/12 | 3421 | Cabling | 8.00 | 12.00 | 4 |
| 02/08/12 | 3421 | Cabling | 12.30 | 16.30 | 4 |
| 03/08/12 | 2310 | Faulty Wiring | 8.00 | 10.00 | 2 |
| 03/08/12 | 3421 | Insulation | 10.30 | 12.30 | 2 |
| 03/08/12 | 4812 | Faulty Wiring | 13.00 | 16.30 | 3.5 |
|  |  |  |  | Total Hours Worked: | 19.5 |
| **SICK LEAVE**: |  | **FROM**: 04/08/12 |  | **TO**: 05/08/12 | |
| Comments: Medical certificate seen | | | | | |

[15 marks]

## Question 4 (Relational Algebra) – 30 marks

a) Consider the following two tables R and S with their instances:

**R**

| A | B | C | D |
|---|---|---|---|
| a | x | y | 9 |
| a | z | w | 5 |
| b | x | k | 4 |
| b | m | j | 3 |
| c | x | y | 1 |
| d | m | y | 3 |
| f | g | h | 5 |

**S**

| E | F | G |
|---|---|---|
| x | a | 5 |
| z | f | 3 |
| g | j | 7 |
| x | h | 8 |
| t | b | 9 |
| x | m | 8 |
| z | d | 2 |

    i)      List the final $RESULT_1$ (table instances) of the following relational algebra query.

$$Result_1 \leftarrow \pi_{A, D, E} (\sigma_{D<G} (R \bowtie_{R.A=S.F} S))$$

    ii)      List the final $RESULT_2$ (table instances) of the following relational algebra query.

$$Temp_1 \leftarrow \pi_{A, C, E, F} (R \bowtie_{R.B=S.E} S)$$
$$Temp_1 \leftarrow \pi_{A, C, E, F} (R \bowtie_{R.B=S.E} S)$$
$$Result_2 \leftarrow \pi_{E, F} (Temp_1 - Temp_2)$$

    iii)      List the outcome of the relational algebra query $RESULT_1 \cup RESULT_2$ from (i) and (ii) above. Justify your answer.

[15 marks]

b) Consider the following relational schemas and sample records. (Note: the primary keys are underlined and the foreign keys are written in italics).

```
FILM (title, year, genre)
PROFESSIONAL (ID, name, nationality, startYear)
WORK_IN (title, ID, role)
```

**FILM**

| Title | Year | Genre |
|---|---|---|
| Django Unchained | 2012 | Western |
| Inglorious Basterds | 2009 | Drama |
| Kill Bill | 2003 | Action |

**PROFESSIONAL**

| ID | Name | Nationality | startYear |
|---|---|---|---|
| QT1 | Quentin Tarantino | American | 1983 |
| LD1 | Leonardo DiCaprio | American | 1989 |
| CW1 | Christoph Waltz | Austrian | 1977 |

WORK_IN

| Title | ID | Role |
|---|---|---|
| Django Unchained | QT1 | Director |
| Inglorious Basterds | QT1 | Director |
| Kill Bill | QT1 | Director |
| Django Unchained | QT1 | Writer |
| Django Unchained | LD1 | Actor |
| Django Unchained | CW1 | Actor |
| Inglorious Basterds | CW1 | Actor |

Write the following queries in relational algebra expression.

i) Display all non-American professionals who start working in the year 2000.

ii) Display the title and year of films directed by "Quentin Tarantino".

iii) Display the name of professionals working in any western film released in 2014 or working in any drama film released in 2013.

[15 marks]

## Question 5 (SQL) – 25 marks

The following tables show a snapshot of a **Real Estate agent database system**. The *VENDOR* table stores the list of people who want to sell their properties. The *BUYER* table lists the people who want to buy a property from the Real Estate agent. The *PREFERENCE* table stores the list of preferences from the buyer (e.g. Number of bedrooms required, the suburb they want, the price range of the property they want to buy, etc.). The *AGENT* table stores the details of the staff who work in the Real Estate agent, and the *PROPERTY* table lists the property currently on-the-market. The *VIEWING* table shows the records of those prospective buyers who have viewed the property on sale.

```
VENDOR(vendor id, vendor_reg_date, last_name, first_name,
     address, phone, email)

BUYER(buyer id, buyer_reg_date, last_name, first_name, address,
  phone, email)

PREFERENCE(preference id, buyer_id_fk, property_type,
  property_suburb, price_range_lower, price_range_upper,
  no_of_bedrooms, train_distance, bus_distance,hospital_distance)

AGENT(agent id, last_name, first_name, address, phone, email)

PROPERTY(property id, agent_id_fk, vendor_id_fk, date_offered,
  suburb, street_address, post_code, property_type,
  property_price, no_of_bedrooms,train_distance, bus_distance,
  hospital_distance)

VIEWING(property id fk, buyer id fk, date time, comments)
```

**NOTE:** Primary Key (PK) is printed bold and underlined, Foreign Key (FK) is printed italic and ends with 'fk', PK that is also FK is printed bold and underlined with the name ending with 'fk'.

Provide the **SQL statements** for questions (a) to (f)

(a)    For each suburb, display the average price of properties that have more than two bedrooms.

[5 marks]

(b)    Display the details of all buyers whose *price range* and *property type* preferences match at least one property.

[5 marks]

(c)    Display the most popular month for putting properties up for sale.

[5 marks]

(d)   Delete all properties that have never been viewed by any buyers in the last 3 (three) months.

[5 marks]

(e)   Create a view that can be used to show the total number of distinct potential buyers that view properties handled by each agent. The number only shows property viewing in the last 6 months.

[5 marks]

## Question 6 (Stored Procedures/Triggers) - 30 marks

The following tables and instances show a **snapshot** of a company share-holders database system:

**COMPANY**

| COMP_ID | COMP_NAME | COMP_ADDRESS | COMP_PHONE | COMP_FAX | COMP_TYPE |
|---------|-----------|--------------|------------|----------|-----------|
| 10 | OZ Buyer | 20 Russel St. Sydney 2000 | 02-9839 4000 1800 489 000 | 02 9839 8371 | 1 |
| 20 | Goodies | 50 Collins St. Melbourne 3000 | 03-9425 5000 1800 900 000 | 03 9425 0005 | 1 |
| 30 | Super Mart | 6/1 George St. Brisbane 4000 | 07-8234 9000 1800 521 325 | 07 8234 0005 | 1 |
| 40 | Housemate | 17/2 Vince St. Sydney 2000 | 02 9200 0001 1800 023 001 | 02 9200 0000 | 2 |
| 50 | Piglet | 10 Bourke St Melbourne 3000 | 03 9830 0000 1800 876 001 | 03 9830 0005 | 2 |
| 60 | Liz & Neil | 5 Lonsdale St Melbourne 3000 | 03 9830 1000 1800 876 005 | 03 9860 1005 | 2 |

**SHARE HOLDERS**

| SH_ID | LNAME | FNAME | ADDRESS | PHONE | CITY | JOIN- DATE |
|-------|-------|-------|---------|-------|------|------------|
| 11 | Dune | John | 12 Plenty Road | 9231455 | Bundoora | 12-12-2008 |
| 22 | Smith | Andy | 2 Castle Ave | 9867055 | Balwyn | 01-02-2008 |
| 33 | Cope | Jennifer | 3 King Street | 9234536 | Preston | 01-03-2008 |
| 44 | Singh | Ramesh | 81 Plenty Road | 9456738 | Bundoora | 01-02-2008 |

**SHARES**

| COMP_ID | SH_ID | SHARE AMOUNT |
|---------|-------|--------------|
| 10 | 11 | 1000 |
| 10 | 22 | 5000 |
| 20 | 22 | 1000 |
| 40 | 33 | 5000 |
| 60 | 11 | 1000 |
| 60 | 22 | 5000 |
| 60 | 44 | 1000 |
| 50 | 44 | 2000 |

Based on the above tables:

a.   Write a **stored procedure** that receives the company id as input, and displays all shareholders' details that have shares more than 1000 for the particular company

[15 marks]

b.   Write a **trigger** on update or delete of "shares" information, which can automatically save the updated/deleted data about the share company ID, share amount, shareholder ID, and the current date into a backup table.

[15 marks]

## Question 7 (Stored Function) - 20 marks

**COMPANY**

| CompNo | CompName | Total_Employee | Average_Salary |
|--------|----------|----------------|----------------|
| 10 | OzSky | 2 | 60,000 |
| 20 | Friend Star | 2 | 85,000 |
| 30 | Media Book | 3 | 55,000 |
| 40 | Plus Health | 3 | 100,000 |
| 50 | IT Plus | 2 | 120,000 |
| 60 | Plan Advance | 2 | 50,000 |

**SESSION**

| SessionNo | SessionName | Location | Total_Participants | EventDate | CompNo |
|-----------|-------------|----------|--------------------|-----------| -------|
| S1 | Eat for Health | Exhibition Hall | 200 | 05/01/09 | 40 |
| S2 | IT for Beginners | Seminar Room | 50 | 05/02/09 | 50 |
| S3 | Superannuation Info Session | Seminar Room | 25 | 07/05/09 | 60 |
| S4 | SAP Short Course | Laboratory | 20 | 08/05/09 | 50 |

a) Based on the COMPANY table above, create a **stored function** that takes *CompName* as input and displays as return values:

   - 'HIGH RATE' if the average salary in that company is equal to the highest average salary of all the companies in the table;
   - 'AVERAGE RATE' if the average salary of that company is less than the highest but greater than the lowest average salary of all the companies in the table;
   - 'LOW RATE' if the average salary is equal to the lowest average salary of all the companies in the table.

   [15 marks]

b) Using the stored function in question a), write the appropriate SQL statement which lists all company numbers and names together with the company's rate (eg. HIGH RATE will be displayed together with the company details if the average salary is equal to the highest average of all the companies and so on).

   [5 marks]