1.8.2 Relational Database Modelling

May/June 2003

10. A sports club runs a number of sports teams.

Each team is made up of a number of members of the club and each member may play for more than one team. Each team has a number of coaches, but the coach's job is so time consuming that each coach can only coach one team.

Represent the above information on an entity relation (ER) diagram, in 3rd normal form, stating the primary key for each entity. **[13]**

Oct/NOV 2003

11. A garden design company keeps records of its customers. Each customer has had a design produced for them which will be one of a library of design types stored by the company.

Each design type uses plants. Each customer is sent an account based on the number of plants in the design.

(a) Draw an E-R (entity-relationship) diagram in third normal form, based on this information. **[10]**

(b) Each delivery of plants to the garden design company is identified by a batch number.

Explain how customers who received eucalyptus trees from batch 12 can be contacted. **[4]**

May/June 2004

1. (a) In relation to databases, describe what is meant by each of the following terms.

(i) Primary key. **[1]**

(ii) Secondary key. **[1]**

(iii) Foreign key. **[1]**

Oct/NOV 2004

2. A landscape garden company services a number of gardens. Each GARDEN is owned by an OWNER. Each owner may have more than one garden. Each garden has a number of PLANTS in it and each plant may be in a number of gardens.

Draw an entity relationship (E-R) diagram to represent this data model in third normal form and label the relationships. **[10]**

1.8.2 Relational Database Modelling

Oct/NOV 2006

2. (a) State what is meant by the terms:

(i) primary key,

(ii) secondary key,

(iii) foreign key

in the context of a table in a relational database. **[3]**

Oct/NOV 2007

2. There are a number of TEAMs which represent a school.

Each team has a TEACHER who runs it and a teacher may run more than one team.

Each team has a number of PLAYERs and each one may play for more than one team.

Draw an entity relationship (E-R) diagram to represent this data model in third normal form and label the relationships. **[6]**

Oct/NOV 2008

3. Part of a school database consists of a table of student details and a table of teacher details.

A teacher teaches many students.

A student is taught by many teachers.

(a) (i) State the type of relationship between the two tables. **[1]**

(ii) Explain how the relationship between the student and teacher tables can be normalised. **[2]**

(iii) Draw the normalised relationship between the tables in the form of an entity-relationship (E-R) diagram. **[3]**

(b) Explain what is meant by each of the following terms and give an example of each from the tables in part (a).

(i) Primary key

(ii) Foreign key **[4]**

1.8.2 Relational Database Modelling

May/June 2009

4. A furniture shop sells a large number of different items whose details are stored in the STOCK table.

The shop has a large number of customers whose details are stored in the CUSTOMER table.

Some customers have an account. Each customer can only use one account. Some accounts can be used by more than one customer (for example all the members of one family may use the same account). Details of accounts are stored in the ACCOUNT table.

(a) Draw the relationship between the CUSTOMER and ACCOUNT tables in the form of an entity-relationship (E-R) diagram. **[1]**

A number of stock items will be stored on each account. Each type of stock item will be stored on many accounts.

(b) (i) State the type of relationship between the ACCOUNT and STOCK tables. **[1]**

(ii) Draw the normalized relationship between the ACCOUNT and STOCK tables in the form of an E-R diagram. **[2]**

(c) By using examples from the CUSTOMER table, explain what is meant by:

(i) primary key, **[2]**

(ii) secondary key, **[2]**

(iii) foreign key. **[2]**

Oct/NOV 2009. P32

7. A library uses a computer system to store data in a database.

There are a large number of members of the library whose details are stored in the MEMBER table.

There are a large number of books, details of which are stored in the BOOK table.

Members can borrow books. Each member can borrow more than one book and each book can be borrowed by many members.

(a) (i) State the type of relationship between the MEMBER and BOOK tables**.** **[1]**

(ii) Draw the relationship between the MEMBER and BOOK tables in third normal form as an E-R diagram. **[2]**

1.8.2 Relational Database Modelling

(b) Use examples of attributes in the MEMBER table to explain what is meant by:

(i) primary key, **[2]**

(ii) foreign key, **[2]**

(iii) secondary key. **[2]**

Oct/NOV 2010. P31

2. The leaders of a youth club want to create a database to store details of:

MEMBERs; SESSIONs and ACTIVITYs.

The sessions are each evening from Monday to Friday. Each member can sign up for one or more of the five sessions.

Each session offers a number of activities but each activity is only offered in one of the sessions.

Draw an entity-relationship (E-R) diagram to represent this model in third normal form. **[5]**

Oct/NOV 2010. P33

2. A buildings maintenance company looks after a number of BUILDINGs in a city. Each BUILDING is occupied by one or more FIRMs. Each FIRM may have premises in more than one BUILDING. Each of the FIRMs has a CONTRACT with the company for their part of the BUILDINGs. Some of the FIRMs may share a CONTRACT.

Draw an entity-relationship (E-R) diagram to represent this data model in third normal form. **[5]**

May/June 2011. P31

10. A country has a national football competition based on leagues.

Each LEAGUE has a number of TEAMs but each TEAM is only in one LEAGUE.

Each TEAM plays at a number of GROUNDs during the season and each GROUND will host a number of TEAMs during the season.

(i) State the relationship between LEAGUE and TEAM.

Draw the entity-relationship (E-R) diagram to show this relationship. **[2]**

(ii) State the relationship between TEAM and GROUND.

Draw the E-R diagram to show this relationship. **[2]**

(iii) Explain how the relationship between TEAM and GROUND can be designed in third normal form. **[4]**

May/June 2011. P33

1.8.2 Relational Database Modelling

10. A farm has a number of FIELDs. A number of CROPs are grown on the farm.

Each CROP is grown in a number of FIELDs but each FIELD only grows one CROP.

A number of different FERTILISERs are used on each FIELD and each FERTILISER can be used on many FIELDs.

(i) State the relationship between FIELD and CROP.

Draw the entity-relationship (E-R) diagram to show this relationship. **[2]**

(ii) State the relationship between FERTILISER and FIELD.

Draw the E-R diagram to show this relationship. **[2]**

(iii) Explain how the relationship between FERTILISER and FIELD can be designed in third normal form. **[4]**

Oct/NOV 2011. P32

7 Data about patients, doctors and treatments in a hospital are stored in a relational database. PATIENTs are seen by one DOCTOR, and each DOCTOR has many PATIENTs. Each PATIENT can be receiving more than one TREATMENT and each TREATMENT can be given to more than one PATIENT.

(a) Draw an entity-relationship (E-R) diagram to represent:

(i) the relationship between PATIENT and DOCTOR **[1]**

(ii) the relationship between PATIENT and TREATMENT in third normal form. **[3]**

(b) State the meaning of each of the following terms and illustrate each of your answers with an example from this database.

(i) Primary key **[2]**

(ii) Foreign key **[2]**

(iii) Secondary key **[2]**

Oct/NOV 2011. P33

6. (b) Data about guests in a hotel are stored in a relational database. One part of the database consists of a table of GUEST details. This is linked to a table ACCOUNT.

Whenever a guest orders something in the hotel, the charge for that service is stored in the ACCOUNT table.

(i) State the primary key of the GUEST table, justifying your choice. **[2]**

(ii) State a secondary key in the ACCOUNT table, justifying your choice. **[2]**

1.8.2 Relational Database Modelling

(iii) State what is meant by a foreign key. **[1]**

(iv) State a foreign key in the ACCOUNT table, justifying your choice. **[2]**

May/June 2012. P31/32

1 A database is designed to store data about students at a college and the subjects that they study.

- All students are based in a tutor group
- A tutor supervises all the students in their tutor group
- Each subject has one subject teacher only
- Students study a number of subjects

The following table StudentSubjects was a first attempt at the database design.

Table: StudentSubjects

StudentName	TutorGroup	Tutor	Subject	Level	SubjectTeacher
Tom	6	SAN	Physics	A	SAN
			Chemistry	A	MEB
			Gen. Studies	AS	DIL
Joe	7	MEB	Geography	AS	ROG
			French	AS	HEN
Samir	6	SAN	Computing	A	VAR
			Chemistry	A	MEB
			Maths	A	COR
			Gen. Studies	A	DIL

(a) (i) Explain why the table is not in First Normal Form (1NF). **[1]**

(ii) Explain your answer by referring to the above data. **[1]**

(b) The design is changed to the following:

Student (StudentName, TutorGroup, Tutor)

StudentSubjectChoices (StudentName, Subject, Level, SubjectTeacher)

Using the data given in the original table, show how this data is now stored in the revised table designs.

Table: Student

StudentName	TutorGroup	Tutor

1.8.2 Relational Database Modelling

Table: StudentSubjectChoices

StudentName	Subject	Level	SubjectTeacher

[3]

(c) (i) Explain what is meant by a primary key. **[2]**

(ii) A student is not allowed to choose the same subject at A Level and AS. What is the primary key of table StudentSubjectChoices? **[1]**

(iii) There is a relationship between tables Student and StudentSubjectChoices. Explain how the relationship is established using a primary key and foreign key. **[2]**

(d) The design of table StudentSubjectChoices is:

StudentSubjectChoices (StudentName, Subject, Level, SubjectTeacher)

Explain why this table is not in Second Normal Form (2NF). **[2]**

(e) The design of table Student is:

Student (StudentName, TutorGroup, Tutor) Explain why this table is not in Third Normal Form (3NF).

[2]

May/June 2012. P33

1 A database is designed to store data about all aircraft owned by an airline and the flight schedules.

The following table AircraftSchedule was a first attempt at part of the database design.

Table: AircraftSchedule

AircraftID	Type	YearBought	FlightCode	Departure	Arrival
1	747	1998	2032	Delhi	Singapore
			1187	Singapore	Melbourne
			1326	Melbourne	Tokyo

1.8.2 Relational Database Modelling

			1556	Tokyo	Delhi
2	747-400	2007	1426	Bristol	Amsterdam
			1427	Amsterdam	Bristol
			5564	Bristol	Rome
			7865	Rome	Istanbul
3	747-400	2007	1090	London	New York
			1165	New York	Boston

(a) (i) Explain why the table is not in First Normal Form (1NF). **[1]**

(ii) Explain your answer in terms of the data above. **[1]**

(b) The design is changed to the following:

`Aircraft (AircraftID, Type, YearBought)`

`Schedules (FlightCode, Departure, Arrival)` Using the data given in the original table:

(i) Show what data is now stored in the table `Aircraft`.

Table: `Aircraft`

AircraftID	Type	YearBought

[1]

(ii) How many records are now stored in table `Schedules`? **[1]**

(c) (i) Explain what is meant by a primary key. **[2]**

(ii) What is the primary key of table Aircraft? **[1]**

(d) (i) Explain what is meant by a foreign key. **[2]**

(ii) State what foreign key needs to be added to the `Schedules` table design. **[1]**

(e) An additional table Airport is designed as shown:

`Airport (AirportName, Country, NoOfRunways)`

Explain why this table is in Third Normal Form (3NF). **[2]**

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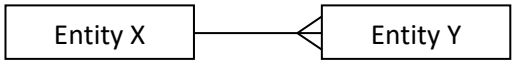
1.8.2 Relational Database Modelling

1 (a) In database design:

(i) Describe what is meant by a foreign key. **[2]**

(ii) Explain how keys are used to implement a one-to-many relationship between the two entities X and Y shown below:



[3]

(b) A company has a number of products for sale and receives orders from customers.

- Customers are given a CustomerID and other customer data are recorded
- Each product has a ProductID and other product data are recorded
- Over a period of time a customer will place many orders, and each product can appear on many customer orders
- You should assume:
  - all orders are for one product only,
  - on any given day a customer will place at most one order.

A table description can be expressed as:

`TableName(Attribute1, Attribute2, Attribute3, ...)`

The primary key is indicated by underlining one or more attributes.

(i) Describe the given data model by adding two attributes to the `Customer` table and **two** attributes to the `Product` table.

`Customer(CustomerID, ..... , ..... )`
`Product(ProductID, ..... , ..... )` **[2]**

(ii) Give the attributes for the `Order` table, showing the primary key.

You should not create an `OrderID` for this table.

`Order( ..... , ..... , ..... , ..... )` **[2]**

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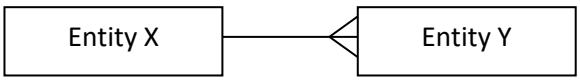
1 (a) In database design:

(i) Explain what is meant by a foreign key. **[2]**

1.8.2 Relational Database Modelling

(ii) Explain how keys are used to implement the one-to-many relationship between the two entities X and Y shown below:



[3]

(b) A company offers training courses to its employees.

Each employee is given a unique `EmployeeID`

Each course has a unique `CourseCode`

Over a period of time an employee will enrol on many courses.

Each course will be attended by many employees.

An employee never enrolls on a particular course more than once.

A table description can be expressed as:

`TableName(Attribute1, Attribute2, Attribute3, ...)`

The primary key is indicated by underlining one or more attributes.

(i) Add two attributes to each of the `Employee` and `Course` tables.

`Employee(EmployeeID,` ..... , ...)

`Course(` ..... , ...) **[3]**

(ii) A third table, `CourseEnrolment`, will record which employee enrolled on which courses.

State two essential attributes for this table. Show the primary key.

You should not create a `CourseEnrolmentID` for the table.

`CourseEnrolment(` ..... , ...) **[2]**

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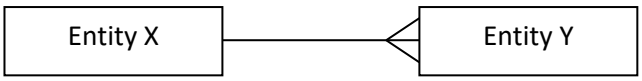
1 (a) In database design:

(i) Describe what is meant by a primary key. **[2]**

1.8.2 Relational Database Modelling

(ii) Explain how keys are used to implement a one-to-many relationship between the two entities X and Y shown below:



[3]

(b) A College library has a stock of books which are loaned to students.

- Each book has a `BookID` and other data about each book are recorded
- Each student has a `StudentID` starting with the year of entry e.g. 2010jamesd
- Other data about each student are also recorded

When a loan is made data are recorded. Any book may be loaned by a particular student more than once.

However, you can assume that the same book is never loaned out to the same student on the same day.

A table description can be expressed as:

`TableName(Attribute1, Attribute2, Attribute3, ...)`

The primary key is indicated by underlining one or more attributes.

(i) Describe the given data model by adding two attributes to the `Student table` and **two** attributes to the `Book` table.

`Student(StudentID,` ..... , ...)

`Book(BookID,` ..... , ...) **[2]**

(ii) Give the attributes for the `Loan` table below, showing the primary key.

You should not create a `LoanID` for this table.

`Loan` (....., ..., ..., ...) **[2]**

May/June 2013. P31/32

1 A hospital has a number of doctors and a number of wards. A ward has a number of patients. A patient may be treated by more than one doctor and a doctor treats many patients. Data is to be recorded in a relational database and the tables include `DOCTOR` and `PATIENT`.

(a) (i) What is the relationship between `DOCTOR` and `PATIENT`? **[1]**

(ii) Show this relationship with an entity-relationship (E-R) diagram. **[1]**

1.8.2 Relational Database Modelling

(iii) Draw an E-R diagram showing a database design which can be produced so that the doctor and patient data are fully normalised.

Explain how the relationships are implemented. **[4]**

(b) (i) What is the relationship between WARD and PATIENT? **[1]**

(ii) Show this relationship with an E-R diagram. **[1]**

(c) Two of the incomplete table designs are:

```
PATIENT(PatientID, PatientName, Address, NextOfKin)

WARD(WardName, NurseInCharge, NumberOfBeds, NumberOfOccupiedBeds, Specialism)
```

Explain how the relationship between PATIENT and WARD is implemented. **[2]**

May/June 2013. P33

1 A database is created to store data about all the football clubs who play in a number of different leagues.

- Each club runs a number of different teams (Men, Women, Boys, Girls).
- Each club has a number of players.
- A player can only be registered with one club.
- Each club team plays in a league.

Data is to be recorded in a relational database and the tables include CLUB and LEAGUE.

(a) (i) What is the relationship between CLUB and LEAGUE? **[1]**

(ii) Show this relationship with an entity-relationship (E-R) diagram. **[1]**

(iii) Draw an E-R diagram showing a database design which can be produced so that the club and league data are fully normalised.

Explain how the relationships are implemented. **[4]**

(b) (i) What is the relationship between CLUB and PLAYER? **[1]**

(ii) Show this relationship with an E-R diagram. **[1]**

(c) Two of the incomplete table designs are:

```
CLUB(ClubName, GroundName, Address, ClubSecretaryName)
```

1.8.2 Relational Database Modelling

`PLAYER(PlayerRegistrationNo, PlayerName, Gender, DateOfBirth,PreferredPosition)`

Explain how the relationship between `CLUB` and `PLAYER` is implemented. **[2]**

Oct/Nov 2013. P31

2 Cross country runners take part in races.

- A runner must be registered with one club only and club names are unique.
- A club has runners; each runner has a unique national MemberID.
- Each race is organised by a club and the Club Secretary records which runners are entered for each race.
- Runners may enter any race.
- There is only one race on any one day.

(b) (i) What is the relationship between runner and race? **[1]**

(ii) What is the relationship between club and race? **[1]**

(c) A database solution is to be developed. Two of the tables are `RUNNER` and `RACE`.

(i) Draw an entity-relationship (E-R) diagram showing a database design which can be produced so that the runner and race data are fully normalised. **[2]**

(ii) Explain how the relationships are implemented. **[2]**

(d) The following table design is suggested for `RUNNER`.

`RUNNER(MemberID, RunnerName, RunnerDOB, ClubName, ClubAddress)`

This is poorly designed.

(i) Is this table in First Normal Form (1NF)? Explain. **[1]**

(ii) Is this table in Second Normal form (2NF)? Explain. **[1]**

(iii) The table is not in Third Normal Form (3NF). Explain. **[1]**

(iv) Using only the attributes given in the `RUNNER` table above, produce a new design which is fully normalised.

The table descriptions should be expressed as:

`TableName(Attribute1, Attribute2, Attribute3, ...)` **[2]**

(e) Explain why all tables in the final design should be fully normalised. **[2]**

Oct/Nov 13. P32

1.8.2 Relational Database Modelling

2 Customers order products from a website.

• An order contains one or more products.

• Over time, a customer places many orders.

• A product will appear on many customer orders.

• Each product is sourced from a single supplier and a number of suppliers are used.

• A supplier can supply more than one product.

At present the company stores and manages all the data using flat files.

(b) (i) What is the relationship between product and supplier? **[1]**

(ii) What is the relationship between product and order? **[1]**

(c) A database solution is to be developed. Two of the tables are `PRODUCT` and `ORDER`.

(i) Draw an entity-relationship (E-R) diagram showing a database design which can be produced so that the product and order data are fully normalised. **[2]**

(ii) Explain how the relationships are implemented. **[2]**

(d) The following table design is suggested for `PRODUCT`.

```
PRODUCT(ProductID, ProductDescription, RetailPrice, SupplierID, SupplierName,
SupplierTelNumber)
```

This is poorly designed.

(i) Is this table in First Norm Form (1NF)? Explain. **[1]**

(ii) Is this table in Second Normal form (2NF)? Explain. **[1]**

(iii) The table is not in Third Normal Form (3NF). Explain. **[1]**

(iv) Using only the attributes given in the `PRODUCT` table above, produce a new design which is fully normalised. The table descriptions should be expressed as:

```
TableName(Attribute1, Attribute2, Attribute3, ...)
```
[2]

(e) Explain why all tables in the final design should be fully normalised. **[2]**

Oct/Nov 2013. P33

2 A car hire company in a large town hires out cars to customers.

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• There are five depots.

• A number of cars are based at each depot.

• Each car registration number is unique.

• Each customer hire is for a single car only.

• Customers may return for future car hires.

• A customer's future hire may involve a different car. At present the company records all car, customer and hire data in flat files.

(b) (i) What is the relationship between car and customer? **[1]**

(ii) What is the relationship between depot and car? **[1]**

(c) A database solution is to be developed. Two of the tables are `CAR` and `CUSTOMER`.

(i) Draw an entity-relationship (E-R) diagram showing a database design which can be produced so that the car and customer data are fully normalised. **[2]**

(ii) Explain how the relationships are implemented. **[2]**

(d) The following table design is suggested for `CAR`.

```
CAR(CarRegistrationNo, CarMake, CarModel, HirePriceCode, DepotID, DepotAddress, DepotManager)
```

This is poorly designed.

(i) Is this table in First Norm Form (1NF)? Explain. **[1]**
(ii) Is this table in Second Normal form (2NF)? Explain. **[1]**

(iii) The table is not in Third Normal Form (3NF). Explain. **[1]**

(iv) Using only the attributes given in the `CAR` table above, produce a new design which is fully normalised.

The table descriptions should be expressed as:

```
TableName(Attribute1, Attribute2, Attribute3, ...)
```

[2]

(e) Explain why all tables in the final design should be fully normalized**.** **[2]**

May/June 2014. P31/ P32

2 A company hires vehicles to customers. A database is to be created to record data for all hire transactions.

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The company has a number of depots in different towns. Each town has one depot only. A number of vehicles are available for hire. Each vehicle is based at one of the depots. Every vehicle starts and ends a hire from its base depot. Depot data consist of:

• Depot town name

• Depot address

Vehicle data consist of:

• A unique registration number

• A vehicle type code. Vehicles are coded as SC – Small Car, LC – Large Car or V – Van.

• Vehicle mileage

Customer data consist of:

• Unique Customer ID

• Customer address

Data for each hire transaction consist of:

• Customer ID

• Vehicle registration number

• Date the booking was made

• Start date of the hire

• Return date

• Driving licence check. A check is carried out to confirm that customers have a valid driving licence and this is recorded. This check is done when the customer shows their driving licence when they collect the vehicle.

• Hire charge

(a) At first, the company used a single table named DepotVehicle. A sample of the table's data is shown below

1.8.2 Relational Database Modelling

DepotTown	RegistrationNo	VehicleType
Dhaka	0987	SC
	0988	SC
	0991	V
	0945	V
Kumba	1431	SC
	1476	LC

Explain why the table is not in normal form. **[2]**

The final design uses these four entities:

- Depot
- Vehicle
- Customer
- Hire.

(b) Consider the relationship between Depot and Vehicle.

(i) Draw the entity-relationship (E-R) diagram. **[1]**

(ii) Complete the description for the Vehicle and Depot tables using the notation:

TableName(Attribute1, Attribute2, …)

where the underlined attribute indicates the primary key.

Vehicle(.....)

Depot(.....) **[4]**

(c) The Customer and Hire tables (with the primary keys not shown) are as follows:

Customer(CustomerID, CustomerAddress)

Hire(CustomerID, DateBooked, RegistrationNo, StartDate, ReturnDate, LicenceChecked, HireCharge)

1.8.2 Relational Database Modelling

Consider the relationship between `Customer` and `Hire`.

(i) Draw the E-R diagram. **[1]**

(ii) Explain how this relationship between Customer and Hire is modelled using the given attributes. **[2]**

May/June 2014. P33

2 Paintings by various artists are on display in art galleries all over the world. When a gallery holds an exhibition, it may display paintings:

• from its own stock,

• or borrowed from other galleries,

• or both.

A database is to be created. It will store data about artists, paintings, galleries and exhibitions.

Artist data consist of:

• artist name (unique).

Painting data consist of:

• a unique reference number (recognised by all galleries)

• painting title

• artist name

• date (year only)

• name of the gallery owning the painting.

Gallery data consist of:

• gallery name (unique)

• country.

An exhibition only takes place once at one gallery and shows either:

• paintings for a single artist only, e.g. the Da Vinci exhibition at the National Gallery in London in 2011, or

• paintings by a number of artists.

Exhibition data consist of:

1.8.2 Relational Database Modelling

• exhibition title (unique)

• gallery name

• exhibition artist (if a single artist only, otherwise contains an empty string)

• start date

• closing date

• all paintings which are included in the exhibition.

Painting-in-exhibition data consist of:

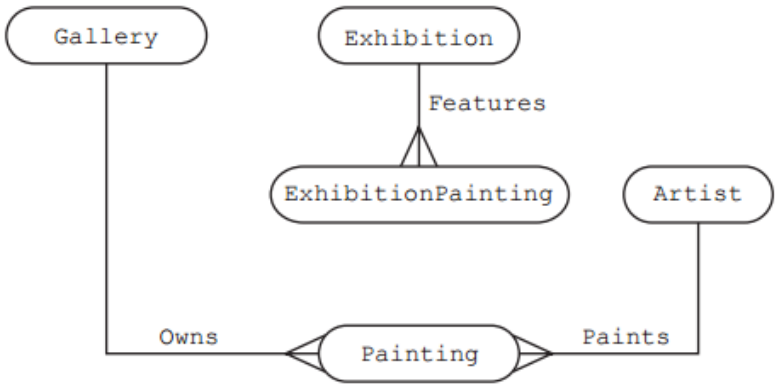
• exhibition title (unique)

• painting reference number

• loan fee.

When a gallery lends a painting to another gallery, it may charge a loan fee.

The database design consists of five entities. These are shown in the entity-relationship (E-R) diagram.



(a) Consider the relationship between `Gallery` and `Exhibition`.

(i) Draw this relationship on the E-R diagram above. **[1]**

(ii) Complete the description for the `Gallery` and `Exhibition` tables.

Use the notation:

`TableName(Attribute1, Attribute2, ...)`

where the underlined attribute indicates the primary key.

`Gallery (..... )`

1.8.2 Relational Database Modelling

`Exhibition (.....)` **[4]**

(b) The Painting and ExhibitionPainting entities (with the primary keys not shown) are as follows:

`Painting(PaintingRefNo, PaintingTitle, ArtistName, PaintingDate, GalleryName)`

`ExhibitionPainting(ExhibitionTitle, PaintingRefNo, LoanFee)`

(i) What is the primary key of table `ExhibitionPainting`? **[1]**

Consider the relationship between `Painting` and `ExhibitionPainting`.

(ii) Draw this relationship on the E-R diagram. **[1]**

(iii) Explain how this relationship is modelled using the given attributes. **[2]**

Oct/Nov 2014. P31/P33

3 A database is to be set up to store data about paintings sold to customers by a gallery.

Several attempts are made at the database design.

(a) Consider Design 1:

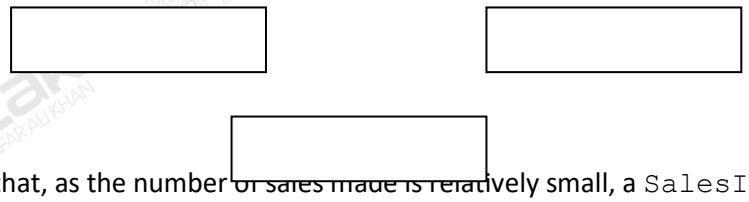
`Customer(CustomerID, CustAddress, DateRegistered)`

`Painting(PaintingID, Description, PaintingDate, Artist, Price)`

`Sales(SalesID, CustomerID, PaintingID, PurchaseDate)`

(i) Circle above the two foreign keys in this database design. **[2]**

(ii) These two foreign keys form two relationships. Complete the entity-relationship (E-R) diagram to show them. **[2]**



(iii) It is suggested that, as the number of sales made is relatively small, a `SalesID` is not required. The `Sales` table could be re-designed as:

`Sales(CustomerID, PurchaseDate, PaintingID)`

This design is to be implemented.

How will this restrict the gallery's sales? **[1]**

(b) More data is to be stored about the artist and the customer.

Consider Design 2:

1.8.2 Relational Database Modelling

```
Customer(CustomerID, CustomerName, CustAddress, DateRegistered)

Painting(PaintingID, Description, PaintingDate, ArtistName, ArtistDateBorn,
ArtistDateDied, ArtistNationality, Price)

Sales(CustomerID, PurchaseDate, CustomerName, PaintingID)
```

(i) Name the table which is not in Second Normal Form (2NF) and explain why. Re-design that table. **[3]**

(ii) Name the table which is not in Third Normal Form (3NF) and explain why. Re-design thas table and add a new table. Both these tables must be fully normalised. **[5]**

Oct/Nov 2014. P32

3 A country has a number of cross-country running clubs. Each club organises races which attract runners from other clubs. A database is to be created storing data about races and runners.

The clubs have agreed to stage one race only on any date.

A number of attempts have been made at the database design.

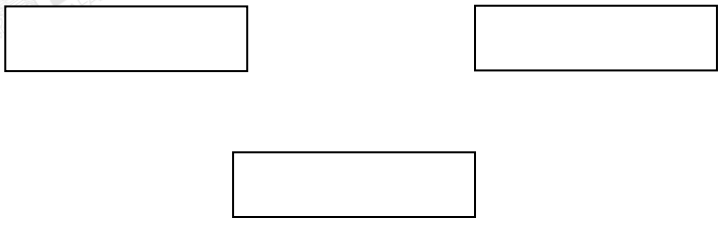
(a) Consider Design 1:

```
Runner(RunnerID, RunnerName, ClubName)

Race(RaceDate, RaceDistance, ClubName)

RaceRunner(RaceDate, RunnerID)
```

(i) Circle the two foreign keys in this database design. **[2]**

(ii) These three entities form two relationships.

Complete the entity-relationship (E–R) diagram to show them.



(b) More data is to be stored.

Consider Design 2:

```
Runner(RunnerID, RunnerName, ClubName)

Race(RaceDate, RaceDistance, ClubName, ClubTown, ClubSecretaryName)
```

1.8.2 Relational Database Modelling

`RaceRunner(RaceDate, RunnerID, RunnerName, FinishingPosition)`

(i) Name the table which is not in Second Normal Form (2NF) and explain why. **[3]**

(ii) Name the table which is not in Third Normal Form (3NF) and explain why. Re-design this table and add a new table. Both these tables must be fully normalised. **[5]**

May/June 2015. P31

1 A sports centre has a gym and a swimming pool. The sports centre has members.

A member is given a unique membership number when they join.

Different types of membership are available:

• J – Junior

• SF – Senior full

• SG – Senior gym only

• SS – Senior swim only

Members who use the gym are assigned a personal trainer.

Sports centre employees are identified with a unique three-character code.

An employee can be a personal trainer to one or more members.

The sports centre organises classes.

Each class has a unique class name. Each class is taken by an employee who acts as the class leader. An employee may be a class leader for zero, one or more classes.

Members can take classes. Each class has a class code. Some classes are assigned a level:

• B – beginners

• I – intermediate

• A – advanced

A relational database is to be created to store data about members, employees, classes and class attendance.

The following table design `MEMBER` was a first attempt at the database design.

Table: `MEMBER`

1.8.2 Relational Database Modelling

MemberNo	MemberType	Trainer	ClassName	ClassLevel	ClassLeader
510	SF	SAF	Yoga B	B	OLO
			Box fit		DAV
			Zumba		ROG
808	SS	OLO	Swimathon	A	ROG
756	J	DAV	Circuits	I	VAR
			Box fit		DAV
			Yoga A	A	OLO
			Body pump		CFD

(a) (i) State why the table is not in First Normal Form (1NF). **[1]**

(ii) Comment on your answer by referring to the data in the table. **[1]**

(b) The design is changed so that there are two tables:

`MEMBER(MemberNo, MemberType, Trainer)`

`MEMBERCLASSES(MemberNo, ClassName, ClassLevel, ClassLeader)`

The primary keys are not shown.

(i) Using the data given in the original table, show the data now stored in table `MEMBER`.

Table: `MEMBER`

MemberNo	MemberType	Trainer

[1]

(ii) Using the data given in the original table, show three rows stored in table `MEMBERCLASSES`.

The `MemberNo` should be different for each row.

Table: `MEMBERCLASSES`

MemberNo	ClassName	ClassLevel	ClassLeader

1.8.2 Relational Database Modelling

[2]

(iii) Using the data given in the original table, state how many rows would be in table MEMBERCLASSES. **[1]**

(iv) State the relationship between MEMBER and MEMBERCLASSES. **[1]**

(v) Explain how the relationship is implemented. **[2]**

(c) The following new design for MEMBERCLASSES was suggested in part (b):

MEMBERCLASSES (MemberNo, ClassName, ClassLevel, ClassLeader)

(i) State the primary key for this table. **[1]**

(ii) Explain why the table is not in Second Normal Form (2NF). **[2]**

(iii) The solution is to create a new third table. Show the revised design including the primary keys.

MEMBER (MemberNo, MemberType, Trainer)

MEMBERCLASSES (.....)
..... (.....)

[3]

(d) Each type of membership has a fixed annual membership fee. The new table design for member data is:

MEMBER (MemberNo, MemberType, MemberTypeFee, Trainer)

(i) The revised MEMBER table is not in Third Normal Form (3NF). Explain this statement. **[2]**

(ii) The solution is to create a new fourth table. Show the revised design including the primary keys.

MEMBER (.....)
..... (.....) **[2]**

May/June 2015.P33

1 A monthly magazine reviews new music releases.

Each music release has a title and a genre. The genre codes are as follows:

- J – Jazz
- P – Pop
- C – Classical

The magazine employs a number of people as reviewers. Reviewers are located all over the world. A reviewer is identified by a unique three-digit code.

1.8.2 Relational Database Modelling

A relational database is to store data for reviews which appear in the magazine.

The data stored for each review are:

- music title
- music genre
- release date
- month and year when the review appeared

The following table REVIEWER was a first attempt at the database design.

Table: REVIEWER

ReviewerID	Location	Title	Genre	ReleaseDate	ReviewDate
510	London	Hits 36	P	12/01/2015	01-15
		Cindy pop	P	26/03/2015	03-15
		Way out	P	11/06/2015	07-15
808	New York	Popular Bach	C	12/01/2015	02-15
		Ultimate Cole	J	31/01/2015	02-15
756	Dhaka	The Messiah	C	11/11/2014	11-14
		Hot Miles	J	02/02/2015	03-15
		Pine points	J	11/04/2015	05-15
		Kylie	P	11/04/2015	05-15

(a) (i) State why the table is not in First Normal Form (1NF). **[1]**

(ii) Comment on your answer by referring to the data in the table. **[1]**

(b) The design is changed so that there are two tables:

REVIEWER(ReviewerID, Location)

REVIEW(Title, Genre, ReleaseDate, ReviewDate, ReviewerID)

The primary keys are not shown.

(i) Using the data given in the original table, show the data now stored in table REVIEWER.

Table: REVIEWER

1.8.2 Relational Database Modelling

ReviewerID	Location

[1]

(ii) Using the data given in the original table, show three rows now stored in table REVIEW. The ReviewerID should be different for each row in the table.

Table: REVIEW

Title	Genre	ReleaseDate	ReviewDate	ReviewerID

(iii) Using the data given in the original table, how many rows would be in table REVIEW? **[1]**

(iv) State the degree of relationship between REVIEW and REVIEWER. **[1]**

(v) Explain how the relationship in part(b)(iv) is implemented. **[2]**

(c) Each title is reviewed once only. The database designer decides to also store the reviewer's name.

A reviewer is paid a set fee for each review completed. The fee paid is determined by the music genre:

Genre	Fee ($)
J	150
P	100
C	200

The following revised design for REVIEW is suggested:

REVIEW(Title, ReviewerID, ReviewerName, Genre, Fee, ReleaseDate, ReviewDate)

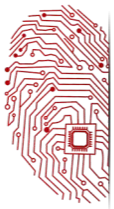
(i) State the primary key for this table. **[1]**

(ii) Explain why the REVIEW table is not in Third Normal Form (3NF). **[2]**

(iii) Currently the design is as follows:

REVIEWER(ReviewerID, Location)

REVIEW(Title, ReviewerID, ReviewerName, Genre, Fee ReleaseDate, ReviewDate)



1.8.2 Relational Database Modelling

Re-design the solution to solve the issue in part (c)(ii). Show all primary keys. **[5]**

Computer Science (9608)

May/June 2015. P11

9 A database has been designed to store data about salespersons and the products they have sold.

The following facts help to define the structure of the database:

- each salesperson works in a particular shop
- each salesperson has a unique first name
- each shop has one or more salespersons
- each product which is sold is manufactured by one company only
- each salesperson can sell any of the products
- the number of products that each salesperson has sold is recorded

The table `ShopSales` was the first attempt at designing the database.

FirstName	Shop	ProductName	NoOfProducts	Manufacturer
Nick	TX	television set refrigerator digital camera	3 2 6	SKC WP HKC
Sean	BH	hair dryer electric shaver	1 8	WG BG
John	TX	television set mobile phone digital camera toaster	2 8 4 3	SKC ARC HKC GK

(a) State why the table is not in First Normal Form (1NF). **[1]**

(b) The database design is changed to:

```
SalesPerson (FirstName, Shop)

SalesProducts (FirstName, ProductName, NoOfProducts, Manufacturer)
```

Using the data given in the first attempt table `(ShopSales)`, show how these data are now stored in the revised table designs.

Table: `SalesPerson`

1.8.2 Relational Database Modelling

FirstName	Shop

Table: SalesProducts

FirstName	ProductName	NoOfProducts	Manufacturer

[3]

(c) (i) A relationship between the two tables has been implemented. Explain how this has been done. **[2]**

(ii) Explain why the SalesProducts table is not in Third Normal Form (3NF). **[2]**

(iii) Write the table definitions to give the database in 3NF. **[2]**

May/ June 2016. P11/ P12

8 A school stores a large amount of data. This includes student attendance, qualification, and contact details. The school's software uses a file-based approach to store this data.

1.8.2 Relational Database Modelling

(b) The database design has three tables to store the classes that students attend.
STUDENT (StudentID, FirstName, LastName, Year, TutorGroup)
CLASS (ClassID, Subject)
CLASS-GROUP (StudentID, ClassID)
Primary keys are not shown.
There is a one-to-many relationship between **CLASS** and **CLASS-GROUP**.

(i) Describe how this relationship is implemented. **[2]**
(ii) Describe the relationship between **CLASS-GROUP** and **STUDENT**. **[1]**

May/ June 2016. P13

5 (c) The database design has three tables to store the qualifications and grades each student has attained. The following is a sample of the data from each table.

STUDENT

StudentID	FirstName	LastName	Tutor
001AT	Ahmad	Tan	11A
003JL	Jane	Li	11B
011HJ	Heather	Jones	10A

QUALIFICATION

QualCode	Level	Subject
CS1	IGCSE	Computer Science
MT9	IGCSE	Maths
SC12	IGCSE	Science

STUDENT-QUALIFICATION

QualCode	StudentID	Grade	DateOfAward
SC12	011HJ	A	31/8/2014
SC12	003JL	C	31/8/2014
CS1	003JL	B	31/8/2014

(i) Draw an Entity-Relationship (E-R) diagram to show the relationships between these three tables. **[2]**
(ii) State the type of relationship that exists between STUDENT and STUDENT-QUALIFICATION. **[1]**
(iii) Describe how the relationship between QUALIFICATION and STUDENT-QUALIFICATION is implemented. **[2]**

Oct/Nov 2016. P11/P13

1 (a) Five descriptions and seven relational database terms are shown below.
Draw a line to link each description to its correct database term.

1.8.2 Relational Database Modelling

Description	Database term
Any object, person or thing about which it is possible to store data	Secondary key
Dataset organised in rows and columns; the columns form the structure and the rows form the content	Candidate key
Any attribute or combination of attributes that can act as a unique key	Entity
Attribute(s) in a table that link to the primary key in another table to form a relationship	Foreign key
Attribute or combination of attributes that is used to uniquely identify a record	Primary key
	Table
	Tuple

[5]

(b) Explain what is meant by referential integrity. **[3]**

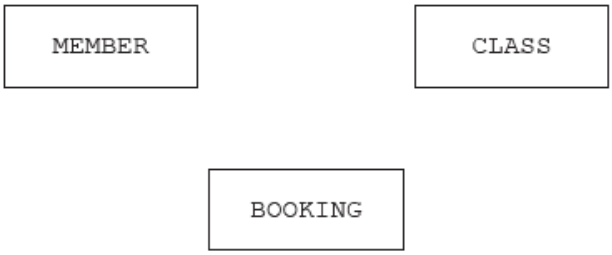
Oct/Nov 2016. P12

9 A health club offers classes to its members. A member needs to book into each class in advance.

(a) The health club employs a programmer to update the class booking system. The programmer has to decide how to store the records. The choice is between using a relational database or a file-based approach.
Give **three** reasons why the programmer should use a relational database. **[6]**

(b) The programmer decides to use three tables: `MEMBER`, `BOOKING` and `CLASS`.
Complete the Entity-Relationship (E-R) diagram to show the relationships between these tables.

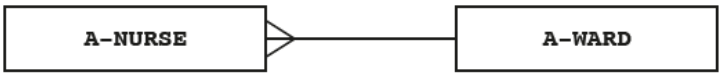
1.8.2 Relational Database Modelling



[2]

May/June 2017. P12/P13

1 A hospital is divided into two areas, Area A and Area B. Each area has several wards. All the ward names are different.
A number of nurses are based in Area A. These nurses always work on the same ward. Each nurse has a unique Nurse ID of `STRING` data type.



(a) Describe the relationship shown above. **[1]**

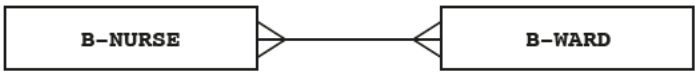
(b) A relational database is created to store the ward and nurse data. The two table designs for Area A are:

```
A-WARD(WardName, NumberOfBeds)
A-NURSE(NurseID, FirstName, FamilyName, .....................)
```

(i) Complete the design for the `A-NURSE` table. **[1]**

(ii) Explain how the relationship in part (a) is implemented. **[2]**

(c) In Area B of the hospital, there are a number of wards and a number of nurses.
Each Area B ward has a specialism.
Each Area B nurse has a specialism.
A nurse can be asked to work in any of the Area B wards where their specialism matches with the ward specialism.
The relationship for Area B of the hospital is:



(i) Explain what the degree of relationship is between the entities `B-NURSE` and `B-WARD`. **[1]**

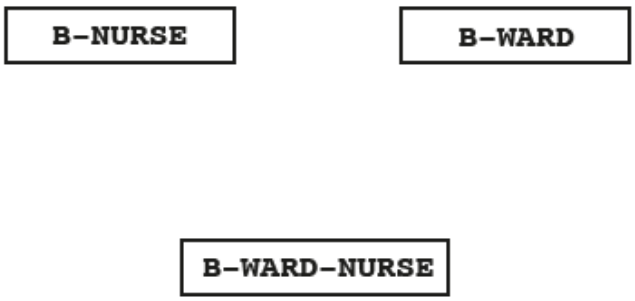
(ii) The design for the Area B data is as follows:

```
B-NURSE(NurseID, FirstName, FamilyName, Specialism)
B-WARD(WardName, NumberOfBeds, Specialism)
B-WARD-NURSE( ..... )
```

Complete the attributes for the third table. Underline its primary key. **[2]**

(iii) Draw the relationships on the entity-relationship (E-R) diagram.

1.8.2 Relational Database Modelling



[2]