Marking Scheme

UNIVERSITY of GREENWICH

EXAMINATION PAPER: ACADEMIC SESSION 2016/2017

FACULTY: Architecture, Computing and Humanities

DEPARTMENT: Computing and Information Systems

LEVEL: 6

TITLE OF PAPER: Database Engineering

COURSE CODE: COMP1639

DATE: 12th December 2016

DURATION: 2 hours

TIME:

BANGLADESH	**18:30**	**BOTSWANA**	**14:00**
GHANA	**12.00**	**KENYA**	**15:00**
HONG KONG	**18:30**	**MALAYSIA**	**18:30**
MALAWI	**14:00**	**MYANMAR**	**16:30**
SINGAPORE	**17:30**	**SYRIA**	**15:00**
SRI LANKA	**17:30**	**TRINIDAD**	**09:30**
TANZANIA	**15:00**	**VIETNAM**	**18:30**
ZAMBIA	**14:00**	**UK**	**13:00**

Answer any **TWO** of the following THREE questions.
Each question is worth 50 marks.

If you answer more than two questions, marks will **ONLY** be awarded for your TWO best answers.

CALCULATORS AND OTHER ELECTRONIC DEVICES ARE **NOT** PERMITTED

1. (a) Which of the following statements are correct?

I M:M relationships can be implemented as a tables in an RDBMS
II M:M relationships are rare
III M:M relationships may have attributes

(i) I only
(ii) I and II only
(iii) I and III only
(iv) I, II and III

[5 marks]

I and III only

(b) Explain why this proposed extract of a relation R is invalid:

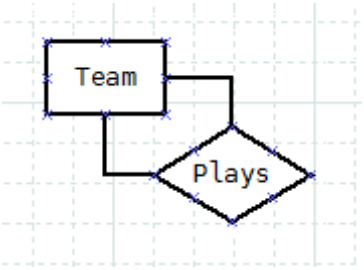
R

Fname	*Sname*	*Age*	*Height*	*EyeColour*
Fred	Bloggs	13	120	green
John	Smith	11	125	green
Debbie	Reynolds	12	145	blue
Mary	Martin	11	132	brown
John	Smith	11	125	green
Scarlett	O'Hara	11	131	blue

[5 marks]

There are two identical tuples for John Smith. All tuples in a valid relation must be unique.

(c) A football information system has been designed using a recursive relationship set on the Team entity set. Teams play each other twice in the league, once at home and once away. A partial ERD is shown below:



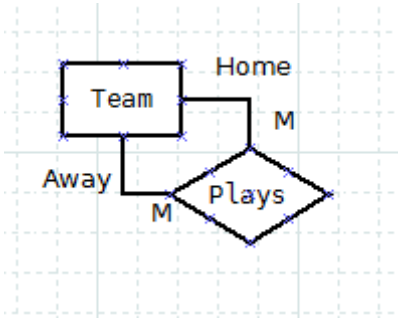
(i) Copy the diagram and add appropriate roles and cardinalities to it.

[4 marks]

Question 1 continues on the following page

Question 1 continued:

Diagram similar to the one below. 1 mark for each cardinality and role indicator. Minimax notation, *e.g.* (2,2) also accepted.



(ii) What constraints need to be applied when this model is implemented?

[6 marks]

These points or similar sensible ones:

Teams cannot play themselves
Plays is implemented as a table
There are two foreign keys in Plays, one for the home team id and one for the away team id.
Teams must have a unique identifier, typically a surrogate.
Up to three points for 2 marks each.

(iii) How can match scores be represented in this kind of model?

[5 marks]

As attributes on the Plays relationship, eg HomeGoals and AwayGoals, or any other sensible scheme.

(iv) The number of goals players score needs to be recorded in the database. Modify the design to include this information.

[10 marks]

Any realistic and sensible scheme that captures the requirement. Will need to have at least a Player entity set – 4 marks - linked in an appropriate way – 6 marks.

Question 1 continues on the following page

Question 1 continued:

(d) Another team working on the footbal information system has come up with a different database design which does not use a recursive relationship. Here is some of the data from the Results table in this design:

MatchID	TeamId	Goals	Home/Away	Possession	Shots on target
1	20	2	H	45%	5
1	21	2	A	55%	15
2	45	0	H	30%	12
2	23	1	A	70%	8

(i) What is the primary key of this table?

[4 marks]

Composite key (MatchID, TeamID): 2 marks for each element.

(ii) What constraints apply to the data in the table?

[6 marks]

These constraints or similar sensible ones:

Possession for a particular match must add up to 100% for both teams.
One of the teams in a match must be labelled the home team (H) and the other the away team (A).
A particular TeamId cannot occur more than twice in the table.

Up to three constraints for 2 marks each.

(iii) Discuss the pros and cons of this design compared to one obtained from the model given in part (c).

[5 marks]

Reasoned discussion of the costs and benefits of using a recursive relationship. Could include consideration of the query/design complexity tradeoff, or any other sensible points. Full marks only given if both pros and cons given.

2. (a) The next page shows data for some of the tables in a database used for congestion charging. Cameras take images of vehicles going into and out of the charging zone. Draw a diagram to show how the tables are related, clearly identifying the primary and foreign keys. You may assume that there is exactly one keeper for each vehicle.

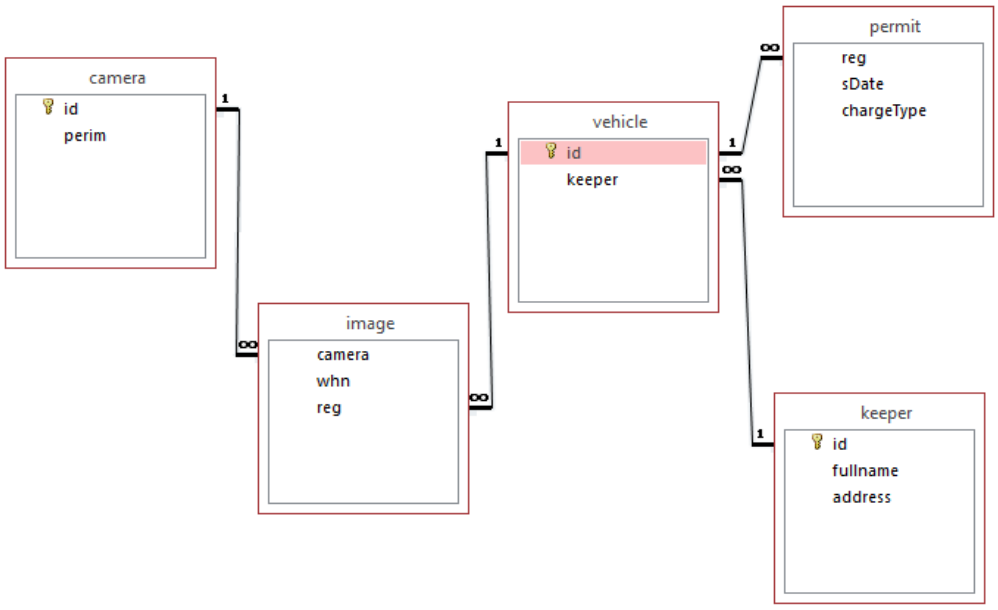
[19 marks]

Question 2 continues on the following page

Question 2 continued :

A diagram similar to the one below is expected. The non-key fields are not required, but all the primary and foreign key fields should be indicated by some clear means.

1 mark for each primary key in camera, vehicle and keeper: up to 3 marks
2 marks for primary keys in permit and image: up to 4 marks
1 mark for each foreign key and 1 mark for its primary key reference, up to a maximum of 8.
Up to 4 marks for clarity of the diagram.



(b) For each of the following requirements, BOTH write the SQL code AND give the expected output using the data in the tables given.

For each of the following, up to 4 marks for the query, 2 marks for the resulting data and 1 mark for the heading, which will depend on the exact query used, particularly in the case of column aliases (as given in the model solution for part (iii) below.)

Question 2 continues on the following page

Question 2 continued :

(i) Find the name and address of the keeper of vehicle SO 02 GSP.
[7 marks]

Query1	
fullname	**address**
Incongruous, Ingrid	Irresolution Pl.

```
select fullname, address
from vehicle, keeper
where vehicle.keeper = keeper.id
and vehicle.id = 'SO 02 GSP';
```

(ii) Find the names of keepers who have more than two vehicles.
[7 marks]

Query2
fullname
Ambiguous, Arthur
Contiguous, Carol

```
select fullname from keeper
where id in (select keeper
from vehicle
group by keeper
having count(id) > 2) ;
```

Question 2 continues on the following page

Question 2 continued :

(iii) There are two types of permit. The most popular type is the one that has been issued the highest number of times. Find out the total number of permits issued and the number issued for the most popular type.

[7 marks]

Query3	
TotalPermits	TotalMostPopularPermits
26	19

SELECT Sum(R.countpermits) AS TotalPermits, Max(R.countpermits) AS TotalMostPopularPermits
FROM (select chargetype, count(reg) as countpermits
from permit
group by chargetype) AS R;

(c) Comment on the design and data in this implementation.

[10 marks]

Some of the keys are surrogate keys, which are consecutive and are probably automatically generated, and some are natural keys, like Vehicle.Id. The pros and cons of using natural versus surrogate keys could be discussed. The implementation also uses composite keys for some of the tables (*e.g.* (reg, sDate) in permit) and this could also be commented upon in a similar way. Some conclusions about the choices should be arrived at with suitable justification.

Regarding the data, both full names and addresses are put into a single field. The naming of some of the attributes and tables are somewhat misleading, making it difficult to understand the semantics of the data. The inclusion of time and date in some of the fields could make processing problematic, especially if these fields form part of a key – timeids might be more suitable. The meaning of the null values in the camera table is unclear.

2 marks for each relevant point up to a maximum of 10, for which both design and data need to be considered.

Question 2 continues on the following page

Question 2 continued:

image		
camera	whn	reg
1	25/02/2007 06:10	SO 02 ASP
17	25/02/2007 06:20	SO 02 ASP
18	25/02/2007 06:23	SO 02 ASP
9	25/02/2007 06:26	SO 02 ASP
17	25/02/2007 06:57	SO 02 CSP
17	25/02/2007 07:00	SO 02 CSP
12	25/02/2007 07:04	SO 02 CSP
8	25/02/2007 07:35	SO 02 CSP
18	25/02/2007 07:39	SO 02 CSP
18	25/02/2007 07:42	SO 02 CSP
10	25/02/2007 07:45	SO 02 CSP
8	25/02/2007 07:48	SO 02 CSP
19	25/02/2007 07:51	SO 02 CSP
18	25/02/2007 07:55	SO 02 CSP
11	25/02/2007 07:58	SO 02 CSP
18	25/02/2007 16:29	SO 02 DSP
19	25/02/2007 16:31	SO 02 DSP
19	25/02/2007 17:42	SO 02 DSP
9	25/02/2007 18:54	SO 02 DSP
3	25/02/2007 17:16	SO 02 ESP
10	25/02/2007 18:08	SO 02 ESP
11	25/02/2007 18:08	SO 02 FSP
5	25/02/2007 07:10	SO 02 GSP
16	25/02/2007 07:13	SO 02 GSP
12	25/02/2007 18:08	SO 02 GSP

camera	
id	perim
1	IN
2	IN
3	IN
4	IN
5	IN
6	IN
7	IN
8	IN
9	OUT
10	OUT
11	OUT
12	OUT
13	OUT
14	OUT
15	OUT
16	OUT
17	
18	
19	

vehicle	
id	keeper
SO 02 ASP	1
SO 02 ATP	1
SO 02 BSP	3
SO 02 BTP	2
SO 02 CSP	1
SO 02 CTP	1
SO 02 DSP	4
SO 02 DTP	3
SO 02 ESP	1
SO 02 ETP	5
SO 02 FSP	3
SO 02 FTP	4
SO 02 GSP	6
SO 02 GTP	5

permit		
reg	sDate	chargeType
SO 02 ASP	21/01/2006 00:00:00	Weekly
SO 02 ATP	21/01/2007 00:00:00	Daily
SO 02 ATP	22/01/2007 00:00:00	Daily
SO 02 BSP	30/01/2006 00:00:00	Weekly
SO 02 BTP	30/01/2006 00:00:00	Daily
SO 02 BTP	31/01/2006 00:00:00	Daily
SO 02 BTP	03/02/2007 00:00:00	Daily
SO 02 BTP	04/02/2007 00:00:00	Daily
SO 02 BTP	05/02/2007 00:00:00	Daily
SO 02 BTP	06/02/2007 00:00:00	Daily
SO 02 BTP	07/02/2007 00:00:00	Daily
SO 02 CSP	21/01/2007 00:00:00	Weekly
SO 02 CTP	21/01/2007 00:00:00	Daily
SO 02 CTP	22/01/2007 00:00:00	Daily
SO 02 DSP	30/01/2007 00:00:00	Weekly
SO 02 DTP	30/01/2007 00:00:00	Daily
SO 02 DTP	31/01/2007 00:00:00	Daily
SO 02 ESP	21/02/2007 00:00:00	Weekly
SO 02 ETP	21/02/2007 00:00:00	Daily
SO 02 ETP	22/02/2007 00:00:00	Daily
SO 02 FSP	25/02/2007 00:00:00	Weekly
SO 02 FTP	25/02/2007 00:00:00	Daily
SO 02 FTP	26/02/2007 00:00:00	Daily
SO 02 GSP	28/02/2007 00:00:00	Weekly
SO 02 GTP	28/02/2007 00:00:00	Daily
SO 02 GTP	01/03/2007 00:00:00	Daily

keeper		
id	fullname	address
1	Ambiguous, Arthur	Absorption Ave.
2	Inconspicuous, Iain	Interception Rd.
3	Contiguous, Carol	Circumscription Close
4	Strenous, Sam	Surjection Street
5	Assiduous, Annie	Attribution Alley
6	Incongruous, Ingrid	Irresolution Pl.

3. (a) *In at most two sentences*, explain what TWO of the following terms mean:

(i) Entity integrity
(ii) Atomicity of transactions
(iii) Relational projection
(iv) Functional dependency

[10 marks]

(i) Entity integrity is the constraint that all relations have a unique primary key .

(ii) Atomicity is on of the properties of a transactions which defines it as a unit of work – it is either done in its entirety or not at all.

(iii) Projection is one of the fundamental relational operators. It may be thought of as taking a vertical slice of a relation including only named attributes.

(iv) A functional dependency exists when one attribute in a relation uniquely determines another-it is used in normalisation. For example, StudentId determines StudentName in a student records database.

Up to 5 marks for each clear explanation. Deduct 2 marks for answers longer than two sentences.

(b) A national 'Do-It-Yourself' company has retail outlets throughout the country. From these outlets it sells products which are obtained from a number of suppliers. Each outlet has a unique identification number as well as an address and telephone number. Each outlet is managed by a manager, who can be identified by her/his staff number. A record is required of a manager's name and home telephone number. At any one time, a manager is never responsible for more than one outlet and it can happen that some managers are not currently responsible for any outlet (as a result of staff transfers, promotions, etc.).

In order to assist in the analysis of sales, the company allocates each product which it sells to one of its sales categories. Each category has a category number and a description such as Kitchens, Gardens, Home Furnishings, and so on. Some of the larger retail outlets are divided into departments. However, some of the smaller retail outlets do not have any departments. Where a retail outlet does have departments, the department name and floor area (in square metres) of each department at that store are recorded. A department may sell a number of categories of product.

Each of the products sold by the company has a unique product code. In addition, for each product there is a need to record its description and the total number of items (which may be zero) of that product held by the company. Each product is supplied by a single supplier. Details of the supplier's identifier and name are held only for those suppliers

currently supplying products. It is important that the number of items of each product stocked at a particular retail outlet is recorded.

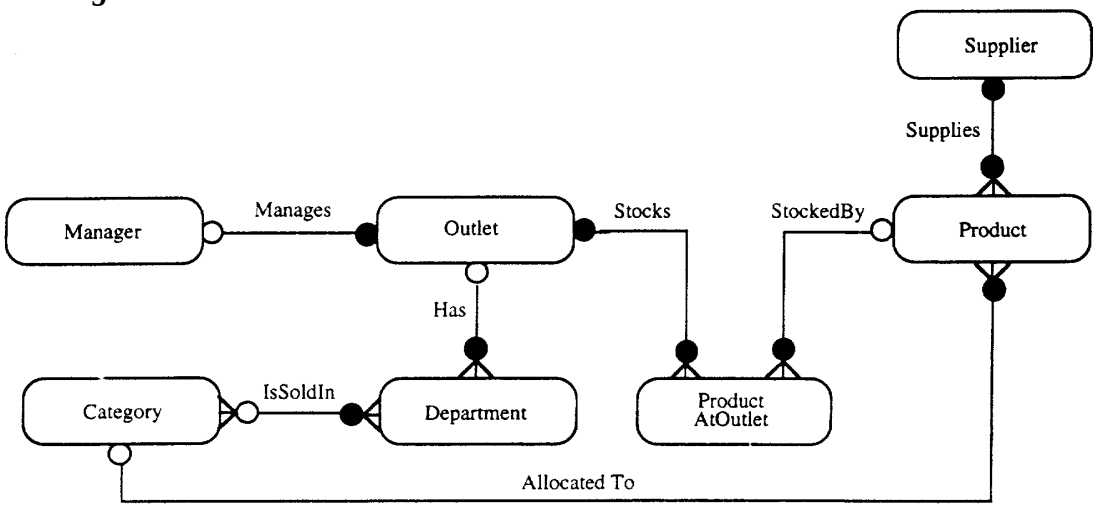
(i) Draw an Enhanced Entity Relationship Diagram for the scenario. Include participation conditions, cardinalities and relationship names in your diagram.

[20 marks]

Sample answer

Up to 7 marks for named entity sets
Up to 7 marks for named relationship sets
Up to 3 marks each for cardinalities and participation conditions

E-R diagram:



Question 3 continues on the following page

Question 3 continued :

(ii) Give the keys, other attributes and their domains for each entity set in your model.

[10 marks]

Entity sets (keys underlined):

Outlet (OutletNo, Address, PhoneNo)

Manager (StaffNo, Name, HomePhoneNo)

Category (CategoryNumber, CategoryName)

Product (ProductCode, Description, TotalNoOfItems)

Supplier (Supplierld, SupplierName)

ProductAtOutlet (OutletNo, ProductCode, NoOfItems)

Department (OutletNo, DepartmentName, FloorArea)

Appropriate domains, to include data types, eg string for PhoneNo and number or int for numerical items like FloorArea and NoOfItems.

Up to 4 marks for keys, and 3 marks each for other attributes and domains.

(iii) List the assumptions and constraints in your model..

[10 marks]

As in the following or similar. Assumptions mentioned in the scenario should not be counted. Up to 2 marks for each item.

Assumptions:

Only the current situation is modelled, e.g. there is no requirement to record the previous responsibilities of managers.

A supplier can supply a product that is not currently stocked at any outlet (i.e. a justification for *StockedBy* being optional with respect to *Product*).

An *Outlet* must stock at least one product. Justification for *Stocks* being mandatory with *Outlet*).

Constraints:

The *TotalNoOfItems* value for a given *Product* is the sum of the *NoOfItems* values in the individual *ProductAtOutlet*.