

PAPER CODE NO.
COMP507

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THE UNIVERSITY
of **LIVERPOOL**

JANUARY 2005 EXAMINATIONS

Degree of Master of Science :

APPLICATIONS OF INFORMATION TECHNOLOGY

TIME ALLOWED : Two Hours

INSTRUCTIONS TO CANDIDATES

Answer ALL questions from Section A
and TWO questions from Section B



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SECTION A

Attempt ALL questions from this section. Each question carries 10 marks.

1. Discuss the relevance of the *Problem Conceptualisation* step in modelling process for a spreadsheet design pointing out its aim and focusing on the role of *Influence Diagrams*: what are they meant to represent? what are the elements they consist of? (provide a brief description for each of them). (10 marks)
2. Briefly describe what *Experimentation* on a spreadsheet model is about and what types of *Experimentations* can typically be performed on a spreadsheet model, illustrating, by means of simple examples, the differences between the *Goal Seek*, the *Scenario Managing* and the *Data Table* experimentation facilities. (10 marks)
3. (a) Describe what is meant by *data integrity* of a database. (4 marks)
(b) Describe the functionality and purpose of the following relational database features:
 - i. Enforce Referential Integrity (2 marks)
 - ii. Cascade Delete (2 marks)
 - iii. Cascade Update (2 marks)(10 marks)
4. Describe, with an example, the following structural constraints that can be imposed on relationships, and demonstrate the conventions used to represent each of them in the ER notation.
 - (a) *cardinality ratio* (4 marks)
 - (b) *participation constraint* (6 marks)



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SECTION B

Attempt **TWO** questions from this section. Each question carries 30 marks. Credit will be given for the best two answers only.

1. The activities of a coach company need to be organized as a database. An initial analysis of the requirements produced the following facts:

- The company has various branches, for each of which the address is maintained.
- For each employee of the company, name, town of birth, date of birth and national insurance number are maintained.
- If the employee is a driver, the number of driving license, and the number of life policy should be also maintained.
- For each vehicle, plate number and number of seats are maintained.
- Drivers are allocated one specific vehicle to be used for one specific route. One driver may work on several routes, and one vehicle may be used for several routes.
- For each route, there are several stops, for each of which a progressive number and the name of the town are recorded.
- Drivers must have permission to work on specific routes (e.g. going abroad).
- Some employees serve as conductors for particular routes. One conductor may be allocated many routes.
- A driver cannot be a conductor and vice-versa.
- Conductors and drivers are allocated to routes on a turn-taking basis: for each turn, date of beginning and date of end is kept.
- Employees may work for one branch only.
- Vehicles are also used by one branch only.

Using a centralised design approach, build an Entity-Relationship diagram describing this scenario:

- identify the entity types (5 marks)
- identify their attributes and primary keys (5 marks)
- identify the relationship types among them, (5 marks)
- identify their cardinalities and participation constraints, (5 marks)
- and draw an ER model of your design. (10 marks)



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2. Consider the following table of famous paintings, for which **four** sample records are shown:

PAINTINGS						
Artist Code*	Artist Name	Artist Birthdate	Picture Codes*	Picture Names	Museum Names	Museum Locations
1	Leonardo da Vinci	15/04/1452	1 2 3	Mona Lisa, Annunciation Lady with an Ermine	Louvre, Uffizi, Czartoryski	Paris France, Florence Italy, Cracow Poland
2	Vincent van Gogh	30/03/1853	4 5	Woman of Arles, Montmartre	Orsay, Art Institute	Paris France, Chicago USA
3	Paul Gauguin	07/07/1848	6 7	Self-Portrait Arearea	Orsay Orsay	Paris France, Paris France
4	Francisco de Goya	30/03/1746	8	Woman with a fan	Louvre	Paris France

- (a) i. Why is the table not in First Normal Form? (3 marks)
- ii. Convert the table to an equivalent one (or equivalent collection of tables) that is in First Normal Form. (6 marks)
- (b) i. Consider the equivalent First Normal Form table(s) you have obtained as a solution of the previous question. Provided that the table's primary key is ArtistCode+PictureCode, why is the table not in Second Normal Form? (3 marks)
- ii. Convert such a the table to an equivalent collection of tables that are in Second Normal Form. (6 marks)
- (c) i. Consider the collection of tables obtained as a solution of previous question and point out if they all satisfy the Third Normal Form criteria. Convert any table among them which is not in Third Normal Form, to an equivalent collection of tables that are in Third Normal Form. (6 marks)
- (d) Describe briefly what is the aim of the Normalisation process in a Relational Database design, discussing the type of problems it is meant to tackle (i.e. the bad properties that tables which are *informally designed* may suffer of). (6 marks)



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3. Consider the following tables, representing the departments of a Megastore having two branches, the Megastore staff members, the departments in which they work as salespersons and the departments they supervise:

DEPARTMENTS		
Code*	Name	Branch
1	Rock	1
2	Classic	2
3	Rock	2
4	Pop	1
5	Classic	2

STAFF			
SNo*	Name	Surname	DateBirth
1	John	Verner	31/12/1947
2	James	Brown	27/10/1952
3	George	Hutton	31/05/1960
4	Jean	Shaw	03/01/1959
5	Freddy	Cawsey	16/07/1968
6	Fiona	May	26/10/1972
7	Frank	Hayes	08/09/1965

WORKS-IN	
Code*	SNo*
1	1
2	1
3	3
4	7
5	7

SUPERVISES	
Code*	SNo*
1	2
2	7
3	3
4	6
5	4

- (a) Using the four tables above, give the expected result of the following SQL queries:
- i. `SELECT S.Name, S.Surname, W.Code
FROM STAFF S INNER JOIN WORKS-IN W ON S.SNo = W.SNo
WHERE S.Surname LIKE "H*";` (2 marks)
 - ii. `SELECT S.Name, S.Surname, W.Code
FROM STAFF S, WORKS-IN W
WHERE S.SNo = W.SNo
AND W.Code IN (SELECT Code FROM DEPARTMENTS WHERE Branch = 1);` (2 marks)
 - iii. `SELECT S.Name, S.Surname, COUNT(*) AS NumDepartments
FROM STAFF AS S INNER JOIN WORKS-IN AS W ON S.SNo = W.SNo
GROUP BY S.SNo;` (2 marks)
 - iv. `SELECT S.Name, S.Surname, SS.Code
FROM STAFF S LEFT JOIN SUPERVISES SS ON S.SNo = SS.SNo
ORDER BY S.DateBirth DESCENDING;` (2 marks)
- (b) Using the four tables above, give the SQL expression and the expected result of the following queries:
- i. Staff Number, Name, Surname and date of birth of all staff members who are neither salespersons nor department supervisors. (4 marks)
 - ii. Name and Surname of salespersons who supervise two or more departments. (4 marks)
 - iii. Code of all departments which are staffed and supervised by the same staff members. (4 marks)
 - iv. Name and Surname of all salespersons who supervise at least one Classic department. (4 marks)
- (c) Describe briefly the basic concepts the Relation Database Model is based on: what is a *Relation Schema*? What is meant by *Attributes* and *Domains*? Point out what is the meaning of the following terms *Superkey* *Key* *Primary Key*? *Candidate Key* and *prime/nonprime attribute*. Furthermore explain what is a *Relational Algebra* describing at least two of its *primitive operators*. (6 marks)