PAPER CODE NO.	EXAMINER : **Floriana Grasso**
COMP507	DEPARTMENT : Computer Science Tel. No. 43680

THE UNIVERSITY
of LIVERPOOL

JANUARY 2003 EXAMINATIONS

Master of Science : Year 1

APPLICATIONS OF INFORMATION TECHNOLOGY

TIME ALLOWED : Two Hours

INSTRUCTIONS TO CANDIDATES

Answer **ALL** questions from Section A.
And **TWO** questions from Section B.

If you attempt to answer more than the required number of questions (in any section), the marks awarded for the excess questions will be discarded (starting with your lowest mark).

THE UNIVERSITY
of LIVERPOOL

SECTION A

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

1. Describe, with an example, what *ARRAY functions* are in spreadsheet modelling. (10 marks)

2. Discuss why null values are a problem in relational databases. (10 marks)

3. Describe the view integration approach to Entity-Relationship (ER) modelling. (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)

THE UNIVERSITY
of LIVERPOOL

SECTION B

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

1. You need to devise a spreadsheet system for the following problem:

   The system is to be created for the lecturer of COMP507. There are each year 90 students registered for COMP507, from three different university programmes: MSc in IT (30 students), MSc in SE (30 students) and MSc in BioComputation (30 students). The module assessment is based on courseworks and final exam. The coursework component is worth 30% of the final mark, and the final exam is worth 70% of the final mark. The lecturer prepares each year three assignments, for the coursework component, whose individual weight may vary, but whose cumulative weight is always 30% (e.g. they can all be worth 10%, or there can be one worth 20% and two worth 5%, and so on). Each student receives for each assignment and for the exam paper a mark out of 100. At the end of the year, the lecturer needs to produce the average mark for each assignment, the average mark for the exam paper, the average final mark for COMP507, and the top final mark for each of the three programmes (i.e. the top MSc in IT final mark, the top MSc in SE final mark and the top MSc in BioComputation final mark).

   (a) Produce a conceptual model of the problem, by creating an *influence diagram* to depict it. (25 marks)

   (b) Sketch **in few words** how you would design the layout of a spreadsheet system implementing the problem. (5 marks)

2. A relational database of the University's accommodation office has the following catalog description:

   - table HALLS-OF-RESIDENCE(HallNo, Address, Postcode, Warden)
   - table HALL-CONTACTS(HallNo,TelephoneNo)
   - table ROOM(HallNo, RoomNo, Description)
   - table RENT(HallNo, RoomNo, StudentNo, Start-date, End-date, Rent)
   - table STUDENTS(StudentNo, Name, Surname, ContactNumber)
   - table COURSEMATES(StudentNo1, StudentNo2)

   The following referential constraints hold in the database:

   - HALLS-OF-RESIDENCE.Warden **references** STUDENTS.StudentNo
   - HALL-CONTACTS.HallNo **references** HALLS-OF-RESIDENCE.HallNo
   - ROOM.HallNo **references** HALLS-OF-RESIDENCE.HallNo
   - RENT.HallNo **references** HALLS-OF-RESIDENCE.HallNo
   - RENT.RoomNo **references** ROOM.RoomNo
   - RENT.StudentNo **references** STUDENTS.StudentNo
   - COURSEMATES.StudentNo1 **references** STUDENTS.StudentNo
   - COURSEMATES.StudentNo2 **references** STUDENTS.StudentNo

   Reverse map the description above in an Entity-Relation schema that could have produced it, by stating any assumption you make in the process. (30 marks)

THE UNIVERSITY
of LIVERPOOL

3. Consider the following description of a University database. The University has various Departments, whose Head is a Lecturer. Each Lecturer works for a department and has another Lecturer as Mentor. Courses of a department can be taught by many lecturers, and each lecturer can teach several courses.

   - table DEPARTMENTS(DepNo, DName, DHead)
   - table LECTURERS(LectNo, LName, LSurname, LDepNo, LMentor)
   - table COURSES(CourseNo, CName, CSemester, CDepNo)
   - table TEACHINGDUTIES(CourseNo, LNo)

   The following referential constraints hold in the database:

   - DEPARTMENTS.DHead **references** LECTURERS.LectNo
   - LECTURERS.LDepNo **references** DEPARTMENTS.DepNo
   - LECTURERS.LMentor **references** LECTURERS.LectNo
   - COURSES.CDepNo **references** DEPARTMENTS.DepNo
   - table TEACHINGDUTIES.CourseNo **references** COURSES.CourseNo
   - table TEACHINGDUTIES.LNo **references** LECTURERS.LectNo

   (a) Give an English explanation of what the following relational algebra queries calculate, and translate them in SQL:

   i. $\pi_{DName,LName,LSurname}(DEPARTMENTS \bowtie_{DepNo=LDepNo} LECTURERS)$ (5 marks)

   ii. $\pi_{LectNo}(\sigma_{DepNo=5}(LECTURERS)) \cup \pi_{LMentor}(\sigma_{DepNo=5}(LECTURERS))$ (5 marks)

   iii. $\pi_{LectNo}(LECTURERS) - \pi_{DHead}(DEPARTMENTS)$ (5 marks)

   (b) Give an English explanation of what the following SQL queries calculate, and translate them in relational algebra:

   i.
```
SELECT Fname,Lname,Address
FROM DEPARTMENTS INNER JOIN LECTURERS
ON DepNo=LDepNo
WHERE DName="Physics";
```
(5 marks)

   ii.
```
SELECT CName,DName,LSurname
FROM (COURSES INNER JOIN DEPARTMENTS on CDepNo=DepNo)
     INNER JOIN LECTURERS ON DepNo=LDepNo
WHERE CSemester=2;
```
(5 marks)

   iii.
```
(SELECT DHead FROM DEPARTMENTS)
 INTERSECT
(SELECT LNo FROM TEACHINGDUTIES);
```
(5 marks)