Attempt THREE questions only. All questions carry equal marks.

1.

(a) Explain the differences between conceptual, logical and physical database design. (9 marks)

(b) A list of steps to be followed during the physical database design stage of a relational database might include the following

- Design base relations for target DBMS
- Analyse transactions
- Choose file organizations
- Choose secondary indexes
- Consider the introduction of controlled redundancy
- Design user views

Give brief explanations of each of the six terms underlined in the context of physical database design. (24 marks)

2.

(a) Define normalisation and briefly explain the role of functional dependencies in the normalisation process. (6 marks)

(b) Identify three problems with recording information about video library loans in the form of the table shown below.

Lender-Name	Lender-Ref-No	Lender-Contact-Info	Loaned -Video - Title	Video-Acquisition-No	Video-Return-Due
Joe Brown	98-124	JoeB@xl.com	Carla's Song	98.452/1	3-01-00
Joe Brown	98-124	JoeB@xl.com	Straw Mobiles	99.565/2	7-12-99
Alice Fry	99-022	ACF@col.co.uk	Bandits II	99.843/1	2-01-00
Sam Cook	99-344	SCook@mod.com	Straw Mobiles	99.565/3	7-12-99
Sam Cook	99-344	SCook@mod.com	Carla's Song	98.452/1	7-01-00
Sam Cook	99-344	SCook@mod.com	Bandits II	99.843/2	3-01-00

(9 marks)

(c) Show how the data in the table could be restructured to overcome the problems you have identified in (b), using the notion of functional dependency to justify your proposals. (12 marks)

(d) Explain how normalisation fits into the database design process. Why might a database be implemented with data structures that are not fully normalised? (6 marks)

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3.

The following tables are part of a relational database maintained by UCL. The primary key in each table is underlined.

Lecturer (Lecturer-initials, Name, Title, Department, Email-address)
Course (Course-code, Course -title)
Teaches (Lecturer-initials, Course-code)
Class (Course-code, day, time, place, term)
Registration (Student-name, Course-code) (assume student names are unique)

Write expressions in BOTH relational algebra and in SQL to retrieve each of the following

(a) Email addresses of lecturers in the department known as SLAIS

(2 x 2 marks)

(b) A list of the names of students taking the course entitled 'Introduction to C++'

(2 x 3 marks)

(c) A list showing the names of lecturers and the titles of the courses they teach

(2 x 4 marks)

(d) A list showing those who will be in the Darwin LT at 11 a.m. on Thursdays in the autumn term

(2 x 6 marks)

(e) Define the term *foreign key*. Identify one in the set of tables given above.

(3 marks)

4.

(a) An Entity-Relationship model is a conceptual model that mediates between users' perceptions and the technical specification of a database system. Discuss.

(8 marks)

(b) A London borough council runs adult education classes for residents of the borough at a number of adult education centres. Several courses are held at each centre each day during the week. Students may enrol on as many courses as they like provided they pay an enrolment fee at the start of each course. Each course is normally given by a single teacher, but this is not always the case. Draw an entity-relationship model showing the relationships between students, courses, course teachers and adult education centres. (9 marks)

[Question 4 cont. overleaf]

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[Question 4 cont.]

(c) A relational database is to be created to record the information about the entities and relationships modelled in (b) above.

A course is described by the following attributes; course code (unique), course name, start date, end date, fee, day of the week and time. Centres are described by; place name (unique), manager name, telephone number. Teachers are described by; name, employee reference number (unique) and contact details.

Show how you would capture the relationships between centres and courses, and between teachers and courses (as you have identified them in your answer to (b)) by adding attributes or tables to the relational data model.

(9 marks)

(d) Define *referential integrity*. Give one example of a referential integrity constraint that you would impose on the database being set up for the adult education service described above. (7 marks)

5.

(a) Briefly define location transparency and replication transparency.

(6 marks)

(b) Explain how the choice of distributed query processing strategy can have a significant effect on the query response time in a distributed database system. Use an example to illustrate your explanation.

(15 marks)

(c) Describe the main advantages and the main disadvantage of data replication in a distributed database management system.

(12 marks)

END OF PAPER