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UNIVERSITI SAINS MALAYSIA

First Semester Examination  
Academic Session 2002/2003

September 2002

**CIT503 - Databases and E-Commerce Rapid Application Development**  
**CSI512 - Database Management Systems**

Duration : 3 hours

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**INSTRUCTION TO CANDIDATES:**

- Please ensure that this examination paper consists of TWO sections and contains **SIX** questions in **SEVEN** printed pages before you start the examination.
- Choose and answer **ANY ONE** questions in Section A and answer **ALL** questions in Section B.
- You can choose to answer either in Bahasa Malaysia or English.

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ENGLISH VERSION OF THE QUESTION PAPER

**Section A**

1. (a) Good database design will lead to the following achievements.

- Controlled data redundancy
- High level of data independence
- Better data abstraction

Briefly explain what is meant by each of the above term and how they can be achieved.

(7 marks)

(b) Describe the 3 types of data stored in the database.

(6 marks)

(c) According to Codd (1982) a DBMS should be able to provide transaction support, concurrency control, user accessible catalogue and many other functions. Explain the three DBMS function as listed above.

(6 marks)

(d) Query processor, data dictionary manager and storage manager are parts of database management system components. Briefly explain the function of each.

(6 marks)

2. (a) Explain the procedures and techniques needed to achieve a conceptual data model.

(5 marks)

(b) Explain the following terminologies with reference to the two given tables below.

**PRODUCT**

| PROD_CODE | PROD_DESCRIPT                   | PROD_PRICE | PROD_ON_HAND | VEND_CODE |
|-----------|---------------------------------|------------|--------------|-----------|
| 001278-AB | Claw hammer                     | \$12.95    | 23           | 232       |
| 123-21UUY | Houselite chain saw, 16-in. bar | \$189.99   | 4            | 235       |
| QER-34256 | Sledge hammer, 16-lb. head      | \$18.63    | 6            | 231       |
| SRE-657UG | Rat-tail file                   | \$2.99     | 15           | 232       |
| ZZX/3245Q | Steel tape, 12-ft. length       | \$6.79     | 8            | 235       |

## VENDOR

| VEND_CODE | VEND_CONTACT       | VEND_AREACODE | VEND_PHONE |
|-----------|--------------------|---------------|------------|
| 230       | Shelly K. Smithson | 608           | 555-1234   |
| 231       | James Johnson      | 615           | 123-4536   |
| 232       | Annelise Crystall  | 608           | 224-2134   |
| 233       | Candice Wallace    | 904           | 342-6567   |
| 234       | Arthur Jones       | 625           | 123-3324   |
| 235       | Henry Ortozo       | 615           | 8993425    |

- (i) Primary key
- (ii) Foreign key
- (iii) Cardinality
- (iv) Degree
- (v) Domain

(10 marks)

- (c) Explain the differences between hierarchical, network and relational data model.

(10 marks)

3. (a) State the differences between the following relational algebra operators:

- (i)  $\theta$ -join
- (ii) equi-join
- (iii) natural join
- (iv) outer join
- (v) semi join

(5 marks)

- (b) What do you understand by "*Rapid Application Development (RAD) Model*"? Describe the five phases of the RAD approach.

(10 marks)

- (c) Explain why the integration of enterprise databases with the web is a requirement for e-commerce success?

(5 marks)

- (d) There are a few requirements in an e-commerce database that we do not encounter in traditional database design. Elaborate on this requirements.

(5 marks)

**Section B**

4. The requirements collection and analysis phase of the database design process has provided the following data requirements for a company called Popular Car Rentals, which rents out vehicles (cars and vans). The company has various outlets (garage/offices) throughout Kuala Lumpur. Each outlet has a number, address, phone number, fax number, and a manager who supervises the operation of the garage and offices at each site.

Each site is allocated a stock of vehicles for hire, however, individual vehicles may be moved between outlets, as required. Only the current location for each vehicle is stored. The registration number uniquely identifies each vehicles for hire and is used when hiring a vehicle to a client.

Clients may hire vehicles for various periods of time (minimum 1 day to maximum 1 year). Each individual hire agreement between a client and the Company is uniquely identified using a hire number. Information stored on the vehicles for hire include: the vehicle registration number, model, make, engine size, capacity, current mileage, daily hire rate, and the current location (outlet) of each vehicle.

The data stored on a hire agreement includes the hire number, the client's number, name, address and phone number, date the client started the hire period, date the client wishes to terminate the hire period, the vehicle registration number, model and make, the mileage before and after the hire period. After each hire a member of staff checks the vehicle and notes any fault(s). Fault report information on each vehicle is stored, which records the name of the member of staff responsible for the check, date checked, whether fault(s) where found (yes or no), the vehicle registration number, model, make and the current mileage.

The Company has two types of clients: personal and business. The data stored on personal clients includes the client number, name (first and last name), home address, phone number, date of birth and driving license number. The data stored on business clients includes the client number, name of business, type of business, address, telephone and fax numbers. The client number uniquely identifies each client and the information stored relates to all clients who have hired in the past and those currently hiring a vehicle.

Information is stored on the staff based at various outlets including: staff number, name (first and last name), home address, home phone number, date of birth (DOB), sex, National Identity Number (NIN), date joined the Company, job title and salary. Each staff member is associated with a single outlet but may be moved to an alternative outlet as required, although only the current location for each member of staff is stored.

- (a) Create a conceptual schema for Popular Car Rentals using the concepts of the Enhanced Entity-Relationship (EER) model. To simplify the diagram, only show entities, relationships and the primary key attributes. Specify the cardinality ratio and participation constraint of each relationship type. State any assumptions you make when creating the EER model (if necessary).

(15 marks)

- (b) Map your EER model to a database schema, identify primary, alternate and foreign keys (if any). List all the attributes.

(10 marks)

5. The table shown below displays the details of the roles played by actors/actresses in films.

| FilmNo | Ftitle     | Director   | ActorNo | AName           | Role           | Time on screen |
|--------|------------|------------|---------|-----------------|----------------|----------------|
| F1100  | Happy Days | Jim Alan   | A1020   | Sheila Toner    | Jean Simson    | 15.45          |
|        |            | Jim Alan   | A1222   | Peter Watt      | Tom Kinder     | 25.38          |
|        |            | Jim Alan   | A1020   | Sheila Toner    | Silvia Simpson | 22.56          |
| F1109  | Snake Bite | Sue Ramsay | A1567   | Steven McDonald | Tim Rosey      | 19.56          |
|        |            | Sue Ramsay | A1222   | Peter Watt      | Archie Bold    | 10.44          |

- (a) Describe why the table shown above is not in first normal form (1NF).

(2 marks)

- (b) The table shown above is susceptible to update anomalies. Provide examples of how insertion, deletion and modification anomalies could occur on this table.

(6 marks)

- (c) Identify the functional dependencies represented by the table shown above. State any assumptions you make about the data shown in this table (if necessary).

(7 marks)

- (d) Using the functional dependencies identified in part (c), describe and illustrate the process of normalisation by converting the table shown in Figure 1 to Boyce-Codd Normal Form (BCNF). Identify the primary and foreign keys in your BCNF relations.

(10 marks)

6. The relations below are part of a university database schema. Answer the following questions based on the given schema.

UnderGrad (StdNo, Name, Major, TelNo)

PostGrad (StdNo, Name, FieldofStudy, SupervisorName)

Society (StdNo, SocietyName)

- (a) Explain the goal of each of the following relational algebra queries.

(i)  $\pi_{\text{StdNo, Name}}(\text{UnderGrad}) \cup \pi_{\text{StdNo, Name}}(\text{PostGrad})$

(ii)  $\pi_{\text{Name, Major}}(\text{UnderGrad} \bowtie \text{Society})$

(iii)  $\pi_{\text{Name, TelNo}}(\sigma_{\text{UnderGrad.StdNo} < \text{PP.StdNo} \wedge \text{UnderGrad.TelNo} = \text{PP.Tel.No}}(\text{Undergrad} \times \rho_{\text{PP}}(\text{Undergrad})))$

(iv)  $\pi_{\text{PostGrad.Name}}(\text{PostGrad} \bowtie_{\text{PostGrad.FieldofStudy}=\text{UnderGrad.Major}} \text{UnderGrad})$

(v)  $\text{PostGrad} \div \pi_{\text{StdNo}}(\sigma_{\text{SocietyName}='SilatCekak'}(\text{Society}))$

(10 marks)

- (b) Answer the following queries in relational algebra.

- (i) List all information about postgraduate student who is taking graphic as the field of study or who are being supervised by Prof. Rani.

- (ii) List the name of all undergraduate students who do not join any society.

(5 marks)

Given a database schema:

Employee (EmpNo, EmpName, BirthDate, TelNo, JobPosition)

Project (ProjCode, ProjName, ProjStartDate, ProjDuration)

Payment (EmpNo, ProjCode, AmountPaid)

Assume that an employee can be assigned to one or more projects and a project can be done by one or more employees. An employee will be paid a certain amount of money once a project has been completed.

- (c) Answer any **FIVE** of the following queries in SQL.
- (i) Assume that the birth date is written in 4-digit year, and the current year is 2002, list the name and the age of all Senior Managers who are above 50 years old.
  - (ii) List all the project names with the project code containing the digits 007.
  - (iii) List the project code and the project name in the ascending order of project duration and descending order of project start date for all projects which take more than 2 years to finish.
  - (iv) List the project code and the total amount paid for each project with more than five employees.
  - (v) Name the employee and the project for which the employee was paid the highest amount. Print the amount under the column name MAXPAID.
  - (vi) Assume that a telephone cannot be shared by more than two employees. List the name and the telephone number of all employees who share the same telephone number. List the same telephone number only once.
  - (vii)
    - Delete all employees who do not do any project from the database.
    - All project durations are to be increased by one year. Reflect this decision into the database.
  - (viii) Create a view called Directory to list all employee names, their telephone number as well as their job positions.

(10 marks)