

UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Pertama  
Sidang Akademik 1994/95

Oktober/November 1994

**CIS401/CSD401 - Design and Management of Databases**

Masa: [3 jam]

---

**ARAHAN KEPADA CALON:**

- Sila pastikan bahawa kertas peperiksaan ini mengandungi **LIMA** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.
  - Jawab **SEMUA** soalan. Anda boleh memilih untuk menjawab **SEBAHAGIAN** daripada soalan di dalam Bahasa Inggeris atau menjawab keseluruhan soalan di dalam Bahasa Malaysia.
- 

ENGLISH VERSION OF THE QUESTION PAPER

## 1. The main database concepts:

- (a) (i) Explain what a data model is and what does it serve for.  
 (ii) Give the definitions of a database, database management system, database system, database definition language, and database manipulation language.  
 (iii) List the classical data models. (25/100)
- (b) Explain the requirements of data independence, integrity and security. (25/100)
- (c) List the principal users of a database system, explain their functions and language tools they use. (25/100)
- (d) Define a multi-level database schema structure, draw a picture, explain the functions of each level. (25/100)

## 2. Relational databases:

- (a) (i) Explain the purpose of normalization.  
 (ii) Give definitions of the first, second, and third normal forms. (30/100)
- (b) (i) Explain what a relational algebra is.  
 (ii) Give definitions of the projection, selection, and join operations. (25/100)
- (c) Suppose we have the following requirements for a university database that is used to keep track of students' transcripts:
- The university keeps track of each student's name (SNAME), student number (SNUM), social security number (SSN), current address (SCADDR) and phone (SCPHONE), permanent address (SPADDR) and phone (SPPHONE), birthdate (BDATE), sex (SEX), class (CLASS) (freshman, sophomore, ..., graduate), major department (MAJORDEPCODE), minor department (MINORDEPCODE) (if any), and degree program (PROG) (B.A., B.S, ..., Ph.D.). Both SSN and student number have unique values for each student.
  - Each department is described by a name (DEPTNAME), department code (DEPTCODE), office number (DEPTOFFICE), office phone (DEPTPHONE), and college (DEPTCOLLEGE). Both name and code have unique values for each department.

- Each course has a course name (CNAME), description (CDESC), code number (CNUM), number of semester hours (CREDIT), level (LEVEL), and offering department (CDEPT). The value of each code number is unique for each course.
- Each section has an instructor (INSTRUCTORNAME), semester (SEMESTER), year (YEAR), course (SEQCOURSE), and section number (SECNUM). Section number distinguishes different sections of the same course that are taught during the semester/year; its values are 1, 2, 3, ...; up to the number of sections taught during each semester.
- A transcript refers to a student (SSN), a particular section, and a grade (GRADE).

Design a relational database schema for this database application which are in the third normal form. Show all the functional dependencies that should hold among the attributes. Specify the key attributes of each relation.

(30/100)

- (d) For the database "Company" (see appendix - figure 2d attached), write an SQL query for the following task: "Make a list of all project names for projects that involve an employee whose last name is 'Borg' as a worker or as a manager of the department that controls the project".

(20/100)

### 3. Object-Oriented Databases

- (a) (i) Give definitions of an object.  
 (ii) Discuss object identity and object structure issues.  
 (iii) Explain what are complex (composite) objects are.
- (25/100)
- (b) (i) Define a class notion and show its similarities and differences with a data type notion.  
 (ii) Define and discuss the notions of inheritance, superclasses, and subclasses.
- (25/100)
- (c) Discuss the different types of schema modification in an OODB.
- (20/100)
- (d) Design an object-oriented tourist database storing data about cities, hotels, monuments, and restaurants in the following way:
- A hotel is characterized by *name*, *rank (stars)*, *number of free rooms*, and procedures of *reserving a room* and *checking-out*.
  - A city is characterized by *name*, *map*, *set of hotels*, and procedures of *creating a new hotel* and *finding rooms of needed rank*.

...4/-

- A monument is characterized by *name, address, admission fee, and statistics* about visitors.
  - A restaurant is characterized by *city, rank (stars), and menus*.
  - A tourist city is regarded as a special kind of city and is characterized, in addition, by a set of *monuments* and a procedure of *creating a new monument*.
- (30/100)

4. Database design:

- (a) Describe the life cycle of the database system. (25/100)
- (b) Describe the assertion integrity constraint. (20/100)
- (c) Define the recovery problem and list the components of the database log. (25/100)
- (d) Describe the various types of fragmentation in a distributed database system. (30/100)

EMPLOYEE	FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO
John	B		Smith	123456789	09-JAN-55	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T		Wong	333445555	08-DEC-45	638 Voss, Houston, TX	M	40000	888885555	5
Alice	J		Zelaya	999887777	19-JUL-58	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S		Wallace	987654321	20-JUN-31	291 Berry, Belaire, TX	F	43000	888885555	4
Ramesh	K		Narayan	666884444	15-SEP-52	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A		Englen	453453453	31-JUL-62	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmed	V		Jabbar	987987987	29-MAR-69	980 Dallas, Houston, TX	M	25000	987654321	4
James	E		Borg	888885555	10-NOV-27	450 Stone, Houston, TX	M	55000	null	1

DEPT_LOCATIONS	DNUMBER	DLOCATION
	1	Houston
	4	Stafford
	5	Belaire
	5	Sugarland
	5	Houston

DEPARTMENT	DNAME	DNUMBER	MGRSSN	MGRSTARTDATE
Research		5	333445555	22-MAY-78
Administration		4	987654321	01-JAN-85
Headquarters		1	888885555	19-JUN-71

WORKS_ON	ESSN	PNO	HOURS
	123456789	1	32.5
	123456789	2	7.5
	666884444	3	40.0
	453453453	1	20.0
	453453453	2	20.0
	333445555	2	10.0
	333445555	3	10.0
	333445555	10	10.0
	333445555	20	10.0
	999887777	30	30.0
	999887777	10	10.0
	987987987	10	35.0
	987987987	30	5.0
	987654321	30	20.0
	987654321	20	15.0
	888885555	20	null

PROJECT	PNAME	PNUMBER	PLOCATION	DNUM
	ProductX	1	Belaire	5
	ProductY	2	Sugarland	5
	ProductZ	3	Houston	5
	Computerization	10	Stafford	4
	Reorganization	20	Houston	1
	Newbenefits	30	Stafford	4

DEPENDENT	ESSN	DEPENDENT NAME	SEX	BDATE	RELATIONSHIP
	333445555	Alice	F	05-APR-78	DAUGHTER
	333445555	Theodore	M	25-OCT-73	SON
	333445555	Joy	F	03-MAY-48	SPOUSE
	987654321	Abner	M	29-FEB-32	SPOUSE
	123456789	Michael	M	01-JAN-78	SON
	123456789	Alice	F	31-DEC-78	DAUGHTER
	123456789	Eliabeth	F	03-MAY-57	SPOUSE

Figure 2.d. A relational database instance of the COMPANY schema

Figure 2d