SECTION 1: PRACTICAL ON DATABASES

1.0 INTRODUCTION

This practical section attempts to provide basic practical skills on a DBMS. A DBMS is a software that supports management of databases, which includes database creation, data manipulation and data retrieval operations. This practical section aims at developing skills of creating ER Diagrams, designing normalized relations, database creation, integrity enforcement, query formulation, etc. You should write SQL queries as well as work using SQL interface provided in software packages. For the present practical you can use MySQL or any other commercial DBMS that supports SQL. SQL is a standard and the skill so obtained can be used in any DBMS, and NoSQL databases too, which in general, use SQL like syntax. You must go through the BCS-092 courseware in order to get the best of these sessions. The questions presented here are from the study material of BCS-092. During the practical sessions you can make suitable assumptions if necessary

1.1 OBJECTIVES

On completing the practical sessions of this section, you will be able to:

- draw ER Diagram from the given description;
- Normalize a given database system;
- create databases using SQL commands;
- create integrity and constraints on databases using SQL;
- write SQL queries;

1.2 SOFTWARE

Database systems are must for day to day functioning, planning, growth, prediction of future needs in an organisation. A number of DBMS software are available these days. These software include both traditional relational, object-relational and NoSQL database management systems. However, in this section, we propose to use any commercial RDBMS or Object-Relational database management system, so that you can appreciate the full range of functionality of SQL, which is a standard across commercial RDBMSs. Though, we have proposed to use MySQL, but you are free to use any open source software like PostGreSQL or any other proprietary DBMS. Please note that acquiring skills of writing good queries

is important. The software may change, but if you have acquired skills on writing good queries using SQL, then you will be able to work with most other databases with little adaptations.

1.3 SESSION DETAILS

This section is of one credit, therefore, it has been divided into 10 practical sessions. The following are the details of these sections.

SESSION 1: ER Diagram

Question 1:

UPS pride itself on having up-to-date information on the processing and current location of each shipped item. To do this, UPS relies on a company-wide information system. Shipped items are the heart of the UPS product tracking information system. Shipped items can be characterized by item number (unique), weight, dimensions, insurance amount, destination, and final delivery date. Shipped items are received into the UPS system at a single retail center. Retail centers are characterized by their type, uniqueID, and address. Shipped items make their way to their destination via one or more standard UPS transportation events (i.e., flights, truck deliveries). These transportation events are characterized by a unique schedule Number, a type (e.g. flight, truck), and a delivery Route.

Perform the following tasks for the description given above:

a) Identify all the entities, relationships and attributes for the description given above.

b) Create an Entity Relationship diagram that captures this information about the UPS system. Be certain to indicate identifiers and cardinality constraints.

Question 2:

A car dealership sells both new and used cars, and it operates a service facility. Create an Entity Relationship diagram based on the following business rules:

- A salesperson may sell many cars, but each car is sold by only one salesperson. A customer may buy many cars, but each car is sold to only one customer. A salesperson writes a single invoice for each car he or she sells.
- A customer gets an invoice for each car he or she buys.
- A customer may come in just to have his or her car serviced, that is, one need not buy a car to be classified as a customer.
- When a customer takes one or more cars in for repair or service, one service ticket is written for each car.
- The car dealership maintains a service history for each of the cars serviced. The service

records are referenced by the car's serial number.

- A car brought in for service can be worked on by many mechanics, and each mechanic may work on many cars.
- A car that is serviced may or may not need parts. (For example, adjusting a carburetor or cleaning a fuel injector nozzle does not require the use of parts).

Question 3:

Draw an EER diagram of the conceptual schema for part of a University database, described as follows:

- Academic staff, general staff and students are the only person at the university. Each person is either an academic staff, or a general staff, or a student.
- A person is uniquely identified by a PerId (person's ID), and has a Name, and an Address. An Address is composed of HouseNo, Street , and City.
- A characteristic property of a student is that she/he has at least one Major and one NoOfPts (number of points) for each major.
- An academic staff has a Position and an AcQual (academic qualification).
- A general staff has a GenPos (general position).
- An academic staff teaches at most one course, whereas a student takes at least one course.
- A course is uniquely identified by a CourId (course ID), and has a CourName (course name).
- Each course is taught by at least one academic staff, and can be taken by many students, but there may be courses that are not taken by any students.
- Each course can use more than one textbook, but there may be courses with no textbook.
- A textbook is uniquely identified by the course which uses the book, and by an OrdNo. The attribute OrdNo is the ordinal number of the book in the list of the textbooks of a particular course. A book also has a Title.

SESSION 2: Normalization

Question 1: Create the relations and Normalize up to 3NF.

A new client comes and asks for you to build them a database from the spreadsheet they have been using to track the company employees. Here's an excerpt:

1	2	3	4	5	6	7	8	9
Sally	Sales	Manager	Sally	$25	35	$875	*N/A*	Company Morale

Sally	Sales	Manager	Sally	$25	35	$875	*N/A*	Recycling Program
Joe	Sales	Salesperson	Sally	$10	35	$350	6%	*N/A*
Sean	Shipping	Clerk	Bob	$8	20	$160	*N/A*	Recycling
Sean	Security	Guard	Kirk	$12	16	$192	*N/A*	United Way

Key for field name:

1 = Name, 2= Department, 3=Position, 4=Manager, 5=Rate, 6=Work_Hrs, 7 = Week_Pay, 8= Commission%, 9= Task_force

Question 2: Design the database relations for the following description and normalize up to 3NF.

The ABC Manufacturing company has a completely automated application system. The system, however, resides on index files and does not allow for decision support at all. In order to move to ad hoc queries, and "what if" queries, the company has decided to convert the existing system to a database. Initially, the only criterion for the application was to replace the existing system with a database system. No ad hoc screen or reports have been anticipated. You will see the reports and screens that exist currently.

Customer Order and Product Application Considerations

i) Each customer must be on file before an order can be placed. The name, address(s), phone number(s), and credit limit must be recorded. All other data items are optional. If there is no shipping address, then the mailing address is used instead. Since customers can have identical names, a customer id has been assigned to each customer.

ii) Each order will have a computer generated id number. The order can have up to 10 line items. Discounts can be given to preferred customers and this discount amount will be recorded on the customer's record. Customers without a discount amount will not be given a discount.

iii) Each product listed on the order will show the standard price for that product. Discounts will be shown at the bottom of the order form.

iv) Orders that can be filled or partially filled are shipped immediately, and the product data is updated accordingly. Orders, or partial orders that cannot be filled will be backordered.

v) As products are manufactured the product data is updated accordingly along with the part inventory data.

vi) A customer can place numerous orders. Products can be ordered by many different customers. The same part can be used in numerous products. (e.g. a screw can be used in a chair, bar stool etc.)

Question 3: Create the normalized database relations up to 3NF.

A college keeps details of its students, staff and courses in a file. Part of this file is shown below.

1	2	3	4	5	6	7	8
0567	J Evans	11/4/89	M	COMP7	Computing A Level	186	H Smith
8453	R Begum	18/3/88	F	BIOL9	Biology A Level	78	D Jones
0567	J Evans	11/4/89	M	MATH5	Maths A Level	186	H Smith

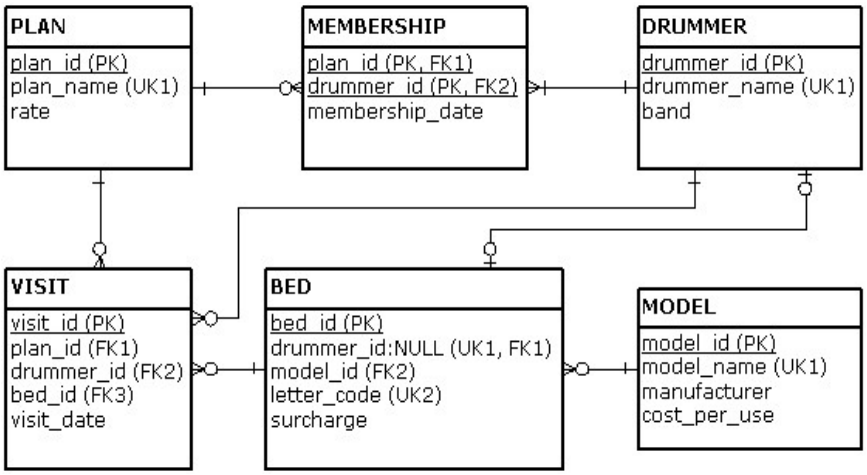
Key for field name:

1 = StudentNo, 2= StudentName, 3=DateOfBirth, 4= Gender, 5= Course No, 6= Course Name, 7 = LecturerNo, 8= Lecturer Name

SESSION 3 & 4: Create Database Tables using SQL and Input Data in Tables and perform data manipulation operations.

Question 1: Create database tables using SQL, specifying primary key, foreign key and constraints. Insert at least 4 to 6 records in each table created for an entity and 8 to 10 records in tables created for a relationship.

Create a database called 'Emporium' with the attached structure below in a ERD and populate it with related data. UNIQUE constraints were used to guarantee unique values for the identifiers from the entity-relationship model. The BED table used an additional UNIQUE constraint on the drummer_id column to make sure that more than one bed can't be named for the same drummer. All currency columns used the FLOAT data type.



Question 2:

(a) Create the database named 'Organization' then a table 'Employee' with the following attributes and its corresponding data declaration:

ATTRIBUTE (FIELD) NAME	DATA DECLARATION
EMP_NUM	CHAR(3)
EMP_LNAME	VARCHAR(15)
EMP_FNAME	VARCHAR(15)
EMP_INITIAL	CHAR(1)
EMP_HIREDATE	DATE
JOB_CODE	CHAR(3)

(b) Populate the table created in with the following data.

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_HIREDATE	JOB_CODE
101	News	John	G	08-Nov-00	502
102	Senior	David	H	12-Jul-89	501
103	Arbough	June	E	01-Dec-96	500
104	Ramoras	Anne	K	15-Nov-87	501
105	Johnson	Alice	K	01-Feb-93	502
106	Smithfield	William		22-Jun-04	500
107	Alonzo	Maria	D	10-Oct-93	500
108	Washington	Ralph	B	22-Aug-91	501
109	Smith	Larry	W	18-Jul-97	501

(c) Write the SQL code to change the job code to 501 for the person whose personnel number is 107. After you have completed the task, examine the results, and then reset the job code to its original value.

(d) Write the SQL code that lists all attributes for a job code of 502.

(e) Write the SQL code to delete the row for the person named William Smithfield, who was hired on June 22, 2004, and whose job code classification is 500. (*Hint*: Use logical operators to include all the information given in this problem.)

(f) Add the attributes EMP_PCT and PROJ_NUM to the Employee table. The EMP_PCT is the bonus percentage to be paid to each employee.

(g) Using a single command, write the SQL code that will enter the project number (PROJ_NUM) = 18 for all employees whose job classification (JOB_CODE) is 500.

(h) Using a single command, write the SQL code that will enter the project number (PROJ_NUM) = 25 for all employees whose job classification (JOB_CODE) is 502 or higher.

(i) Write the SQL code that will change the PROJ_NUM to 14 for those employees who were hired before January 1, 1994, and whose job code is at least 501. (You may assume that the table will be restored to its original condition preceding this question.)

SESSION 5, 6 and 7: Create Database Tables using SQL, Input Data in Tables and write and run database queries.

Question 1:

(a) Create a database for an Employee management system, which has following tables and constraints:

EMPLOYEE

EmployeeID	Character	5	Primary Key
Emp_Name	Character	25	Not Null
DateofBirth	Date		
Gender	Character	1	It can accept blank or M/F
Salary	Number	8	Not Null, should be more than 10000
Department	Character	5	Foreign key to DEPARTMENT table

DEPARTMENT

Department	Character	5	Primary Key
DepartName	Character	30	
ManagerID	Character	5	Foreign key to EMPLOYEE table EmployeeID

(b) Enter 10 records in each table.

(c) Answer the following queries using SQL:

i) List the details of all the employees in each department

ii) Find those departments that has the same manager

iii) Find all the employees who are more than 50 years old today.

iv) Find the average salary of Male and Female employees

v) List the departments in the order of total amount paid as salary in that department. You may select increasing or decreasing order as per your choice

vi) List all the employee who are managing more than one department.

vii) Find the number of employees in each department

viii) List all the departments, which have no employee

ix) Insert details of a new department, which has been assigned a new manager, whose details are yet to be entered in the employee table.

x) What will happen, if a particular department is to be deleted? Check with the help of an example.

xi) List the department, department name and manger name of all the departments

xii) List all the manager names, who are younger than 30 years

xiii) Compute the total salary of each department

xiv) Find the department which has minimum Male to Female employee ratio

xv) List the details of those employees who are working in "Finance" (name of department) department.

Question 2:

(a) Create a database for a library management system with the following data. You must normalize the relations and then create tables (which would be more than 3) with primary key, foreign key and constraints.

1. Book Details, which includes a Book Number, ISBN Number of Book, book title, all the authors of the book, Publisher information, Book price
2. Member Details, which includes Member Id, Member Name, Member Phone, Date of expiry of membership, Member from.
3. Book issue details, which includes Book Number, Member Id, expected date of return of book, actual date of return of the book

Please note the following points about this system:

- A book can be written by several authors
- A member can have multiple phone numbers
- Books are issued for a period of 15 days. The library charges Rs 5/- per day, if a book is returned late.
- Multiple copies of a book may be available with the library. You may please note that in such case details and ISBN number of the books would be same, but Book Number of each copy would be different.

(b) Enter about 10 records in all the tables.

(c) Answer the following queries using SQL:

i) List all the book details including the names of all the authors of the book.

ii) List all the books written by an author whose name is "ABC"

iii) Find the publisher with maximum number of books in the library

iv) List the members, whose membership is expiring in this month

v) Find the book with a maximum number of copies

vi) Find the books with lowest price

vii) Find the book which has been issued the most.

viii) Find the fine received from the members in the last week.

ix) Find the books which are expected to be returned in this week.

x) Find the price of the books which has not been returned by a member whose name is "XYZ".

xi) List the unique book titles

xii) List all the phone numbers of a member whose membership is going to end in the next week.

xiii) Find the name of the member who has got maximum numbers of book issued.

xiv) Find the oldest member of the library

xv) List all the members who either have joined the library last week or have renewed the membership last week.

Question 3:

(a) Convert the EER drawn in Session , Question 3 into relational tables, normalize these tables and create the database and the tables. You must include all the keys and constraints in your tables.

(b) Enter about 5 records in entity tables and 10 records in relationship tables.

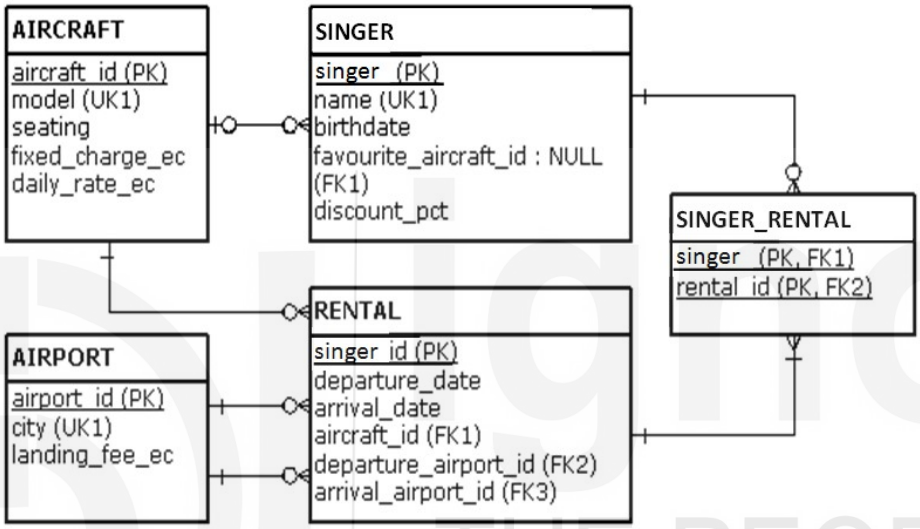
(c) Answer the following queries using SQL:

i) Count the number of all type of staff members
ii) Find the list of students, who are majoring in Computer Science.
iii) List the academic qualification of all the staff members related to a specific department/section
iv) Create the list of students who has taken a course "ABC".
v) Create a list of all the courses taken by a student.
vi) List the text books, which can be used in more than one courses.
vii) List all the books whose title contains "DBMS".
viii) Find the list of pair of persons who are located in the same city.
ix) List all the unique positions in the University.
x) List all the staff members who holds the position of a Professor.

SESSION 8, 9: Create Database Tables using SQL and Input Data in Tables and Query the database.

Question 1:

(a) Create a database for the fictitious 'Singer Prop Rentals Company', which rents WWII-vintage fighter aircraft to a select group of singing clients: singers. The singers rent aircraft and fly between a numbers of European capital cities and are charged by the company based upon the model of aircraft and the length of the rental. The name of the database should be 'SingerProp'.



(b) Populate each table with a at least 4 to 6 records for tables created for entities and 8 to 10 records for tables created for relationship.

(c) Answer the following queries using SQL:

i) What is the average aircraft fixed charge for all of the models of aircraft?

ii) What is the average aircraft fixed charge for all of the rentals?

iii) What price would each singer pay, including discounts, of a 3 day rental of the specific aircraft? Sort the results in descending order by price. (*Hint: you'll need to use both the AIRCRAFT and SINGER table in your query, but you do not INNER JOIN them together.*)

iv) What is the average price a Singer would pay, including discounts, of a 5 day rental of a specific aircraft?

v) What is the total landing fee incurred for any rentals of aircraft that have the letter "c" (uppercase or lowercase) in the model name?

vi) Excluding Singer discounts, what is the total charge (fixed and daily rate) and landing fee for each of the rentals? (*Hint: calculate the number of days for each rental by subtracting the departure date from the arrival date and then adding 1.*)

vii) How many times has each model of aircraft been rented? Sort the results so that the most-often-rented model appears first.

viii) How many times has each airport been visited either as a departure or arrival city? Sort the results so that the most-often-visited airport appears first. (*Hint: use an OR in the join condition between AIRPORT and RENTAL.*)

ix) What is the total amount charged per aircraft model (fixed charge and daily rate), excluding singer discounts, for all of the rentals? Sort the results so that the model producing the most income appears first.

x) What is the average profit or loss per aircraft model (total charge minus landing fees), excluding singer discounts, for all of the rentals? Sort the results so that the least profitable model appears first.

xi) On what dates have airplanes departed from London?

xii) Which singers have favorite airplanes? And what is the model name and seating capacity of those aircraft?

xiii) Which singer have flown to Berlin (arrivals only)? And on which dates did they arrive?

xiv) Which models of aircraft (together with their seating capacities) have visited a particular city (arrivals or departures)?

xv) Which singers have flown in an aircraft that is not their favorite model, other than the XYZ (whether or not they have a favorite)? Display both the singer name and model in your result set. First try to answer the question without the "favorite model" restriction. That is, start off by just finding the aircraft models in which each singer has flown.

SESSION 10: Query the database.

Question 1: Refer to the question 1 of Session 3 & 4 and answer the following queries:

1. Show the list of all drummers, and the code of the tanning bed that has been named for each, or "N/A" if a bed has not been named for the drummer.
2. Show the list of all tanning beds, and the name of the drummer for which each has been named, or just the letter code again for unnamed beds.
3. What has each drummer paid (rate + surcharge) for their visits, broken down by the bed they used? If a drummer uses a bed named for himself, he does not pay the surcharge. (*Hint: You'll need an extra copy of BED. Use COALESCE() to "refund" the surcharge. You may run into trouble using ROUND(), so skip it.*)

Question 2: Refer to the question 1 of Session 8 & 9, and answer the following queries:

1. The company institutes a new promotional incentive so that singers that fly on their favorite aircraft get a bonus 5% discount on each rental that applies even if the rental is shared (but that's the maximum discount even if more than one singer fly together in their favorite model). Create

a view called INCENTIVE_DISCOUNT that contains the columns rental_id and incentive_factor (0.95) for each of the rentals in the RENTAL table. This step doesn't require an outer join.

2. What is the income, expense, discount factor, incentive factor, and profit/loss (including discounts and incentives) for each of the rentals? (*Hint: Use the RENTAL_SUMMARY, RENTAL_DISCOUNT (from last week), and INCENTIVE_DISCOUNT views. Use the COALESCE() function to calculate an incentive factor of 1.00 when it doesn't apply to a particular rental.*)
3. What is the total and average profit/loss for all rentals, including diva discounts and incentives?
4. How many times has each diva flown on a model of aircraft that is not her favorite? (*Hint: first try to answer the question without the bit about it not being her favorite aircraft. No outer join is needed, but you will need to use the COALESCE() function to force the SINGER .favourite_aircraft_id column to be an impossible value when it is NULL (e.g. 0).*)

1.4 SUMMARY

This section lists most of the problems that you should solve to obtain skills related to SQL in a database management system. The section also asks you to solve problems relating to ER diagram and Normalization. You must attempt as many questions as possible. You may make suitable assumption, if any of the question is not clear. You may please note that you may also refer to DBMS books on SQL and try to write as many queries as possible using SQL.

Please note this course just introduces you to the skills, you must master them by continuous practice.