B.TECH/CSE/5TH SEM/CSEN 3102/2018
DATABASE MANAGEMENT SYSTEMS
(CSEN 3102)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.
Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.
Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) If in a relation R(X,Y), the functional dependencies X→Y and Y→X hold, then it implies _____ association between and X and Y
(a) many to many (b) one to many (c) many to one (d) one to one.

(ii) In an RDBMS, which of the following statements about **WeakEntities** and **TotalParticipation** is true?
(a) Total Participation guarantees Weak Entity
(b) Weak Entity must have Total Participation
(c) Weak Entity may not have Total Participation
(d) Total Participation will never be applicable for Weak Entities.

(iii) Consider a schedule S_1 which is conflict serializable. Which of the following is false?
(a) S_1 is always view serializable (b) S_1 may not be view serializable
(c) S_1 is equivalent to at least one serial schedule (d) cannot comment.

(iv) **Consider the following DDL statement:**
Create table Employee(empId number(5) primary key, salary number(10,2), deptno number(5) references Department(deptId));
Which of the following is true:
(a) deptId of Department table must be a foreign key
(b) deptId of Department table must be candidate key
(c) deptno of Employee table must be a primary key
(d) None of these.

(v) Which of the following statements is true?
(a) Isolation property of a transaction can always be achieved for any possible concurrent schedule of execution of transactions.
(b) Atomicity ensures proper normalization of tables used in a transaction.
(c) Consistency property can never be achieved if isolation property also holds simultaneously.
(d) Durability property of a transaction can be achieved by using appropriate log-based recovery scheme along with regular database backup in stable storage.

(vi) In a relation R, a multivalued dependency A→→B is non-trivial one if
(a) A ∩ B = Φ (b)B **U** A=R
(c) R-(B **U** A) is not null, i.e., non-empty. (d)None of these.

(vii) A decomposition of R to R1 and R2 is lossy-join decomposition if
(a) common attributes between R1 and R2 form a super key of neither R1 nor R2.
(b) common attributes between R1 and R2 form a super key of both R1 and R2.
(c) common attributes between R1 and R2 form a super key of R1, but not of R2.
(d) common attributes between R1 and R2 form a super key of R2 but not of R1.

(viii) The following SQL on relation **Borrower**(customer_id, loan_id)and Depositor(customer_id, account_id) select * from borrower where customer-id not in(select * from Depositor) will produce an output:
(a) all customers who have loan in the bank only
(b) all customers who have account in the bank only
(c) all customers who have both loan and account in the bank
(d) error.

(ix) In 2-phase locking protocol, which of the following locks are compatible?
(a) Read-lock(A) by T1 transaction and write-lock(A) by T2 transaction
(b) Write-lock(A) by T1 transaction and write-lock(A) by T2 transaction
(c) Write-lock(A) by T1 transaction and read-lock(A) by T2 transaction
(d) Read-lock(A) by T1 transaction and read-lock(A) by T2 transaction

(x) For a relation **R= { J, K, L }** with functional dependencies **F = { JK –>L L –> K },** the candidate keys are :
(a) J and K (taken separately) (b) JK (taken together)
(c) only J (d) JK and JL.

Group – B

2. Consider the requirements of database of an online bus ticket booking website as following:
Each user must register with the website using a unique email id and a unique mobile number along with other personal details like name, age, gender and address. Only registered customer can book any bus ticket at the website.
Each bus has a unique vehicle number. Each bus has a model name, number of seats, manufacturing year, date of vehicle registration, etc. A bus can undertake several bus trips, where each trip will be conducted on a specific bus route. A bus trip has a unique Trip_id, along with the start time and date of journey. A bus route has unique route_no, a source stop, a terminal stop and total distance.

Ticket of a particular bus trip is issued for reserving seat from the source to terminal stop only. On basis of availability of seats for a particular bus trip, a ticket with unique ticket number will be issued for seat reservation of one or many passengers. During booking of a ticket, only the name and age of each passenger must be provided. A passenger does not require any user registration with the website in order to travel using a valid ticket, in the form of a printout or an SMS. Based on total booking amount for a particular ticket, a certain loyalty reward points will be added to the corresponding registered user account, which has been used for booking the ticket.

Bus owners, registered with the website, are only allowed to sell ticket of different trips of their bus/buses, through reservation process of the website. Information of bus owner such as name, address, unique mobile number, unique email, etc are also maintained in the system.

(a) Based on the above problem statement, design an Entity Relationship Diagram, that should have
- at least 6 strong entities appropriately chosen,
- at least 1 weak entity appropriately chosen
- all necessary relationships among these entities and corresponding cardinalities, as per given requirements

(b) List all the non-trivial functional dependencies that can be obtained from the above mentioned requirements of online bus ticket booking problem.

8 + 4 =12

3. (a) By using a single illustrative example define and explain the terms, **Primary Key, Candidate Key, Foreign Key, Alternate Key** and **Super Key**. Also, highlight the difference between a Primary Key and a Unique Key.

(b) Explain what **DDL, DML, DCL** are. Give an example of each.

(c) Discuss the different types of **Constraints** that should be present in a good database design.

(d) By using a single illustrative example bring out the difference between **Left Outer Join, Right Outer Join,** and **Full Outer Join**.

3 + 3 + 3 + 3= 12

Group – C

4. Consider the Relational Schema given below:

EMPS (Aadhaar, Name, Address, Phone, Deptno, JobTitle, Salary)
CITY (PIN, City, State)
DEPTS (Deptno, DeptName, DeptMgrAaadhaar)
TRIPS (TripId, DestinationCity, DepartureDate, ReturnDate, Aadhaar)
EXPENSES (TripId, Item, Date, Amount)

(a) Suggest the **Primary Keys** for the relations **TRIPS** and **EXPENSES**.

(b) Find out all the **Foreign Keys** for the given schema and show them by drawing arrows to their corresponding relation and attribute.

(c) Write Relational Algebra Expressions for the following problems:

I. List the Trip ID, dates, amounts, destination city, departure date, and return date for employee "Kunal Shah".

II. List out ALL employee names and phone numbers from the "Accounting" department who have not travelled.

III. List out ALL employee names who have travelled to "Kolkata" at least twice.

1 + 2 + (3 × 3)= 12

5. (a) Why is normalization of database required?

(b) What is partial functional dependency?

(c) Consider a relation R1 **(A, B, C, D)** on which the following FDs are applicable: AB → C; B → D. Explain with a suitable case/scenario how insertion anomaly can affect this relation R1.

(d) Consider a relation R2 **(X, Y, Z)** on which the following FDs are applicable: X→Y; Y→ Z. Explain with a suitable case/scenario that how deletion anomaly can affect this relation R2.

2+ 2 +4 + 4 = 12

Group – D

6. Consider the following tables of a database of a computer training institute:

STUDENT (rollno, name, courseId, yearOf_enroll); **COURSE** (courseId, courseName), **SUBJECT_PAPER**(pcode, pname, courseId) ;
MARKS_OBTAINED(rollno, pcode, yearOfexam, marks), **FACULTY** (empid, name, salary), **SUBJECT_TAUGHT** (empid, pcode, courseId, year Of_teaching)
Write the **SQL** for the following queries using the given tables:

(i) Display the course name along with course id, in which maximum number of students have enrolled in the year 2018.

(ii) Display the name with employee id of those faculties, who have been teaching at least three papers in the year 2018.

(iii) For each paper, display the paper name and the corresponding average of the paper's marks, obtained by those students, who have appeared for its exam in the year 2017.

3 × 4 = 12

7. Consider the relation T(A,B,C,D,E,F) and the following set of functional dependencies **F** = {AF→B; BD→C; CE→A, A→F; B→D; C→E, F→D; D→E}.

(i) Determine the highest normal form of relation **T** with respect to the given **F**; justify your answer with proper reasons.

(ii) If T is not in 3NF, then **normalize** it to 3NF first and then further normalize it to BCNF.

6 + 6 = 12

Group – E

8. Consider two transactions T1 and T2 with following database operations:

T_1: $R_1(A)$ $W_1(A)$ $R_1(B)$ $W_1(B)$

T_2: $R_2(A)$ $W_2(A)$ $R_2(C)$ $W_2(C)$

where, Ri(x) and Wi(x) are read and write operations of Ti on data item x respectively.

S = $R_1(A)$ $R_1(B)$ $W_1(A)$ $R_2(A)$ $W_2(A)$ $W_1(B)$ $R_2(C)$ $W_2(C)$

(a) Is it possible to execute the given concurrent schedule S using 2-phase locking protocol? Justify your answer.

(b) Every conflict serializable schedule is also a view serializable , but all view serializable schedules are not conflict serializable; justify this statement

6 + 6 =12

9. Write short notes on **any three** of the following:

(i) B+ Tree Database Indexing

(ii) Cost-based Query Optimization.

(iii) ACID properties

(iv) TimeStamp-based Protocol

(v) Weak Entity Set

3 × 4=12