OBE

REFNO044668

B.Sc. (Hons.) SEMESTER - V EXAMINATION 2021-22

CS - 203T: Database Management Systems

Time : 4.30 hours **Max. Marks : 70**

Instructions

1. **The Question Paper contains 08 questions out of which you are required to answer any 04 questions. The question paper is of 70 marks with each question carrying 17.5 marks.**

   प्रश्नपत्र में आठ प्रश्न पूँछे गये हैं जिनमें से 4 प्रश्नों का उत्तर देना है। प्रश्नपत्र 70 अंकों का है, जिसमें प्रत्येक प्रश्न 17.5 अंक का है।

2. The total duration of the examination will be **4.30 hours** (Four hours and thirty minutes), which includes the time for downloading the question paper from the Portal, writing the answers by hand and uploading the hand-written answer sheets on the portal.

   परीक्षा का कुल समय 4.30 घंटे का है जिसमें प्रश्नपत्र को पोर्टल से डाउनलोड करके पुनः हस्तलिखित प्रश्नों का उत्तर पोर्टल पर अपलोड करना है।

3. For the students with benchmark disability as per Persons with Disability Act, the total duration of examination shall be **6 hours** (six hours) to complete the examination process, which includes the time for downloading the question paper from the Portal, writing the answers by hand and uploading the hand-written answer sheets on the portal.

   दिव्यांग छात्रों के लिये परीक्षा का समय 6 घंटे निर्धारित हैं जिसमें प्रश्नपत्र को पोर्टल से डाउनलोड करना एवं हस्तलिखित उत्तर को पोर्टल पर अपलोड करना है।

4. Answers should be hand-written on a plain white A4 size paper using black or blue pen. Each question can be answered in upto 350 words on 3 (Three) plain A4 size paper (only one side is to be used).
   हस्तलिखित प्रश्नों का उत्तर सादे सफेद A4 साइज के पन्ने पर काले अथवा नीले कलम से लिखा होना चाहिये। प्रत्येक प्रश्न का उत्तर 350 शब्दों तक तीन सादे पृष्ठ A4 साइज में होना चाहिये। प्रश्नों के उत्तर के लिए केवल एक तरफ के पृष्ठ का ही उपयोग किया जाना चाहिए।

5. Answers to each question should start from a fresh page. All pages are required to be numbered. You should write your Course Name, Semester, Examination Roll Number, Paper Code, Paper title, Date and Time of Examination on the first sheet used for answers.

   प्रत्येक प्रश्न का उत्तर नये पृष्ठ से शुरू करना है। सभी पृष्ठों को पृष्ठांकित करना है। छात्र को प्रथम पृष्ठ पर प्रश्नपत्र का विषय, सेमेस्टर, परीक्षा अनुक्रमांक, प्रश्नपत्र कोड, प्रश्नपत्र का शीर्षक, दिनांक एवं समय लिखना है।

Questions

1. **A.** Describe the three-schema architecture. Why do we need mappings between schema levels? **[8.5]**

   B. Discuss the main characteristics of the database approach and how it differs from traditional file systems. **[9]**

2. **A.** Explain the differences among an entity, an entity type, and an entity set. **[5]**

   B. Consider the following set of requirements for a university database that is used to keep track of students' transcripts. **[12.5]**

   - The university keeps track of each student's name, student number, social security number, current address and phone, permanent address and phone, birthdate, sex, class (freshman, sophomore, . . ., graduate), major department, minor department (if any), and degree program (B.A., B.S., . . ., Ph.D.). Some user applications need to refer to the city, state, and zip code of the student's permanent address and to the student's last name. Both social security number and student number have unique values for each student.
   - Each department is described by a name, department code, office number, office phone, and college. Both name and code have unique values for each department.
   - Each course has a course name, description, course number, number of semester hours, level, and offering department. The value of course number is unique for each course.
   - Each section has an instructor, semester, year, course, and section number. The section number distinguishes sections of the same course that are taught during the same semester/year; its values are 1, 2, 3, . . ., up to the number of sections taught during each semester.
   - A grade report has a student, section, letter grade, and numeric grade (0, 1, 2, 3, or 4).

   Design an ER schema for this application and draw an ER diagram for that schema. Specify key attributes of each entity type and structural constraints on each relationship type. Note any unspecified requirements and make appropriate assumptions to make the specification complete.

P.T.O.

3. **A.** Discuss the entity integrity and referential integrity constraints. Why is each considered important? **[5]**

B. Consider the following six relations for an order processing database application in a company: **[12.5]**

CUSTOMER (Cust#, Cname, City)

ORDER (Order#, Odate, Cust#, Ord_Amt)

ORDER_ITEM (Order#, Item#, Qty)

ITEM (Item#, Unit_price)

SHIPMENT (Order#, Warehouse#, Ship_date)

WAREHOUSE (Warehouse#, City)

Here, Ord_Amt refers to total dollar amount of an order; Odate is the date the order was placed; Ship_date is the date an order is shipped from the warehouse. Assume that an order can be shipped from several warehouses. Specify the foreign keys for the above schema, stating any assumptions you make. Then specify the following queries in relational algebra:

a. List the Order# and Ship_date for all orders shipped from Warehouse number 'W2'.
b. List the Warehouse information from which the Customer named 'Jose Lopez' was supplied his orders. Produce a listing: Order#, Warehouse#.
c. Produce a listing: CUSTNAME, #OFORDERS, AVG_ORDER_AMT, where the middle column is the total number of orders by the customer and the last column is the average order amount for that customer.
d. List the orders that were not shipped within 30 days of ordering.
e. List the Order# for orders that were shipped from *all* warehouses that the company has in New York.

4. **A.** What is a view in SQL, and how is it defined? Discuss the problems that may arise when one attempts to update a view. **[5]**

B. Consider the following employee database, where the primary keys are underlined. Give an expression in SQL for each of the following queries. **[12.5]**
Employee (employee-name, street, city)
Works (employee-name, company-name, salary)
Company (company-name, city)
Manages (employee-name, manager-name)

a. Find the names of all employees who work for First Bank Corporation.
b. Find the names and cities of residence of all employees who work for First Bank Corporation.
c. Find the names, street addresses, and cities of residence of all employees who work for First Bank Corporation and earn more than $10,000.
d. Find all employees in the database who live in the same cities as the companies for which they work.
e. Find all employees in the database who live in the same cities and on the same streets as do their managers.

5. **A.** Compute the closure of the set of functional dependencies F = {A →BC, CD →E, B → D, E → A} for relation schema R = (A, B, C, D, E). List the candidate keys for R. **[8.5]**

B. Consider the universal relation R = {*A, B, C, D, E, F, G, H, I, J*} and the set of functional dependencies *F* = {*AB→C, A→DE, B→F, F→GH, D→IJ*}. What is the key for *R?* Decompose *R* into 2NF, then 3NF relations. **[9]**

6. **A.** Discuss the different measures of transaction equivalence. What is the difference between conflict equivalence and view equivalence? **[8.5]**

B. Consider the following two transactions: **[9]**

T_1: **read**(A);
read(B);
if $A = 0$ **then** $B := B + 1$;
write(B).

T_2: **read**(B);
read(A);
if $B = 0$ **then** $A := A + 1$;
write(A).

Let the consistency requirement be $A = 0 \vee B = 0$, with $A = B = 0$ the initial values.

a. Show that every serial execution involving these two transactions preserves the consistency of the database.
b. Show a concurrent execution of T_1 and T_2 that produces a nonserializable schedule.
c. Is there a concurrent execution of T_1 and T_2 that produces a serializable schedule?

P.T.O.

7. A. What are some variations of the two-phase locking protocol? Why is strict or rigorous two-phase locking often preferred? |8.5|

B. Consider the following two transactions: |9|

T_{31}: read(A);
read(B);
if $A = 0$ then $B := B + 1$;
write(B).

T_{32}: read(B);
read(A);
if $B = 0$ then $A := A + 1$;
write(A).

Add lock and unlock instructions to transactions T_{31} and T_{32}, so that they observe the two-phase locking protocol. Can the execution of these transactions result in a deadlock?

8. A. Describe the shadow paging recovery technique. Under what circumstances does it not require a log? |8.5|

B. What is meant by transaction rollback? What is meant by cascading rollback? Why do practical recovery methods use protocols that do not permit cascading rollback? |9|

END