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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (R,S) / S4 (PT) (R,S) Examination June 2023 (2019 Scheme)

Course Code: CST 204

Course Name: Database Management Systems

Max. Marks: 100 **Duration: 3 Hours**

| | PART A (Answer all questions; each question carries 3 marks) | | | | | | | |
|---|---|---|---|--|---|---|--|--|
| 1 | List any SIX major advantages of using a DBMS | | | | | | | |
| 2 | What is the concept of a weak entity used in data modelling? Define the terms owner | | | | | | | |
| | entity type, Identifying relationship type. | | | | | | | |
| 3 | B Define theta join. | | | | | | | |
| | Given the two relations R and S: | | | | | | | |
| | A | В | С | | D | Е | | |
| | 1 | 2 | 3 | | 3 | 1 | | |
| | 4 | 5 | 6 | | 6 | 2 | | |
| | 7 | 8 | 9 | | | | | |

Find $R\theta_{B < D}S$.

- Define primary key, candidate key and super key.
- What is the difference between the WHERE and HAVING clause? Illustrate with an 5 3 example.
- Explain the difference between Hash indexes and B+-tree indexes.
- Define the term functional dependency. Why are some functional dependencies called trivial?
- List Armstrong Axiom rules

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List the ACID properties of transactions.

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10 What is a key-value database? List its major properties.

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11 Draw an ER diagram to model the application with the following assumptions. Specify key attributes of each entity type and (min, max) constraints on each relationship type.

- Each home uniquely defined by home identifier, street address, city, state, a number of bedrooms and a number of bathrooms and an associated owner.
- Each owner has a Social Security Number, first name, last name, phone, and profession.
- An owner can spouse one or more homes.
- Agents represent owners in the sale of a home. An agent can list many homes, but only one agent can list a home.
- An agent has a unique agent number, name, phone number and an associated office.
- When an owner agrees to list a home with an agent, a commission and a selling price are determined.
- An office has office identifier, phone number, the manager name, address and an optional agent number.
- Many agents can work at one office.

b)

- A buyer entity type has a Social Security Number, first name, last name, phone, preferences for the number of bedrooms and bathrooms, and a price range.
- An agent can work with many buyers, but a buyer works with only one agent.
- 12 a) What is the difference between logical data independence and physical data 6 independence? Which one is harder to achieve? Why?

BRANCHES BANK_BRANCH BANK Name Addr Branch_no ACCTS LOANS Loan_no Balance Amount ACCOUNT LOAN Type М AC CUSTOMER Phone Addr

Consider the bank database given above and answer the following questions

- i. List the strong (nonweak) entity types in the ER diagram.
- ii. Is there a weak entity type? If so, give its name, partial key, and identifying relationship.
- iii. What constraints do the partial key and the identifying relationship of the weak entity type specify in this diagram?
- iv. List the names of all relationship types, and specify the (min, max) constraint on each participation of an entity type in a relationship type.

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v. Suppose that every customer must have at least one account but is restricted to at most two loans at a time, and that a bank branch cannot have more than 1,000 loans. How does this show up on the (min, max) constraints?

Module -2

13 a) Consider the UNIVERSITY database with the following relations:

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STUDENT (**rollNo**, name, degree, year, sex, deptNo, advisor)

DEPARTMENT (**deptId**, name, hod, phone)

PROFESSOR (empId, name, sex, startYear, deptNo, phone)

COURSE (courseId, cname, credits, deptNo)

ENROLLMENT (<u>rollNo, courseId, sem, year</u>, grade)

TEACHING (empId, courseId, sem, year, classRoom)

PREREQUISITE(preReqCourse, courseID)

Write relational algebra expressions for the following queries:

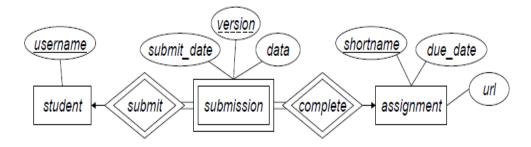
- i. For each department, find its name and the name, sex and phone number of the head of the department.
- ii. Find courses offered by each department.
- iii. Find those students who have registered for all courses offered in the department of Computer Science.
- iv. Obtain the department Ids for departments with no lady professor.
- v. Obtain the rollNo of girl students who have obtained at least one S grade.
- b) What is a foreign key constraint? Why are such constraints important?

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What is referential integrity?

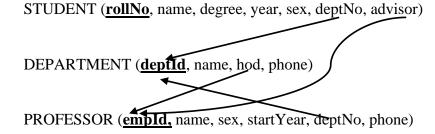
14 a) Convert the following ER diagram into a relational schema

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b) Consider the following relation schema with referential integrity constraints:

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Write SQL DDL statements for the following:

- i. Create table STUDENT, DEPARTMENT, PROFESSOR including primary and foreign key integrity constraints.
- ii. Add an address attribute in the table STUDENT
- iii. Write an SQL statement to delete the "CS" department. Given the referential integrity constraints, explain what happens when this statement is executed.

Module -3

- 15 a) What is an assertion? How they differ from triggers?
 - Consider the following relation schema and write SQL queries to find:

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EMPLOYEE(Fname, Minit, Lname, <u>SSN</u>, Bdate, Address, Sex, Salary SuperSSN, Dno)

DEPARTMENT(Dname, **Dnumber**, MgrSSN, MgrStartDate)

DEPT_LOCATIONS(**Dnumber**, **Dlocaions**)

PROJECT(Pname, **Pnumber**, Plocation, Dnum)

WORKS_ON(**ESSN, Pno**,Hours)

b)

- Retrieve the name and address of all employees who work for the 'Research' department.
- ii. For each employee, retrieve the employee's name, and the name of his or her immediate supervisor.
- iii. Retrieve the name of each employee who works on all the projects controlled by department number 5.
- iv. Make a list of all project numbers for projects that involve an employee whose last name is 'Smith' as a worker or as a manager of the department that controls the project.
- v. Retrieve the SSN of all employees who work on project number 1, 2, or 3.
- 16 a) Consider a disk with block size B =512 bytes. A block pointer is P=6 bytes long and a 9 record pointer is P_R =7 bytes long. A file has r=30,000 EMPLOYEE records of fixed length. Each record has the following fields: Name (30 bytes),Ssn (9 bytes), Department_code (9 bytes), Address (40 bytes), Phone (10 bytes), Birth_date (8 bytes), Sex (1 byte), Job_code (4 bytes), and Salary (4 bytes, real number). An additional byte is used as a deletion marker.
 - i. Calculate the record size R in bytes.

- ii. Suppose that the file is ordered by the key field Ssn and we want to construct a primary index on Ssn. Calculate The number of first-level index entries and the number of first-level index blocks
- iii. Calculate the number of levels needed if we make it into a multilevel index.
- b) What is a grid file? What are its advantages and disadvantages?

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Module -4

- 17 a) Consider a relation R with five attributes (A,B,C,D,E). You are given the following 6 dependencies: $A \rightarrow B$, $BC \rightarrow E$, and $ED \rightarrow A$.
 - i. List all keys for R.
 - ii. Is R in 3NF?
 - iii. Is R in BCNF?
 - b) Define minimal cover. Let the given set of functional dependencies be: $E: \{B \to A, D \to 8\}$ A, $AB \to D$. Find the minimal cover of E
- 18 a) Explain with example 2NF, 3NF and BCNF.

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b) Consider a relation schema R(X Y Z W P) (above table R) is decomposed into R1(X Y & Z) and R2(Z W P). Determine whether the above R1 and R2 are Lossless or Lossy?

Module -5

- 19 a) What is a schedule? Define the concepts of recoverable, cascade less and strict schedules, 8 and compare them in terms of their recoverability.
 - b) Which of the following schedule is conflict serializable? For each serializable schedule 6 determine the equivalent serial schedule.
 - (a) r1(X); r3(X); w1(X); r2(X); w3(X)
 - (b) r1(X); r3(X); w3(X); w1(X); r2(X)
 - (c) r3(X); r2(X); w3(X); r1(X); w1(X)
- 20 a) What is the two-phase locking (2PL) protocol? How does it guarantee serializability? 7 How strict 2PL differs from basic 2PL?
 - b) Explain the need for multimodal database. List the important characteristics of 7 ArangoDB.
