a b c d

NATIONAL INSTITUTE OF TECHNOLOGY KURUKSHETRA
END SEMESTER EXAMTNATTONS (2024-2025)

Course No.: *ITPC 206*
Duration: *180 Mins*

Course Title: *Database Management Systems*
Date: *15-05-2025*

Max. Marks: *50*
Time: *2:00 PM*

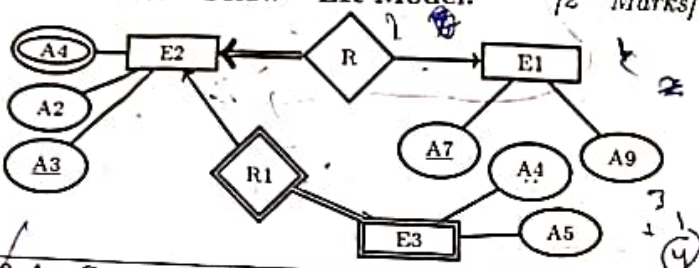Note 1: The question paper contains 7 questions.
Note 2: All questions are compulsory.
Note 3: Number of Pages: 2

ROLL NO:.....................

Q1:A: Find the number of candidate and super-keys in the relation $R(A,B,C,D,E)$ with FDs $(AB \to CD, ABC \to E, C \to A)$ *[1.5 Marks]*

Q1:B: Find the highest normal form of the relation $R(A,B,C,D)$: FDs $(ABC \to D, D \to A)$ · *[1.5 Marks]*

Q1:C: Consider the following ER-Model. Find the relational models of the below ER-Model. *[2 Marks]*

Q1:D: Consider the following ER-Model. Find the minimum number of tables needed to represent E1, E2, and R is *[2 Marks]*
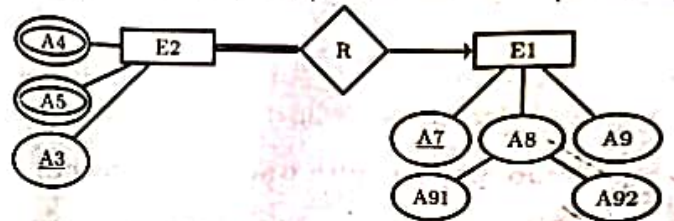
Q2:A: Suppose that we have an ordered file with one 20,000 records, stored on a disk. The block size is 2048B. Records are of fixed size and are unspanned. Record length is 256B. Then a binary search on the data file would need how many block access? *[2 Marks]*

Q2:B: Consider a disk with block size $B = 1024$ bytes, block pointer is $P = 12$ bytes, record pointer is $Pr = 15$ bytes, and ordered file with respect to ID# (12 bytes) has $r = 50,000$ records of fixed-size $R = 200$ bytes. we want to construct a secondary indexing on ID#. How many block accesses needed to search for and retrieve a record from the file in single level and multilevel indexing? *[3 Marks]*

Q2:C: In a B+ tree, if the search-key value is 10 bytes long, the block size is 512 bytes and the block pointer is 6 bytes, record pointer is 9 bytes then the minimum number of keys that can be accommodated in each non-leaf and leaf node of the tree is *[1+1 Marks]*

Q2:D: Consider a B-Tree of order 5. Find the maximum and minimum number of nodes, keys, block pointers in a B-Tree of height 2 (root= 0 height) *[1+1 Marks]*

Q2:E: Consider a disk with block size $B = 1024B$, with Table R1 (A,B,C) has 200 records of fixed-size 250B and R2(C,D,E) has 300 records of fixed-size 200B. The memory buffer space available can hold exactly two blocks of records for R1 and two blocks of records for R2 simultaneously at any point in time. Compute the number of block accesses required for below expressions: *[2.5+2.5 Marks]*

  i. R1 ⋈ R2 using nested loop join
  ii. R2 ⋈ R1 using nested block join

Q2:F: Consider a disk with block size $B = 1024B$, with Table R1 (A,B,C) has 200 records of fixed-size 250B and R2(C,D,E) has 100 records of fixed-size 200B. Compute the minimum number of block required to store result of below expression *[2+2 Marks]*

  i. R1 ∪ R2 NOTE: size of A, B, E: 100B, and C, D: 50B

  ii. R1 ⋈ R2 NOTE: size of A, B, E: 100B, and C, D: 50B, R2:C foreign key refer to R1: C. No null value for R2:C

Q3: Consider the schedule S1, S2, and S3 given below. Draw the precedence graphs for S1, S2, and S3. State where each schedule is conflict serializability or not. [5 Marks]

S1. r1(x),r3(x),w3(x),w1(x),r2(x)

S2. r1(x), r2(z), r1(z), r3(x),r3(y),w1(y),r2(y),w2(z),w2(y)

S3. r1(x),r2(x),r2(z),r1(z),r3(x),r3(y),w1(x),w3(y),r2(y),w2(z),w2(y)

Q4: Consider the below relation schema. Here, domain of values of the attribute Manager-Name is same as the domain of values of the attribute Employee-Name. Write Sql statement to create below table. [2 Marks]

Employee-Works (Employee-Name, Street, E-City, Salary, Company-Name),
Company (Company-Name, C-City),
Manages (Employee-name, Manager-Name)

Give an expression in the relational algebra (RA) and tuple relation calculus (TRC) (mentioned in bracket) to express each of the following queries: [4 Marks]

- Find all employees who live in the city where the company work is located.

- Find employees name and company city name for SBI employee.

Q5:　 Given a schema R(A, B, C, D, E, F, G, H), and the following set of FDs (A→B,ABCD→E,ACDF→EG,EF→GH)

A. Find the highest normal form and decompose R into 3NF using 3 NF decomposition rule. [2 Marks]

B. Prove that your decomposition is a lossless join AND dependency preserving. [2 Marks]

Q6: Construct a B-tree and B+ tree for the following set of key values: (10, 12, 23, 33, 48, 50, 20, 21, 31, 45, 52). Given that the block size is 321 bytes, data record pointer is 30 bytes long, the value field is 15 bytes long and a block pointer is 16 bytes long. [4 Marks]

- Q6 A: How would the tree change if we deleted the element with key 48, 20, and 21 from B Tree. [2 Marks]

Q7:CSE Department intends to maintain a database that should contain information about PRO-FESSORS (identified by ID, name, age, rank, and research specialty) and COURSES (identified by course id, course name, course prerequisites, and course description). Professors teach courses. In the NIT Kurukshetra system, courses can be taught jointly by a team of professors. An additional entity set called CourseTeam is introduced to identify a team of professors who teach such a course. Each CourseTeam has one professor as lead professor. In addition, there can be courses handled by a single professor. You can assume that only the courses of the current semester in an academic year are captured in the database. Develop an ER design, introducing additional entity sets, relationship sets, and attributes. [4 Marks]