Nirma University

Institute of Technology

Semester End Examination (IR/RPR), December 2022

M. Tech. in Computer Science and Engineering, Semester I

M. Tech. in Computer Science and Engineering (Data Science), Semester I

6CS204 Advanced Database Systems

Roll/ Exam No | Supervisor's initial with date

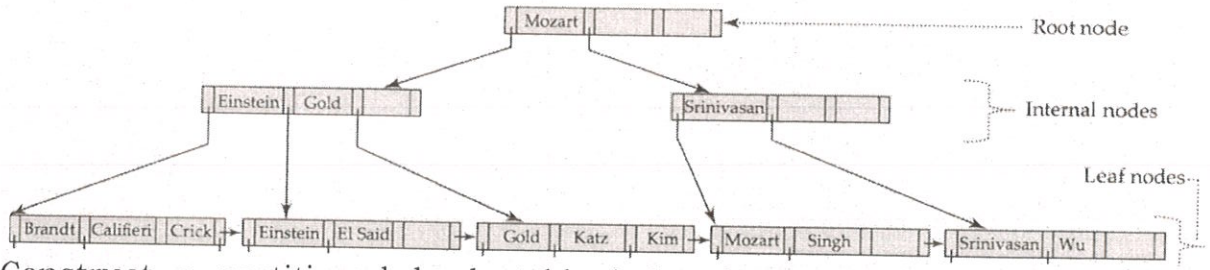
Time: 3 Hours | Max Marks: 100

Instructions :
1. **All questions are compulsory. (No optional questions)**
2. **Use section-wise separate answer books**
3. Figure to right indicate full marks
4. Draw neat sketches wherever necessary.

Section I

Q. 1 **Do as directed** **18**

CLO1 BL3 A Demonstrate how the B+Tree will be restructured after adding the values Adams, Lamport in this tree one by one. Show the tree status after each insert operation. 6



CLO1 BL3 B Construct a partitioned hash table index for the following points. For Indexing three bits are used, where first bit indicates the age modulo 2 and last two bits indicate salary (in thousands) modulo 4. First value in the following points represent age and second value represent salary in thousand for one company database. 6

1:	(25, 60)	2:	(45, 60)	3:	(50, 75)	4:	(50, 100)
5:	(50, 120)	6:	(70, 110)	7:	(85, 140)	8:	(30, 260)
9:	(25, 400)	10:	(45, 350)	11:	(50, 275)	12:	(60, 260)

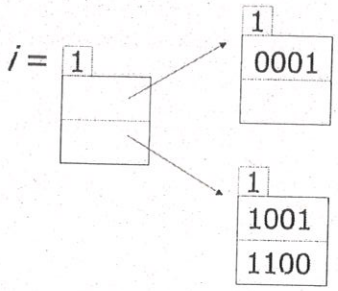
CLO3 BL4 C Check for the serializability of following schedules: 6

1. r1(A)w1(A)r2(A)w2(A)r1(B)w1(B)r2(B)w2(B)
2. r1(A)w1(A)r2(A)w2(A) r2(B)w2(B)r1(B)w1(B)

Justify your answer for each case.

Q. 2 **Do as directed** **16**

CLO1 BL3 A On the given hash index based on extendible hashing insert following values and show the index status along with other parameters with every insertion. Keys to be inserted: 1010, 0111, 0000, 1001. 8



Output of h(k) is of 4 bits and maximum 2 keys/bucket.

CLO2 BL4 B Compare any two page replacement policy for database blocks in physical memory with suitable example. 4

CLO1 BL3 C With example demonstrate how bit map index size can be reduced with compression technique. 4

Q. 3 **Do as directed** **16**

CLO2 BL5 A Given the following SQL query: 12

Supplier (sid, name, rank, address)
Part (pid, pname, category)
Orders (sid, pid, Qty)

```
SELECT S.name
FROM Supplier S, Part P, Order O
WHERE S.sid = O.sid
AND P.pid = O.pid AND P.category = 'Peripherals'
AND S.rank > 12 AND S.rank < 20
```

And assuming:
There are 20000 Supplier records stored on 2000 pages. There are 100000 Part records stored on 10000 pages. There are 600000 Order records stored on 30000 pages. There are 1000 different categories. Supplier ranks are from 7 to 24.

a. Show a physical query plan for this query, assuming there are no indexes and data is not sorted on any attribute.
b. Compute the cost of this query plan and the cardinality of the result.
c. Suggest two indexes and an alternate query plan for this query.
d. Compute the cost of your new plan.

CLO2 BL3 B Consider the following for a join operation to be performed. 4

$T(P) = 1000$ $V(P,A)=50$ $V(P,B)=100$
$T(Q) = 2000$ $V(Q,B)=200$ $V(Q,C)=30$
$T(R) = 3000$ $V(R,C)=900$ $V(R,D)=500$

Estimate the result size for $Z = P(A,B) \bowtie Q(B,C) \bowtie R(C,D)$.

Section II

Q. 4 **Do as directed** **18**

CLO3 BL4 A Show how MongoDB handles distributed data placement requirements for the large-scale applications. 6

CLO3 BL3 B Which of these schedules are legal and well-formed? 6

S1 = l1(A)l1(B)r1(A)w1(B)l2(B)u1(A)u1(B)r2(B)w2(B)u2(B)l3(B)r3(B)u3(B)

S2 = l1(A)r1(A)w1(B)u1(A)u1(B)l2(B)r2(B)w2(B)l3(B)r3(B)u3(B)

S3 = l1(A)r1(A)u1(A)l1(B)w1(B)u1(B)l2(B)r2(B)w2(B)u2(B)l3(B)r3(B)u3(B)

Justify your answer for each case.

CLO1 BL5 C Suggest the indexing mechanisms preferred for variety of data access patterns where data may be accessed by the application or users in bulk, single value search, range-based searching, multi attribute search-based queries etc. 6

Q. 5 Do as directed **16**

CLO3 BL4 A Compare row-oriented DB and column-oriented DB behaviour for the following operations. 6

1. Adding a column
2. Insert a record
3. Update a record

CLO2 BL2 B Show how page merging and page splitting works in MySQL database. 6

CLO1 BL5 C Sequential scan using primary index is efficient, but a sequential scan using a secondary index is expensive. Justify the statement. 4

Q. 6 Do as directed **16**

CLO3 BL4 A Demonstrate with suitable example the difference between differed database modification and immediate database modification in the context of database recovery. 8

CLO1 BL3 B How a database table can be optimized from storage and retrieval point of view? 4

CLO2 BL3 C Given the following data file: Student (NAME, Roll No, ADDRESS, Division, Teacher ID, ...), record size R=300 bytes, block size B=1024 bytes, total 60000 records, for an index on the Roll No field, assume the field size VRN=18 bytes, assume the record pointer size PR=14 bytes. Find out the following, 4

1. Blocking factor for data blocks and total number of data blocks
2. Size of an individual index entry
3. Blocking factor for index blocks
4. Total number of index blocks