**Assignment 2**

**Department:** Computer Engineering & Applications **Set:** I

**Programme:** B.Tech **Branch:** CSE/CSED/AIML/DA/CCV/IIOT

**Subject Name:** Database Management System **Subject Code:** BCSC1003

**Year:** II **Semester:** III

1. Suppose that we decompose the schema *r*(*A*, *B*, *C*, *D*, *E*) into

*r*1(*A*, *B*, *C*)

*r*2(*A*, *D*, *E*)

Show that this decomposition is a lossless decomposition if the following set *F* of functional dependencies holds:

*A* → *BC*

*CD* → *E*

*B*→*D*

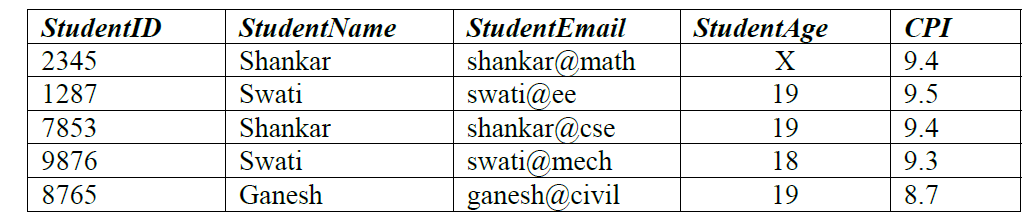
*E*→*A*

1. Let *R*1, *R*2, . . . , *Rn* be a decomposition of schema *U*. Let *u*(*U*) be a relation, and let *ri* = *RI* (*u*). Show that *u*⊆*r*1 I*r*2 I···I*rn*
2. Consider a disk with block size *B*=512bytes.Ablockpointeris*P*=6bytes long, and a record pointer is *PR* = 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.

Calculate the record size *R* in bytes.

Calculate the blocking factor *bfr* and the number of file blocks *b*, assuming an unspanned organization.

1. Consider a relation schema R( X Y Z W P ) (above table R) is decomposed into R1( X Y Z W ) and R2( W P). determine whether the above R1 and R2 are Lossless or Lossy?
2. Consider two files systems A and B, that use contiguous allocation and linked allocation, respectively. A file of size 100 blocks is already stored in A and also in B. Now, consider inserting a new block in the middle of the file (between 50th and 51st block), whose data is already available in the memory. Assume that there are enough free blocks at the end of the file and that the file control blocks are already in memory. Let the number of disk accesses required to insert a block in the middle of the file in A and B are nA and nB, respectively, then the value of nA + nB is \_\_\_\_\_\_\_\_\_\_\_\_\_.
3. Given the STUDENTS relation as shown below.



For (StudentName, StudentAge) to be the key for this instance, the value X should not be equal to? **[Gate 2014]**

1. A functional dependency → is called a partial dependency if there is a proper subset of such that → . We say that is *partially dependent* on . A relation schema *R* is in second normal form (2NF) if each attribute *A* in *R* meets one of the following criteria:

• It appears in a candidate key.

• It is not partially dependent on a candidate key.  
Show that every 3NF schema is in 2NF.

**Assignment 2**

**Department:** Computer Engineering & Applications **Set:** II

**Programme:** B.Tech **Branch:** CSE/CSED/AIML/DA/CCV/IIOT

**Subject Name:** Database Management System **Subject Code:** BCSC1003

**Year:** II **Semester:** III

1. Given a relational schema *r* ( *A*, *B* , *C* , *D*), does *A* →→ *B C* logically imply *A* →→ *B* and *A* →→ *C* ? If yes prove it, else give a counter example.
2. The keys 12, 18, 13, 2, 3, 23, 5 and 15 are inserted into an initially empty hash table of length 10 using open addressing with hash function h(k) = k mod 10 and linear probing. What is the resultant hash table?
3. **Given a relation R(A, B, C, D) and Functional Dependency set FD = { AB → CD, B → C }, determine whether the given R is in 2NF? If not convert it into 2 NF.**
4. Consider a relation schema R(X Y Z W P ) (above table R) is decomposed into R1( X Y Z W) and R2( X Z W P). determine whether the above R1 and R2 are Lossless or Lossy?
5. Database file consist 1250 records. Block can hold either 3 records or (10 keys, 11 pointers). The maximum number of levels of index required for sparse B+ tree index for database file is \_\_\_\_\_\_.
6. Suppose that we are using extendable hashing on a file that contains records with the following search-key values:

2, 3, 5, 7, 11, 17, 19, 23, 29, 31  
Show the extendable hash structure for this file if the hash function is

*h*(*x*) = *x* mod 8 and buckets can hold three records.

1. The relation scheme Student Performance (name, courseNo, rollNo, grade) has the following functional dependencies:

name, courseNo → grade

rollNo, courseNo → grade

name → rollNo

rollNo → name

Identify The highest normal form of this relation scheme. **[Gate 2004]**

**Assignment 2**

**Department:** Computer Engineering & Applications **Set:** III

**Programme:** B.Tech **Branch:** CSE/CSED/AIML/DA/CCV/IIOT

**Subject Name:** Database Management System **Subject Code:** BCSC1003

**Year:** II **Semester:** III

1. Normalize the following schema, with given constraints, to 4NF.

*books*(*accessionno*, *isbn*, *title*, *author*, *publisher*)

*users*(*userid*, *name*, *deptid*, *deptname*)

*accessionno* → *isbn  
isbn* → *title*

*isbn* → *publisher*

*isbn* →→ *author*

*userid* → *name*

*userid* → *deptid*

*deptid* → *deptname*

1. **Given a relation R( P, Q, R, S, T) and Functional Dependency set FD = { PQ → R, S → T }, determine whether the given R is in 2NF? If not convert it into 2 NF.**
2. A file has 229 records each of size 8B. One block of main memory is 128B.  Sparse indexing is done with one index record per memory block and one index record is of 1 Byte. The blocks stored by the index records are stored in disk. Blocks occupied by index are searched using binary search technique. Maximum number of blocks need to be read is \_\_\_\_\_.
3. Indices speed query processing, but it is usually a bad idea to create indices on every attribute, and every combinations of attributes, that is a potential search keys. Explain why.
4. Consider the following database relations containing the attributes **[Gate 2000]**

Book\_id

Subject\_Category\_of\_book

Name\_of\_Author

Nationality\_of\_Author

with Book\_id as the Primary Key.

(a). What is the highest normal form satisfied by this relation ?

(b). Suppose the attributes Book\_title and Author\_address are added to the relation, and the primary key is changed to (Name\_of\_Author, Book\_Title), what will be the highest normal form satisfied by the relation?

1. Consider two relations R(A, B, C) and S(B, D) with R contains 5000 tupples stored in a sequential file sorted on attribute A and S contain 100000 tupples stored in a sequential file sorted on attribute B. Each block can hold 10 R tupples or 10 S tupples. Which one of the following index is most appropriate for answering query  (Assume index always stored in memory)

A A dense index on R.B

B A sparse index on R.B

C A dense index on S.B

D A sparse index on S.B

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

**Assignment 2**

**Department:** Computer Engineering & Applications **Set:** IV

**Programme:** B.Tech **Branch:** CSE/CSED/AIML/DA/CCV/IIOT

**Subject Name:** Database Management System **Subject Code:** BCSC1003

**Year:** II **Semester:** III

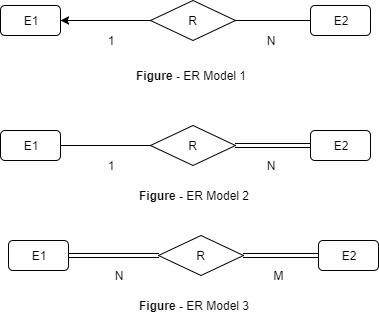
1. **Design Given a relation R(P, Q, R, S, T, U, V, W, X, Y) and Functional Dependency set FD = { PQ → R, PS → VW, QS → TU, P → X, W → Y }, determine whether the given R is in 2NF? If not convert it into 2 NF.**
2. Consider a relation schema R(X Y Z W P ) (above table R) is decomposed into R1( X Y Z ) and R2( Z W P). determine whether the above R1 and R2 are Lossless or Lossy?
3. Consider the following relation:  
   CAR\_SALE(Car#, Date\_sold, Salesperson#, Commission%, Discount\_amt)

Assume that a car may be sold by multiple salespeople, and hence {Car#, Salesperson#} is the primary key. Additional dependencies are

Date\_sold → Discount\_amt and Salesperson# → Commission%

Based on the given primary key, is this relation in 1NF, 2NF, or 3NF? Why or why not? How would you successively normalize it completely?

1. A data file consisting of 1,50,000 student-records is stored on a hard disk with block size of 4096 bytes. The data file is sorted on the primary key RollNo. The size of a record pointer for this disk is 7 bytes. Each student-record has a candidate key attribute called ANum of size 12 bytes. Suppose an index file with records consisting of two fields, ANum value and the record pointer the corresponding student record, is built and stored on the same disk. Assume that the records of data file and index file are not split across disk blocks. The number of blocks in the index file is \_\_\_\_\_\_\_\_
2. How many minimum relation tables are required which satisfy 1NF? **[Gate 2005]**



1. **Consider a relation R(a, b, c) ordered on a non-key attribute b, and an index is maintained on attribute c. To evaluate the following expression, which is a better order of operation? σ(b=‘abc’∧c=12)(R) [Gate 2023]**

A. First filter tuples using index on c and then search for b

B. First search tuples for the given value of b and then use index on c

C. The order of operation does not matter

D. Insufficient data to answer

1. A database relation has 5000 records block can hold either 10 records or 15 keys and pointer pairs. If sparse index is used at 1st level and multilevel indexing is used in system, then the number of disk block required to store relation and index is \_\_\_\_\_\_\_.  
     
   1. Explain the approach used.  
     
   2. what had been the answer if instead of sparse it would have been dense indexing?

**Assignment 2**

**Department:** Computer Engineering & Applications **Set:** V

**Programme:** B.Tech **Branch:** CSE/CSED/AIML/DA/CCV/IIOT

**Subject Name:** Database Management System **Subject Code:** BCSC1003

**Year:** II **Semester:** III

1. Reduce Given a relation R( X, Y, Z) and Functional Dependency set FD = { X → Y and Y → Z }, determine whether the given R is in 3NF? If not convert it into 3 NF.
2. Consider a schema R(X, Y, Z, W) and functional dependencies FD = { X -> Y and Z -> W }. Then the decomposition of relational schema R into relation R1( X Y ) and relation R2( Z W ) is ?
3. Consider the following relation for published books:  
   BOOK (Book\_title, Author\_name, Book\_type, List\_price, Author\_affil, Publisher)  
   Author\_affil refers to the affiliation of author. Suppose the following dependencies exist:

Book\_title → Publisher, Book\_type

Book\_type → List\_price

Author\_name → Author\_affil

* 1. What normal form is the relation in? Explain your answer.
  2. Apply normalization until you cannot decompose the relations further.

State the reasons behind each decomposition.

1. Suppose that in a file organization record size(R)=150 bytes, block size (B)=512 bytes. there are totally 30000 records. the data field on which indexing is done is 9 bytes and block pointer size is 7 bytes how many block access will be needed to access a data item in case of single level primary indexing?
2. Given a relational schema R = { SSN, ENAME, PNUMBER, PNAME, PLOCATION, HOURS } and the decomposed table R1 = { ENAME, PLOCATION } and R2 = { SSN, PNUMBER, HOURS, PNAME, PLOCATION } and FD = { SSN → ENAME, PNUMBER → { PNAME, PLOCATION}, { SSN, PNUMBER } → HOURS }. Identify whether the given decomposition of R, R1 and R2 is lossless or lossy decomposition ?
3. Consider the following four relational schemas. For each schema, all non-trivial functional dependencies are listed, The underlined attributes are the respective primary keys.

Schema I: Registration(rollno, courses) Field ‘courses’ is a set-valued attribute containing the set of courses a student has registered for. Non-trivial functional dependency rollno → courses

Schema II: Registration (rollno, coursid, email) Non-trivial functional dependencies: rollno, courseid → email email → rollno

Schema III: Registration (rollno, courseid, marks, grade) Non-trivial functional dependencies: rollno, courseid, → marks, grade marks → grade

Schema IV: Registration (rollno, courseid, credit) Non-trivial functional dependencies: rollno, courseid → credit courseid → credit

Which one of the relational schemas above is in 3NF but not in BCNF? **[Gate 2018]**

1. Block size 1000B records are of size 100B of which 12B are the key field and pointer of size 8B. a file consist of 10000 records  
     
   1.the number of blocks required for a sparse index on this file?  
     
   2.the number of blocks required for for a dense index on this file