INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY, SHIBPUR

Five Year Dual Degree B. Tech.-M. Tech. (IT) 5th Semester Examination, 2017

Database Management System (IT-503)

Time : 3 Hours **Full Marks: 70**

Answer question no.1 and any FIVE from the rest

1. Chose the appropriate answers.

i. A data dictionary is a special file that contains
   a) the names of all fields in all files
   b) the data types of all fields in all files
   c) the width of all fields in all files
   d) all of these

ii. A top to bottom relationship among the items is established by a
   a) hierarchical schema
   b) network schema
   c) relationship schema
   d) none of these

iii. Generally for a weak entity set to be meaningful it must be a part of a
   a) one-to-one relationship
   b) one-to-many relationship
   c) many-to-many relationship
   d) none of the above

iv. Chose the correct statement
   a) An alternate key is a candidate key, that is not a primary key
   b) An alternate key is a primary key, that is not a candidate key
   c) An alternate key is a candidate key, that is also a primary key
   d) None of these

v. Consider the join of a relation R (m tuples) with a relation S (n tuples). The maximum and minimum sizes of the join respectively, are
   a) m+n and 0
   b) mn and 0
   c) m+n and |m-n|
   d) mn and m+n

vii. A functional dependency of the form $X \rightarrow Y$ is trivial if
   a) $Y \subseteq X$
   b) $Y \subset X$
   c) $X \subseteq Y$
   d) $X \subset Y$ and $Y \subset X$

vi. Referential integrity dictates that:
   a) the value of a primary key must appear in a foreign key of the related table.
   b) the value of a foreign key must appear in a primary key of the related table.
   c) the value of a foreign key cannot appear in a primary key of the related table.
   d) None of the above

vii. Which of the following is not a property of transactions?
   a) Atomicity
   b) Concurrency
   c) Isolation
   d) Durability

viii. If one attribute is a determinant of a second, which in turn is a determinant of a third, then the relation cannot be:
   a) well-structured.
   b) in 1NF.
   c) in 2NF.
   d) in 3NF attributes

ix. Every cascade less schedule is
   a) Non recoverable schedule
   b) Recoverable schedule
   c) Strict schedule
   d) Both (b) and (c).

x. There is a possibility of a cascading rollback when
a) a transaction writes items that have been written only by a committed transaction.
b) a transaction writes items that is previously written by an uncommitted transaction
c) a transaction reads an items that is previously written by an uncommitted transaction
d) both (b) and (c)

1 X 10

2. Describe the advantages of DBMS over file processing with respect to redundancy and integrity. What are the disadvantages of DBMS? Represent the following relational model into network model. Also write the advantages of relational model over network model.

Employee

name	Sal	age
Ram	1000	30
Sam	1500	30
Rabi	2000	40

Project

pno	pname	ploc
P1	X	Kol
P2	Y	Del
P3	Z	Kol

Workson

Name	pno	hour
Ram	P1	4
Ram	P2	6
Ram	P3	8
Sam	P1	6
Sam	P3	4

4+2+6

3. What is recursive relationship? Why is role name required in recursive relationship? With an example explain the concept of aggregation. What is relation in relational database? Describe the properties of relation with respect to RDBMS.

1+3+4+4

4. Consider the following relations containing airline flight information:
Sailors (sid, sname, rating, age)
Boats (bid, bname,color)
Reserves(sid, bid, day)

Write the queries in relational algebra.
a) Find the names of sailors who have reserved all the boats.
b) Find the names of sailors who have reserved at least two boats.
Write the queries in SQL.
c) Find the names of the youngest sailor who is eligible to vote (age at least 18) for each rating with at least two such sailors.
d) Find name of the sailors who have not reserved a red boat and age more than 25. Write the query in tuple relational calculus.
e) Find the names of sailors who have reserved a red and a green boat.

5+5+2

6. Why should NULL values in a relation be avoided as far as possible? Explain prime of attribute with example. Consider the relation R(A,B,C,D,E) and two sets of FDs. , are the FD's equivalent.

a) $A \rightarrow B$, $AB \rightarrow C$, $D \rightarrow AC$, $D \rightarrow E$ b) $A \rightarrow BC$, $D \rightarrow E$

Explain clearly why the lossless-join property is a necessary condition for decomposition while dependency preservation is only a desirable condition. Prove that any relation with two attributes is in BCNF.

2+2+3+3+2

7. What is the role of recovery manager to ensure atomicity and durability of transaction? Explain lost update and temporary update problems for concurrent execution of transactions. Consider the following schedule:

r3(Y);r3(Z);r1(X);w1(X);w3(Y);w3(Z);r2(Z);r1(Y);w1(Y);r2(Y);w2(Y);r2(X);w2(X);

Is the schedule is serializable ? If yes, find all the possible serial schedule.

3+4+5

7. What are the disadvantages of two phase locking? In which situation deadlock detection and deadlock prevention techniques are used? Prove that cautious waiting is deadlock free. What are the advantages and disadvantages of deferred update technique?

3+3+2+4

8. Describe the problems of byte string representation for variable length record. Compare sparse index and dense index. Explain how insert and delete operation in a file with sparse index is done. Consider a disk with block size 512 bytes. A record pointer is 7 bytes long. A file has 30000 EMPLOYEE records of fixed size and length of each record is 100 bytes. Suppose the file is not ordered by the key field eno (8 bytes) and we have constructed a multilevel index on eno. Find out the number of levels needed if we make it into a multilevel index.

3+4+5

9. Explain the differences between key constraint and entity integrity with an example. Describe the steps involved in Query Processing. Consider the join operation: EMP $*_{dno=dnum}$ DEPT. EMP file has 10000 records stored in 2000 blocks. DEPT file consists of 125 records stored in 13 blocks. Primary key of DEPT is *dnum*. The multilevel index for *dno* and *dnum* are 3 and 2 respectively. Compare the cost of single loop join operation if we use *dno* and *dnum* as access structure.

3+4+5

EER—Enhanced entity Relationship

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Answer question no.1 and any FIVE from the rest

1. Choose the appropriate answers.

i. The attribute composed of multiple components, each with an independent existence is called
   a) composite attribute b) simple attribute
   c) single-valued attribute d) derived attribute

ii. EER stands for
   a) extended E-R b) effective E-R
   c) enhanced E-R d) none of these

iii. Which of the following ensures the consistency of transactions?
   a) application programmer b) concurrency control
   c) recovery management d) none of the above

iv. Choose the correct statement
   a) An alternate key is a candidate key, that is not a primary key
   b) An alternate key is a primary key, that is not a candidate key
   c) An alternate key is a candidate key, that is also a primary key
   d) None of these

v. Which of the following is a comparison operator in SQL?
   a) = b) LIKE c) BETWEEN d) All of the above

vi. The operation which is not considered a basic operation of relational algebra is
   a) Join b) Selection c) Union d) Cross product.

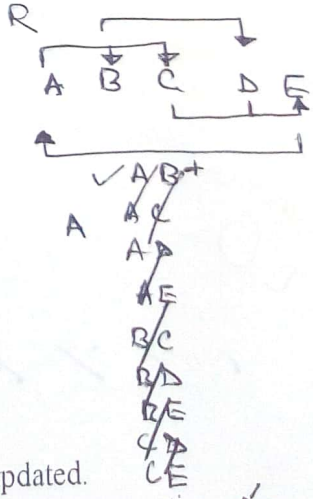
vii. A relation schema R is in 3rd normal form if
   a) each nonprime attribute in R is fully dependent on every key
   b) all attributes in R have atomic domains
   c) R satisfies 2nd normal form and no nonprime attribute of R is transitively dependent on the primary key
   d) R contains only 3 keys

viii. Consider a relation R (A,B,C,D,E) with the following functional dependency:
   A →BC, CD →E, B →D, E →A.
   the candidate key for is
   a) A b) B c) AC d) C

ix. Every cascadeless schedule is
   a) Non recoverable schedule b) Recoverable schedule
   c) Strict schedule d) Both (b) and (c).

x. If concurrent execution of transaction occurs then dirty read problem happens when
   a) One transaction updates a database item and this data is lost.
   b) One transaction updates a database item and then transaction fails.
   c) Aggregate function of one transaction calculate some values before they are updated.
   d) The aggregate function of one transaction calculate some values and while other transaction are updating some of these values.

1×10



2. What is data dictionary? What is symmetric query? "*Symmetric query retrieval is symmetric in relational model*". Explain the above statement. How are data stored in hierarchical data model? Compare logical data independence and physical data independence.

2+2+3+2+3

3. What is the need of composite attribute in E-R diagram? What is the role of cardinality ratio E-R diagram? Discuss the differences between specialization and generalization in EER diagram. Describe the entity integrity and referential integrity constraints with example.

2+2+4+4

4. Consider the following relations for a company database:

Employee (eno, ename, age, city, salary)
Works (eno, dno, hour)
Dept (dno, budget,city, managerid)

Write the following queries in relational algebra.

a) Find the ages of employees who live in same city as their department.
b) Find the names of employees who work for both the department d1 and d2.

Write the following queries in SQL.

c) Find names of managers who manage departments with budget larger than Rs. 50000.
d) Find names of managers who manage departments with largest budget.

Write the query in tuple relational calculus.

e) Find names of employees who work more than 10 hours

5+5+2

5. List all functional dependencies for the following relation R(A,B,C):

A	B	C
a1	b1	c1
a1	b1	c2
a2	b1	c1
a2	b1	c3

What are full functional dependency and partial dependency? Consider a relation *emp_info (eno, ename, city, dnumber, dname, dlocation)*. What are the insert, delete and update anomalies associated with the relation *emp_info* and how can we solve them? Available functional dependency of the relation *emp_info* is *dnumber → (dname, dlocation)*. Describe multivalued dependency with an example.

2+2+5+3

6. Draw a state diagram and explain the different states that a transaction goes through during execution. What is unrepeatable read problem? Why is result equivalent not used for the equivalence of two schedules? Consider the following schedule:

r1(X);r2(Z); r1(Z);r3(X);r3(Y); w1(X);w3(Y);r2(Y); w2(Z);w2(Y);c1;c2;c3

Is the schedule strict? If yes, give reasons.

4+2+3+3

TRANSACTION

7. Consider the following transactions:

T0 :	T1 :
read(A);	read(B);
read(B);	read(A);
if A=0 then B:=B+1;	if B=0 then A:=A+1;
write(B);	write (A);

Add lock and unlock instructions to transactions T0 and T1, so that they observe two phase locking protocol. Can the execution of these transactions result in deadlock?
Prove that wait-die technique avoids deadlock. Why is recovery using deferred update start from the end of the log? Explain shadow paging recovery mechanism. Also write the disadvantages of this approach. 3+2+2+5

8. What are the reasons for having variable length records? Why is secondary index considered? Describe the options for implementing secondary index using non-key field. Consider a disk with block size 256 bytes. A block (tree) pointer is 6 bytes long and record (data) pointer is 7 bytes long. A file has 90000 EMPLOYEE records of fixed size and length of each record is 100 bytes. The file is not ordered by the key field *Eno* (9 bytes) and we want to construct a B tree index on *Eno*. Calculate the number of level of the tree if nodes are 69% full. 3+2+3+4

9. What is meant by safe expression in relational calculus? Describe the steps involved in Query Processing. Consider the join operation: EMP $*_{dno=dnum}$ DEPT. EMP file has 10000 records stored in 2000 blocks. DEPT file consists of 150 records stored in 15 blocks. Primary key of DEPT is dnum. There is a multilevel secondary index on non key attribute dno with level x_{dno} =2. Also, consider that EMP file and DEPT file are sorted with respect to dno and dnum respectively. Find out the efficient join strategy for the above operation. 3+4+5