

Department of Computer Science and Engineering
University of Rajshahi

B.Sc.(Engg.) Part III (Odd semester) Examination 2020

Course code: CSE 3121

Full marks: 52.5

Course Title: Database Management System

Time: 3 Hours

[Answer three questions from each part]

Part A

- | | |
|--|------|
| 1(a) What is DBMS? Discuss its advantages over file based system in storing data? 4-17-41 ch-1 pg-4 | 3 |
| (b) Describe the level of abstraction in a DBMS. 4- 49-53 | 3 |
| (c) What are the responsibilities of a Database Administrator? 4-66 | 2.75 |
| | |
| 2(a) What is Mapping Cardinalities? Explain different types of Mapping Cardinalities 5- 31-33 | 2.5 |
| (b) Express the operation of Deletion, Insertion and updating in relational algebra. 8-127-133 | 2.5 |
| (c) Write an expression in relational algebra | 3.75 |
| (i) to find all customers who have both a loan and an account. 8 - 50-51 | |
| (ii) to find the largest account balance in the bank 8 -35-52 | |

customer-name	lomt_number
Adams	L-16
Curry	L-93
Hayes	L-15
Jackson	L-14
Jones	L-17
Smith	L-11
Smith	L-23
Williams	L-17

customer-name	account-number
Hayes	A-102
Johnson	A-101
Johnson	A-201
Jones	A-217
Lindsay	A-222
Smith	A-215
Turner	A-305

account-number	branch-name	balance
A-101	Downtown	500
A-102	Perryridge	400
A-201	Brighton	900
A-215	Mianus	700
A-217	Brighton	750
A-222	Redwood	700
A-305	Round Hill	350

customer-name	customer-street	customer-city
Adams	Spring	Pittsfield
Brooks	Senator	Brooklyn
Curry	North	Rye
Glenn	Sand Hill	Woodside
Green	Walnut	Stamford
Hayes	Main	Harrison
Johnson	Alma	Palo Alto
Jones	Main	Harrison
Lindsay	Park	Pittsfield
Smith	North	Rye
Turner	Putnam	Stamford
Williams	Nassau	Princeton

borrower

depositor

account

customer

- | | |
|---|------|
| 3(a) What are tests those must be made in order to preserve the following referential integrity constraint $\Pi_{\alpha}(r_2) \subseteq \Pi_K(r_1)$ for Insert and Update operation. 9-10-11 | 3 |
| (b) Explain every step, how can you use an Operation to get boys name (B.Name) and their roll registered on those courses that are taken by ALL the girls (G.Name)? " 8-74-83 | 5.75 |

B Name	Roll	Cell	CourseID
X	201	01711	CSE101
X	201	01711	CSE 102
Y	202	01711	CSE 103
Y	202	01911	CSE 102
Y	202	01911	CSE 101
Z	203	01811	CSE 104
Z	203	01811	CSE 101
W	204	01811	CSE 102

G.Name	Roll	Cell	CourseID
A	101	01711	CSE101
A	101	01711	CSE 102
A	101	01711	CSE 103
B	102	01911	CSE 102
B	102	01911	CSE 101
C	103	01811	CSE 104
C	103	01811	CSE 101
C	103	01811	CSE 102

- 4(a) For the followings relations, derive the contents of relations for natural-join, left-outer-join, right-outer-join and full-outer-join. **8- 122-124**

loan_number	branch_name	amount
L-170	Downtown	3000
L-230	Redwood	4000
L-260	Perryridge	1700

customer_name	loan_number
Jones	L-170
Smith	L-230
Hayes	L-155

- (b) Consider the relations given in question no#2, derive the contents of the relation found from the following query:

(i) select customer-name
from customer
where customer-street like '%Main%'

Hayes
Jones

(ii) (select customer-name
from depositor)

sob names asbe of these 2 tables

(select customer-name
from borrower)

downtown 500

(iii) select branch-name, avg (balance)
from account
group by branch-name

perryridge 400

bridgton 1650

mianus 750

redwod 700

round hill 350

Part-B

- 5(a) What are the tests to be done to check referential integrity constrain when a database is modified by Insert or Delete or Update operations? 9-10 3
- (b) What are Triggers? What are the Triggering Events? 9- 29, 44 3
- (c) What is View? Explain with an example. 9 - 48-51 2.75
- 6(a) What is a database transaction? Discuss ACID properties of database transaction. 10 - 3-7 2.75
- (b) Consider the following transactions- 3
- T1: read(A) slide a nai
read(B) khatay korachi
B=A+B sure na hoyeche kina
- write(B)
- T2: write(A)
read(B)
- Add lock and unlock instruction so that the transaction T1 and T2 observe two-phase locking protocol. Is it deadlock free?
- (c) What is RAID? Discuss different RAID Levels. 11- 24-25 3
- 7(a) What are the Conflicting Instructions? Explain them with examples. [copy te likhechi](#) 4.75
- (b) For $R = (A, B, C)$, $F = \{A \rightarrow B, B \rightarrow C\}$, if R is decomposed in (i) $R1 = (A, B)$, $R2 = (B, C)$ and (ii) $R1 = (A, B)$, $R2 = (A, C)$, then explain whether they are Lossless-join decomposition and/or Dependency preserving 4.00
- 8(a) What do you mean by Closure of a Set of Functional Dependencies? 2
- (b) Given relation schema $R = \{A, B, C, D, E\}$. and FDs $A \rightarrow BC$, $CD \rightarrow E$, $B \rightarrow D$, $E \rightarrow A$, now find out A^+ , $(AB)^+$, $(BC)^+$, $(ABC)^+$. 2
- (c) The given relational scheme R with attributes A, B, C, D, F and the FDs $A \rightarrow BC$, $B \rightarrow E$, $CD \rightarrow EF$, prove that functional dependency $AD \rightarrow F$ holds in R . 2.25
- (d) Given $F = \{A \rightarrow C, AB \rightarrow C\}$, prove that B is extraneous in $AB \rightarrow C$. 2.5

[lecture video-34](#)

University of Rajshahi

Dept. of Computer Science and Engineering

B.Sc. (Eng.), Part-III (Odd Semester), Examination 2019

CSE3121: Database Management Systems

Full Marks: 52.5

Time: 3 hours

[Answer Six questions taking any three questions from each Section]

Section A

1.
 - a) Discuss about some advantages and disadvantages of a database system. 2.00
 - b) List six major steps that you would take in setting up a database for an enterprise. 3.00
 - c) Keyword queries used in Web search are quite different from database queries. List key differences between the two, in terms of the way the queries are specified, and in terms of what is the result of a query. 3.75
 2.
 - a) Explain the term "integrity constraints". What integrity constraints are required to be implemented in DBMS? 3.00
 - b) What are five main functions of a database administrator (DBA)? 2.75
 - c) What do you know about the components of a storage manager? Describe each components' responsibilities in your own language. 3.00
 3.
 - a) Describe the differences in meaning between the terms *relation* and *relation schema*. 2.00
 - b) List some reasons why 'null' values should be avoided in database design? 2.75
 - c) Discuss the relative merit of procedural and nonprocedural query languages. 2.00
 - d) Can you explain the concept of super key, candidate key and, primary key? 2.00
 4.
 - a) How the term 'relational algebra' is defined in literature? 2.00
 - b) How can we describe the *selection* and the *projection* operation in relational algebra? Explain with example. 2.75
 - c) Let's consider the following relations: 4.00
Employee (employee-name, street, city)
Works (employee-name, company-name, salary)
Company (company-name, city)
- Now write the appropriate relational algebra to express the following queries:
- Find the names and cities of residence of all employees who work for "Pubali Bank Limited".
 - Find the names, street address, and cities of residence of all employees who work for "Pubali Bank Limited" and earn more than BDT 50,000.
 - Find all employees in the database whose residence is in same city as their company city.
 - Find all employees in the database (employee name only) who do not work for "Pubali Bank Limited" and whose current company address is located in "Rajshahi".

Section B

5.
 - a) "For small applications, it may be feasible for a database designer who understands the application requirements to decide directly on the relations to be created, their attributes, and constraints on the relations. However, such a direct design process is difficult for real-world applications, since they are often highly complex." – what's the solution for such highly complex application? 3.75
 - b) What are the two major pitfalls in designing a database schema? 1.00
 - c) For a binary relationship set, what are the mapping cardinalities? How these cardinalities are represented in ER diagram? 4.00

6. a) Compute the closure of the following set F of functional dependencies for relation schema $r(A, B, C, D, E)$. 4.00

$$A \rightarrow BC$$

$$CD \rightarrow E$$

$$B \rightarrow D$$

$$E \rightarrow A$$

List the candidate keys for R .

- b) Normalize the following schema, with given constraints, to 4NF. 4.75

*books(accessionno, isbn, title, author, publisher)
users(userid, name, deptid, deptname)
accessionno \rightarrow isbn
isbn \rightarrow title
isbn \rightarrow publisher
isbn \leftrightarrow author
userid \rightarrow name
userid \rightarrow deptid
deptid \rightarrow deptname*

7. a) "The SQL language has several parts" – explain the parts. 3.00
 b) Write a query to create the following tables (primary key is underlined): 1.75
department (dept-name, building, budget)
course (course-code, title, dept-name, credits)
// (dept-name is a foreign key references table department)
 c) How to remove the relation from database and remove data only of the above relations (department & course)? 2.00
 d) Write a short note on possible String operations of SQL. 2.00

8. a) Consider the following schema: 6.00
branch (branch-name, branch-city, assets)
customer (customer-name, customer-street, customer-city)
loan (loan-number, branch-name, amount)
borrower (customer-name, loan-number)
account (account-number, branch-name, balance)
depositor (customer-name, account-number)

Construct the following SQL queries for this relational database.

- 1) Find all customers of the bank who have an account but not a loan.
 - 2) Find the names of all customers who live on the same street and in the same city as "Mr. Mushfiq".
 - 3) Find the names of all branches with customers who have an account in the bank and who live in "Rajshahi".
 - 4) Find all customers who have an account at all the branches located in "Pabna".
 - 5) Find out the total sum of all loan amounts in the bank.
 - 6) Create a Trigger so that any update made in account table will be automatically backed up in another table named account-log (account-number, branch-name, balance, time-stamp), where time-stamp will store the time of update.
- b) Define RAID. Why should we choose RAID as reliable storage device? Explain RAID Level 0-6 with appropriate figure. 2.75

University of Rajshahi

Department of Computer Science and Engineering

B. Sc. (Engg.) Part-III, Odd Semester, Examination 2018

Course: CSE 3121 (Database Management System)

Full Mark: 52.5 Duration: 3 hours

Answer 3 questions from each Section

SECTION-A

1. a) Define Database Management Systems. List and explain four reasons why DBMS is used instead of file processing system. 4

- b) What are the functions of the database languages DDL and DML? How they differ from each other? 2.75

- c) What are the major roles of a DBA? Discuss. 2

2. a) Define Primary key. How does it differ with Candidate key? Explain with examples. 2

- b) Consider the foreign key constraint from the 'dept_name' attribute of 'instructor' to the 'department' relation. Give examples of inserts and deletes to these relations which can cause a violation of the foreign key constraints. The schema definitions of instructor and department are as follows-

instructor(ID, name, dept_name, salary)

department(dept_name, building, budget)

- c) In an instance of the *instructor* relation, if no two or more instructors have the same name, can we conclude that 'name' can be used as the super key or primary key of *instructor*? Explain your answer. 2.25

- d) Explain the uses of 'select' and 'project' relational algebra operations in a single query with appropriate relations. 2

3. a) Consider the following relational schemas: 8

branch(branch_name, branch_city, assets)

customer(customer_name, customer_street, customer_city)

account(account_number, branch_name, balance)

loan(loan_number, branch_name, amount)

depositor(customer_name, account_number)

borrower(customer_name, loan_number)

Write SQL expressions for the following queries:

- i) Find the names of all branches where the average account balance is more than Tk 50000.

- ii) Find the names of all customers who have a loan, an account, or both from the bank.

- iii) Find all customers who have both an account and a loan at the "Rajshahi" branch.

- iv) Find the total loan amount of different branches.

- b) What is SQL cursor? 0.75

- a) What are the core features of SQL-92 standard? 3

- b) Given the schema 3

Sailors (sid: integer, sname: string, rating: integer, age: real)

Boats (bid: integer, bname: string, color: string)

Reserves(sid: integer, bid: integer, day: date)

Write SQL query for the following statements :

- i. Find the names and ratings of all sailors whose rating are above 7 and age below 45
 ii. Find the names of sailors who have reserved at least one boat
 iii. Find the age of the youngest sailor for each rating level.
- c) What is database trigger? Discuss the strengths and weaknesses of the trigger mechanism. 2.75
- SECTION-B**
5. a) What is meant by 'lossy decomposition'? If the database schema $\text{employee}(ID, name, street, city, salary)$ is decomposed into two smaller schemas $\text{employee1}(ID, name)$ and $\text{employee2}(name, street, city, salary)$, then we actually have a lossy decomposition. Explain it. 4
- b) Define 1NF. Consider the relational schema $\text{department}(dept_number, dept_name, deptmngr_no, dept_location)$ whose primary key is dept_number and each of the departments can have a number of locations. Explain with a sample state of the schema why it is not in 1NF and how could you achieve first normal form for such a relation. 4.75
6. a) Why should NULL in a relation be avoided as possible? Explain. 2
 b) Define functional dependency. In the instance of a relation r given below, functional dependency $A \rightarrow C$ holds on, but $C \rightarrow A$ is not satisfied. Explain. 3

A	B	C	D
a1	b1	c1	d1
a1	b2	c1	d2
a2	b2	c2	d2
a2	b3	c2	d3
a3	b3	c2	d4

- c) Define Boyce-Codd normal form. How does it differ from 3NF? Why is it considered a stronger form of 3NF? 3.75
7. a) What is a database transaction? Discuss ACID properties of database transaction. 2.75
 b) Consider the following transactions- 3
- T1: **read(A)**
read(B)
 $B=A+B$
write(B)
- T2: **write(A)**
read(B)
- Add lock and unlock instruction so that the transaction T1 and T2 observe two-phase locking protocol. Is it deadlock free?
- c) What is RAID? Discuss different RAID Levels. 3
8. a) What do you mean by log-based recovery? Explain deferred database modification technique of crash recovery with example. 2.75
- (b) Discuss various component of a data warehouse. 3
 (c) Discuss different approaches of storing relation in the distributed database. 3

W.M.T.

University of Rajshahi
Department of Computer Science and Engineering
 B.Sc. Engg. Part III Odd semester Examination-2017
 Course: CSE3121 (Database Management System)
 Full marks: 52.5 Time: 3 Hours
 [Answer three questions from each part]

Part A

- 1(a) Explain the distinctions among the terms primary key, candidate key, and super key. **5-35** 2
- (b) Consider the E-R diagram in Figure 1, which models an online bookstore. 6.75
 Derive the table(s) for relationship set and entity set from Figure 1. Suppose the bookstore adds music cassettes and compact disks to its collection. The same music item may be present in cassette or compact disk format, with differing prices. Extend the E-R diagram to model this addition (for simplicity, you may ignore the effect on shopping baskets).
- 2(a) Define the following terms: 3
 (i) Database schema (ii) Relation instance (iii) Schema diagram and (iv) Relationship.
- (b) What is mapping cardinalities? Discuss different mapping cardinalities with example. 3
- (c) Differentiate between specialization and generalization. 2.75
- 3(a) What are tests those must be made in order to preserve the following referential integrity constraint $\prod_a(r_1) \subseteq \prod_K(r_1)$ for Insert and Update operation. 2
- (b) Given the relations: branch (branch_name, branch_city, assets), customer (customer_name, customer_street, customer_city), account (account_number, branch_name, balance), loan (loan_number, branch_name, amount), depositor (customer_name, account_number), borrower (customer_name, loan_number)
 Write relational algebra for the following quarry:
 (i) Find all customers who have an account at all branches located in Rajshahi city.
 (ii) Find all customers who have an account from at least the "Rajshahi" and the "Dhaka" branches.
- (c) For the relations given in Figure 4, derives the contents of relations for natural-join, left-outer-join, right-outer-join and full-outer-join. 3.75
- 4(a) Compare Oracle with SQL server.
 (b) Consider the relations given in Figures 5-8, and then derive the contents of the relation found from the following query: 4.75
 (i) **select customer-name**
from customer
where customer-street like '%Main%'
 (ii) **select customer-name**
from depositor
union
(select customer-name
from borrower)
 (iii) **select branch-name, avg(balance)**
from account
group by branch-name
- (c) Where and why do you need SQLite? 2

Part-B

- 5(a) Compare Oracle with MySQL 2
 (b) What are the different states of transaction? Give some example of non-ACID Transactions. 2
 (c) What will happen if transaction T1 is followed by T2 instead of as described in schedule 1? Explain if there is any problem or inconsistency that may occur in schedule 2, and 3. (in Fig. 9, 10 and 11 respectively) 4.75
- 6(a) What are software RAID and hardware RAID? Explain Block-level striping and Bit-level striping? What is an Elevator Disk-arm-scheduling algorithm? Explain RAID Levels 2 and 3. 4.75
 (b) What are exclusive (X) mode and shared (S) mode? Explain Lock-compatibility matrix. What will happen in partial schedule as given in Figure 12? 4

- 7(a) What is Big Data? What are usual techniques to handle Big Data? 2
- (b) Explain the Figure. 13 describing data access from a storage. 3
- (c) When *Deferred database modification* approach is used, how does log look like at different instances of time for the transactions T_0 and T_1 (T_0 executes before T_1): as given in Figure. 14. 3.75
- 8(a) What is recovery? Discuss different types of failures. 2.75
- (b) Mention at least three reasons for what we trend to distributed database system. 2
- (c) Differentiate between horizontal and vertical fragmentation with suitable example. 4

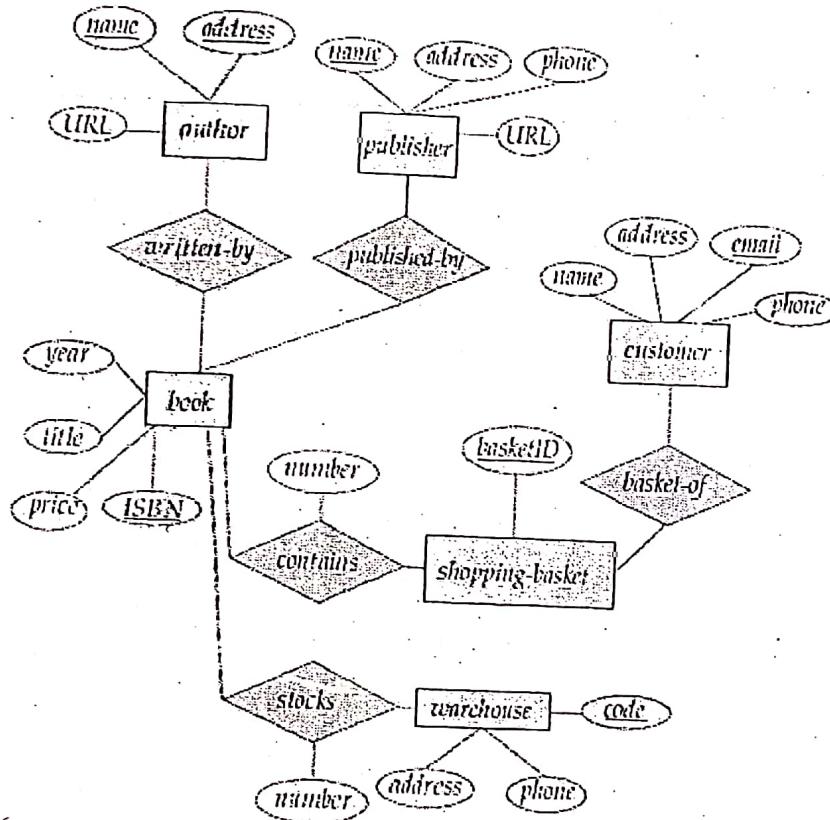


Figure 1

X1	X2	Y1	Y2
A	1	P	3
B	1	Q	2
A	1	P	3
C	2	P	1
A	1	P	1
B	1	Q	2
A	1	P	2
C	2	P	2
A	1	Q	2

Figure 2

Y1	Y2
P	1
P	2
Q	2

Figure 3

loan_number	branch_name	amount	customer_name	loan_number
L-170	Downtown	3000	Jones	L-170
L-230	Redwood	4000	Smith	L-230
L-260	Perryridge	1700	Hayes	L-155

Loan relation

borrower relation

Figure 4

University of Rajshahi
Department of Computer Science and Engineering
B. Sc. Engg. Part3 Odd Semester, Examination-2016
Course: CSE-3121 (Database Management System)

Full Marks: 52.5

Time: 3 Hours

[Answer three questions from each part]

Part 1

Property of Rajshahi University
 Dept. of Computer Science & Engineering
 Exam. No. _____
 Date. _____

- | | | |
|----|--|------|
| 1. | a) What is database management system? | 1 |
| | b) Mention some of the applications of database. | 2 |
| | c) Differentiate between data definition language (DDL) and data manipulation language (DML). | 3 |
| | d) What is meant by database administrator? What are the functions of a database administrator? | 2.75 |
| 2. | (a) What is Entity Relationship Diagram? Explain the notational conventions used in ERD. | 2.75 |
| | (b) What do you meant by data models? Which is the most preferred data model and why? | 2 |
| | (c) Explain entity integrity and referential integrity rules in relational model. | 2 |
| | (d) Construct the E-R diagram for the following relational schemas:

Person(<u>driver_id</u> , name, address)
Car(<u>license</u> , year, model)
Accident(<u>report_number</u> , date, location)
Owns(<u>driver_id</u> , <u>license</u>)
Participated(<u>driver_id</u> , <u>license</u> , <u>report_number</u> , damage_amount) | |
| 3. | (a) Explain the distinction between total and partial constraints. | 1.75 |
| | (b) State the use of '%' character in string operations. | 1 |
| | (c) Explain the basic operations of the relational algebra. | 4 |
| | (d) Consider following schema:

Employee(emp_no, emp_name, dept, designation, salary, dept_location)

Solve the following queries:
(i). List all managers in Dhaka location.
(ii). Set salary of all 'project leaders' to 70000/-.
(iii). List employees with having alphabet 'A', as second letter in their name.
(iv). Display details of those employees who work in Dhaka or Chittagong. | 2 |
| 4. | (a) Explain basic structure of SQL expression. | 3 |
| | (b) Explain the various types of "joins" supported in SQL. | 1.75 |
| | (c) Consider the following relational schema:

Branch(<u>branch_name</u> , <u>branch_city</u> , assets)
Customer(<u>customer_name</u> , <u>customer_street</u> , <u>customer_city</u>)
Account(<u>account_number</u> , <u>branch_name</u> , balance)
Loan(<u>loan_number</u> , <u>branch_name</u> , amount)
Depositor(<u>customer_name</u> , <u>account_number</u>)
Borrower(<u>customer_name</u> , <u>loan_number</u>)

Write the SQL expression for the following queries:
(i). Find the names of all branches where the average account balance is more than \$1,200.
(ii). Find the names of all customers who have a loan, an account, or both from the bank.
(iii). Find all customers who have both an account and a loan at the "Perryridge" branch.
(iv). Find all branches that have greater assets than some branches located in "Brooklyn" | 4 |

Part 2

5. (a) Briefly explain functional dependency with example. 2
 (b) What is normalization? Differentiate between 3NF and BCNF. 2.75
 (c) Given R(A,B,C,D,E) with the set of FDs, F{AB→CD, ABC→E, C→A} 4
 (i). Find any two candidate keys of R
 (ii). Are there 2NF and 3NF of R exist? Justify.
6. (a) What is index file? What are the types of single-level ordered indexes? 1.75
 (b) Discuss how RAID can be used to improve reliability via redundancy? 4
 (c) Discuss two indices techniques in index-sequential file to organize records into a file. 2
 (d) Construct a B+ tree of order 4 for the following set of key values: 2
 (1, 12, 8, 2, 25, 6, 14, 28, 17, 7, 52, 16, 48, 68, 3, 26, 29, 53, 55, 45)
7. (a) What do you understand by concurrency control? Explain timestamp ordering concurrency control protocol. 2.75
 (b) Draw the state diagram of transaction. 1
 (c) Define lock? Explain shared and exclusive locks. 2
 (d) Consider the following two transactions 3
- T1: read(A)
 read(B)
 $B=A+B$
 write(B)
- T2: write(A)
 read(B)
- Add lock and unlock instructions so that the transaction T1 and T2 observe two-phase locking protocol. Is it deadlock free.
8. (a) What do you mean by parallel system? How can you measure the performance of a database system? 3
 (b) What is meant by log-based recovery? Explain deferred database modification technique of crash recovery with example. 2.75
 (c) Describe the shadow paging technique of crash recovery. 3

University of Rajshahi
Department of Computer Science and Engineering
B. Sc. Engg. Part 3 Odd Semester, Examination-2015
Course: CSE-3111 (Database Management System)
Syllabus: 2010-11

Full Marks: 52.5

Time: 3 Hours

[Answer three questions from each part]

Part 1

- | | | |
|----|--|------|
| 1. | a) What are the purposes to use database system? | 2.75 |
| | b) Explain the difference between physical and logical data independence. | 3 |
| | c) Discuss different types of database users. | 3 |
| 2. | a) Define the terms primary key and foreign key. | 1 |
| | b) What is ER modeling? How can ER Model be mapped to a relational model? Explain. | 4 |
| | c) What do you understand by generalization and specialization? Explain.. | 3.75 |
| 3. | a) What is a view? How can you create a view? Discuss with example | 2 |
| | b) Explain the differences between the candidate keys and the primary key of a table. | 1.75 |
| | c) Explain selection and projection operations of relational algebra with example. | 3 |
| | d) What is referential integrity? What does a null present? | 2 |
| 4. | a) What are the major components of SQL and what function do they serve? | 2 |
| | b) Explain the function of each of the clauses in the SELECT statement. What restrictions are imposed on these clauses? | 3 |
| | c) What is the difference between WHERE and HAVING clauses? | 1 |
| | d) Consider the following relational schema:

$\text{Emp}(\underline{\text{eid}}, \text{ename}, \text{age}, \text{salary})$
$\text{Works}(\underline{\text{eid}}, \underline{\text{did}}, \text{pct_time})$
$\text{Dept}(\underline{\text{did}}, \text{budget}, \text{managerid})$
Briefly answer the questions
(i) define a table constraint on Emp that will ensure that every employee makes at least Tk.10,000.
(ii) define a table constraint on Dept that will ensure that all managers have age > 30. | 2.75 |

Part 2

- | | | |
|----|--|------|
| 5. | a) Describe the types of update anomalies that may occur on a table that has redundant data. | 1.75 |
| | b) Describe the characteristics of a table that violates first normal form (1NF) and then describe how such a table is converted to 1NF? | 3 |
| | c) Compute the closure of the following set F of functional dependencies for relation schema $R = (A, B, C, D, E)$.
$F = \{ A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A \}$
(i) List the candidate keys for R and
(ii) Suppose that we decompose the above schema R into $R_1(A, B, C)$ and $R_2(A, D, E)$. Is this lossy or lossless-join decomposition? Explain. | 4 |

- | | | |
|-----------|--|------|
| 7. (a) a) | What is a transaction? Discuss different transaction states. | 3 |
| (b) b) | What is a lock? | 1 |
| (c) c) | Discuss lock-based protocols. | 4.75 |
| 8. (a) | Explain the different types of failure that may occur in a system. | 2.75 |
| (b) | What is mean by log-based recovery? Describe the shadow paging technique of crash recovery. | 4 |
| (c) | How does the recovery manager ensure atomicity of transactions? How does it ensure durability? | 2 |