United International University (UIU)
Dept. of Computer Science & Engineering (CSE)

Mid Term Exam, Trimester: Spring 2022
Course Code: CSE-3521, Course Title: Database Management Systems
Total Marks: 30, Duration: 1 hour 45 minutes

Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules.

1. a) Compare and contrast different types of attributes used in Entity Relationship Diagram.   3+7
   b) You have been asked to design an Employee Tracking Database for CITS UIU. CITS wants to track information about employees, the employees job history, and their certifications. Employee information includes employee id, first name, last name, NID, address, city, state, zip, home phone and email address. An employee will have two addresses, current and permanent. Job history would include job title, job description, pay grade, salary, joining date, and total service year. For certifications they want certification name, type, complexity level, and date achieved. An employee can have multiple designation at the same time, (i.e., Professor, Director).
   Now draw an ER diagram for this application. Be sure to mark the multiplicity of each relationship of the diagram. Decide key attributes and identify them on the diagram. Please state clearly if you make any assumption in your answer.

2. a) "All candidate keys are super keys, but not all super keys are candidate keys" – justify this statement with example.   3+7
   b) Write the corresponding schema of the ER diagram shown in Fig. 1 on the next page.

3. a) Consider the schema in Fig. 2 for writing the SQL mentioned in i to vi: 6+4
       i.   Write the DDL commands for the existing tables of the given schema:

   - Add a new column in the 'Project' table named 'Project_details' with varchar (500) data type. Then, change the data type of 'Project_details' to varchar (1000).
   - In the 'Department' table add two new constraints to the column Dept_name so that it should be unique and not null.

   ii.   Show the Dept_Id wise total no of employees and average salary from the 'Employee' table. Only consider those departments that have the total no of employees greater than 5.

   iii.   From the 'Department' table, show Dept_name and Location group name. Group the location based on the following criteria:

Location	Location_group
Tokyo, Singapore, Beijing	Asia
London, Paris, Venice	Europe
Any other city	Unknown

iv. From the 'Project' table, show the project details of the projects that have the pattern "IT" in Project_name with minimum 6 characters in the name. Consider the projects whose Project_Id is an even number.

v. Use join operation:

Show employee full name, salary, and project name by the descending order of salary from 'Employee' and 'Project' table for all the employees (even if they have not been assigned in any project).

vi. Use subquery:

Show the first_name, salary, Dept_Id of the employees from the 'Employee' table. Include the employees with the maximum salary of 50000 and the minimum salary of 15000.

b) Consider the following relations,

Shop_details

Shop_ID	Name	Address
84620	A	Uttora
45632	B	Gulshan
86145	C	Dhanmondi

Inventory

Item_Number	Item_Name	Available	Demand	Shop_ID
1	Burger	10	8	45632
2	Pizza	5	15	84620
3	sandwich	6	10	45632

Write relational algebra to,

i. Find out the product names which have available product quantity in between 5 to 8.

ii. Find out those shop names with addresses who have a demand greater than 8 or less than 3.

iii. Find out the output relation for,

A) π Address, Item_Number (σ Shop_ID > 50000 (Inventory $\bowtie$ Shop_details))

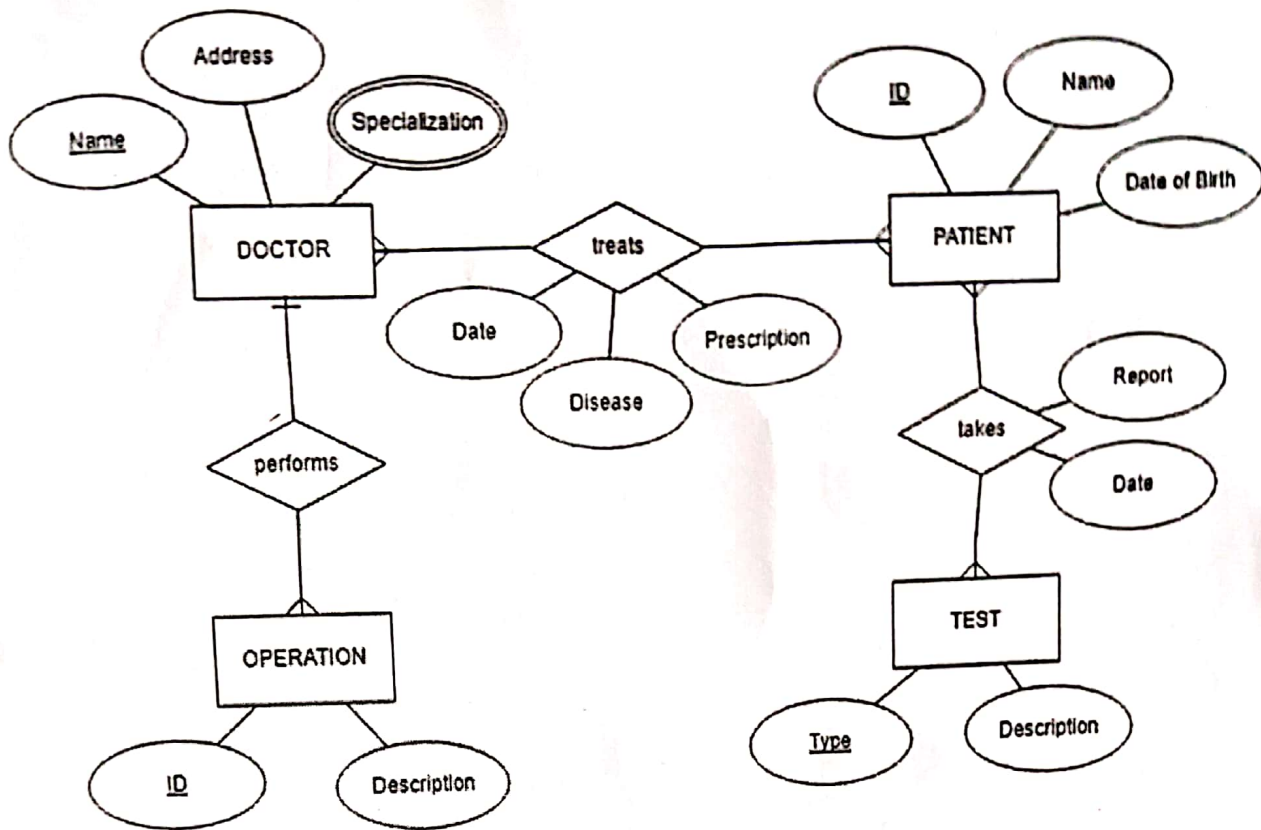B) π Name, Available, Item_number(σ Available>5(Shop_details X Inventory)

Fig. 1: ER Diagram for Question 2(b)

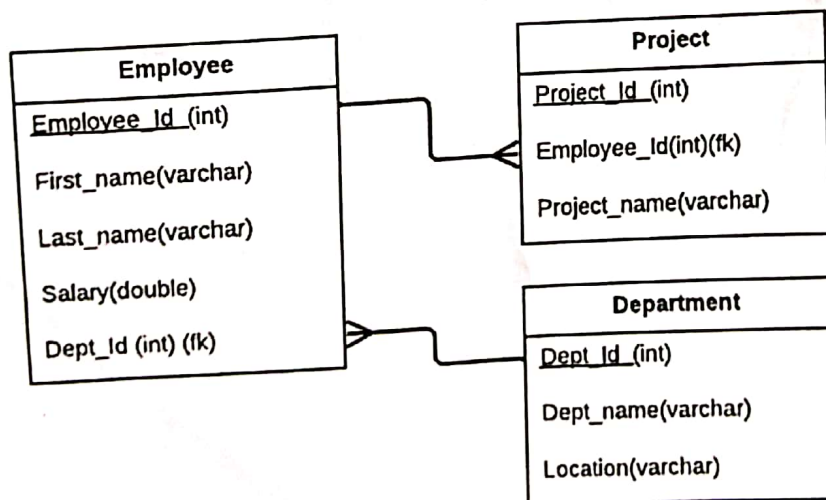Fig. 2: Schema Diagram for Question 3(a)

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1. (a) Consider a relation with schema R(A,B,C,D) with following functional dependencies (FD's):   2+2+ 3+5

$$BC \rightarrow A, AD \rightarrow B, CD \rightarrow B, AC \rightarrow D.$$

Find all the candidate keys of R.

(b) Consider a relation R (A, B, C, D) with the following instance

A	B	C	D
1	1	2	3
1	2	2	3
1	3	2	3
2	4	5	6
5	6	7	8

Which of the following functional dependencies are satisfied by this relation? How?

(i) $A \rightarrow B$ ✗
(ii) $A \rightarrow CD$ ✓
(iii) $BD \rightarrow AC$ ✓
(iv) $AD \rightarrow BC$ ✗

(c) What is decomposition? Briefly explain lossless decomposition with an example.

(d) Consider a relation with schema R(A,B,C,D) with following functional dependencies (FD's):

$$AB \rightarrow C, B \rightarrow D, C \rightarrow A$$

Can we decompose the relation into BCNF form by preserving dependency? If not, then what will be the maximum normalized form that can be achieved by preserving dependency.

2. b) "A secondary index is always a dense index" – explain this statement   3+5
with examples.

[Answer any one of the following 2(b) questions]

b) Consider an extensible hashing scheme where the bucket capacity is 2
and the initial local and global depth are both 1. Insert the following five
records in the hash table **showing the state of the table for each record
insertion**. Assume that the LSB (least-significant bit) is being checked to
find the directory for a record.

Record	Key	hash(Key)	hash(Key) in binary
Record-1	1620	20	10100
Record-2	1821	29	11101
Record-3	1075	18	10010
Record-4	2115	11	01011
Record-5	5659	27	11011

or, b) Write short notes on the following five topics in context of indexing.
Sector, Track, Search Key, Record, Multilevel indexing

3. a) If the order of a B+ tree is 6, then determine the minimum number of   3+7
keys and minimum number of pointers for root node and internal
nodes.

b) Construct a B+ tree for the following set of key values, where each
internal node can contain at most 5 children. Assume that the tree is
initially empty and values are added sequentially one by one.

7, 10, 1, 23, 5, 15, 17, 9, 11, 39, 35, 8, 40, 25

4. a) How can we ensure atomicity and durability of transactions? Write   3+7
down what you understand by view serializability.

[See rest of the Q4 on the next page]

b) Find out whether the following schedule is conflict serializable or not. If it is conflict serializable, show the serial schedule.

T1	T2	T3	T4
read(A)			
read(B)			
	read(B)		
write(A)			
			read(C)
		read(A)	
		write(A)	
	write(B)		
	Write(C)		
			write(C)
		write(B)	
read(C)			