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Internal Assessment Test 1 – June 2024

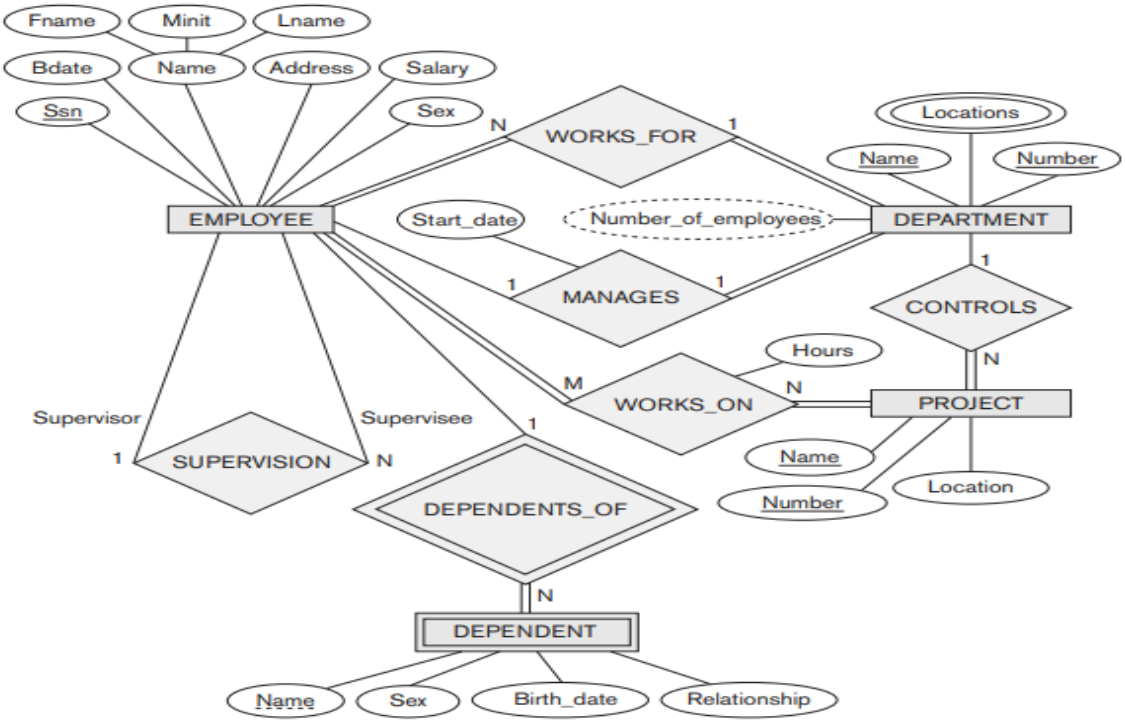
Sub:	**Database Management Systems**					Sub Code:	BCS403	Branch:	ISE	
Date:	**04/06/2024**	Duration:	90 min's	Max Marks:	50	Sem/Sec:	IV A, B & C		OBE	

	Answer any FIVE FULL Questions	MARKS	CO	RBT
1 a	Discuss the main characteristics of the database approach	5	CO1	L2
1 b	Explain the main advantages of using a DBMS	5	CO1	L2
2	Design an ER diagram for company database taking into account at least 4 entities	10	CO1	L3
3 a	With a neat diagram explain the three schema architecture of database systems	5	CO1	L2
3 b	Discuss the entity integrity and referential integrity constraints. Why each is considered important.	5	CO3	L2
4	Explain the steps involved in ER to relational mapping algorithm with an example.	10	CO3	L3
5	Consider the company Database EMPLOYEE(fname,minit,lname,ssn,bdate,address,sex,salary,super_ssn,dno) DEPARTMENT(dname,dnumber,mgr_ssn,mgr_start_date) DEPART_LOCATIONS(dnumber,dlocation) PROJECT(pname,pnumber,plocation,dnum) WORKS_ON(essn,pno,hours) DEPENDENT(essn,dependent_name,sex,bdate,relationship) Specify the following queries using Relational Algebra. a. For every project located in Stafford, list the project number, the controlling department number and the department manager's last name, address and birthdate. (3) b. Retrieve the birthdate and address of the employees whose name is John B Smith. (1) c. Retrieve the name and address of all employees who work for the research department (1) d. Retrieve the salary of every employee (1) e. To select the tuples for all employees who either work in department 4 and make over $25,000 per year, or work in department 5 and make over $30,000 (2) f. Retrieve the name of the manager of each department (2)	10	CO3	L3
6	Consider the following schema: SAILORS(sid,sname,rating,age) BOATS(bid,bname,color) RESERVES(sid,bid,day) Write the queries in relational algebra to: i) Find the names of sailors who have reserved all boats called interlake. (2) ii) Find the sids of sailors with age over 20, who have not reserved a red boat. (2) iii) Find the names of sailors, who have reserved at least two boats. (2) iv) Find all sailors ID of sailors who have rating of 10 or reserved the boat 105. (2) v) Find sailors whose rating is better than a sailor called "RAJ" (2)	10	CO3	L3

IAT 1- Scheme of Evaluation

Sem: IV — Date: 04/06/2024
Sub: Database Management System — Sub Code: BCS403
Faculty: Prof. Poornima Manjunath, Prof. Ciyamala Kushbu — Max Marks: 60 Marks

Sl. No.	**QUESTIONS**
1a. Sol:	Discuss the main characteristics of the database approach The main characteristics of the database

	☐ Self-describing nature of a database system ☐ Insulation between programs and data, and data abstraction ☐ Support of multiple views of the data ☐ Sharing of data and multiuser transaction processing List: 2M Explanation: 3M
1b. Sol:	Explain the main advantages of using a DBMS Advantages of Using the DBMS Approach 1. Controlling Redundancy: 2. Restricting Unauthorized Access: 3. Providing Persistent Storage for Program Objects: 4. Providing Storage Structures and Search Techniques for Efficient Query Processing: 5. Providing Backup and Recovery: 6. Providing Multiple User Interfaces: 7. Representing Complex Relationships Among Data: 8. Enforcing Integrity Constraints: 9. Permitting Inferencing and Actions Via Rules: Any 5 advantages with explanation: 5M
2. Sol:	Design an ER diagram for company database taking into account at least 4 entities 
3a. Sol:	With a neat diagram explain the three schema architecture of database systems

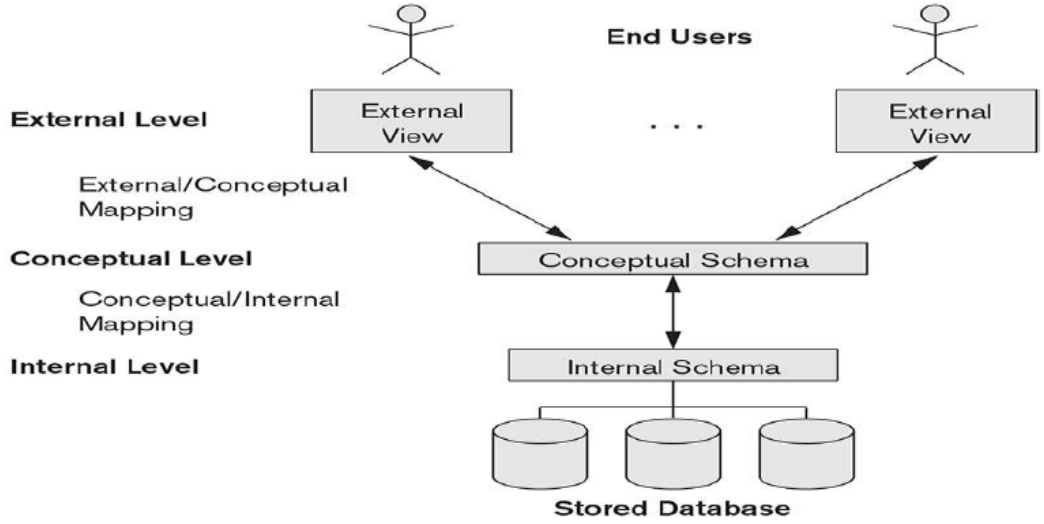


Diagram: 2M
Explanation: 3M

3b. Discuss the entity integrity and referential integrity constraints. Why each is considered important.

Sol: The entity integrity constraint states that no primary key value can be NULL. This is because the primary key value is used to identify individual tuples in a relation. Having NULL values for the primary key implies that we cannot identify some tuples. For example, if two or more tuples had NULL for their primary keys, we may not be able to distinguish them if we try to reference them from other relations. Key constraints and entity integrity constraints are specified on individual relations.

The referential integrity constraint is specified between two relations and is used to maintain the consistency among tuples in the two relations. Informally, the referential integrity constraint states that a tuple in one relation that refers to another relation must refer to an existing tuple in that relation. For example: The attribute Dno of EMPLOYEE gives the department number for which each employee works; hence, its value in every EMPLOYEE tuple must match the Dnumber value of some tuple in the DEPARTMENT relation.

Explanation: 2.5M each

4 Explain the steps involved in ER to relational mapping algorithm with an example.

Sol: Steps involved in ER to relational mapping are as follows:

Step 1: Mapping of Regular Entity Types.

For each regular (strong) entity type E in the ER schema, create a relation R that includes all the simple attributes of E.

Step 2: Mapping of Weak Entity Types

For each weak entity type W in the ER schema with owner entity type E, create a relation R, and include all simple attributes (or simple components of composite attributes) of W as attributes. In addition, include as foreign key attributes of R the primary key attribute(s) of the relation(s) that correspond to the owner entity type(s).

Step 3: Mapping of Binary 1:1 Relationship Types.

For each binary 1:1 relationship type R in the ER schema, identify the relations S and T that correspond to the entity types participating in R. Choose one of the relations, say S, and include the primary key of T as a foreign key in S. Include all the simple attributes of R as attributes of S.

Step 4: Mapping of Binary 1:N Relationship Types.

For each regular binary 1:N relationship type R identify the relation (N) relation S. the primary key of T as a foreign key of S. Simple attributes of R map to attributes of S.

Step 5: Mapping of Binary M:N Relationship Types.

For each binary M:N relationship type R, create a relation S. Include the primary keys of participant relations as foreign keys in S. Their combination will be the primary key for S. Simple attributes of R become attributes of S.

Step 6: Mapping of Multivalued Attributes.

For each multi-valued attribute A, create a new relation R. This relation will include an attribute corresponding to A, plus the primary key K of the parent relation (entity type or relationship type) as a foreign key in R. The primary key of R is the combination of A and K.

	Step 7: Mapping of N-ary Relationship Types For each n-ary relationship type R, where n>2, create a new relation S to represent R. Include the primary keys of the relations participating in R as foreign keys in S. Simple attributes of R map to attributes of S. The primary key of S is a combination of all the foreign keys that reference the participants that have cardinality constraint > 1. For a recursive relationship, we will need a new relation Explanation : 10 Marks
5 Sol:	Consider the company Database EMPLOYEE(fname,minit,lname,ssn,bdate,address,sex,salary,super_ssn,dno) DEPARTMENT(dname,dnumber,mgr_ssn,mgr_start_date) DEPART_LOCATIONS(dnumber,dlocation) PROJECT(pname,pnumber,plocation,dnum) WORKS_ON(essn,pno,hours) DEPENDENT(essn,dependent_name,sex,bdate,relationship) Specify the following queries using Relational Algebra. For every project located in Stafford, list the project number, the controlling department number and the department manager's last name, address and birthdate. (3) Retrieve the birthdate and address of the employees whose name is John B Smith. (1) Retrieve the name and address of all employees who work for the research department (1) Retrieve the salary of every employee (1) To select the tuples for all employees who either work in department 4 and make over $25,000 per year, or work in department 5 and make over $30,000 (2) Retrieve the name of the manager of each department (2) 1. For every project located in Stafford, list the project number, the controlling department number and the department manager's last name, address and birthdate. (3) $\pi_{Pnumber, Dnum, Lname, Address, Bdate}(((\sigma_{Plocation='Stafford'}(PROJECT)) \bowtie_{Dnum=Dnumber}(DEPARTMENT)) \bowtie_{Mgr_ssn=Ssn}(EMPLOYEE))$ 2. Retrieve the birthdate and address of the employees whose name is John B Smith. (1) π [redacted] Address, Bdate $SMITH \leftarrow \sigma_{Fname='John' \text{ AND } Lname='Smith'}(EMPLOYEE)$ 3. Retrieve the name and address of all employees who work for the research department (1) $RESEARCH\_DEPT \leftarrow \sigma_{Dname='Research'}(DEPARTMENT)$ $RESEARCH\_EMPS \leftarrow (RESEARCH\_DEPT \bowtie_{Dnumber=Dno} EMPLOYEE)$ $RESULT \leftarrow \pi_{Fname, Lname, Address}(RESEARCH\_EMPS)$ 4. Retrieve the salary of every employee (1) $\pi_{Sex, Salary}(EMPLOYEE)$ 5. To select the tuples for all employees who either work in department 4 and make over $25,000 per year, or work in department 5 and make over $30,000 (2) $\sigma_{(Dno=4 \text{ AND } Salary>25000) \text{ OR } (Dno=5 \text{ AND } Salary>30000)}(EMPLOYEE)$ 6. Retrieve the name of the manager of each department (2) $DEPT\_MGR \leftarrow DEPARTMENT \bowtie_{Mgr\_ssn=Ssn} EMPLOYEE$ $RESULT \leftarrow \pi_{Dname, Lname, Fname}(DEPT\_MGR)$

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Consider the following schema:
SAILORS(sid,sname,rating,age)
BOATS(bid,bname,color)
RESERVES(sid,bid,day)
Write the queries in relational algebra to:
i) Find the names of sailors who have reserved all boats called interlake. (2)
ii) Find the sids of sailors with age over 20, who have not reserved a red boat. (2)
iii) Find the names of sailors, who have reserved at least two boats. (2)
iv) Find all sailors ID of sailors who have rating of 10 or reserved the boat 105. (2)
v) Find sailors whose rating is better than a sailor called "RAJ" (2)

Sol:

i) Find the names of sailors who have reserved all boats called interlake. (2)

Find the names of sailors who have reserved all boats called Interlake.

$$\rho(Tempsids, (\pi_{sid,bid}Reserves)/(\pi_{bid}(\sigma_{bname='Interlake'}Boats)))$$
$$\pi_{sname}(Tempsids \bowtie Sailors)$$

ii) Find the sids of sailors with age over 20, who have not reserved a red boat. (2)

Find the sids of sailors with age over 20 who have not reserved a red boat.

$$\pi_{sid}(\sigma_{age>20}Sailors) -$$
$$\pi_{sid}((\sigma_{color='red'}Boats) \bowtie Reserves \bowtie Sailors)$$

iii) Find the names of sailors, who have reserved at least two boats. (2)

Find the names of sailors who have reserved at least two boats.

$$\rho(Reservations, \pi_{sid,sname,bid}(Sailors \bowtie Reserves))$$
$$\rho(Reservationpairs(1 \to sid1, 2 \to sname1, 3 \to bid1, 4 \to sid2,$$
$$5 \to sname2, 6 \to bid2), Reservations \times Reservations)$$
$$\pi_{sname1}\sigma_{(sid1=sid2)\wedge(bid1\neq bid2)}Reservationpairs$$

iv) Find all sailors ID of sailors who have rating of 10 or reserved the boat 105. (2)

v) Find sailors whose rating is better than a sailor called "RAJ" (2)
