

CS-2005: Database Systems

Serial No:

Sessional Exam-II

Total Time: 1 Hour

Total Marks: 60

Thursday, 12th May, 2022

Course Instructors

Dr. Javaria Imtiaz, Dr. Waseem Shahzad

Signature of Invigilator

Student Name

Roll No.

Section

Signature

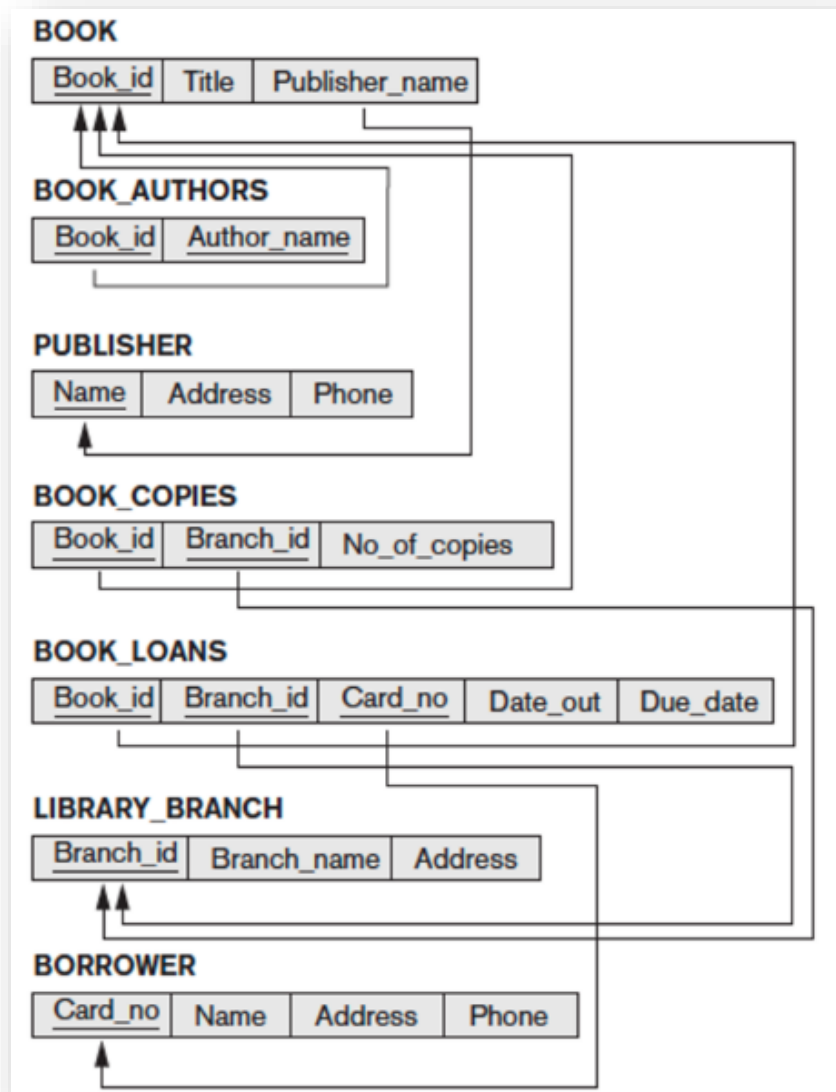
DO NOT OPEN THE QUESTION BOOK OR START UNTIL INSTRUCTED.

Instructions:

1. Attempt on question paper. Attempt all of them. Read the question carefully, understand the question, and then attempt it.
2. No additional sheet will be provided for rough work. Use the back of the last page for rough work.
3. If you need more space, write on the back side of the paper and clearly mark question and part number etc.
4. After asked to commence the exam, please verify that you have **12** different printed pages including this title page. There are a total of **3** questions.
5. Calculator sharing is strictly prohibited.
6. Use permanent ink pens only. Any part done using soft pencil will not be marked and cannot be claimed for rechecking.

	Q-1	Q-2	Q-3	Total
Marks Obtained				
Total Marks	20	20	20	60

Question 1 [20 Marks]



1. Encircle the right answer for the given description. (4 marks)

How many copies of the book titled "The Lost Tribe" are owned by the library branch whose name is "Sharpstown"?

- a) `SELECT No_Of_Copies
FROM BOOK, BOOK_COPIES, LIBRARY_BRANCH
WHERE Title='The Lost Tribe' AND BranchName='Sharpstown'`
- b) `SELECT No_Of_Copies
FROM BOOK_COPIES, LIBRARY_BRANCH
WHERE Title='The Lost Tribe' AND BranchName='Sharpstown'`

- c) `SELECT No_Of_Copies
FROM BOOK, BOOK_COPIES
WHERE Title='The Lost Tribe' OR BranchName='Sharpstown'`
- d) `SELECT No_Of_Copies
FROM ((BOOK
INNER JOIN BOOK_COPIES ON BOOK.Book_id = BOOK_COPIES. Book_id)
INNER JOIN LIBRARY_BRANCH ON BOOK.Branch_id = LIBRARY_BRANCH. Branch_id);`

2. Please provide the right answer for the given description. (4 marks)

How many copies of the book titled "The Lost Tribe" are owned by each library branch?

- a) `SELECT BranchId, NoOfCopies
FROM BOOK, BOOK_COPIES
WHERE Title='The Lost Tribe'
GROUP BY BranchId`
- b) `SELECT BranchId, NoOfCopies
FROM BOOK, BOOK_COPIES
INNER JOIN BOOK_COPIES ON BOOK. Book_id = BOOK_COPIES. Book_id
WHERE Title='The Lost Tribe'`
- c) `SELECT BranchId, NoOfCopies
FROM BOOK
INNER JOIN BOOK_COPIES ON BOOK. Book_id = BOOK_COPIES. Book_id
WHERE Title='The Lost Tribes'
GROUP BY BranchId`
- d) Both options a and c

3. Encircle the right answer for the given description. (4 marks)

Retrieve the names of all borrowers who do not have any books checked out.

- a) `SELECT Name
FROM BORROWER B
WHERE NOT EXIST (SELECT *
FROM BOOK_LOANS L
WHERE B.CardNo = L.CardNo)`
- b) `SELECT Name
FROM BORROWER B
WHERE CardNo NOT IN (SELECT CardNo FROM BOOK_LOANS);`
- c) `SELECT *
FROM BOOK_LOANS AS BL
FULL OUTER JOIN BORROWER AS BW ON BL.CardNo = BW.CardNo
WHERE DateOut IS NULL`

- i. Only a
- ii. Only b
- iii. Only c
- iv. Both options a and b
- v. Both options a and c
- vi. All of the above options

4. Guess the description of the below query (4 marks)

```
SELECT B.Title, R.Name, R.Address
FROM BOOK B, BORROWER R, BOOK_LOANS BL, LIBRARY_BRANCH LB
WHERE LB.BranchName='Sharpstown' AND LB.BranchId=BL.BranchId AND
BL.DueDate='today' AND BL.CardNo=R.CardNo AND BL.BookId=B.BookId
```

For each book that is loaned out from the "Sharpstown" branch and whose DueDate is today, retrieve the book title, the borrower's name, and the borrower's address.

5. Write the query for the given description: Retrieve the names, addresses, and the number of books checked out for all borrowers who have more than five books checked out. (2 marks)

```
SELECT B.CardNo, B.Name, B.Address, COUNT(*)
FROM BORROWER B, BOOK_LOANS L
WHERE B.CardNo = L.CardNo
GROUP BY B.CardNo
HAVING COUNT(*) > 5
```

6. For each book authored (or co-authored) by "Stephen King", retrieve the title and the number of copies owned by the library branch whose name is "Central". (Do it using full outer join) (2 marks)

```
SELECT Title, No_Of_Copies, BranchName
FROM BOOK AS BK
FULL OUTER JOIN BOOK_COPIES AS BC ON BK.BookID = BC.BookID
FULL OUTER JOIN LIBRARY_BRANCH AS LB ON BC.BranchId = LB.BranchId
FULL OUTER JOIN BOOK_AUTHORS AS BA ON BK.BookID = BA.BookID
WHERE BranchName = 'Central'
AND AuthorName = 'Stephen King'
```

Question 2 [20 Marks]

1. Consider the following four relational algebra expressions over the database schema $R(A,B)$, $S(A,B,C)$, $T(B,D,E)$

$$Q1 = \sigma_{A=1, B>2}((R \bowtie S) \bowtie T)$$

$$Q2 = \pi_E(\sigma_{D=1}(T \bowtie S))$$

$$Q3 = \pi_E(S) \bowtie \pi_{B,E}(\sigma_{D=1}(T))$$

$$Q4 = (\sigma_{A=1, B>2}(R \bowtie S)) \bowtie T$$

Which ones of the following statements are correct? Please note that multiple statements can be correct. In the following statements, equivalent means that queries return the same answer when evaluated on any instance of the database. You must justify your answer for each correct statement. No marks will be awarded without proper justification. [4 marks]

- a. Q1 and Q2 are equivalent
- b. Q3 and Q4 are equivalent
- c. Q1 and Q2 are not equivalent
- d. Q3 and Q4 are not equivalent
- e. Q1 and Q4 are equivalent
- f. Q2 and Q3 are equivalent
- g. None of the above
- h. Not enough information to answer the question

1. The following two relational algebra queries are equivalent:

$$Q_1 = \sigma_{A=1, B>2}((R \bowtie S) \bowtie T)$$

$$Q_2 = (\sigma_{A=1, B>2}(R \bowtie S)) \bowtie T$$

TRUE

2. The following two relational algebra queries are equivalent:

$$Q_3 = \pi_E(\sigma_{D=1}(T \bowtie S))$$

$$Q_4 = \pi_B(S) \bowtie \pi_{B,E}(\sigma_{D=1}(T))$$

FALSE

2. Which ones of the following relational algebra statements are correct? Please note that multiple statements can be correct. In the following statements, equivalent means that queries return the same answer when evaluated on any instance of the database. You must justify your answer for each correct statement. No marks will be awarded without proper justification. [4 marks]

$$Q1 = \pi_{title}(\sigma_{length \geq 100}(Movie) \cap \sigma_{studio='Fox'}(Movie))$$

$$Q2 = \pi_{title}(\sigma_{length \geq 100}(Movie)) \cap \pi_{title}(\sigma_{studio='Fox'}(Movie))$$

$$Q3 = \pi_{title}(\sigma_{length \geq 100 \wedge studio='Fox'}(Movie))$$

a. Q1, Q2 and Q3 are equivalent

b. All queries are not equivalent

c. Q1 and Q2 are equivalent

d. Q1 and Q2 are not equivalent

e. Q1 and Q3 are equivalent

f. Q1 and Q3 are not equivalent

g. Q2 and Q3 are equivalent

h. Q2 and Q3 are not equivalent

i. None of above

$\sigma_{\text{length} \geq 100}(\text{Movie})$

Title	Year	Length	Genre	StudioName	producerC#
Star Wars	1977	124	SciFi	Fox	12345
Galaxy	1999	104	Comedy	DreamWorks	67890

$\sigma_{\text{studio} = 'Fox'}(\text{Movie})$

Title	Year	Length	Genre	StudioName	producerC#
Star Wars	1977	124	SciFi	Fox	12345

- Set tuples in the relation movies that represent Fox Movies at least 100 minutes long.

Title	Year	Length	Genre	StudioName	producerC#
Star Wars	1977	124	SciFi	Fox	12345
Galaxy	1999	104	Comedy	DreamWorks	67890
Wayne's World	1992	95	Comedy	Paramount	99999

$\sigma_{\text{Length} \geq 100 \text{ AND } \text{studioName} = 'Fox'}(\text{Movies})$

Title	Year	Length	Genre	StudioName	producerC#
Star Wars	1977	124	SciFi	Fox	12345

3. Consider the following database schema:

- a. LIKES (student, teacher)
- b. ATTENDS (student, course)
- c. OFFEREDBY (course, teacher)

The relation **LIKES** indicates the teachers liked by the students. The relation **ATTENDS** depicts the courses attended by the students. The relation **OFFEREDBY** represents the courses offered by the teachers.

Write a relational algebra query that answers the following question: Which students attends only those courses that are only offered by the teachers they like? You can only use natural join (\bowtie) difference (-) and project (π) operator. No other operator is allowed. [5 marks]

$$\pi_{student} (LIKES) - \pi_{student} \left(\pi_{student, teacher} (ATTENDS \bowtie OFFEREDBY) - Likes \right)$$

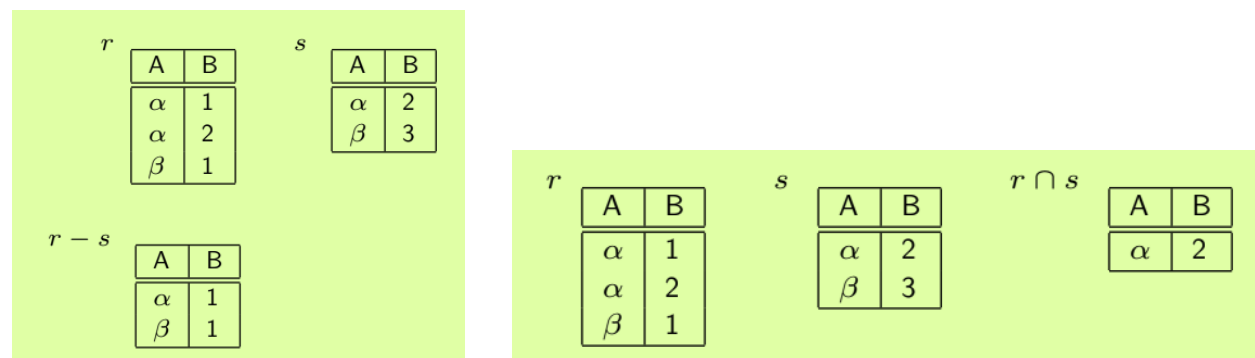
4. Given the relations R (A, B, C) and S (D, E), the output of the natural join $R \bowtie S$ is equivalent to the output of which (other) relational algebra operator? Justify your answer. [2 marks]

Natural join is used to join two relations having any number of attributes. It is denoted by a symbol (\bowtie). It is the combination of projection and filtered cartesian product. It optimizes the query as the cartesian product gives unnecessary results and set union and set intersection operations are application only on those relations that have an equal number of attributes with the same data types.

$R \times S$

5. How to express the relational algebra operator intersection (\cap) on relations r and s using the difference operator? Justify your answer with Venn diagram. [2 marks]

$$r \cap s = r - (r - s)$$



6. Write SQL statement that correspond to the following relational algebra expression. [3 marks]

$$Q = \sigma_{year, COUNT(ID)}(ARTICLES)$$

SELECT year, COUNT(ID)
FROM Articles
GROUP BY year;

Question 3 [20 Marks]

1. Consider the given database instance and answer the following questions. If there are multiple answers to a question, encircle all the correct options. Note: If there is only 1 correct option and you encircle multiple options then you'll get zero marks. [8]

Student

<u>RegNo</u>	Fname	Lname	DNo
1001	Alice	David	1
1002	Tom	Antony	1
1003	Lucy	Edward	3

Department

<u>DNo</u>	Dname	Building
1	SE	A
2	EE	B
3	BBA	C
4	DS	A

Instructor

<u>TID</u>	Fname	Lname	Salary	DNo
001	Matt	LBlanc	300000	4
002	Methew	Perry	200000	1
003	Jennifer	Anniston	450000	1
004	Pheobe	Buffay	320000	3

- a) Which of the following update operation(s) will cause the violation of Referential Integrity constraint? Must provide justification in the given box (2 marks)

- (i) Delete the DEPARTMENT tuple with DNo = 1.
- (ii) Insert (004, 'Mark', 'Stevens', 28000, 5) into INSTRUCTOR.
- (iii) Insert (4, 'EEE', B4) into DEPARTMENT.
- (iv) Insert (null, 'Anna', 'Smith', 7) into STUDENT.

Justify your answer

- b) Which of the following update operation will cause the violation of Entity Integrity constraint? (2 marks)

- (i) Insert (4, 'EEE', B4) into DEPARTMENT.
- (ii) Insert (null, 'Anna', 'Smith', 7) into STUDENT.
- (iii) Insert (004, 'Mark', 'Stevens', 28000, 5) into INSTRUCTOR.
- (iv) Insert (1004, 'Peter', 'Weston', 2) into STUDENT.

Justify your answer

- c) Modify the DNo of STUDENT tuple with RegNo = 1002 to 3. This operation leads to the violation of which of the following constraint? (2 marks)

- (i) Referential Integrity Constraint
- (ii) Entity Integrity Constraint
- (iii) Domain Constraint
- (iv) None of the above

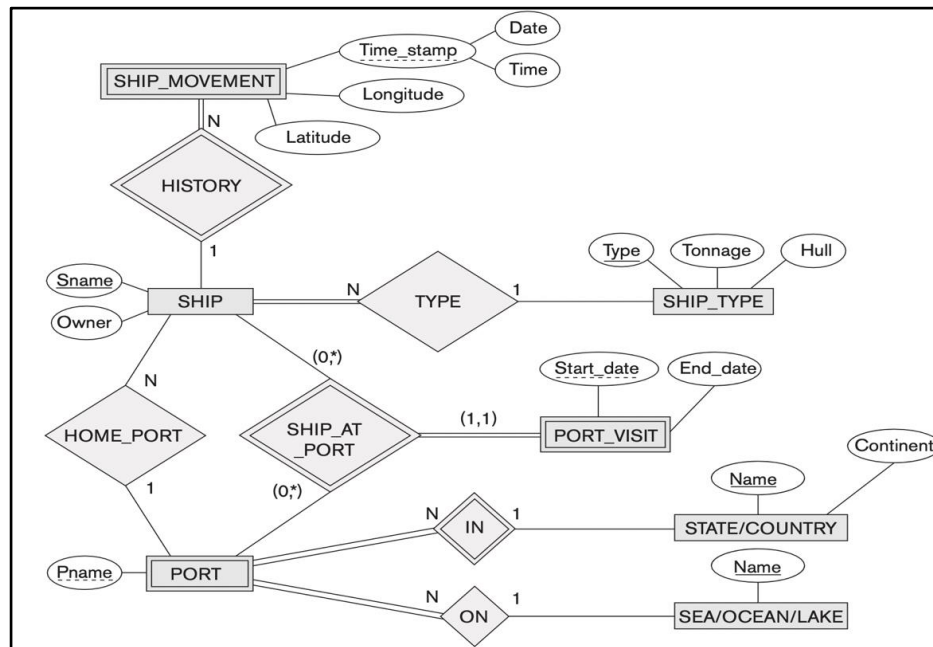
Justify your answer

- d) Modify the DNo attribute of the INSTRUCTOR tuple with TID = 003 to 8. This operation will lead to the violation of which of the following constraint? (2 marks)

- (i) Referential Integrity constraint
- (ii) Entity Integrity constraint
- (iii) Domain Constraint
- (iv) None of the above

Justify your answer

2. Consider the following ER diagram and answer the given questions. [4]



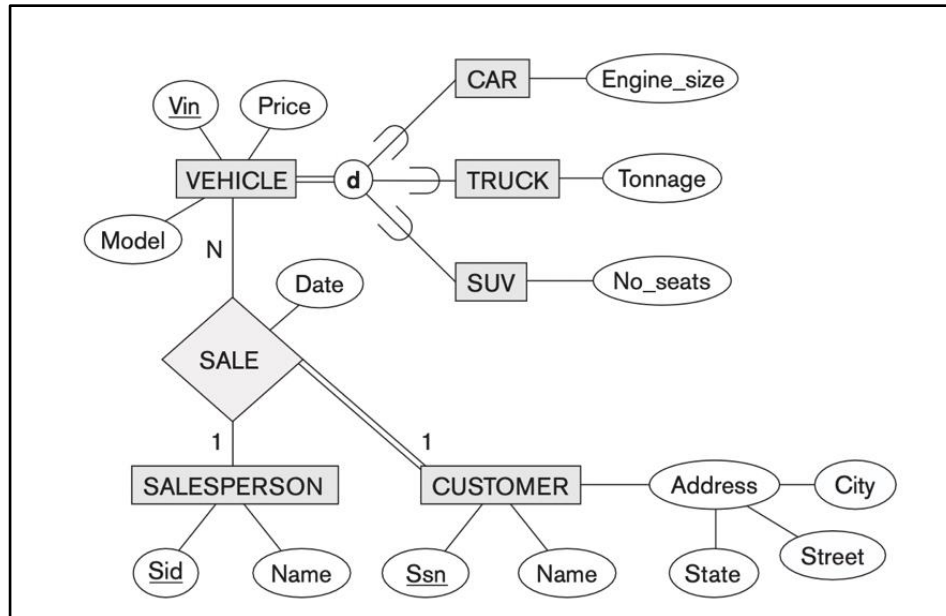
a) Which of the following is the possible mapping of weak entity type SHIP_MOVEMENT? (2 marks)

- a. {Time_stamp, Longitude, Latitude}
- b. {Date, Time, Latitude, Longitude}
- c. {Sname, Date, Time, Latitude, Longitude}
- d. {Sname, Time_stamp, Latitude, Longitude}

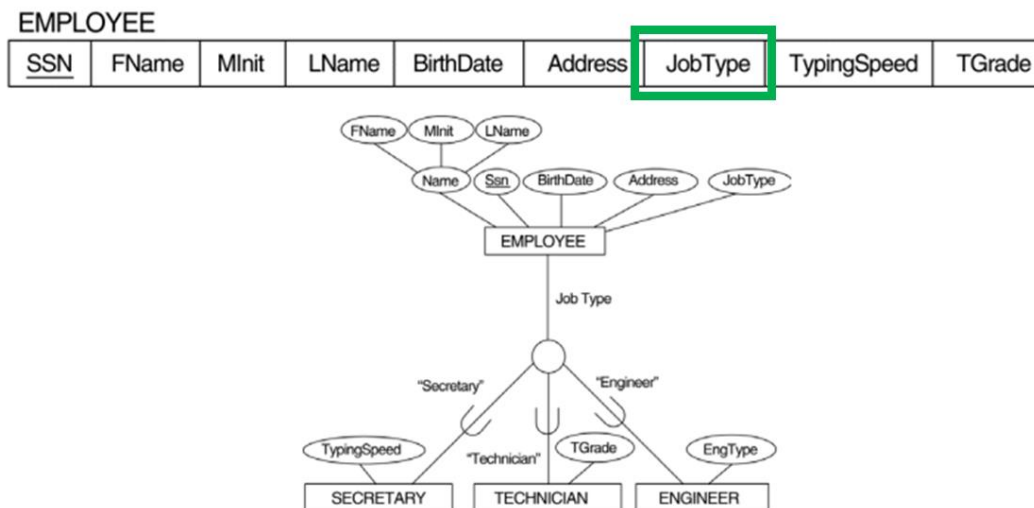
b) Which of the following is the possible mapping of weak entity type PORT_VISIT? (2 marks)

- a. {Start_date, End_date}
- b. {Sname, Start_date, End_date}
- c. {Sname, Start_date, End_date}
- d. {Pname, Start_date, End_date}

3. Consider the given EER diagram and answer the following questions. [8]



- a) Map the given EER diagram into relational schema using option “**single relation with one type attribute**”. [3+1.5+1.5]



- b) Which of the following is not a full functional dependency? [2]
- Sid → Name
 - Vin → Price, Model
 - Ssn, Name → City**
 - None of the above
 - All of the above