

Indian Statistical Institute
BSDS, Second Year, Mid-Sem of Second Semester Examination, 2025-26
Database Management Systems

Full Marks: 15

Date: 20-03-2026

Time: 1 Hour

FIRST HALF

Answer any *three* of the following questions

$3 \times 5 = 15$

1. For a pair of arbitrary relations R_1 and R_2 ($A(R_1) = A(R_2)$), prove or disprove the following:
 $\sigma_{\theta}(R_1 - R_2) \equiv \sigma_{\theta}(R_1) - R_2$.

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2. Show examples of the following things with tables having data therein:

- (a) A table with no superkey.
- (b) A table with two candidate keys.
- (c) Two tables connected by a foreign key.
- (d) A table with a multi-valued attribute.
- (e) Two tables reflecting overlapping generalization.

$1+1+1+1+1$

3. (a) Suppose a relation $R = \langle W, X, Y \rangle$ is indexed using a B^+ -tree. Justify whether the following operations will be efficient on the relation or not.

- (i) $\sigma_{W > 0}(R)$
- (ii) $\sigma_{Y \neq 1000}(R)$

- (b) What are the disadvantages of a B^+ -tree?

$(2+2)+1$

4. Let there be a relation $R = \langle V, W, X, Y, Z \rangle$ having all the attributes as atomic and holding the functional dependencies $FD = \{V \rightarrow W, W \rightarrow X, X \rightarrow Y, Y \rightarrow W, VZ \rightarrow X\}$.

- (a) Derive all the non-trivial functional dependencies from the given set FD .
- (b) What is the closure of the attribute set VZ ?
- (c) Suggest a decomposition of the relation R that is both lossless and dependency preserving. Justify your answer.

$1+1+3$

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SECOND HALF

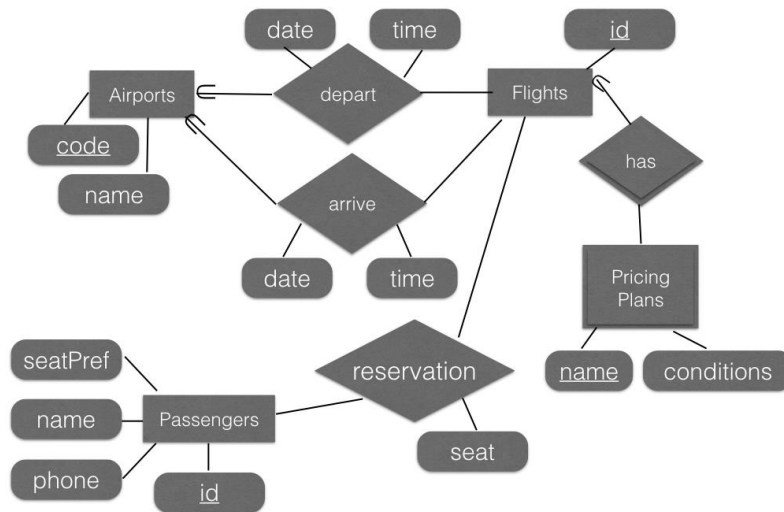
Answer any *three* of the following questions

$3 \times 5 = 15$

1. For a pair of arbitrary relations R_1 and R_2 ($A(R_1) = A(R_2)$), prove or disprove the following:
 $\sigma_{\theta}(R_1 \cup R_2) \equiv \sigma_{\theta}(R_1) \cup R_2$.

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2. Convert the following Entity-Relationship Diagram (ERD), corresponding to a database designed for managing airline reservations, into appropriate relational schemas (i.e., tables) with the primary keys underlined therein.



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3. Show the construction of a B^+ -tree, having both the order and degree parameters as 3, step by step accepting the elements in the sequence 3, 8, 1, 4, 9 and 7 to be inserted.

5

4. Consider the relation $R = \langle V, W, X, Y, Z \rangle$ having all the attributes as atomic and holding the functional dependencies $FD = \{V \rightarrow W, W \rightarrow X, X \rightarrow Y, Y \rightarrow W, VZ \rightarrow X\}$. Answer all the following questions with proper justifications.
- What is the highest normal form that R satisfies?
 - Decompose R such that every decomposed subrelation of R satisfies the Boyce-Codd normal form.
 - Is your decomposition dependency preserving? Is your decomposition unique? If so, justify why its unique, and if not, show the other possible decompositions.

1+2+2