

# **23BCS10193 – Shivanshu Ranjan**

## **Session-7 :- Data Normalization**

### **Q1**

**Relation:** R(A, B, C, D)

**Functional Dependencies:**

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

**Solution:**

**Attribute Closure:**

- $(AB)^+ = \{A, B, C, D\}$
- $(BC)^+ = \{A, B, C, D\}$
- $(BD)^+ = \{A, B, C, D\}$

**Candidate Keys:** {AB, BC, BD}

**Prime Attributes:** A, B, C, D

**Non-Prime Attributes:** None

### **Q2**

**Relation:** R(A, B, C, D, E)

**Functional Dependencies:**

$$A \rightarrow D, \quad B \rightarrow A, \quad BC \rightarrow D, \quad AC \rightarrow BE$$

**Solution:**

**Attribute Closure:**

- $(BC)^+ = \{A, B, C, D, E\}$
- $(AC)^+ = \{A, B, C, D, E\}$

**Candidate Keys:** {BC, AC}

**Prime Attributes:** A, B, C

**Non-Prime Attributes:** D, E

## Q3

**Relation:** R(A, B, C, D, E)

**Functional Dependencies:**

$$B \rightarrow A, \quad A \rightarrow C, \quad BC \rightarrow D, \quad AC \rightarrow BE$$

**Solution:**

**Attribute Closure:**

$$(B)^+ = \{A, B, C, D, E\}$$

**Candidate Key:** {B}

**Prime Attributes:** B

**Non-Prime Attributes:** A, C, D, E

## Q4

**Relation:** R(A, B, C, D, E, F)

**Functional Dependencies:**

$$A \rightarrow BCD, \quad BC \rightarrow DE, \quad B \rightarrow D, \quad D \rightarrow A$$

**Solution:**

**Candidate Keys:** {B, D}

**Prime Attributes:** A, B, D

**Non-Prime Attributes:** C, E, F

## Q7

**Relation:** R(A, B, C, D, E)

**Functional Dependencies:**

$$CE \rightarrow D, \quad D \rightarrow B, \quad C \rightarrow A$$

**Solution:**

**Attribute Closure:**

$$(CE)^+ = \{A, B, C, D, E\}$$

**Candidate Key:** {CE}

**Highest Normal Form:** 2NF

## Q8

**Relation:** R(A, B, C, D, E, F)

**Functional Dependencies:**

$$AB \rightarrow C, \quad DC \rightarrow AE, \quad E \rightarrow F$$

**Solution:**

**Attribute Closure:**

$$(BD)^+ = \{A, B, C, D, E, F\}$$

**Candidate Key:** {BD}

**Highest Normal Form:** 3NF