

COMPUTER SCIENCE



Database Management System

FD's & Normalization

Membership Set & Equality
Between FD Sets

Lecture_04

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An orange diamond-shaped sign with a black border and the text 'TOPICS TO BE COVERED' in black capital letters.

TOPICS
TO BE
COVERED

A red diamond-shaped marker with a white border and the number '01' in white.


01

Finding Candidate keys

A red diamond-shaped marker with a white border and the number '02' in white.

02

Membership Set

A green arrow pointing upwards from the bottom of the slide towards the 'Membership Set' text.



RDBMS Concept

FD Concept

FD Type

Attribute closure

Key Concept

Super key

↳ Candidate key

Primary key

Alternate/secondary key

Keys Concept

Super key

Minimal → Candidate key (Assume
U.C.K)

I select as Primary key

All C.K except
Primary key Alternate/secondary key.

How to find multiple Candidate key

IV $X_{\text{Attribute}} \longrightarrow [\text{Prime Attribute}]$

then Multiple Candidate key are possible.

Q.1

R(ABCDEF) {A → B, B → C, D → CEF}

Find candidate keys for the relation R?



Solⁿ

$$[A]^+ = [ABC]$$

$$[D]^+ = [DEEF]$$

$$[AD]^+ = [ABCDEF]$$

Prime Attribute = [A, D]

If X Attribute → [Prime Attribute]

AD is Candidate Key

①

AD is

Composite Key

AD Ans



key with two or more attribute
is called composite key.

No Multiple Candidate key.

Q.2

$R(ABCDE) \{AB \rightarrow C, C \rightarrow D, D \rightarrow E, B \rightarrow A, C \rightarrow B\}$

Find candidate keys for the relation R ?

Soln

Candidate key = $[B, C]$



Q.3

$R(ABCD) \{A \rightarrow B, \underline{B \rightarrow C}, C \rightarrow D, D \rightarrow A\}$

Find candidate keys for the relation R?

$$[A]^+ = [ABCD]$$

A is Candidate key — (1)

$$\underline{D \rightarrow A}$$

$$[D]^+ = [DABCD]$$

D is Candidate key. — (2)

key/Prime Attribute = $[A, D, C, B]$

$$\underline{C \rightarrow D}$$

$$[C]^+ = [CDAB]$$

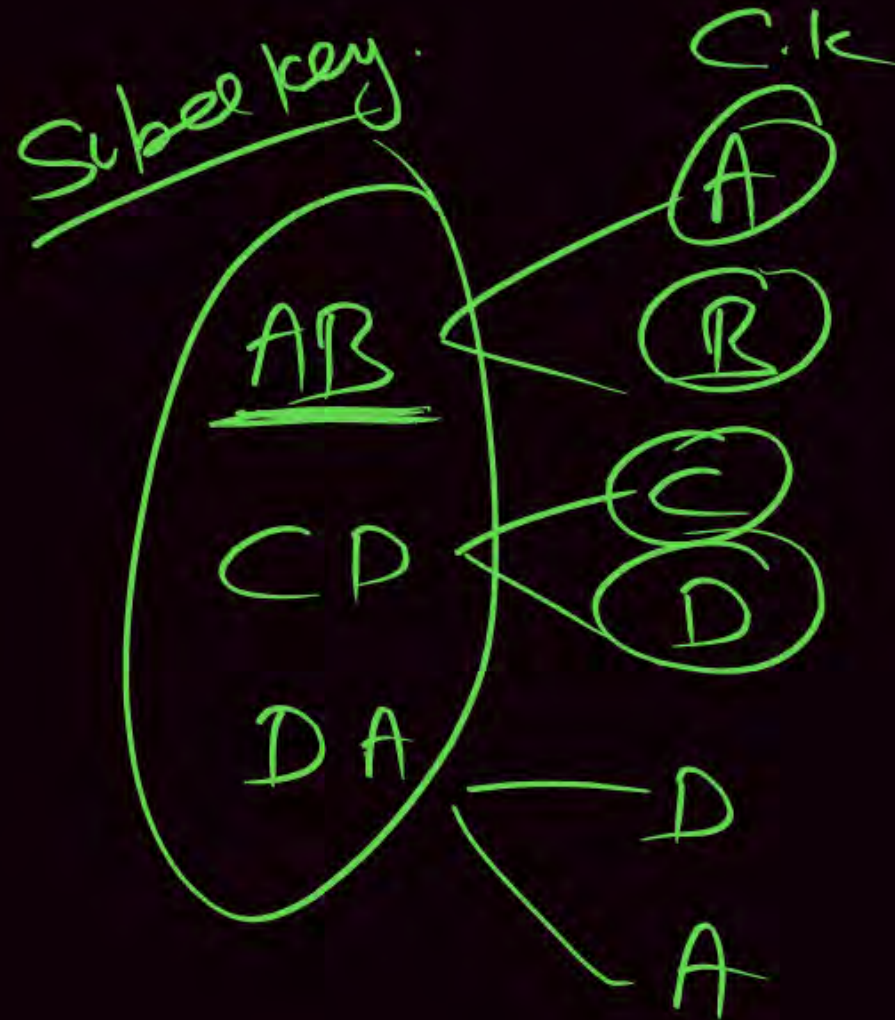
C is Candidate key. — (3)

$$B \rightarrow C$$

$$[B]^+ = [BCDA]$$

B is Candidate key — (4)

<u>YCK</u>
A
B
C
D



key concept

Super key

Minimal

Candidate key

1 ck select as Primary key

Remaining ck → Alternate / Secondary key.

All C.K are Super key
but all Super key are
Not Candidate key.

Only Candidate key is Minimal of
Super key.

Q. 4

R(ABCDEF) {A \rightarrow BCDE, BC \rightarrow AD, D \rightarrow EF}

Find candidate keys for the relation R ?



Solⁿ

Candidate key = [A, BC] Ans

Q.5



R(ABCD) F: {AB → C, B → D, C → B, D → B}

Find all candidate key of R?

Prime/Key Attribute = [A, B, D, C]

Soln $[AB]^+ = [ABCD]$

AB is Super key

$[A]^+ = [A]$

$[B]^+ = [BD]$

AB is Candidate key — (1)

If X Attribute → [Prime Attribute]

$[AD]^+ = [ADBC]$
 $[D]^+ = [DB]$

AD is Candidate key — (2)

$C \rightarrow B$

$[AC]^+ = [ACBD]$

$[C]^+ = [CBD]$

AC is C.K — (3)

$B \rightarrow D$

AB already taken

AB → C

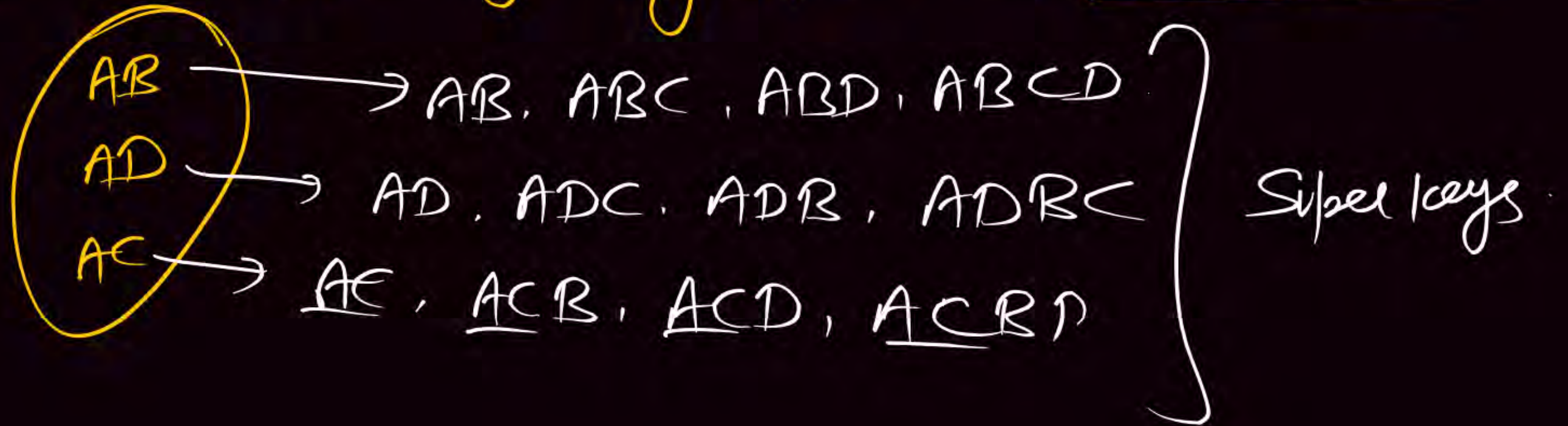
AB already taken

3 C.K

AB
AD
AC } Ans

R(ABCD)

Subkey: Any super set of AB, AD, AC.



Q.6.



Consider the following relational schema $R(ABCDEF)$ with functional dependency $\{AB \rightarrow C, C \rightarrow D, D \rightarrow E, \underline{E \rightarrow F}, F \rightarrow B\}$

The number of candidate keys for relation R?

$R(ABCDEF) \{AB \rightarrow C, C \rightarrow D, \underline{D \rightarrow E}, \underline{E \rightarrow F}, \underline{F \rightarrow B}\}$

key/
Prime
Attribute

$= [A, B, F, E, D]$

(Solⁿ)

$[AB]^+ = [ABCDEF]$

AB is super key.

$[A]^+ = [A]$

$[B]^+ = [B]$

AB is Candidate key — (1)

$\begin{matrix} A \\ E \end{matrix} \xrightarrow{E \rightarrow F} [AE]^+ = [AEFBCD]$

$[E]^+ = [EFB]$

AE is Candidate key — (3)

$\begin{matrix} A \\ C \end{matrix} \xrightarrow{C \rightarrow D} [AC]^+ = [ACDEFB]$

$[C]^+ = [CDEFB]$

AC is Candidate key — (5)

If $X \text{ Attribute} \rightarrow \text{Prime Attribute}$

$\begin{matrix} A \\ F \end{matrix} \xrightarrow{F \rightarrow B} [AF]^+ = [AFBCDE]$

$[F]^+ = [FB]$

AF is Candidate key — (2)

$\begin{matrix} A \\ D \end{matrix} \xrightarrow{D \rightarrow E} [AD]^+ = [ADEFBC]$

$[D]^+ = [DEFB]$

AD is Candidate key — (4)

5 Candidate key
AB
AF
AD
AE
AC

Ans

Q. 7



$R(ABCDE) : \{AB \rightarrow C, BC \rightarrow D\}$

Find Candidate keys for the Relation R?

$$[AB]^+ = [ABCD]$$

Not getting 'E'

AB is Not Candidate key

(or)
Not Super key

Because all Attributes Not determined from $[AB]^+$

(E is Not Derived)

Note

Whenever Any attribute Not Present in the FD then Make a Part (or)

ADD in Candidate key.

$$[ABE]^+ = [ABCDE]$$

ABE is Super key

$$[AB]^+ = [ABCD]$$

$$[AE]^+ = [AE]$$

$$[BE]^+ = [BE]$$

ABE is Candidate key

⊕

Prime Attribute = $\{E, A, B\}$

No Multiple C.K

Q.8

$R(ABCDEFG) : \{A \rightarrow B, B \rightarrow C, C \rightarrow D, D \rightarrow E, F \rightarrow G\}$

Find Candidate keys for the Relation R?

$$\begin{aligned} [A]^+ &= [ABCDE] \\ [F]^+ &= [FG] \\ [AF]^+ &= [ABCDEFG] \end{aligned}$$

AF is Candidate key — ①

Key / Prime Attribute = [A, F]

If X Attribute \rightarrow (Prime Attribute)

No Multiple Candidate key.

Only AF is C.K. Ans

Q. 9



$R(ABCDEFGH) : \{AB \rightarrow C, AC \rightarrow B, AD \rightarrow E, B \rightarrow D, BC \rightarrow A, E \rightarrow G\}$

Find Candidate keys for the Relation R?

$R(ABCDEFGH) [AB \rightarrow C, AC \rightarrow B, AD \rightarrow E, B \rightarrow D, BC \rightarrow A, E \rightarrow G]$
 key / Prime Attribute = $[F, H, A, B, C]$

$[AB]^+ = [ABCDEG]$

F, H are Not Present in the FD
 so add in Candidate key.

$[ABFH]^+ = [ABCDEFGH]$

ABFH is Candidate key — ①

If X Attribute \rightarrow (Prime Attribute)

$BC \rightarrow A$
 $[BCFH]^+ = [ABCDEFGH]$

$[BFH]^+ = [BDFH]$

$[CFH]^+ = [CFH]$

BCFH is C.K. — ②

$AC \rightarrow B$
 $[ACFH]^+ = [ABCDEFGH]$
 $[AFH]^+ = [AFH]$

ACFH is C.K. — ③

3 C.K
 ABFH
 ACFH
 BCFH
 Ans

Q.10

$R(ABDLPT), \{B \rightarrow PT, T \rightarrow L, A \rightarrow D\}$

Find candidate keys for the relation R?

$$[B]^+ = [BPTL]$$

$$[A]^+ = [AD]$$

$$[AB]^+ = [ABDLPT]$$

Prime Attribute = $[A, B]$

No Multiple C.K.

AB is Candidate key — ①

Q.11



$R(ABCDEFGHI) = \{AB \rightarrow C, A \rightarrow DE, B \rightarrow F, F \rightarrow GH, D \rightarrow I\}$

Find candidate keys for the relation R?

$R(ABCDEFGHI) \{ \underline{AB} \rightarrow \underline{C}, A \rightarrow \underline{DE}, B \rightarrow \underline{F}, F \rightarrow \underline{GH}, D \rightarrow \underline{I} \}$

$(AB)^+ = [ABCDEFGHI]$

Prime Attribute = $[A, B]$

AB is Super key

$(A)^+ = [ADEI]$

$(B)^+ = [BFCH]$

No Multiple Candidate key

Only AB is C.K. Ans

AB is Candidate key — ①

Q.12

R(ABCDEFGG)

$[A \rightarrow B, B \rightarrow A, C \rightarrow D, D \rightarrow E, E \rightarrow FG]$

Find candidate keys for the relation R?

$R(ABCDEFGG) \quad [A \rightarrow B, B \rightarrow A, C \rightarrow D, D \rightarrow E, E \rightarrow FG]$

$[A]^+ = [AB]$

$[C]^+ = [CDEFG]$

$[AC]^+ = [ABCDEFGG]$

AC is Candidate key

①

Prime Attribute = $[A, C, B]$

$B \rightarrow A$

$(BC)^+ = [ABCDEFGG]$

$[B]^+ = [BA]$

BC is C.K

②

2 C.K
AC
BC

Ans

Q.13.



$R(ABCDEFGG) \{AB \rightarrow CDEF, C \rightarrow ADE, D \rightarrow EBF, F \rightarrow DA, BE \rightarrow AF\}$

Find candidate keys for the relation R?

$R(ABCDEFGG) \{AB \rightarrow CDEF, C \rightarrow ADE, D \rightarrow EBF, F \rightarrow DA, BE \rightarrow AF\}$

Key/Prime Attribute = $\{ \check{A}, \check{B}, E, F, C, \}$

$(AB)^+ = \{AB CDEF\}$

G is Not Present in FD

So $(ABG)^+ = \{AB CDEFG\}$

ABG is Super key

$(AB)^+ = \{AB CDEF\}$

$(AG)^+ = \{AG\}$

$(BG)^+ = \{BG\}$

ABG is C.K — (1)

$BE \rightarrow AF$

$(BEG)^+ = \{AB CDEFG\}$

$(EG)^+ = \{EG\}$

BEG is C.K — (2)

$F \rightarrow DA$

$(FBG)^+ = \{AB CDEFG\}$

$(BG)^+ = \{BG\}$

$(FG)^+ = \{FG DAEB C\}$

FG is C.K — (3)

$C \rightarrow ADE$

$(CBG)^+ = \{AB CDEFG\}$

$(CG)^+ = \{CG ADEBF\}$

CG is C.K — (4)

Q.13.



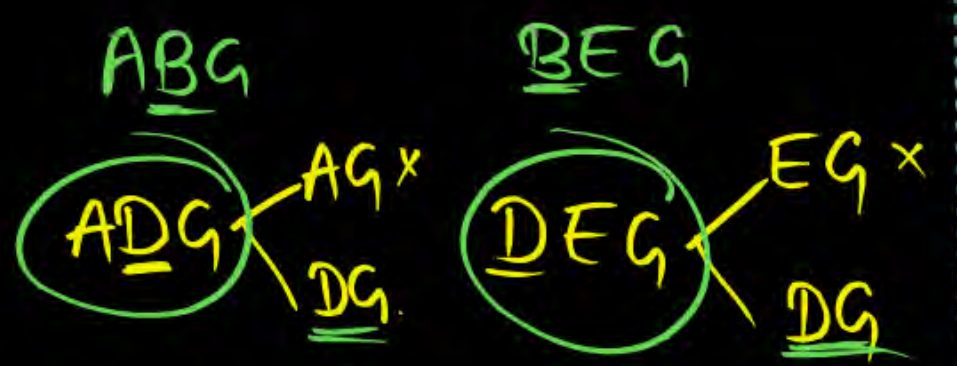
$R(ABCDEFGG) \{AB \rightarrow CDEF, C \rightarrow ADE, D \rightarrow EBF, F \rightarrow DA, BE \rightarrow AF\}$

Find candidate keys for the relation R?

$R(ABCDEFGG) [AB \rightarrow CDEF, C \rightarrow ADE, D \rightarrow EBF, F \rightarrow DA, BE \rightarrow AF]$

Key/Prime Attribute = $[A, B, E, F, C, D]$

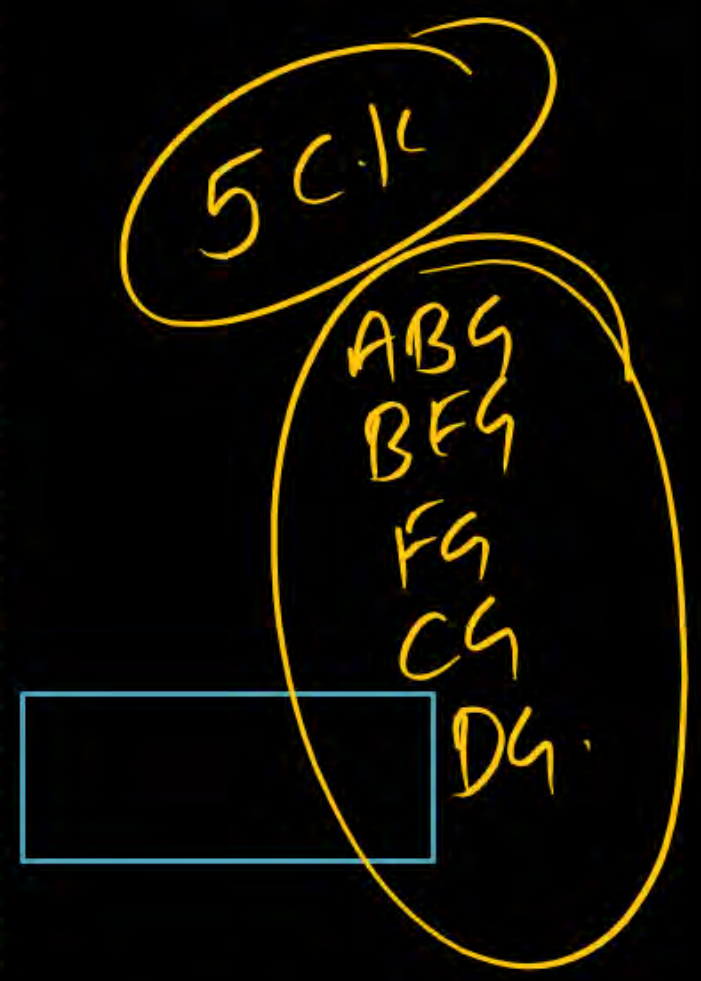
$D \rightarrow EBF$



$[DG]^+ = [DGEBFAC]$

DG is c.k. (5)

$D \rightarrow EBF$



Q. 14



$R(ABCDEFGH) \{A \rightarrow BC, B \rightarrow DEF, DE \rightarrow AGH\}$

Find candidate keys for the relation R?

$R(ABCDEFGH) \{A \rightarrow BC, B \rightarrow DEF, \underline{DE} \rightarrow AGH\}$

$[A]^+ = [ABCDEFGH]$

Prime Attribute = $[A, D, E, B]$

A is candidate key — (1)

$DE \rightarrow AGH$
 $\begin{matrix} D \\ E \end{matrix} \rangle [DE]^+ = [DEAGHBCF]$

$[D]^+ = [D]$

$[E]^+ = [E]$

DE is C.K — (2)

$B \rightarrow DEF$
 $\begin{matrix} E \\ B \end{matrix} \rangle [BE]^+ = [BEACDFGH]$

$[E]^+ = [E]$

$[B]^+ = [BDEFAGHC]$

B is C.K — (3)

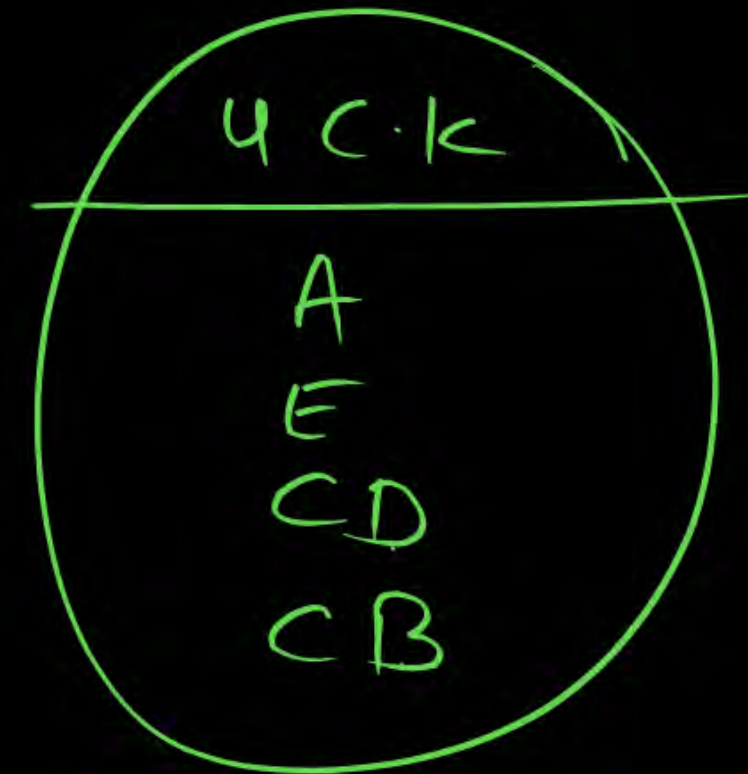
3 C.K
A
DE
B

Ans

Q. 15.

$R(ABCDE) \{A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A\}$

Find candidate keys for the relation R ?



Q.

 $R(ABCDEFGH)$ $\{AB \rightarrow CD, D \rightarrow EG, F \rightarrow H, C \rightarrow EF, H \rightarrow A, G \rightarrow B, A \rightarrow B\}$

Find candidate keys for the relation R ?



Consider the relation scheme $R(A,B,C)$ with the following functional dependencies



$$AB \rightarrow C$$

$$C \rightarrow A$$

Determine the minimal keys of relations R .

[1995: 2 Marks]



Let $R = (A, B, C, D, E, F)$ be a relation scheme with the following dependencies $C \rightarrow F$, $E \rightarrow A$, $EC \rightarrow D$, $A \rightarrow B$. Which of the following is a key for R ?



[1999: 1 Mark]

A CD

B EC

C AE

D AC



The relation scheme student Performance (name course No, rollNo, grade) has the following functional dependencies:



name, courseNo \rightarrow grade

[1999: 1 Mark]

RollNo, courseNo \rightarrow grade

name \rightarrow rollNo

rollNo \rightarrow name

Find candidate keys?



Consider a relation scheme $R = (A, B, C, D, E, H)$ on which of the following functional dependencies hold:

$\{A \rightarrow B, BC \rightarrow D, E \rightarrow C, D \rightarrow A\}$

What are the candidate keys of R ? [2005: 2 Marks]

- A** AE, BE
- B** AE, BE, DE
- C** AEH, BEH, BCH
- D** AEH, BEH, DEH



Let $R(A,B,C,D,E,F,P,G)$ be a relational schema in which of the following functional dependencies are known to hold:



$A \rightarrow BCD$, $DE \rightarrow P$, $C \rightarrow E$, $P \rightarrow C$ and $B \rightarrow G$.

Find candidate key of Relations R?



Consider a relation R with five attributes V, W, X, Y, and Z. The following functional dependencies hold : $VY \rightarrow W$, $WX \rightarrow Z$, and $ZY \rightarrow V$. Which of the following is a candidate key for R?

[2006: 2 Marks]

- A VXZ
- B VXY
- C VWXY
- D VWXYZ



Relation R has eight attributes ABCDEFGH. Fields of R contain only atomic values.

$F = \{CH \rightarrow G, A \rightarrow BC, B \rightarrow CFH, E \rightarrow A, F \rightarrow EG\}$ is a set of functional dependencies (FDs) so that F is exactly the set of FDs that hold for R.

How many candidate keys does the relation R have? **[2013: 2 Marks]**

- A** 3
- B** 4
- C** 5
- D** 6



Consider the relation scheme $R = (E, F, G, H, I, J, K, L, M, N)$ and the set of functional dependencies $\{ \{EF\} \rightarrow \{G\}, \{F\} \rightarrow \{I, J\}, \{E, H\} \rightarrow \{K, L\}, \{K\} \rightarrow \{M\}, \{L\} \rightarrow \{N\} \}$ on R . What is the key of R ?

[2014: 1 Mark]

- | | |
|------------------------------|------------------------|
| A $\{E, F\}$ | B $\{E, F, H\}$ |
| C $\{E, F, H, K, L\}$ | D $\{E\}$ |



A prime attribute of a relation scheme R is an attribute that appears



[2014: 1 Mark]

- ☐ A In all candidate keys of R.
- ☐ B In some candidate key of R.
- ☐ C In a foreign key of R.
- ☐ D Only in the primary key of R.



Which of the following is NOT a superkey in a relational schema with attributes V, W, X, Y, Z and primary key VY? [2016: 1 Mark]



- A VXYZ
- B VWXZ
- C VWXY
- D VWXYZ

Any Doubt ?



**THANK
YOU!**

