TOPICS TO BE COVERED

01 Membership Set

02 Equality between FD Set

Candidate key : Minimal of Super key.

If $X_{Attribute} \longrightarrow [Prime\ Attribute]$ then Multiple Candidate key Possible.

Q.6 Consider the following relational schema R(ABCDEF) with functional dependency {AB → C, C → D, D → E, E → F, F → B} The number of candidate keys for relation R ?

$P.A = (A, B, F, E, D, C)$

AB is CK

$F → B$

(AF)

$E → F$

AE

$D → E$

AD

$C → D$

AC

$(A)^t = (A)$

$(F)^t = (FB)$

$(E)^t = (EFB)$

$(D)^t = (DEFB)$

$(C)^t = (CDEFB)$

5 C.K

AB
AF
AE   5 CK
AD
AC

R(ABCDE) : {AB→C, BC →D}

Find Candidate keys for the Relation R?

$(AB)^+ = [ABCD]$

E is Not Present in FD then E Must be Present in C·k

Note Whenever Any Attribute Not Present in FD then that Attribute Make a Part of (ADD in) Candidate key

AB
BE $(ABE)^+ = [ABCDE]$
AE

ABE is CK ——①

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

If X Attribute → [Prime Attribute]

No Multiple C·k

Any Doubt ?

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?

$[A]^{+} = [ABCDE]$

$[AF]^{+} = [ABCDEFG]$

$\boxed{\text{AF is Candidate key.}}$ —①

Only 1 C.K

AF <u>Ans</u>

$\begin{array}{l}\text{Prime} \\ \text{Attribute}\end{array} = [A, F]$

$\boxed{\text{If. } X_{\text{Attribute}} \rightarrow [\text{Prime Attribute}]}$

No Multiple C.K

Q.9 R(ABCDEFGH) : {AB→C, AC→B, AD→E, B→D, BC→A, E→G}

Find Candidate keys for the Relation R?

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

$[AB]^+ = [ABCDEG]$

F, H Not Present in FD So

$[ABFH]^+ = [ABCDEFGH]$

$[AFH]^+ = [AFH]$

$[BFH]^+ = [BFHD]$

ABFH is Candidate key —①

ACFH

3Ck
ABFH
BCFH
ACFH

$\underline{BC→A}$

$[BCFH]^+ = [BCFHADEG]$

$[BFH]^+$
$[CFH]^+ = [CFH]$

BCFH is Candidate key —②

ACFH

ABFH already taken

$\underline{AC→B}$

$[ACFH]^+ = [ABCDEFGH]$

$[AFH]^+ = [AFH]$

$[CFH] = [CFH]$

ACFH is c·k —③

$\underline{AB→C}$

ABFH

R(ABDCPT), {B→PT, T→L, A→D}

Find candidate keys for the relation R?

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

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

$$[AB]^+ = [ABDPTL]$$

$$[ABC]^+ = [ABCDPTL]$$

ABC is CK ——①

Prime Attribute = [A, B, C]

No Multiple C.K.

R(ABCDEFGHIJ) = {AB→C, A → DE, B → F, F → GH, D → IJ]

Find candidate keys for the relation R?

$(AB)^+ = (ABCDEFGHIJ)$

$(A)^+ = (ADEIJ)$

$(B)^+ = (BFGH)$

AB is Candidate key —①

Prime/key Attribute = (A, B)

No Multiple ck.

Non Prime/ Non key Attribute = (C, D, E, F, G, H, I, J)

Q.12

R(ABCDEFG)

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

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

Find candidate keys for the relation R?

(Soln) $[A]^+ = [AB]$

$[AC]^+ = [ABCDEFG]$

$$\boxed{AC \text{ is Candidate key}} - ①$$

$B \to A$

$$\underset{C}{\overset{B}{\Big\rangle}} [BC]^+ = [BCADEFG]$$

$[C]^+ = [CDEFG]$

$[B]^+ = [BA]$

$$\boxed{BC \text{ is Candidate key}} - ②$$

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

$$\underline{A \to B}$$

AC already taken

$$\boxed{\begin{array}{c} 2 \text{ CK} \\ AC \\ BC \end{array}} \text{ Ans}$$

Q.13 R(ABCDEFG) {AB→CDEF, C→ADE, D→EBF, F→DA, BE→AF}

Find candidate keys for the relation R?

R(ABCDEFGH) {A→BC, B → DEF, DE → AGH}

Find candidate keys for the relation R?

Q.15 R(ABCDE) {A → BC, CD → E, B → D, E → A}

Find candidate keys for the relation R ?

$(A)^+ = (ABCDE)$

$\boxed{A \text{ is Candidate key}}$ —①

$\text{Prime}_{\text{Attribute}} = (\check{A}, \check{E}, \check{C}, \check{D}, \check{B})$

$E → A$

$(E)^+ = (EABCD)$

$\boxed{E \text{ is Candidate key}}$ —②

$CD → E$

$_{D})\underline{(CD)^+} = (CDEAB)$

$(C)^+ = (C)$

$(D)^+ = (D)$

$\boxed{CD \text{ is Candidate key}}$ —③

$\overset{A}{\textcircled{A}} → BC$

✓ already taken.

$B → D$

$_B^C)(CB)^+ = (CBDAE)$

$(C)^+ = (C)$

$(B)^+ = (BD)$

$\boxed{CB \text{ is CK}}$ —④

$\boxed{\begin{array}{l} 4 \text{ Candidate key} \\ A, \quad CD \\ E, \quad CB \quad \underline{Ans} \end{array}}$

$\underline{A}$ is CK , then A is first super key.

Any super set of A is also super key.

$$\left.\begin{array}{l} \underline{A}\ B \\ \underline{A}\ C \\ \underline{A}\ D \\ \underline{A}\ E \end{array}\right\} \begin{array}{l} \text{Super key} \\ \text{But Not Candidate key.} \end{array}$$

(2 marks)

R(ABCDEFGH) $C \rightarrow F$
$F \rightarrow H$

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

Find candidate keys for the relation R ?

$[AB]^+ = (ABCDEFGH)$

$[A]^+ = (ABCDEFGH)$

$[B]^+ = (B)$

$\boxed{A \text{ is Candidate key}} \ -①$

$H \rightarrow A$

$[H]^+ = (HABCDEFG)$

$\boxed{H \text{ is Candidate key}} \ -②$

$\text{Prime Attribute} = (A, \underline{H}, F, C)$

$F \rightarrow H$

$[F]^+ = (FHABCDEG)$

$\boxed{F \text{ is Candidate key}} \ -③$

$C \rightarrow EF$

$[C]^+ = (CFHABDEG)$

$\boxed{C \text{ is Candidate key}} \ -④$

4 C.K

A
F
H
C

Ans

$\boxed{AB} \rightarrow C$

$\boxed{A} \quad B$

↳ already CK
so AB ✗

SUPER KEY

Minimal → Candidate key (Assume 4 C.K)

Ex) C.K [A, E, BC, CD]

Primary key = [A]

Alternative
or Secondary key = [E, BC, CD]

I Select as → Primary key

Remaining all ck except P.K → Alternative/ Secondary key.

(Note) In a Table (Relation) At Most One Primary key Possible

Primary key $\longrightarrow$ (Unique & NOT NULL).

(Note)

More than One Alternate/Secondary key Possible in a Relation.

Q.1 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]**

Prime Attribute = (A, B, C)

$(AB)^+ = (ABC)$

$(A)^+ = (A)$

$(B)^+ = (B)$

$\dfrac{C \rightarrow A}{}$

$(CB)^+ = (ABC)$

$(C)^+ = (CA)$

AB is Candidate key —①

CB is Candidate key —②

2 Candidate key

AB
BC Or CB

An

Q.2 Let R = (A,B,C,D,E,F) be a relation scheme with the following dependencies C→F, E→A, EC→D, A→B. Which of the following is a key for R?

[ISRO - 2015]

(A) CD

(B) EC

(C) AE

(D) AC

$(CD)^+ = (CDF)$

$(AE)^+ = (AEB)$

$(AC)^+ = (ACBF)$

$(EC)^+ = (EC\,DABF)$

⇓

$(ABCDEF)$

Q.3

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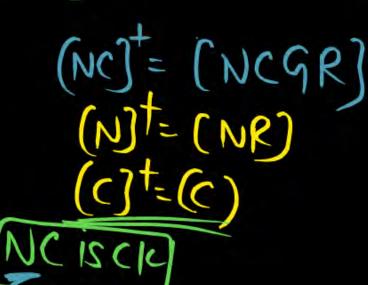
name, courseNo → grade

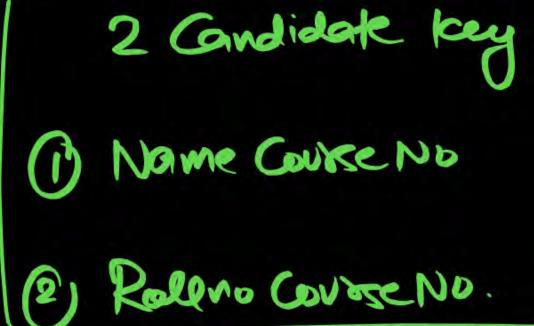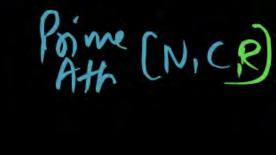$[1999: 1 \text{ Mark}]$

RollNo, courseNo → grade

name → rollNo

rollNo → name

Find candidate keys?

Performance $[N \, C \, R \, G]$

$NC \rightarrow G$
$RC \rightarrow G$
$N \rightarrow R$
$R \rightarrow N$

$(NC)^+ = [NCGR]$

$(N)^+ = [NR]$

$(C)^+ = (C)$

NC is CK

2 Candidate key

① Name CourseNo $\}$ Arg

② Rollno CourseNo.

Prime Att (N, C, R)

$R \rightarrow N$

C)
R) $(RC)^+ = [RCNG]$

$(R)^+ = [RN]$

RC is CK

Q.4 Consider a relation scheme R = (A, B, C, D, E, H) on which of the following functional dependencies hold:

{A → B, BC → D, E → C, D → A}

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

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

ISRO &

A. AE, BE

B. AE, BE, DE

C. AEH, BEH, BCH

D. AEH, BEH, DEH

$[A]^+ = [AB]$
$[AE]^+ = [ABECD]$
$[AEH]^+ = [ABCDEH]$

AEH is Candidate key — ①

$D → A$
$[DEH]^+ = [ABCDEH]$
DEH is CK — ②

BEH
CEH
BC → D
$[BCEH]^+ = [ABCDEH]$
$[CEH]^+ = [CEH]$
$[BEH]^+ = [BEHCDA]$
BEH is CK — ③

Q.5 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:

$AB \to CD$, $DE \to P$, $C \to E$, $P \to C$ and $B \to G$.

Find candidate key of Relations R?

Prime Attribute $= (A, B, F)$

$(AB)^+ = (ABCDEPG)$

$(ABF)^+ = (ABCDEFPG)$

ABF is C.K   —① Ans

Q.6 Consider a relation R with five attributes V, W, X, Y, and Z. The following functional dependencies hold : VY → W, WX → Z, and ZY → V. Which of the following is a candidate key for R?

A   VXZ $[VXZ]^+ = [VXZ]$

B   VXY $[VXY]^+ = [VXYWZ]$

C   VWXY

D   VWXYZ

Super key But
Not Candidate key.

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

4 Candidate key
① AD
② BD
③ ED
④ FD

$R(ABCDEFGH)$ $[CH \rightarrow G, \quad A \rightarrow BC, \quad B \rightarrow CFH, \quad E \rightarrow A, F \rightarrow EG]$

$(A)^+ = [ABCFHEG]$

D is Not Present in FD

$(AD)^+ = [ABCDEFGH]$

$\boxed{AD \text{ is Candidate Key}} - \textcircled{1}$

$\left. \begin{matrix} D \\ E \end{matrix} \right\rangle$ $\underline{E \rightarrow A}$

$(ED)^+ = [ABCDEFGH]$

$(E)^+ = [EABCFGH]$

$\boxed{ED \text{ is } CK} - \textcircled{2}$

Prime Attribute $= [\breve{D}, \breve{A}, \underline{E}, F, \cancel{B}]$

$F \rightarrow \underline{E} G$

$(FD)^+ = [ABCDEFGH]$

$\boxed{FD \text{ is } CK} - \textcircled{3}$

$B \rightarrow C\underline{F}H$

$(BD)^+ = [ABCDEFGH]$

$\boxed{BD \text{ is } CK} - \textcircled{4}$

$\boxed{\begin{matrix} 4 \text{ CK} \\[4pt] AD \\ ED \\ FD \\ BD \end{matrix}} \right\} Ans$

Q.7 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

Key
⇓
Candidate Key

4 Candidate key
① AD
② BD
③ ED
④ FD

Q.8 Consider the relation scheme R = (E, F, G, H, I, J, K, L, M, N) and the set of functional dependencies{{EF} → {G}, {F} → {I,J}, {E,H} → {K,L},{K} → {M},{L} → {N}no R. What is the key of R?

R(EFGHIJKLMN)

[EF→G, F→IJ, EH→KL, K→M L→N]

(A) {E,F}

(B) {E,F,H}

(C) {E,F,H,K,L}

(D) {E}

(d) $(E)^+ = (E)$

(a) $(EF)^+ = (EFGIJ)$

(B) $(EFH)^+ = (EFHGIJKLMN)$

Q.9 A prime attribute of a relation scheme R is an attribute that appears

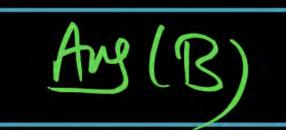A   In all candidate keys of R.

B   In some candidate key of R.

C   In a foreign key of R.

D   Only in the primary key of R.

$$\text{Candidate key} = [A, H, BC, D]$$

$$\text{Prime Attribute} = [A, B, C, D, H]$$

Ans (B)

Q.10 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) V X Y Z

(B) V W X Z → is Not Candidate key

(C) V W X Y

(D) V W X Y Z

Primary key = vy.

Any Suber Set of VY is also Superkey

↳ Because y is Not in this option.

Any Doubt ?