Page No.
Date

[Section - B]

[Answer - 6]

Solⁿ- Equivalence Relation → Reflexive, Symmetric, Transitive

i) Reflexive - If $\delta(q_1, a) = \delta(q_1, a)$
then
$q_1 R q_2 \quad \forall a \in \Sigma$
$\therefore$ R is a reflexive

ii) Symmetric - If $\delta(q_1, a) = \delta(q_2, a)$
$\delta(q_2, a) = \delta(q_1, a)$
then
$q_1 R q_2 = q_2 R q_1$
$\therefore$ R is a Symmetric

iii) Transitive - if $\delta(q_1, a) = \delta(q_2, a)$ — (i)
$\delta(q_2, a) = \delta(q_1, a)$ — (ii)
from (i) & (ii)
$\delta(q_1, a) = \delta(q_3, a)$
$\therefore \quad q_1 R q_3, \; q_1 R q_2 \;\&\; q_2 R q_3$

Therefore, R is a transitive
hence,
R is a equivalence Relation.

Page No.
Date

[Answer − 8]

$S \rightarrow aAa$, $A \rightarrow Sb / bCC / DaA$, $C \rightarrow abb / DD$
$E \rightarrow aC$, $D \rightarrow aDA$

Sol^n: Step-1(a): Construction of V_N'

$W_1 = \{C\}$ as $C \rightarrow abb$
$W_2 = \{W_1\} \cup \{E, A\}$ as $E \rightarrow aC$, $A \rightarrow bCC$
$W_2 = \{C\} \cup \{E, A\}$
$W_2 = \{A, E, C\}$
$W_3 = W_2 \cup \{S\}$
$W_3 = \{S, A, E, C\}$
$W_4 = W_3 \cup \phi$

$V_N' = \{S, A, E, C\}$

Step 1(b) - Construction of P'

$P' = \{A \rightarrow \alpha : A$

$P' = \{S \rightarrow aAa, A \rightarrow bCC / Sb, C \rightarrow abb$
$E \rightarrow aC\}$

$\therefore G' = (\{S, A, E, C\}, \{a, b\}, P', S)$

Step 2: $W_1 = \{S\}$ as $S \rightarrow aAa$
$W_2 = W_1 \cup \{A, a\}$ as $A \rightarrow Sb / bCC$
$W_2 = \{S, A, a\}$
$W_3 = \{S, A, a\} \cup \{S, b, C\}$
$W_3 = \{S, A, a, b, C\}$
$W_4 = W_3 \cup \phi = W_3$

Page No.
Date

$\therefore V_N'' = \{S, A, C\}$

$\Sigma' = \{a, b\}$

$P'' = \{S \to aAa, A \to Sb / bCC, C \to abb\}$

~~Therefore~~ $G'' = (\{S, A, C\}, \{a, b\}, P'', S\}$

is reduced grammar.

[Answer-9]

$S \to aS / AB, A \to \Lambda, B \to \Lambda, D \to b$

Solⁿ:- Step 1:- Construct of the set W of all null variables -

$W_1 = \{A_i \in V_N : A \to \Lambda$ is a production of $P\}$

$W_1 = \{A, B\}$ as $A \to \Lambda$ & $B \to \Lambda$

$W_2 = \{A, B\} \cup \{S\}$ as $S \to AB$

$W_2 = \{S, A, B\}$

$W_3 = W_2 \cup \phi = W_2$

Thus, $W = W_2 = \{S, A, B\}$

Step-2- Construction of P'

i) $D \to b$ is included in P'

ii) $S \to aS$ gives rise to $S \to aS$ & $S \to a$

iii) $S \to AB$ gives rise to $S \to A$ & $S \to B$

here, the required grammar without null P.

$G_1 = (\{S, A, B, D\}, \{a, b\}, P', S)$

where

$P' = \{S \to aS, S \to a, S \to AB, S \to A, S \to B, D \to b\}$

Page No.
Date

[Answer - 10]

$S \to AB$, $A \to a$, $B \to C/b$, $C \to D$, $D \to E$, $E \to a$

Step 1: $w_0(S) = \{S\}$

$w_1(S) = \{S\} \cup \phi$

hence $w(S) = \{S\}$

Similarly

$w_0(A) = \{A\}$

$w_0(B) = \{B\}$

$w_1(B) = w_0(B) \cup \{C\}$

$w_1(B) = \{B, C\}$

$w_2(B) = \{B, C, D\}$

$w_3\{B\} = \{B, C, D, E\}$

Similarly

$w_0(C) = \{C\}$

$w_1(C) = \{C, D\}$

$w_2(C) = \{C, D, E\}$

Similarly

$w_0(D) = \{D\}$

$w_1\{D) = \{D, E\}$

$w_0(E) = \{E\}$

Step 2: The grammar without unit production

$G' = (\{S, A, D, B, C, E\}, \{a\}, P', S)$

where

$P' = \{S \to AB, A \to a, E \to a, B \to b/a, C \to a, D \to a\}$

but if we can see,

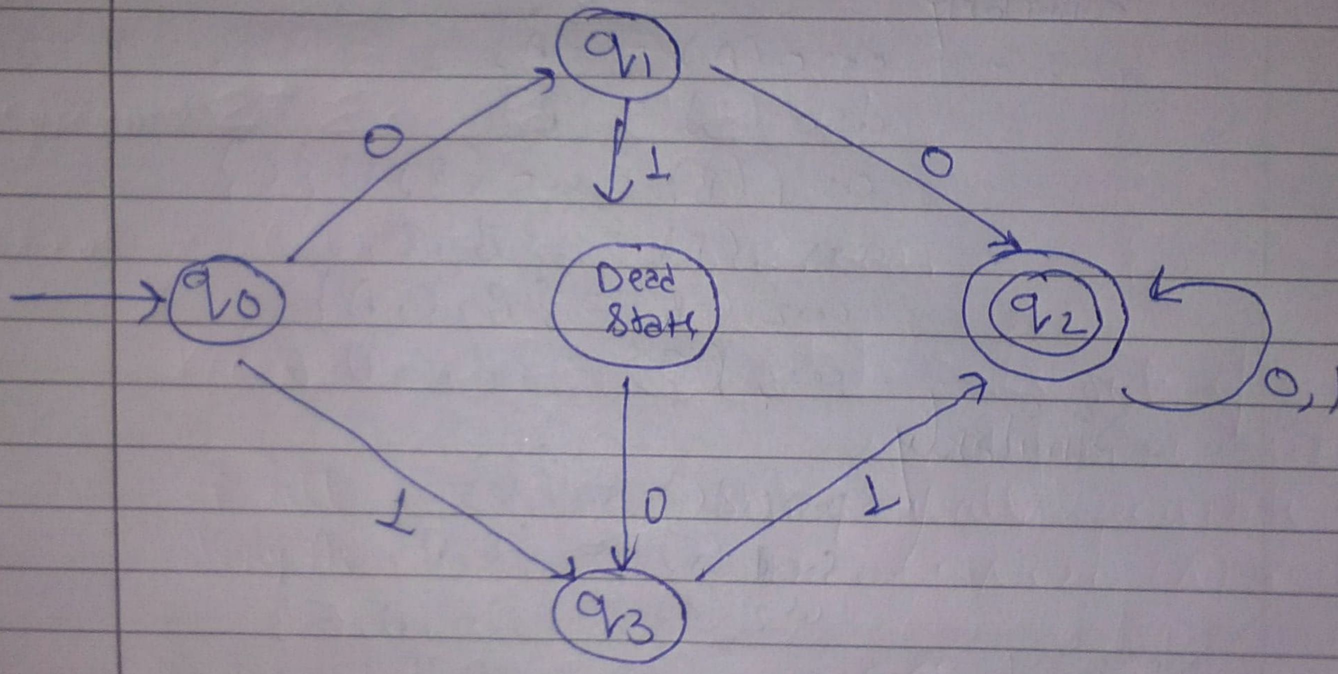
$C \to D$, $D \to E$ & $E \to a$ production are useless

$P' = \{S \to AB, A \to a, B \to b/a\}$

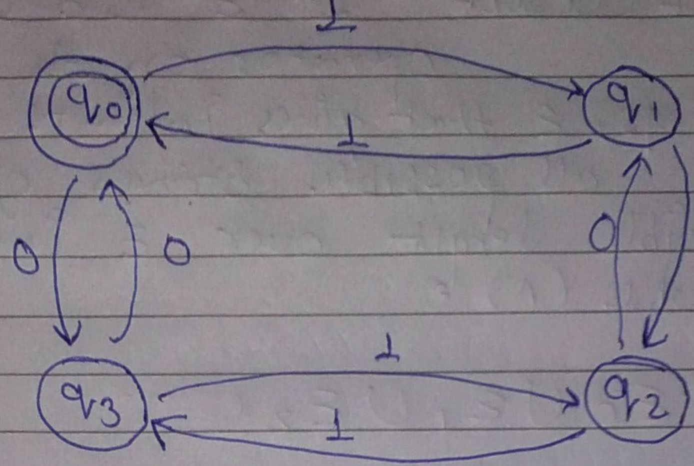
{Section - A}

[Answer - 1]

00 or 11 over {0, 1}



[Answer - 2]



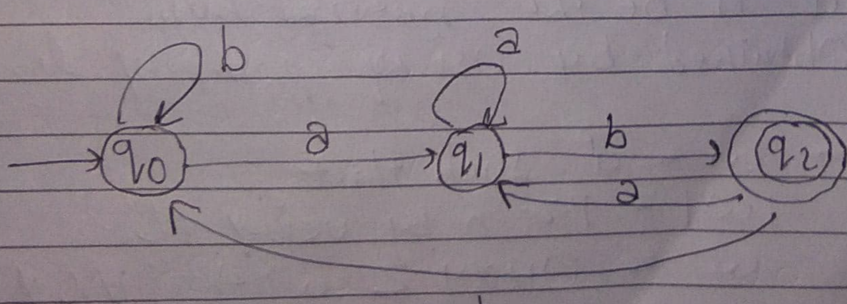
Suppose the string is 1010

$$\delta(q_0, 1010) = \delta(q_1, 010)$$
$$= \delta(q_2, 10)$$
$$= \delta(q_3, 0)$$
$$= \delta(q_0, \wedge)$$
$$= q_0 = \text{final state.}$$

[Answer - 3]

The length of string = ab

The minimum num of states required = 3



(DFA)

Page No.
Date

[Ans - 4]

KLEENE CLOSURE* - It Σ^* is a unary operator on the set of strings, Σ that gives infinite set of all possible strings of all possible length over Σ including NULL (Λ).

represent → $\Sigma^* \; \Sigma_0 \cup \Sigma_1 \cup \Sigma_2 \cup \cdots$

Example - $(a)^* = \{\Lambda, a, aa, aaa, \cdots\}$

KLEENE Closure Plus [Σ^+] - The set of Σ^+ is infinite set of all possible string of all possible length over Σ without NULL (Λ).

Representation - $\Sigma^+ = \Sigma^* - \{\Lambda\}$

[Answer - 5]

$L = \{a^p\}$ P is prime is not.

Step 1: Let L is context free
Let n be the natural num
Obtained by using pumping lemma

Step 2: Let $w = a^p$ such that
$|w| = p > n$ by using PL
$w = uvxyz$ with $|vxy| \leq$
& $|vy| \geq 1$

Page No.
Date

Now, $uv^i x y^i z = a^{p-r-s-t-m} \, a^r a^s a^t a^m$

$u = a^{p-r-s-t-m}$, $v = a^r$, $x \Rightarrow a^s$ $y = a^t$ $z = a^m$

Step 3: for $i = p+1$

$$|uv^i x y^i z| = |uvxyz| + |v^{i-1}| + |y^{i-1}|$$
$$= |a^p| + |a^{r(i-1)}| + |a^{t(i-1)}|$$
$$= p + r(i-1) + t(i-1)$$
$$= p + r(p+1-1) + t(p+1-1)$$
$$= p + rp + tp$$
$$= p(1+r+t)$$

Since, p is prime but $p(1+r+t)$ is not a prime.