Name: Aaditya G Faye
Rollnumber: 29
PRN - 0120190483
Seat no - T214109

5) Regular Expression - $(0+1)(0+1)011(0+1)^*$

D E B C

A

S

$S \rightarrow ABC$
$A \rightarrow DE$
$D \rightarrow 0|1$
$E \rightarrow 0|1$
$B \rightarrow 0.1.1$
$C \rightarrow FC|E$
$F \rightarrow 0|1$

1) Removal of ϵ
$S \rightarrow ABC|AB$
$A \rightarrow DE$
$D \rightarrow 0|1$
$E \rightarrow 0|1$
$B \rightarrow 011$
$C \rightarrow FC|F$
$F \rightarrow 011$

2) Removal of useless symbol
- Every state has terminal so it is generating
- There is terminal state directly and not entering infinity loop so it is reachable

3) Removal of unit production
$C \rightarrow Fc|011$ After removal

Convert SGF to CNF

$S \to ABC \mid AB$ ✓
$A \to DE$ ✓
$D \to 0 \mid 1$ ✓
$E \to 0 \mid 1$ ✓
$B \to 0 \mid 1$ ×
$C \to FC \mid 0 \mid 1$ ✓
$F \to 0 \mid 1$ ✓

• In CNF there should be 2 non-terminal state or one terminal state

After conversion

$S \to AG \mid AB$
$A \to DE$
$D \to 0 \mid 1$
$E \to 0 \mid 1$
$B \to HJ$
$C \to FC \mid 0 \mid 1$
$F \to 0 \mid 1$
$G \to BC$
$H \to 0$
$J \to II$
$I \to 1$

~~GNF~~ ENF to GNF

Let

$S \to A_1$
$A \to A_2$
$G \to A_3$
$B \to A_4$
$D \to A_5$
$E \to A_6$
$H \to A_7$
$J \to A_8$
$C \to A_9$
$F \to A_{10}$
$E \to A_{11}$

$A_1 \rightarrow A_2A_3 \mid A_2A_4$ ×

$A_2 \rightarrow A_5A_6$ ×

$A_5 \rightarrow 0 \mid 1$ ✓

$A_6 \rightarrow 0 \mid 1$ ✓

$A_4 \rightarrow A_7A_8$ ×

$A_9 \rightarrow A_{10}A_9 \mid 0 \mid 1$ ×

$A_{10} \rightarrow 0 \mid 1$ ✓

$A_3 \rightarrow A_4A_9$ ×

$A_7 \rightarrow 0$

$A_8 \rightarrow A_{11}A_{11}$ ×

$A_{11} \rightarrow 1$ ✓

→ No left recursion possible

$A_1 \rightarrow 0A_6A_3 \mid 1A_6A_3 \mid 0A_8A_4 \mid 1A_8A_4$

$A_2 \rightarrow 0A_6 \mid 1A_6$

$A_5 \rightarrow 0 \mid 1$

$A_6 \rightarrow 0 \mid 1$

$A_4 \rightarrow 0A_8$

$A_9 \rightarrow 0A_9 \mid 1A_9 \mid 0 \mid 1$

$A_{10} \rightarrow 0 \mid 1$

$A_3 \rightarrow 0A_6A_9$

$A_7 \rightarrow 0$

$A_8 \rightarrow 1A_{11}$

$A_{11} \rightarrow 1$