



1. Grammar and Language

Objective: This part aims to test the knowledge of student to define grammars and languages with their types classifications under Chomsky hierarchy.

Q1\ (6 Marks)

Define formal language for each of the following productions, where the Start State is S:

1-  $P = \{ (S \rightarrow ASB), (SB \rightarrow AS | 0), (AS \rightarrow SB | 1) \}$

1-  $S \rightarrow ASB \rightarrow A\epsilon \rightarrow \epsilon$  if  $A \rightarrow \epsilon$   
 $S \rightarrow ASB \rightarrow AAS \rightarrow A1 \rightarrow 1$  if  $A \rightarrow \epsilon$   
 $S \rightarrow ASB \rightarrow AAS \rightarrow ASB \rightarrow A\epsilon \rightarrow \epsilon$   
 :

$$\therefore L(G) = \{ w \mid w = \{0, 1\}^* \}$$

2-  $P = \{ (S \rightarrow 0A1B), (0A \rightarrow 0B1), (1B \rightarrow 0AB), (A \rightarrow 0), (B \rightarrow 1) \}$

2-  $S \rightarrow 0A1B \rightarrow 0011$   
 $S \rightarrow 0A1B \rightarrow 0A0AB \rightarrow 00001$   
 $S \rightarrow 0A1B \rightarrow 0B11B \rightarrow 01111$   
 $S \rightarrow 0A1B \rightarrow 0B11B \rightarrow 0B10AB \rightarrow$   
 $0B10B1B \rightarrow 0B10B0AB \rightarrow 01101001$

$$\therefore L(G) = \{ w \mid w = 0(1+0)^n 1, n \geq 2 \}$$

Q2/(7 Marks)

Construct context free grammars (formal definition) that accept the following languages:

1-  $L = \{ W \mid W \in (a + b)^* \text{ such that number of } a\text{'s equal to the number } b\text{'s} \}$

$$P = \{ S \rightarrow aSb \mid bSa \mid A, \\ A \rightarrow ba \mid ab \mid \epsilon \}$$

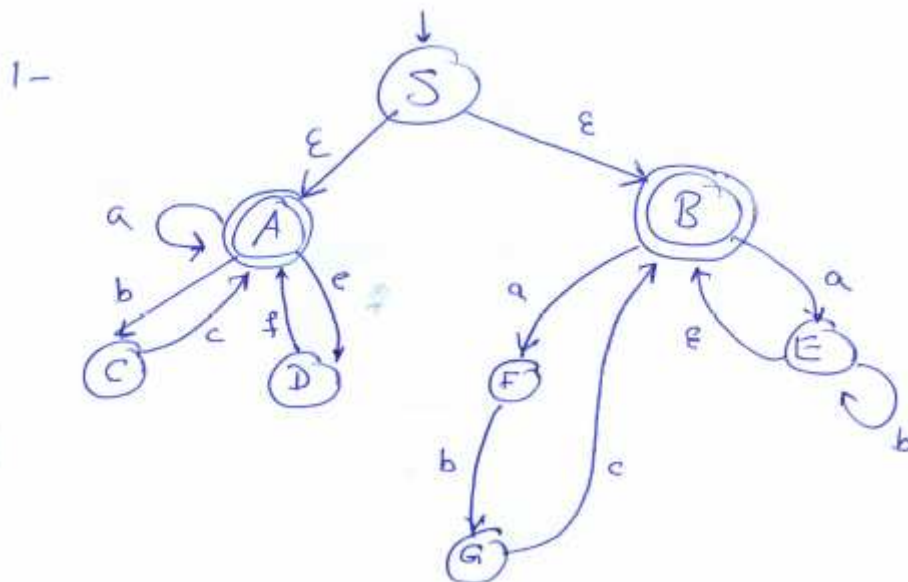
2-  $L = \{ (ab)^n (ba)^n \mid n \geq 0 \}$

$$P = \{ S \rightarrow abSba \mid A, A \rightarrow \epsilon \}$$

Q3/(7 Marks)

Draw transition graph for the following regular expressions

1-  $(a + bc + ef)^* + (ab^* + (abc)^*)^*$



2-  $(ac(a+(b+e)^*)^*+ab)^*$

