**Name:- KRUNAL RANK**

**Roll No:- U18CO081**

**Class:- Btech III , Computer Eng.**

**Sem:- Semester 6**

System
Softwares
Tutorial 10

**Ans1:** Some of the types of Grammars are as follows:-
- Type 0 : Unrestricted Grammar :- It is recursively enumerable grammer.
- Type 1 :- Content Sensitive Grammar:- It is content sensitive language.
- Type 2 :- Content free Grammar :- It is content free language.
- Type 3 :- Regular Grammar :- It is regular language.

**Ans 2:**

i)
$$E \rightarrow E+T \mid T$$
$$T \rightarrow T \times F \mid F$$
$$F \rightarrow id$$

Converting it into Left Recursive Grammar,

$$E \rightarrow TE'$$
$$E' \rightarrow \cancel{E+E} +TE' \mid \varepsilon$$

$$T \rightarrow FT'$$
$$T' \rightarrow *FT' \mid \varepsilon$$
$$F \rightarrow (E) \mid id$$

$S \rightarrow L|a$

$L \rightarrow L \cdot S|S$

(i) Eliminating Left Recursion,

$S \rightarrow aS'$

$S' \rightarrow LS'|\varepsilon$

$L \rightarrow SL'$

$L' \rightarrow \cdot SL'|\varepsilon$

iv) $X \rightarrow XSb|Sa|b$

$S \rightarrow Sb|Xa|a$

Eliminating Left Recursion,

$X \rightarrow SaX'|bX'$

$X' \rightarrow SbX'|\varepsilon$

$S \rightarrow Sb|Xa|a$

$S' \rightarrow aS'|XaS'$

$S' \rightarrow bS'|\varepsilon$

iii) $S \rightarrow A$

$A \rightarrow Ad|Ae|aB|ac$

$B \rightarrow bBc|f$

Eliminating Left Recursion,

$S \rightarrow A$

$A \rightarrow aBA'|acA'$

$A' \rightarrow dA'|eA'|\varepsilon$

$B \rightarrow bBc|f$

(3.) $S \rightarrow SS$

$S \rightarrow a$  $\Rightarrow$  $S \rightarrow SS|a|b$

$S \rightarrow b$

$S \rightarrow SS$

$SS \rightarrow aS$

$aS \rightarrow aaS$

$aaS \rightarrow aab aab$

$S \rightarrow SS$

$SS \rightarrow aS$

$aS \rightarrow aSb$

$aSb \rightarrow aab$

Hence, it is ambiguous.

ii) let us consider a string W = ab



Since 2 different parse trees exist for w, the grammar is ambiguous.

iii) $S \rightarrow aSbS \mid bSaS \mid \varepsilon$

Let us consider a string w = abab



Since 2 different parse trees exist for w, the grammar is ambiguous.