UNIT II CONTEXT FREE GRAMMER

1. Let G = ({S,C}, {a,b}, P,S} where P consists of S → aCa, C→ aCa, Find L(G))?

Solution:
S → aCa
→ aaCaa C→ aCa
.
.

→ a_nCa_n
→ a_nba_n C → b
L (G) = { a_nba_n ; n >0}

2. Consider G whose productions are S→ aAS/ a ,A→SbA / SS / ba, show that → aabbaa and

construct a derivation tree.

Solution: S
S → aAs
→ aSbAs A →SbA a A S
→ aabAS S →a a
→ aabbaS A→ba S b A
→ aabbaa S→a
a b a

3. Find L(G) where G = ({S},{0,1}, {S→0S1, s→ε },S)

Solution:
S → 0S1
→ 00S11
.
.
.
→ 0_nS1_n
L (G) = { 0_n1_n ; n >0}

4. Define a derivation tree for CFG.

A derivation tree for a CFG G=(V,T,P,S) is a tree satisfying the following

- Every vertex has a label, which is a symbol of V U T U ε
- The label of the root is S.
- If a vertex is interior and has a label A, then A must be in V.
- If n has a label A and vertices n1, n2,……nk are sons of the vertex n, in x1,x2,……xk must be a production in P.
- If vertex n has label ε, then n is a leaf and is the only son of its father.

5. Construct CFG L= { a_nb_n ; n≥1}.

Solution:
The Production are
S → aSb / ε, where G= ({S}, {a,b,ε}, P, S)

6. Find a LM derivation for aaabbabbba with the productions.

P : S → aB / bA, A → a /S / bAA, B → b / bS / aBB

Solution:

S → aB → aaBB → aaaBBB→aaabBB→ aaaabbB→aaabbaBB→aaabbabB
→ aaabbabbS → aaabbabbbA
S → aaabbabbba

7. Find L(G), S → aSb, S → ab.

Solution:

S → aSb
→ aaSbb C→ aSb
.
.
➔ $a_n S b_n$
➔ $a_n b_n$ C → ab

L (G) = { $a_n b_n$; $n \geq 1$}

8. Show that id* id can be generated by two distinct leftmost derivation in the grammar

E→ E+E / E*E / (E) / id

Solution:

(i)	(ii)
E → E +E	E → E *E
→id+E	→ E +E*E
→id+E*E	→E+E*id
→id+id*E	→E+id*id
→id+id*id	→id+id*id

We showed that id+id*id can be generated by two distinct LMD.

9. Define pushdown automaton.

A Pushdown Automata is a finite automation with extra resource called stack.
It consists of 7 tuples.

P = (Q, Σ, Γ, δ, q_0, Z_0, F)

Where

Q – Finite set of states
Σ - Finite set of input symbols
Γ - Finite set of stack symbols
δ - Transition function
q_0 – Start State
Z_0 – Start symbol of the stack
F – Final State.

10. What are the different ways of language acceptances by a PDA and define them.

i) Acceptance by final state

L (M) = { w | (q_0, w, z_0) |--*(p, ε, γ) for some P in F and γ in |--*}

ii) Acceptance by empty stack

N (M) = { w | (q_0, w, z_0) |--*(p, ε, ε) for some P in Q}

PART-A

1. Define CFG.2.Find L(G)where G=({S},{0,1},{S->0S1,S->ε},S).
2. Define derivation tree for a CFG(or)Define parse tree.
3. Construct the CFG for generating the language L={$a^n b^n$/n>=1}.
4. Let G be the grammar S->aB/bA,A->a/aS/bAA,B->b/bS/aBB.for the string aaabbabbba find the left most derivation.
5. Let G be the grammar S->aB/bA,A->a/aS/bAA,B->b/bS/aBB.obtain parse tree for the string aaabbabbba.
6. For the grammar S->aCa,C->aCa/b.Find L(G).
7. Show that id+id*id can be generated by two distinct leftmost derivation in the grammar E->E+E | E*E | (E) | id .
8. For the grammar S->A1B,A->0A | ε, B-> 0B | 1B| ε,give leftmost and rightmost derivations for the string 00101.
9. Find the language generated by the CFG G=({S},{0,1},{S->0/1/ ε, S->0S0/1S1},S).
10. obtain the derivation tree for the grammar G=({S,A},{a,b},P,S) where P consist of S->aAS / a, A->SbA / SS / ba.
11. Consider the alphabet ∑={a,b,(,),+,*, ., ε} .Construct the context free grammar that generates all strings in ∑* that are regular expression over the alphabet {a,b}.
12. Write the CFG to generate the set {$a^m b^n c^p$ | m + n=p and p>=1}.
13. Construct a derivation tree for the string 0011000 using the grammar S->A0S |0 | SS , A-> S1A | 10.
14. Give an example for a context free grammar.
15. Let the production of the grammar be S-> 0B | 1A, A-> 0 | 0S | 1AA, B-> 1|1S | 0BB.for the string 0110 find the right most derivation.
16. What is the disadvantages of unambiguous parse tree. Give an example.

PART-B

1. a) Let G be a CFG and let a=>w in G. Then show that there is a leftmost derivation of w.

   b) Let G=(V,T,P,S) be a Context free Grammar then prove that if S=> αthen there is a derivation tree in G with yield α.

2. Let G be a grammar s->OB/1A, A->O/OS/1AA, B->1/1S/OBB. For the string 00110101 find its leftmost derivation and derivation tree.

3) a) If G is the grammar S->Sbs/a, Show that G is ambiguous.

b) Give a detailed description of ambiguity in Context free grammar

4. a) Show that E->E+E/E*E/(E)/id is ambiguous. (6) b)Construct a Context free grammar G which accepts N(M), where M=({q0, q1},{a,b},{z0,z},δ,q0,z0,Φ) and where δis given by

δ(q0,b,z0)={(q0,zz0)}

δ(q0, ε,z0)={(q0, ε)}

δ(q0,b,z)={(q0,zz)}

δ(q0,a,z)={(q1,z)}

δ(q1,b,z)={(q1, ε)}

δ(q1,a,z0)={(q0,z0)}

5. a)If L is Context free language then prove that there exists PDA M such that L=N(M).

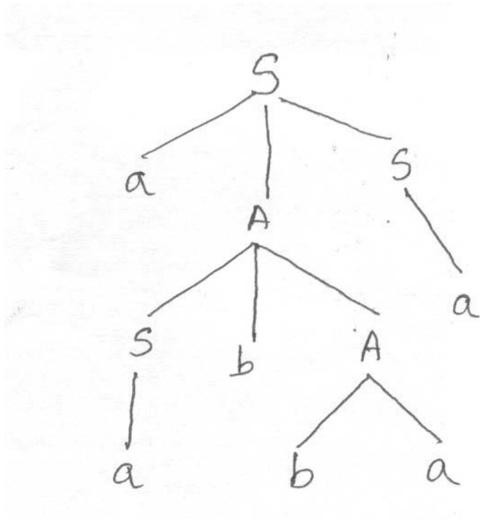
b)Explain different types of acceptance of a PDA.Are they equivalent in sense of language acceptance? Justify your answer.

6. Construct a PDA accepting $\{a^n b^m a^n /m,n>=1\}$ by empty stack. Also construct the corresponding context-free grammar accepting the same set.

7. a) Prove that L is L(M2) for some PDA M2 if and only if L is N(M1) for some PDA M1.

b)Define deterministic Push Down Automata DPDA. Is it true that DPDA and PDA are equivalent in the sense of language acceptance is concern? Justify Your answer.

8.a) Construct a equivalent grammar G in CNF for the grammar G1 where G1 =({S,A,B},{a,b},{S->bA/aB,A->bAA/aS/a, B->aBB/bS/b},S) b)Find the left most and right most derivation corresponding to the tree.



9. a) Find the language generated by a grammar

G=({S},{a,b},{S->aSb, S->ab},S) (4)

b) Given G=({S,A},{a,b},P,S) where P={S->AaS|S|SS,A->SbA|ba}
S-Start symbol. Find the left most and right most derivation of the string w=aabbaaa. Also construct the derivation tree for the string w.

c) Define a PDA. Give an Example for a language accepted byPDA by empty stack.

10. G denotes the context-free grammar defined by the following rules. ` S->ASB/ab/SS A->aA/A ,B->bB/A

(i)Give a left most derivation of aaabb in G. Draw the associated parse tree.

(ii)Give a right most derivation of aaabb in G. Draw the associated parse tree.

(iii) Show that G is ambiguous. Explain with steps.

(iv) Construct an unambiguous grammar equivalent to G. Explain.