Tutorial Sheet – I (Module-II)

Course: B. Tech (CSE) **Year/Semester: 3rd , VI** **Session: 2022-23**

Subject Name & Code: Theory of Automata & Formal Languages (BCSC0011)

Max. Marks: 10 **Time allowed: 50 Min.**

Q1. Write a CFG, which generates palindrome for binary numbers.

Q2. Write CFG for L={ $a^n b^n$/ n>=1}.

Q3. Write CFG for L={ ww^R/ w€$(0,1)^*$}.

Q4. Write CFG for L={ $a^n b^n c^m d^m$/ n>=1, m>=1}.

Q5. Write CFG for L={ $a^n b^{2n}$ / n>=0}.

Q6. Write CFG for L={ $a^n b^n c^m$ / n, m>=0}.

Q7. Discuss the following with examples:

- Derivation tree
- Ambiguity
- Elimination of Ambiguity

Tutorial Sheet – II (Module-II)

Course: B. Tech (CSE) **Year/Semester: 3rd , VI** **Session: 2022-23**

Subject Name & Code: Theory of Automata & Formal Languages (BCSC0011)

Max. Marks: 10 **Time allowed: 50 Min.**

Q1. Simplify the grammar by eliminating useless symbols and useless productions:

S→a | aA | B | C A→aB | ε B→ Aa C→cCD D→dd.

Q2. Convert the following in GNF:

S→AB A→aA | bAa |a B→bbA |aB | AB C→aCa|aD D→aD | bC

Q3. The following Grammar generates the language of regular expression 0*1(0+1)*:

S→A1B A→0A|ε B→0B|1B|ε

Give the leftmost and right most derivation of the following strings

a)00101 b)1001.

Q4. Define Ambiguity with help of an example. Also explain inherent ambiguity. Show that following Grammar is Ambiguous:

S → AB | C A → aAb | ab B → cBd | cd C → aCd |aDd D → bDc | bc

Q5. State Pumping Lemma for CFL. Prove that following Language is not CFL:

L1={$a^n b^n c^n$ | n≥1}

L2={ a^p | p is prime number}.

Q6. Explain the steps to remove null productions from a CFG with suitable example.

Tutorial Sheet – III (Module-II)

Course: B. Tech (CSE) **Year/Semester: 3rd , VI** **Session: 2022-23**

Subject Name & Code: Theory of Automata & Formal Languages (BCSC0011)

Max. Marks: 10 **Time allowed: 50 Min.**

Q1. Design PDA to accept each of the following languages. You may accept either by final state or by empty stack, whichever is more convenient.

a. $L=\{ a^n b^n \mid n \geq 1\}$
b. The set of all strings of 0's and 1's with equal number of 0's and 1's.

Q2.Convert the following grammar to PDA:

a) $S \rightarrow 0S1 \mid A$
$A \rightarrow 1A0 \mid S \mid 1$

(b) $S \rightarrow aAA$
$A \rightarrow bB \mid aB \mid a$
$B \rightarrow aAA$

Q3. Consider the given PDA M=({q0}, {0,1}, {a,b,Z0}, δ, q0, Z0, Ø)

Where δ is defined as follows:
δ (q0 , 0, Z0)= {(q0, aZ0)}
δ(q0,1,Z0)={(q0, bZ0)}
δ (q0 , 0, a)= {(q0, aa)}
δ (q0 ,1, b)= {(q0, bb)}
δ (q0 , 0, b)= {(q0, ε)}
δ (q0 , 1, a)= {(q0, ε)}
δ (q0 , ε, Z0)= {(q0, ε)}
Convert the given PDA M to corresponding CFG. [UPTU2006/8]

Q4. Explain the working of PDA.

Q5. Convert the given CFG into CNF

$S \rightarrow S + S \mid S^* S \mid S \cup S \mid a \mid b$

Q6. Explain the steps to remove unit productions from a CFG with suitable example.

Assignment Sheet – I (Module-II)

Course: B. Tech (CSE) **Year/Semester: 3rd , VI** **Session: 2022-23**

Subject Name & Code: Theory of Automata & Formal Languages (BCSC0011)

Max. Marks: 10 **Time allowed: 50 Min.**

1. Design a CFG for the language L={a^{4n}/ n>0}.
2. Give the Chomsky hierarchy of grammar specifically the form of production rules in each class of grammar.
3. What is Ambiguity in a grammar? Write the steps to remove the ambiguity in any grammar. [GATE 2010]
4. The given grammar is:

   $S \rightarrow aB / bA$

   $A \rightarrow a / aS / bAA$

   $B \rightarrow b / bS / aBB$

   Find leftmost derivation and rightmost derivation for the string **aaabbabbba.**
5. Context free languages are closed under intersection. Prove the statement or give a counter example. [UPTU 2006]
6. Remove the useless symbol from the given context free grammar:
   S->aB/bX
   A->BAd/bSX/a
   B->aSB/bBX
   X->SBD/aBx/ad
8. Consider the context free grammar G:
   S->AB
   A->a
   B->C/b
   C->D/aB
   D->E/b , E->a. Remove the unit production and reduce the grammar.
9. Write CYK algorithm with example. [GLAU 2011]
10. State and prove pumping lemma for CFL with example.
11. Construct PDA for
    {$a^n b^{3n}$/n>0}. [GLAU2012]
    {$a^n b^m c^n$ /n,m>0}
    {$a^n b^n$/n>0}
13. Prove that if L is a CFL and R is a regular then, L∩R is a CFL.
14. Construct a PDA accepting all palindromes over {a,b}. [UPTU 2008]
15. Find a grammar in GNF equivalent to the grammar:
    E->E+T/ T, T->T*F/ F, F-> (E) /a [RGPV 2005]

Some Extra questions for practice Session

1. **Explain why the grammar this is ambiguous. S → 0A | 1B A → 0AA | 1S | 1 B → 1BB | 0S | 0**
2. **Given the following ambiguous context free grammar S → Ab | aaB A → a | Aa B → b**
   (a)Find the strings generated by the grammar that has two leftmost derivations. Show the derivations.
   (b) Show the two derivation trees for the strings.
   (c) Give the unique leftmost derivation and derivation tree for the string s generated from the grammar.
3. **state and prove pumping lemma for CFG.**

4. **Eliminate null productions**

   S -> aSb/aAb/ab/a

   A -> ε

5. **Eliminate null productions**

   S -> AB

   A -> aAA/ε

   B -> bBB/ε

6. **Prove that given grammar is ambiguous**

S->0s/1AA

A->0/1A/0B

B->1/0BB for string 0100110

7. **for the grammar S->aAS/a, A->SbA/SS/ba. To generate the string aabaaabbaaa find:**

a. **LMD**

b. **RMD**

c. **Parse tree**

8. **Reduce the given CFG into CNF**

   S->~S/[SX]/p/q (S being only variable)

9. **Reduce the given CFG into CNF**

   S->bA/aB

   A->bAA/aS/a

   B->aBB/bS/b

10. **convert the grammar into GNF**

    S->AB

    A->BS/a

    B->SA/b

11. **Eliminate unit production from the given grammar**

E->E+T/T

T->T*F/F

F->(E)/a

12. Eliminate unit production from the given grammar

S->AB

A->a

B->C/b

C->D

D->E

E->a