FORMAL LANGUAGE AND AUTOMATA THEORY
UNIT II

PART A

1. Push down automata accepts which language
a) Context sensitive language
b) Context free language
c) Recursive language
Answer: d)

2. A context free grammar G is in Chomsky normal form if every production is of the form
a) A → BC or A → A
b) A → BC or A → a
c) A → BCa or B → b
d) None of these
Answer: b)

3. Which of the following statement is false?
a) A recursive language is also a regular language
b) A context free language is also a regular language
c) A context free language is also recursive enumerable language
d) Both (a) and (b)
Answer: b)

4. A context free language is called ambiguous if
a) It has two or more leftmost derivations for some terminal string w ϵ L (G)
b) It has two or more leftmost derivations for some terminal string w ϵ L (G)
c) Both (a) and (b)
d) None of these
Answer:c)

5. Which of the following statement is false?
a) The context free language can be converted into Chomsky normal form
b) The context free language can be converted into Greibach normal form
c) The context free language is accepted by pushdown automata
d) None of these
Answer:d)

6. The language $L=\{0^m1^m0^m \mid m \geq 1\}$ is a
a) Regular language
b) Context free language
c) Both (a) and (b)
d) None of these
Answer:d)

7. While converting the context free grammar into Greibach normal form, which of the following is not necessary
a) Elimination of null production
b) Elimination of unit production

c) Converting given grammar in Chomsky normal form
d) None of these
Answer:d)

8. The context free grammar S → A111|S1, A → A0 | 00 is
equivalent to a) $\{0^n1^m \mid n=2, m=3\}$
b) $\{0^n1^m \mid n=1, m=5\}$
c) $\{0^n1^m \mid$ n should be greater than two and m should be greater than four$\}$
d) None of these
Answer:a)

9. The context free grammar S → SS | 0S1 | 1S0 | ε generates
a) Equal number of 0's and 1's
b) Unequal number of 0's and 1's
c) Any number of 0's followed by any number of 1's
d) None of these
Answer:a)

10. Which of the following statement is false?
a) In derivation tree, the label of each leaf node is terminal
b) In derivation tree, the label of all nodes except leaf nodes is a variable
c) In derivation tree, if the root of a sub tree is X then it is called –tree
d) None of these
Answer:d)

11. Push down automata accepts which language
a) Context sensitive language
b) Context free language
c) Recursive language
d) None of these

Answer: b)

12. A context free grammar G is in Chomsky normal form if every production is of the form
a) A → BC or A → A
b) A → BC or A → a
c) A → BCa or B → b
d) None of these
Answer:b)

13. Which of the following statement is false?
a) A recursive language is also a regular language
b) A context free language is also a regular language
c) A context free language is also recursive enumerable language
d) Both (a) and (b)
Answer: b)

14. A context free language is called ambiguous if

a) It has two or more leftmost derivations for some terminal string w ϵ L (G)
b) It has two or more leftmost derivations for some terminal string w ϵ L (G)
c) Both (a) and (b)
d) None of these
Answer:c)

15. Which of the following statement is false?
a) The context free language can be converted into Chomsky normal form
b) The context free language can be converted into Greibach normal form
c) The context free language is accepted by pushdown automata
d) None of these
Answer:d)

16. The language L={$0^m1^m0^m$| m ≥ 1} is a
a) Regular language
b) Context free language
c) Both (a) and (b)
d) None of these
Answer:d)

17. While converting the context free grammar into Greibach normal form, which of the following is not necessary
a) Elimination of null production
b) Elimination of unit production
c) Converting given grammar in Chomsky normal form
d) None of these
Answer:d)

18. The context free grammar S → A111|S1, A → A0 | 00 is
equivalent to a) {0^n1^m | n=2, m=3}
b) {0^n1^m | n=1, m=5}
c) {0^n1^m | n should be greater than two and m should be greater than four}
d) None of these
Answer:a)

19. The context free grammar S → SS | 0S1 | 1S0 | ε generates
a) Equal number of 0's and 1's
b) Unequal number of 0's and 1's
c) Any number of 0's followed by any number of 1's
d) None of these
Answer:a)

20. Which of the following statement is false?
a) In derivation tree, the label of each leaf node is terminal
b) In derivation tree, the label of all nodes except leaf nodes is a variable
c) In derivation tree, if the root of a sub tree is X then it is called –tree
d) None of these

Answer:d)

21. A CFG is closed under

a) Union

b) Kleene star

c) Concatenation

d) None of the mentioned

Answer: (d)

2. **Which of these does not belong to CFG?**

a) Terminal Symbol

b) Non terminal Symbol

c) Start symbol

d) End Symbol

Answer: d)

3. **The context free grammar S → SS | 0S1 | 1S0 | ε generates _____**
a) Equal number of 0's and 1's
b) Unequal number of 0's and 1's
c) Number of 0's followed by any number of 1's
d) Equal number of 0's

Answer: a)

4. **Assume the statements S1 and S2 given as:**

S1: Given a context free grammar, there exists an algorithm for determining whether L (G) is infinite.

S2: There exists an algorithm to determine whether two context free grammars generate the same language. Which of the following is true?

a) S1 is correct and S2 is not correct

b) Both S1 and S2 are correct
c) Both S1 and S2 are not correct
d) S1 is not correct and S2 is correct

Answer: a

5. **If P & R are regular and also given that if PQ=R, then?**

a) Q has to be regular
b) Q cannot be regular
c) Q need not be regular
d) Q has to be a CFL

Answer: c

PART B

1. Consider the following statements about the context free grammar
   G = {S -> SS, S -> ab, S -> ba, S -> ?}
   I. G is ambiguous
   II. G produces all strings with equal number of a's and b's
   III. G can be accepted by a deterministic PDA

   which combination below expresses all the true statements about G?
   A. I only
   B. I and III only
   C. II and III only
   D. I, II and III

   Answer : B. I and III only

2. Which one of the following statements is FALSE?
   A. There exist context-free languages such that all the context-free grammars generating them are ambiguous.
   B. An unambiguous context free grammar always has a unique parse tree for each string of the language generated by it.
   C. Both deterministic and non-deterministic pushdown automata always accept the same set of languages.
   D. A finite set of string from one alphabet is always a regular language

Answer: C. Both deterministic and non-deterministic pushdown automata always accept the same set of languages.

3. Let us now consider the following grammar:

Set of alphabets ∑ = {0,…,9, +, *, (,)}
E -> I
E -> E + E
E -> E * E
E -> (E)
I -> ε | 0 | 1 | … | 9

From the above grammar String 3*2+5 can be derived in 2 ways:

I) First leftmost derivation	II) Second leftmost derivation
E=>E*E	E=>E+E
=>I*E	=>E*E+E
=>3*E+E	=>I*E+E
=>3*I+E	=>3*E+E
=>3*2+E	=>3*I+E
=>3*2+I	=>3*2+I
=>3*2+5	=>3*2+5

Which combination below expresses all the true statements about G?
A. I only
B. Both I and II
C. II only
D. Neither I nor II

Answer: B. Both I and II

4. Consider the following statements about the context free grammar

G = {S->SS, S->ab, S->ba, S->Ɛ}

- **I** G is ambiguous
- **II** G produces all strings with equal number of a's and b's
- **III** G can be accepted by a deterministic PDA

Which combination below expresses all the true statements about G?

A. I only
B. I and III only
C. II and III only
D. I, II and III

Answer: B I and III only

5. **Identify and remove the unit productions from the following CFG**

S -> S + T/ T
T -> T * F/ F
F -> (S)/a

Consider

i. S->S + T/ T * F/ (S)/ a
T -> T * F/ F
F -> (S)/ a

ii. S->S + T/ T + F/ (S)/ a
T -> T * F/ F
F -> (S)

Which combination below expresses all the true statements about G?

A. I only
B. II only
C. Both I and II
D. Both I and II

Answer: A. I only

6. What are the three ways to simplify a context free grammar?

i. By removing the useless symbols from the set of productions.

ii. By eliminating the empty productions.

ii. By eliminating the unit productions.

Which of the above statements are true

a. i true

b. ii true

c. i and ii true

d. i , ii and iii true

Answer d. i , ii and iii true

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7. Which of the following CFG's can't be simulated by an FSM ?
i. S --> Sa | b
ii. S --> aSb | ab
iii.S --> abX, X --> cY, Y --> d | aX
iv. None of these

Which of the following option justifies the above question

A. Option (ii) generates the set {a^n b^n ,n=1,2,3 ....}which is not regular ,
B. Option (i) is left linear
C. Option (iii) is right linear .

Answer Option (ii) generates the set {a^n b^n ,n=1,2,3 ....} which is not regular

8. Correct hierarchical relationship among context- free, right-linear, and context-sensitive language is

A. Context-free ⊂ right-linear ⊂ context-sensitive
B. context-free ⊂ context-sensitive ⊂ right-linear
C. Context-sensitive ⊂ right-linear ⊂context-free
D. Right-linear ⊂context-free ⊂context-sensitive

Answer: Right-linear ⊂context-free ⊂context-sensitive

9. For the language **L = {$x^n y^n z^n$ | n ≥ 1}**

Let **L** is context free. Then, **L** must satisfy pumping lemma.

At first, choose a number **n** of the pumping lemma. Then, take z as $0^n1^n2^n$.

Break **z** into **uvwxy,** where

|vwx| ≤ n and vx ≠ ε.

Hence **vwx** cannot involve both 0s and 2s, since the last 0 and the first 2 are at least (n+1) positions apart.

There are two cases −

Case 1 − **vwx** has no 2s. Then **vx** has only 0s and 1s. Then **uwy**, which would have to be in **L**, has **n** 2s, but fewer than **n** 0s or 1s.

Case 2 − **vwx** has no 0s.

From the above statements

i. **L** is not a context-free language

ii **L** is a context-free language

iii. **L** is not a PDA

iv **L** is a PDA

Which of the above statements are true?

A. I only
B. I and II only
C. II only
D. II and III only
Answer A. I only

10. **From the following –**

S → ASA | aB | b, A → B, B → b | ∈ which is the resultant production set after removing null production

i. S→ASA | aB | b | a | SA | AS | S, A → B| b, B → b
ii. A → B, B → b
iii. S → ASA | aB | b
iv. S → ASA | aB | b, A → B

A. I only
B. i and ii only
C. i , ii , iii only
D. ii, iii, iv only

Answer A. I only

PART C

1. **Consider the given grammar G1:**

S → XA|BB
B → b|SB
X → b
A → a

Consider:

1. S → bA| bCB|bABCB|bB|bABB

B → bC|bABC|b|bAB
C → BBC

C → bCB|bABCB|bB|bABB 6
X → b
A → a

2. S → bA| bCB|bABCB|bB|bABB
B → bC|bABC|b|bAB5
C → BBC|BB
X → b
A → a

3. S → XA|BB
B → b|XAB|BBB 1
X → b
A → a

4. S → bA|BB
B → bC|bABC|b|bAB4
C → BBC|BB
X → b
A → a

5. S → bA|BB
B → b|bAB|BBB 2
X → b
A → a

6. S → bA|BB
B → bC|bABC 3
C → BBC| ε
X → b
A → a

7. S → bA| bCB|bABCB|bB|bABB
B → bC|bABC|b|bAB
C → bCBC|bABCBC|bBC|bABBC 7
C → bCB|bABCB|bB|bABB
X → b
A → a

Under the following options which are the steps to be followed to achieve the GNF 7

A. 3, 5, 6, 4, 2, 1, 7
B. 1, 2, 3, 4, 5, 6, 7

C. 5, 6, 3, 4, 1, 2, 7
D. 3, 6, 4, 5, 1, 2, 7

Answer: 3, 5, 6, 4, 2, 1, 7

2. Let us take an example to convert CFG to CNF. Consider the given grammar G1:

S → ASB
A → aAS|a|ε
B → SbS|A|bb

Consider:

1. S0->S

S → ASB|SB
A → aAS|aS|a
B → SbS| A|ε|bb

2. S0-> AS|ASB| SB

S → AS|ASB| SB
A → XAS|XS|a
B → SYS|bb|XAS|XS|a
X →a
Y→b

3. S0-> AS|ASB| SB

S → AS|ASB| SB
A → XAS|XS|a
B → SYS|VV|XAS|XS|a
X → a
Y → b
V → b

4. S0->S

S → AS|ASB| SB| S
A → aAS|aS|a
B → SbS|bb|aAS|aS|a

5. S0-> AS|ASB| SB

S → AS|ASB| SB
A → aAS|aS|a

B → SbS|bb|aAS|aS|a

6. S0->S

S → AS|ASB| SB| S
A → aAS|aS|a
B → SbS| A|bb

7. S0-> AS|ASB| SB| S

S → AS|ASB| SB| S
A → aAS|aS|a
B → SbS|bb|aAS|aS|a

8. S0-> AS|PB| SB

S → AS|ASB| SB
A → XAS|XS|a
B → SYS|VV|XAS|XS|a
X → a
Y → b
V → b
P → AS

9. S0->S

S → AS|ASB| SB| S
A → aAS|aS|a
B → SbS|bb|aAS|aS|a

10. S0-> AS|PB| SB

S → AS|QB| SB
A → XAS|XS|a
B → SYS|VV|XAS|XS|a
X → a
Y → b
V → b
P → AS
Q → AS

11. S0-> AS|PB| SB

S → AS|QB| SB
A → RS|XS|a
B → SYS|VV|XAS|XS|a
X → a
Y → b

V → b
P → AS
Q → AS
R → XA

12. S0 -> AS|PB| SB

S → AS|QB| SB
A → RS|XS|a
B → TS|VV|XAS|XS|a
X → a
Y → b
V → b
P → AS
Q → AS
R → XA
T → SY

13. S0-> AS|PB| SB

S → AS|QB| SB
A → RS|XS|a
B → TS|VV|US|XS|a
X → a
Y → b
V → b
P → AS
Q → AS
R → XA
T → SY
U → XA

Under the following options which are the steps are correct to achieve the CNF

a. 1,4,6,7,9,2,5,8,3,12,11,13,10
b. 2,3,1,5,7,4,12,10,8,9,13,6,11
c. 1,6,4,9,7,5,2,3,8,10,11,12,13
d. 3, 6, 4, 5, 1, 2, 7

Answer: 1,6,4,9,7,5,2,3,8,10,11,12,13

3. **Remove the unit productions from the following grammar results in which of the following answers**

S -> AB

A -> a

B -> C / b
C -> D
D -> E
E -> a

Answer:

i. **S -> AB**
A -> a
B -> a / b

ii. **S -> AB**
A -> a
B -> a / b
C -> a
D -> a
E -> a

Solutions:

a. i only true
b. i and ii true
c. ii only true
d. neither I nor ii true

Answer: a. i only true

4. Let any set of production rules in a CFG be

   X → X+X | X*X |X| a

   over an alphabet {a}.

   The leftmost derivation for the string **"a+a*a"** may be

FORMAL LANGUAGE AND AUTOMATA THEORY
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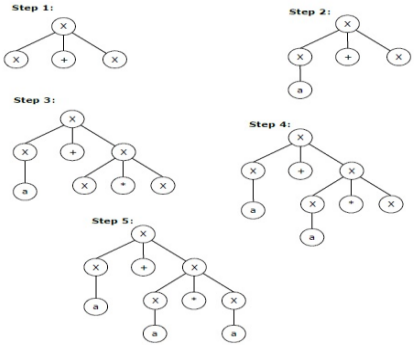
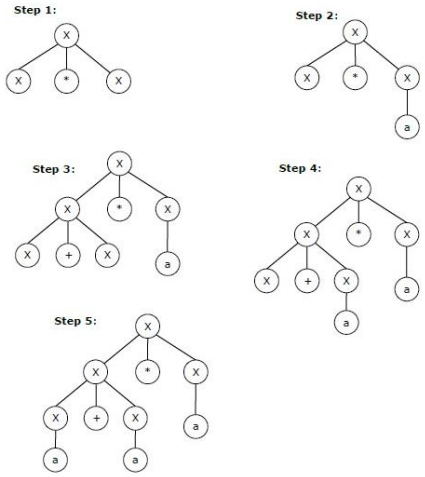
i



ii



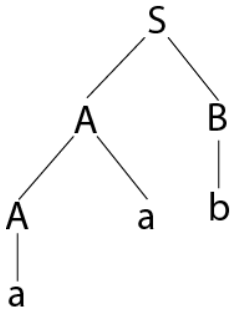
A. i only
B. ii only
C. Both i and ii
D. Neither i nor ii

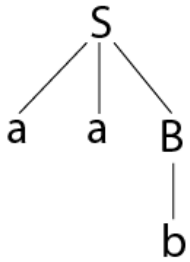
Answer A i only

5. Consider a grammar G is given as follows:

S → AB | aaB
A → a | Aa
B → b

State which option is right based on the following grammar G



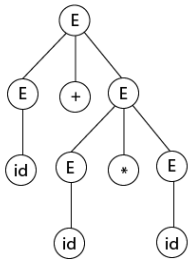


i. Grammar is ambiguous
ii. Grammar is Unambiguous
iii. Ambiguity cant be determined
iv. None of these

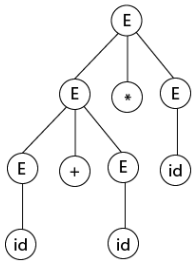
Answer : i. Grammar is ambiguous

6. Consider

E → E + E
E → E * E
E → id



Parse tree 1



Parse tree 2

Based on the above parse trees state which of the following is unambiguous grammar

A. E → E + T
T → T * F
F → id

B. E → E + T
T → F
F → id

C. E → E + T
E → T
T → T * F
T → F
F → id

D. $E \rightarrow E + T$
$E \rightarrow T$
$T \rightarrow T * F$

Answer C: $E \rightarrow E + T$
$E \rightarrow T$
$T \rightarrow T * F$
$T \rightarrow F$
$F \rightarrow id$