The LNM Institute of Information Technology, Jaipur

CS331 Theory of Computation

Quiz-II **Tuesday, Nov 21, 2017**

Time: 45 Minutes Maximum Marks: 60

Name: _____ Roll No:_____

Read the Instructions Carefully:
All are objective questions with 4 choices. There may be more than one correct answers. Each question carry three marks. You need to select all the correct answers to get full marks. For example, if a question has 2 correct choices and you did only one correctly you will get 1.5 marks. If out of your choices even one choice is wrong then there won't be any marks given (even if there are correct choices that you have made). So be careful when are finding and marking the correct choices. **Encircle all the correct answer/s. Any other marking will be considered as invalid**. Do not write anything in the answer sheet except the answer. No justification is required. **There is no negative marking for wrong answer/s.**

1. Consider the following rules. If you are asked to remove the ϵ rules how many rules you may have to replace it with to have the equivalent grammar?

   1. $S \longrightarrow SaSbScS$
   2. $S \longrightarrow \epsilon$

   (a) 8 rules

   (b) 7 rules

   (c) 16 rules

   (d) 15 rules

2. If the above rules are part of the grammar $G = (\{S\}, \{a, b, c\}, P, S\})$ then what is the language L generated by G?

   (a) $L = \{a, b, c\}^+$

   (b) $L = \{a^m b^n c^k \mid n, m, k \geq 1\}$

   (c) $L = \{a^m b^m c^k \mid n, m, k \geq 1\}$

   (d) None of the above

3. In the above grammar G if you want to make S not a nullable nonterminal but want to construct an equivalent grammar how many rules you will require in total? (Hint: You may include one new non-terminal)

   (a) 17

   (b) 33

   (c) 16

   (d) 32

4. A context-free grammar after the removal of ϵ-rules, unit productions and useless symbols is called as

   (a) Regular Grammar

   (b) CFG in Chomsky Normal Form

   (c) a reduced CFG

   (d) CFG in Greibach Normal Form

5. A context free language L is called ambiguous if

   (a) It has two or more leftmost derivations for no terminal strings $w \in L$

   (b) It has two or more leftmost derivations for some terminal string $w \in L$

   (c) If there are no rightmost derivations possible for any string $w \in L$

   (d) None of the above

6. Let $G = (\{S, A, B, D\}, \{a, b\}, P, S)$ be a grammar where P is given by

$$S \longrightarrow AD$$

$$D \longrightarrow SB$$

$$S \longrightarrow AB$$

$$A \longrightarrow a$$

$$B \longrightarrow b$$

   What is the language accepted by G?

   (a) $L = \{a, b\}^+$

   (b) $L = \{w \in \{a, b\}^+ \mid n_a(w) = n_b(w)\}$

   (c) L is a Dyck set

   (d) None of the above Note: $n_a(w)$ denotes number of a's in w and $n_b(w)$ denotes number of b's in w

7. In the above grammar G, which of the following statement(s) is (are) true?
   (a) D is a useless symbol
   (b) There are no useless symbols
   (c) G has unit productions
   (d) Number of non-terminals required here can be reduced
8. Every Context-Free Grammar is a
   (a) Regular Grammar
   (b) Context Sensitive Grammar
   (c) Linear Grammar
   (d) English Grammar
9. Take the language

$$L_1 = \{a^i b^j c^k \mid i, j, k \geq 1, i = j \text{ or } j = k\}.$$

   Which of the following statement(s) is (are) true?
   (a) L is a regular language
   (b) L is a context-free language
   (c) L is accepted by a non-deterministic finite state automata
   (d) L is accepted by a pushdown automata
10. Let $G = (\{S, A, \}, \{a\}, P, S)$ be a grammar where P is given by

$$S \longrightarrow A$$

$$A \longrightarrow AA$$

$$A \longrightarrow a$$

    Which of the following statement(s) is (are) false?
    (a) G is ambiguous
    (b) G is inherently ambiguous
    (c) We can reduce number of non-terminals in G
    (d) Language generated by G is not regular

11. Checking whether any context-free grammar G is ambiguous are not
    (a) can be done efficiently in polynomial running time
    (b) can be done but in exponential running time
    (c) question is senseless
    (d) cannot be done at all

12. Dyck set is a
    (a) language that can be generated by a CFG with always a bounded number of non-terminals in its derivations
    (b) language that cannot be generated by a CFG
    (c) language that cannot be generated by a CFG with always a bounded number of non-terminals in its derivations
    (d) language spoken by Dyck

13. Let $G = (\{S, A, B, C, E\}, \{a, b, c, d\}, P, S)$ be a grammar where P is given by

1.	$S \longrightarrow AB$	6.	$C \longrightarrow cEd$
2.	$S \longrightarrow AC$	7.	$E \longrightarrow cEd$
3.	$B \longrightarrow B'$	8.	$E \longrightarrow cd$
4.	$B' \longrightarrow b$	9.	$A \longrightarrow aA$
5.	$S \longrightarrow BC$		

    For the above grammar G which is (are) the correct choice(s)?
    (a) B and A are useless symbols
    (b) A is a useless symbol
    (c) C and A are useless symbols
    (d) S is not a useless symbol

14. For the above grammar G pick the correct choice(s) from the following:
    (a) Rules $2, 1, 8$ are not needed
    (b) Rules $1, 3, 9$ are not needed
    (c) Rules $9, 2, 1$ are not needed
    (d) Rules $4, 5, 6$ are needed

15. Consider the English language. In your understanding which type of grammar comes closer to English Grammar?

    (a) Regular Grammar

    (b) Context-Free Grammar

    (c) Context Sensitive Grammar

    (d) Type-0 Grammar

16. In the following rules pick all the non-terminals which are nullable:

1.	$S \longrightarrow AC$	3.	$B \longrightarrow \epsilon$
2.	$C \longrightarrow AB$	4.	$A \longrightarrow \epsilon$
5.	$S \longrightarrow a$	6.	$B \longrightarrow b$

    (a) All non-terminals are nullable

    (b) A, B and C are nullable

    (c) A and C are nullable

    (d) Only A is nullable

17. Let $G = (\{S, A, B\}, \{a, b\}, P, S)$ be the grammar with following rules:

1.	$S \longrightarrow aB$	5.	$S \longrightarrow bA$
2.	$B \longrightarrow b$	6.	$A \longrightarrow a$
3.	$B \longrightarrow bS$	7.	$A \longrightarrow aS$
4.	$B \longrightarrow aBB$	8.	$A \longrightarrow bAA$

    Which of the following statements are true?

    (a) It is a CFG in Greibach Normal Form

    (b) It accepts all strings over $\{a, b\}^*$

    (c) It accepts all strings over $\{a, b\}^*$ but with equal number of a's and b's

    (d) It is a CFG in Chomsky Normal Form

18. Let $G = (\{S, B\}, \{a, b, c\}, P, S)$ be a grammar where P is given by

$$S \longrightarrow aSBc$$

$$S \longrightarrow abc$$

$$cB \longrightarrow Bc$$

$$bB \longrightarrow bb$$

The language generated by G is given by $L(G) = \{a^n b^n c^n \mid n \geq 1\}$. To generate $a^n b^n c^n$ how many times the rule $cB \longrightarrow Bc$ should be used?

(a) n times

(b) $n - 1$ times

(c) n^2 times

(d) None of the above

19. The above grammar G is a

(a) Context-free grammar

(b) Context-sensitive grammar

(c) Type-0 grammar

(d) Regular grammar

20. In the above grammar what is the role of the third rule $cB \longrightarrow Bc$?

(a) It collects c's in correct place

(b) It helps to collect b's in correct place

(c) This rule is unnecessary

(d) It moves a's into the left

Answer Key for Exam A

1. Consider the following rules. If you are asked to remove the ϵ rules how many rules you may have to replace it with to have the equivalent grammar?

   1. $S \longrightarrow SaSbScS$
   2. $S \longrightarrow \epsilon$

   (a) 8 rules

   (b) 7 rules

   (c) 16 rules

   (d) 15 rules

2. If the above rules are part of the grammar $G = (\{S\}, \{a, b, c\}, P, S\})$ then what is the language L generated by G?

   (a) $L = \{a, b, c\}^+$

   (b) $L = \{a^m b^n c^k \mid n, m, k \geq 1\}$

   (c) $L = \{a^m b^m c^k \mid n, m, k \geq 1\}$

   (d) None of the above

3. In the above grammar G if you want to make S not a nullable nonterminal but want to construct an equivalent grammar how many rules you will require in total? (Hint: You may include one new non-terminal)

   (a) 17

   (b) 33

   (c) 16

   (d) 32

4. A context-free grammar after the removal of ϵ-rules, unit productions and useless symbols is called as

   (a) Regular Grammar

   (b) CFG in Chomsky Normal Form

   (c) a reduced CFG

   (d) CFG in Greibach Normal Form

5. A context free language L is called ambiguous if

   (a) It has two or more leftmost derivations for no terminal strings $w \in L$

   [(b)] It has two or more leftmost derivations for some terminal string $w \in L$

   (c) If there are no rightmost derivations possible for any string $w \in L$

   (d) None of the above

6. Let $G = (\{S, A, B, D\}, \{a, b\}, P, S)$ be a grammar where P is given by

$$S \longrightarrow AD$$

$$D \longrightarrow SB$$

$$S \longrightarrow AB$$

$$A \longrightarrow a$$

$$B \longrightarrow b$$

   What is the language accepted by G?

   (a) $L = \{a, b\}^+$

   (b) $L = \{w \in \{a, b\}^+ \mid n_a(w) = n_b(w)\}$

   (c) L is a Dyck set

   [(d)] None of the above Note: $n_a(w)$ denotes number of a's in w and $n_b(w)$ denotes number of b's in w

7. In the above grammar G, which of the following statement(s) is (are) true?

   (a) D is a useless symbol

   [(b)] There are no useless symbols

   (c) G has unit productions

   [(d)] Number of non-terminals required here can be reduced

8. Every Context-Free Grammar is a

   (a) Regular Grammar

   [(b)] Context Sensitive Grammar

   [(c)] Linear Grammar

   (d) English Grammar

9. Take the language

$$L_1 = \{a^i b^j c^k \mid i, j, k \geq 1, i = j \text{ or } j = k\}.$$

Which of the following statement(s) is (are) true?

(a) L is a regular language

[(b)] L is a context-free language

(c) L is accepted by a non-deterministic finite state automata

[(d)] L is accepted by a pushdown automata

10. Let $G = (\{S, A, \}, \{a\}, P, S)$ be a grammar where P is given by

$$S \longrightarrow A$$

$$A \longrightarrow AA$$

$$A \longrightarrow a$$

Which of the following statement(s) is (are) false?

(a) G is ambiguous

[(b)] G is inherently ambiguous

(c) We can reduce number of non-terminals in G

[(d)] Language generated by G is not regular

11. Checking whether any context-free grammar G is ambiguous are not

(a) can be done efficiently in polynomial running time

(b) can be done but in exponential running time

(c) question is senseless

[(d)] cannot be done at all

12. Dyck set is a

(a) language that can be generated by a CFG with always a bounded number of non-terminals in its derivations

(b) language that cannot be generated by a CFG

[(c)] language that cannot be generated by a CFG with always a bounded number of non-terminals in its derivations

(d) language spoken by Dyck

13. Let $G = (\{S, A, B, C, E\}, \{a, b, c, d\}, P, S)$ be a grammar where P is given by

1.	$S \longrightarrow AB$	6.	$C \longrightarrow cEd$
2.	$S \longrightarrow AC$	7.	$E \longrightarrow cEd$
3.	$B \longrightarrow B'$	8.	$E \longrightarrow cd$
4.	$B' \longrightarrow b$	9.	$A \longrightarrow aA$
5.	$S \longrightarrow BC$		

For the above grammar G which is (are) the correct choice(s)?

(a) B and A are useless symbols

[(b)] A is a useless symbol

(c) C and A are useless symbols

[(d)] S is not a useless symbol

14. For the above grammar G pick the correct choice(s) from the following:

(a) Rules $2, 1, 8$ are not needed

(b) Rules $1, 3, 9$ are not needed

[(c)] Rules $9, 2, 1$ are not needed

[(d)] Rules $4, 5, 6$ are needed

15. Consider the English language. In your understanding which type of grammar comes closer to English Grammar?

(a) Regular Grammar

[(b)] Context-Free Grammar

(c) Context Sensitive Grammar

(d) Type-0 Grammar

16. In the following rules pick all the non-terminals which are nullable:

1.	$S \longrightarrow AC$	3.	$B \longrightarrow \epsilon$
2.	$C \longrightarrow AB$	4.	$A \longrightarrow \epsilon$
5.	$S \longrightarrow a$	6.	$B \longrightarrow b$

[(a)] All non-terminals are nullable

(b) A, B and C are nullable

(c) A and C are nullable

(d) Only A is nullable

17. Let $G = (\{S, A, B\}, \{a, b\}, P, S)$ be the grammar with following rules:

1.	$S \longrightarrow aB$	5.	$S \longrightarrow bA$
2.	$B \longrightarrow b$	6.	$A \longrightarrow a$
3.	$B \longrightarrow bS$	7.	$A \longrightarrow aS$
4.	$B \longrightarrow aBB$	8.	$A \longrightarrow bAA$

Which of the following statements are true?

- [(a)] It is a CFG in Greibach Normal Form
- (b) It accepts all strings over $\{a, b\}^*$
- [(c)] It accepts all strings over $\{a, b\}^*$ but with equal number of a's and b's
- (d) It is a CFG in Chomsky Normal Form

18. Let $G = (\{S, B\}, \{a, b, c\}, P, S)$ be a grammar where P is given by

$$S \longrightarrow aSBc$$

$$S \longrightarrow abc$$

$$cB \longrightarrow Bc$$

$$bB \longrightarrow bb$$

The language generated by G is given by $L(G) = \{a^n b^n c^n \mid n \geq 1\}$. To generate $a^n b^n c^n$ how many times the rule $cB \longrightarrow Bc$ should be used?

- (a) n times
- [(b)] $n - 1$ times
- (c) n^2 times
- (d) None of the above

19. The above grammar G is a

- (a) Context-free grammar
- [(b)] Context-sensitive grammar
- (c) Type-0 grammar
- (d) Regular grammar

20. In the above grammar what is the role of the third rule $cB \longrightarrow Bc$?

- [(a)] It collects c's in correct place
- [(b)] It helps to collect b's in correct place
- (c) This rule is unnecessary
- (d) It moves a's into the left

The LNM Institute of Information Technology, Jaipur

CS331 Theory of Computation

Quiz-II **Tuesday, Nov 21, 2017**

Time: 45 Minutes Maximum Marks: 60

Name: _____ Roll No:_____

Read the Instructions Carefully:
All are objective questions with 4 choices. There may be more than one correct answers. Each question carry three marks. You need to select all the correct answers to get full marks. For example, if a question has 2 correct choices and you did only one correctly you will get 1.5 marks. If out of your choices even one choice is wrong then there won't be any marks given (even if there are correct choices that you have made). So be careful when are finding and marking the correct choices. **Encircle all the correct answer/s. Any other marking will be considered as invalid**. Do not write anything in the answer sheet except the answer. No justification is required. **There is no negative marking for wrong answer/s.**

1. Checking whether any context-free grammar G is ambiguous are not
   (a) can be done efficiently in polynomial running time
   (b) can be done but in exponential running time
   (c) question is senseless
   (d) cannot be done at all

2. Let $G = (\{S, A, B, D\}, \{a, b\}, P, S)$ be a grammar where P is given by

$$S \longrightarrow AD$$

$$D \longrightarrow SB$$

$$S \longrightarrow AB$$

$$A \longrightarrow a$$

$$B \longrightarrow b$$

   What is the language accepted by G?
   (a) $L = \{a, b\}^+$
   (b) $L = \{w \in \{a, b\}^+ \mid n_a(w) = n_b(w)\}$
   (c) L is a Dyck set
   (d) None of the above Note: $n_a(w)$ denotes number of a's in w and $n_b(w)$ denotes number of b's in w

3. In the above grammar G, which of the following statement(s) is (are) true?
   (a) D is a useless symbol
   (b) There are no useless symbols
   (c) G has unit productions
   (d) Number of non-terminals required here can be reduced

4. Consider the following rules. If you are asked to remove the ϵ rules how many rules you may have to replace it with to have the equivalent grammar?

   1. $S \longrightarrow SaSbScS$
   2. $S \longrightarrow \epsilon$

   (a) 8 rules
   (b) 7 rules
   (c) 16 rules
   (d) 15 rules

5. If the above rules are part of the grammar $G = (\{S\}, \{a, b, c\}, P, S\})$ then what is the language L generated by G?
   (a) $L = \{a, b, c\}^+$
   (b) $L = \{a^m b^n c^k \mid n, m, k \geq 1\}$
   (c) $L = \{a^m b^m c^k \mid n, m, k \geq 1\}$
   (d) None of the above

6. In the above grammar G if you want to make S not a nullable nonterminal but want to construct an equivalent grammar how many rules you will require in total? (Hint: You may include one new non-terminal)
   (a) 17
   (b) 33
   (c) 16
   (d) 32

7. Take the language

$$L_1 = \{a^i b^j c^k \mid i, j, k \geq 1, i = j \text{ or } j = k\}.$$

Which of the following statement(s) is (are) true?

(a) L is a regular language

(b) L is a context-free language

(c) L is accepted by a non-deterministic finite state automata

(d) L is accepted by a pushdown automata

8. Let $G = (\{S, B\}, \{a, b, c\}, P, S)$ be a grammar where P is given by

$$S \longrightarrow aSBc$$

$$S \longrightarrow abc$$

$$cB \longrightarrow Bc$$

$$bB \longrightarrow bb$$

The language generated by G is given by $L(G) = \{a^n b^n c^n \mid n \geq 1\}$. To generate $a^n b^n c^n$ how many times the rule $cB \longrightarrow Bc$ should be used?

(a) n times

(b) $n - 1$ times

(c) n^2 times

(d) None of the above

9. The above grammar G is a

(a) Context-free grammar

(b) Context-sensitive grammar

(c) Type-0 grammar

(d) Regular grammar

10. In the above grammar what is the role of the third rule $cB \longrightarrow Bc$?

(a) It collects c's in correct place

(b) It helps to collect b's in correct place

(c) This rule is unnecessary

(d) It moves a's into the left

11. A context-free grammar after the removal of ϵ-rules, unit productions and useless symbols is called as

    (a) Regular Grammar

    (b) CFG in Chomsky Normal Form

    (c) a reduced CFG

    (d) CFG in Greibach Normal Form

12. Dyck set is a

    (a) language that can be generated by a CFG with always a bounded number of non-terminals in its derivations

    (b) language that cannot be generated by a CFG

    (c) language that cannot be generated by a CFG with always a bounded number of non-terminals in its derivations

    (d) language spoken by Dyck

13. A context free language L is called ambiguous if

    (a) It has two or more leftmost derivations for no terminal strings $w \in L$

    (b) It has two or more leftmost derivations for some terminal string $w \in L$

    (c) If there are no rightmost derivations possible for any string $w \in L$

    (d) None of the above

14. Let $G = (\{S, A, B, C, E\}, \{a, b, c, d\}, P, S)$ be a grammar where P is given by

    1. $S \longrightarrow AB$
    2. $S \longrightarrow AC$
    3. $B \longrightarrow B'$
    4. $B' \longrightarrow b$
    5. $S \longrightarrow BC$
    6. $C \longrightarrow cEd$
    7. $E \longrightarrow cEd$
    8. $E \longrightarrow cd$
    9. $A \longrightarrow aA$

    For the above grammar G which is (are) the correct choice(s)?

    (a) B and A are useless symbols

    (b) A is a useless symbol

    (c) C and A are useless symbols

    (d) S is not a useless symbol

15. For the above grammar G pick the correct choice(s) from the following:

    (a) Rules $2, 1, 8$ are not needed

    (b) Rules $1, 3, 9$ are not needed

    (c) Rules $9, 2, 1$ are not needed

    (d) Rules $4, 5, 6$ are needed

16. Consider the English language. In your understanding which type of grammar comes closer to English Grammar?

    (a) Regular Grammar

    (b) Context-Free Grammar

    (c) Context Sensitive Grammar

    (d) Type-0 Grammar

17. Let $G = (\{S, A, \}, \{a\}, P, S)$ be a grammar where P is given by

$$S \longrightarrow A$$

$$A \longrightarrow AA$$

$$A \longrightarrow a$$

    Which of the following statement(s) is (are) false?

    (a) G is ambiguous

    (b) G is inherently ambiguous

    (c) We can reduce number of non-terminals in G

    (d) Language generated by G is not regular

18. In the following rules pick all the non-terminals which are nullable:

1.	$S \longrightarrow AC$	3.	$B \longrightarrow \epsilon$
2.	$C \longrightarrow AB$	4.	$A \longrightarrow \epsilon$
5.	$S \longrightarrow a$	6.	$B \longrightarrow b$

    (a) All non-terminals are nullable

    (b) A, B and C are nullable

    (c) A and C are nullable

    (d) Only A is nullable

19. Let $G = (\{S, A, B\}, \{a, b\}, P, S)$ be the grammar with following rules:

1.	$S \longrightarrow aB$	5.	$S \longrightarrow bA$
2.	$B \longrightarrow b$	6.	$A \longrightarrow a$
3.	$B \longrightarrow bS$	7.	$A \longrightarrow aS$
4.	$B \longrightarrow aBB$	8.	$A \longrightarrow bAA$

Which of the following statements are true?

(a) It is a CFG in Greibach Normal Form

(b) It accepts all strings over $\{a, b\}^*$

(c) It accepts all strings over $\{a, b\}^*$ but with equal number of a's and b's

(d) It is a CFG in Chomsky Normal Form

20. Every Context-Free Grammar is a

(a) Regular Grammar

(b) Context Sensitive Grammar

(c) Linear Grammar

(d) English Grammar

Answer Key for Exam B

1. Checking whether any context-free grammar G is ambiguous are not
   (a) can be done efficiently in polynomial running time
   (b) can be done but in exponential running time
   (c) question is senseless
   [(d)] cannot be done at all

2. Let $G = (\{S, A, B, D\}, \{a, b\}, P, S)$ be a grammar where P is given by

$$S \longrightarrow AD$$
$$D \longrightarrow SB$$
$$S \longrightarrow AB$$
$$A \longrightarrow a$$
$$B \longrightarrow b$$

   What is the language accepted by G?
   (a) $L = \{a, b\}^+$
   (b) $L = \{w \in \{a, b\}^+ \mid n_a(w) = n_b(w)\}$
   (c) L is a Dyck set
   [(d)] None of the above Note: $n_a(w)$ denotes number of a's in w and $n_b(w)$ denotes number of b's in w

3. In the above grammar G, which of the following statement(s) is (are) true?
   (a) D is a useless symbol
   [(b)] There are no useless symbols
   (c) G has unit productions
   [(d)] Number of non-terminals required here can be reduced

4. Consider the following rules. If you are asked to remove the ϵ rules how many rules you may have to replace it with to have the equivalent grammar?

$$1. \quad S \longrightarrow SaSbScS$$
$$2. \quad S \longrightarrow \epsilon$$

(a) 8 rules

(b) 7 rules

(c) 16 rules

(d) 15 rules

5. If the above rules are part of the grammar $G = (\{S\}, \{a, b, c\}, P, S\})$ then what is the language L generated by G?

(a) $L = \{a, b, c\}^+$

(b) $L = \{a^m b^n c^k \mid n, m, k \geq 1\}$

(c) $L = \{a^m b^m c^k \mid n, m, k \geq 1\}$

(d) None of the above

6. In the above grammar G if you want to make S not a nullable nonterminal but want to construct an equivalent grammar how many rules you will require in total? (Hint: You may include one new non-terminal)

(a) 17

(b) 33

(c) 16

(d) 32

7. Take the language

$$L_1 = \{a^i b^j c^k \mid i, j, k \geq 1, i = j \text{ or } j = k\}.$$

Which of the following statement(s) is (are) true?

(a) L is a regular language

(b) L is a context-free language

(c) L is accepted by a non-deterministic finite state automata

(d) L is accepted by a pushdown automata

8. Let $G = (\{S, B\}, \{a, b, c\}, P, S)$ be a grammar where P is given by

$$S \longrightarrow aSBc$$

$$S \longrightarrow abc$$

$$cB \longrightarrow Bc$$

$$bB \longrightarrow bb$$

The language generated by G is given by $L(G) = \{a^n b^n c^n \mid n \geq 1\}$. To generate $a^n b^n c^n$ how many times the rule $cB \longrightarrow Bc$ should be used?

(a) n times

(b) $n - 1$ times

(c) n^2 times

(d) None of the above

9. The above grammar G is a

(a) Context-free grammar

(b) Context-sensitive grammar

(c) Type-0 grammar

(d) Regular grammar

10. In the above grammar what is the role of the third rule $cB \longrightarrow Bc$?

(a) It collects c's in correct place

(b) It helps to collect b's in correct place

(c) This rule is unnecessary

(d) It moves a's into the left

11. A context-free grammar after the removal of ϵ-rules, unit productions and useless symbols is called as

(a) Regular Grammar

(b) CFG in Chomsky Normal Form

(c) a reduced CFG

(d) CFG in Greibach Normal Form

12. Dyck set is a

    (a) language that can be generated by a CFG with always a bounded number of non-terminals in its derivations

    (b) language that cannot be generated by a CFG

    [(c)] language that cannot be generated by a CFG with always a bounded number of non-terminals in its derivations

    (d) language spoken by Dyck

13. A context free language L is called ambiguous if

    (a) It has two or more leftmost derivations for no terminal strings $w \in L$

    [(b)] It has two or more leftmost derivations for some terminal string $w \in L$

    (c) If there are no rightmost derivations possible for any string $w \in L$

    (d) None of the above

14. Let $G = (\{S, A, B, C, E\}, \{a, b, c, d\}, P, S)$ be a grammar where P is given by

    1. $S \longrightarrow AB$
    2. $S \longrightarrow AC$
    3. $B \longrightarrow B'$
    4. $B' \longrightarrow b$
    5. $S \longrightarrow BC$
    6. $C \longrightarrow cEd$
    7. $E \longrightarrow cEd$
    8. $E \longrightarrow cd$
    9. $A \longrightarrow aA$

    For the above grammar G which is (are) the correct choice(s)?

    (a) B and A are useless symbols

    [(b)] A is a useless symbol

    (c) C and A are useless symbols

    [(d)] S is not a useless symbol

15. For the above grammar G pick the correct choice(s) from the following:

    (a) Rules $2, 1, 8$ are not needed

    (b) Rules $1, 3, 9$ are not needed

    [(c)] Rules $9, 2, 1$ are not needed

    [(d)] Rules $4, 5, 6$ are needed

16. Consider the English language. In your understanding which type of grammar comes closer to English Grammar?

    (a) Regular Grammar

    [(b)] Context-Free Grammar

    (c) Context Sensitive Grammar

    (d) Type-0 Grammar

17. Let $G = (\{S, A, \}, \{a\}, P, S)$ be a grammar where P is given by

$$S \longrightarrow A$$

$$A \longrightarrow AA$$

$$A \longrightarrow a$$

    Which of the following statement(s) is (are) false?

    (a) G is ambiguous

    [(b)] G is inherently ambiguous

    (c) We can reduce number of non-terminals in G

    [(d)] Language generated by G is not regular

18. In the following rules pick all the non-terminals which are nullable:

1.	$S \longrightarrow AC$	3.	$B \longrightarrow \epsilon$
2.	$C \longrightarrow AB$	4.	$A \longrightarrow \epsilon$
5.	$S \longrightarrow a$	6.	$B \longrightarrow b$

    [(a)] All non-terminals are nullable

    (b) A, B and C are nullable

    (c) A and C are nullable

    (d) Only A is nullable

19. Let $G = (\{S, A, B\}, \{a, b\}, P, S)$ be the grammar with following rules:

1.	$S \longrightarrow aB$	5.	$S \longrightarrow bA$
2.	$B \longrightarrow b$	6.	$A \longrightarrow a$
3.	$B \longrightarrow bS$	7.	$A \longrightarrow aS$
4.	$B \longrightarrow aBB$	8.	$A \longrightarrow bAA$

Which of the following statements are true?

- [(a)] It is a CFG in Greibach Normal Form
- (b) It accepts all strings over $\{a, b\}^*$
- [(c)] It accepts all strings over $\{a, b\}^*$ but with equal number of a's and b's
- (d) It is a CFG in Chomsky Normal Form

20. Every Context-Free Grammar is a

- (a) Regular Grammar
- [(b)] Context Sensitive Grammar
- [(c)] Linear Grammar
- (d) English Grammar