Theory of Computation (BTCS-702)

Question Bank

SECTION A

1. State the difference between Context free and Context sensitive grammars.
2. Define cellular automata with example.
3. What do mean by reduced grammars? Give examples.
4. What is push down automata? List the parts of push down automata.
5. What do you mean by equivalent form of acceptance?
6. The deterministic pushdown automata is not equivalent to non-deterministic Pushdown automata. Justify the statement.
7. State the pumping lemma for context free language.
8. Explain the term recursively enumerable language.
9. What is the degree or ambiguity? Explain with examples.
10. What do you mean by unrestricted grammar? Give examples.
11. What do you mean by Pumping lemma for CFLs?
12. What do you mean by Context sensitive language? Discuss.
13. What is the role of derivation graph in Finite Automata?
14. How you will show the equivalence of automata with regular grammar?
15. What do you mean by a rewriting a system?
16. Describe unambiguous grammar and degree or ambiguity?
17. What do you mean by cellular automata?
18. List some formal properties of LR(k) grammar?
19. Show that finite pushdown automata and non-finite pushdown automata are different.
20. What do you mean by derivation graph?
21. State the difference between Context free and Context sensitive language?
22. What do you mean by Homomorphism of regular sets?
23. Eliminate E production from the following grammars:-

    S -> ABAC

$$A \to aA \;/\; E$$
$$B \to b\,B \;/\; E$$
$$C \to C$$

24. What do you mean by KNF?

25. What do you mean by left linear & right linear grammar? Explain properly.

26. Simplify following regular expression:

$$(1+01^*)+(1+01^*)(10^*+1)(11^*+0)$$

27. What is E closure of a state'?

28. Write regular expression for the language which consists of string of 0's and 1's with at most one pair of consecutive 1's.

29. What is idempotence law of union?

30. What is homomorphism and inverse homomorphism?

31. What is meant by yield of a parse tree?

32. Give formal notation of pushdown automata?

33. What are useless symbols?

34. What is 2 push down automata?

35. State the Dyck's language.

36. Consider a set L= {0,1}.What is L+ and L *?

37. What do you mean by reduced grammars?

38. Every non-empty CFL is generated by a CFG with no use less symbols. justify the statement

39. What do you mean by reduced grammars? Explain.

40. Give the Leftmost order of derivation of a string id+id*id. Also draw the derivation tree.

41. What do you understand by recursively enumerable language?

42. Define regular expression.

43. What do you mean by Canonical derivation?

SECTION B

44. The conversion from a grammar to Chomsky normal form can square the number of production in a grammar. Justify statement.

45. Show that CSL is closed under Union, iteration & catenation.

46. Construct a Turing m/c that accepts following language

$$L= \{0^n 1^n \text{ for } n>=1\}$$

47. What do you mean by pumping lemma for regular languages?

48. What do you mean by canonical derivation?

49. Construct the NFA for the following regular expressions:

    a. aba* I bcb*

    b. (a l b)* abb (a l b)*.

50. What is a context free language? Explain closure properties of a language.

51. Construct PDA equivalent to the following grammar

$$S \rightarrow as \ /aSbS/E$$

52. Explain algebraic properties and complexity variants with the help of suitable examples.

53. Language is said to be regular if and only if it has left linear and right linear grammar. Prove

54. Explain that various Algebraic properties and complexity variants of a cellular automata with same example.

55. Compare and construct context free grammars with context sensitive language. Give some examples of each.

56. Show that the context sensitive language (CSLs) arc closed under the operation union, concatenation & intersection.

57. Give a deterministic finite automata accepting the set of all strings of 0's and 1's in which both the number of o's and 1's are even.

58. Let L be the set of all strings given by 0's where I is an integer greater than 1, i.e

$$L = \{ 0 \ I \ 1 \ I \text{ for I is an integer. } I >= 1 \ J$$

Prove that I, is not a regular set.

59. Let G be a grammar given by (V,T,P,S) with V = {S, A , B , C} , T={a,b,c}. P={ S$\rightarrow$ aSa , S$\rightarrow$ bSb , S$\rightarrow$ C}, which generates the language {wcw^T : w$\in$ {a,b } and w^T is reverse of string w. Construct a PDA equivalent to the following grammar.

60. What are the Ambiguous grammars? Explain with a suitable example.

61. What is rewriting systems? Give various fundamental operations?

62. Write a note on LL(k) grammars?

63. Find the reduced grammar that is equivalent to CFG given below:

$$S \rightarrow aC/SB$$

$$A \rightarrow bSCa$$

$$B \rightarrow aSl3 \text{ I } bBc$$

$$C \rightarrow aBC/ad$$

64. Construct the finite automata for accepting all possible strings of zeros and one which does not contain 011 as substring.

65. What arc ambiguous grammars? Is the following grammar ambiguous:

$$E \rightarrow E+E \mid E*E \mid a \mid b$$

66. List and explain the properties of context free grammar/languages.

67. What are translation lemmas in complexity theory? Explain.

68. Prove that $\{ 0^n /n$ is a power of $2\}$ is not a regular language.

69. What is a parse tree? What is meant by yield of a parse tree? Draw a parse tree for the following grammar which derives the string 00011:

$$S \rightarrow A \text{ I } B$$

$$A \rightarrow 0A \mid C$$

$$B \rightarrow 0B \mid 1B \mid C$$

70. State and prove ARDEN's Theorem.

71. What arc ambiguous grammars? Show that the following grammar is ambiguous.

$$S \rightarrow aS \mid aSbS \mid E$$

SECTION C

72. For the grammar given in Q no 80 , show that the string aab has two:

(i)Parse trees.

(ii) Leftmost derivations

(iii) Right most derivations

73. Write a brief note about universality and complexity in cellular automata.

74. How equivalent are finite automata and nonfinite automata?

75. What arc various algebraic properties and complexity variants of cellular

automata?

76. What is turning machine? Develop a turning machine for accepting words of type

$$1^n 2^n 3^n$$

77. State and prove Greibach normal Form(GNF).

78. How can a grammar be converted to Chomsky Normal Form(CNF).

79. Prove that if L is a Context Free Language, then there exists a PDA which accepts L.

80. Construct regular grammars to generate the following:

    a) The set of all strings over { a, b } ending in a.

    b) The set of all strings over { a, b } beginning with a.

81. Construct transition systems equivalent to the regular expressions given below:

    a. (ab + a) * (aa + b).

    b. (a*b + b*a)*a.

    c. a* + (ab + a)*.

82. Construct an DFA with reduced states equivalent to following regular expression:

$$10 + (0 + 11)0^*1$$

83. Reduce the following grammars to GNF :

    a) $S \to SS$, $S \to 0S1 \mid 01$

    b) $S \to AB$, $A \to BSB$, $A \to BB$, $B \to aAb$, $B \to a$, $A \to b$

    c) $S \to A0$, $A \to 0B$, $B \to A0$, $B \to 1$

84. Reduce the following grammars to CNF

    I. $S \to 1A \mid 0B$, $A \to 1AA \mid 0S \mid 0$, $B \to 0BB \mid 1S \mid 1$

    II. $G = (\{S\}, \{a,b,c\}, \{S \to a \mid b \mid cSS\}, S)$

    III. $S \to abSb \mid a \mid aAb$, $A \to bS \mid aAAb$

85. Consider the language consisting of all arithmetic expressions involving + , * , (and) over the variables x1 and x2. This language is generated by a grammar $G = (\{T,F,E\}, V, P, E)$, where $V = \{ x, 1, 2, +, *, (,)\}$ and P consists of

    $E \to E + T$ $F \to (E)$ $E \to T$ $F \to x1$

    $T \to T * F$ $F \to x2$ $T \to F$

Construct a top-down parser for it.

86. Prove that if L is a context free language, then we can construct a pda A accepting l by empty store i.e. L = N(A)

87. Prove that if A = (Q, Σ, Γ, δ, q₀ , Z₀ , F) is a pda, then there exists a CFG G such that L(G) = N(A).

88. Construct a pda A accepting the set of all integers over {a , b} with equal number of a's and b's.

89. Let G be S → AB , B→ C│b , A→a , C →D , D→E and E →a.
    Eliminate unit productions and get an equivalent grammar.

90. Construct a Turing Machine that can accept the set of all even palindromes over {0,1}.

91. Some languages which are not accepted either by a finite Automation or by a Push Down Automation arc accepted by a Turing Machine. Explain the statements with suitable examples.

92. Convert the following regular expression to NFA
    a) (0+ 1)* 1(0+1)
    b) 00 (0+ 1)*
    c) 01*
    d)(0 + 1)0 1

93. Consider a Grammer G=(V,T,P,S).Prove that for any CFG G there is a CFG G' in Chomsky Normal Form such that L(G')=L(G)-(TU{E)). where L is the language accepted by the grammar.

94. What is Turing Machine?Give a formal notation for a turing machine explaining each of the tuples. Design a turing Machines which generates a set of string with equal numbers of 0's and 1's.

95. Explain Chomsky Normal Forms and Griebach Normal Forms in   Detail.

96. Construct a PDA A equivalent to the fol.owing context free grammar:
    S→ 0BB , BB → 0S | 1S | 0
    Test whether 011110 is in N(A).

97. Draw turing machine over [{1,b}: which can compute concatenation   function over terminal symbol={ 1}.If a pair of words (w,w*).is the input the output should be ww*.

98. What is a LR grammar. Give its properties. Show that the grammar

$S \rightarrow aAb$, $A \rightarrow aAb \mid a$ is LR(1).Is it LR(0).

99. Prove the following identity

(a*ab+ ba)*a*=(a +- ab +ba)

100. Construct a transition system corresponding to the regular expression

i) (ab + c*)* b

ii) a+ bb + bab*a

101. Consider the following productions:

$S \rightarrow aB \mid bA$;

$A \rightarrow aS \mid bAA \mid a$

$B \rightarrow bS \mid aBB \mid b$

   For the string aaabbabbba find

   i) The Leftmost derivation.

   i i)The Rightmost Derivation

     iii) parse Tree.

102.   What is a rewriting system? Explain non-terminal rewriting system?

103.   List and explain the various formal languages aspects in detail.

104. Find a reduced grammar equivalent to the grammar G whose productions are

$S \rightarrow AB \mid CA$, $B \rightarrow BC \mid AB$, $A \rightarrow a$, $C \rightarrow aB \mid b$