DRONACHARYA GROUP OF INSTITUTIONS, GREATER NOIDA

Department of Computer Science & Engineering

Question Bank

Subject Code: NCS-402

Subject: Theory of Automata and Formal Language

1) What are the applications of automata?

2) Find a CFG with no useless symbols equivalent to grammar :
   1. S-> AB | CA
   2. A->a
   3. B-> BC | AB
   4. C-> AB |b

3) State pumping lemma for regular language.

4) What is the difference between concatenation and intersection of two FA's also what is the difference among Union of two FA's and addition of them?

5) Define Moore Machine and Mealy Machine with examples.

6) Draw a finite-automaton state transition table that accepts bit-strings representing numbers divisible by 5.

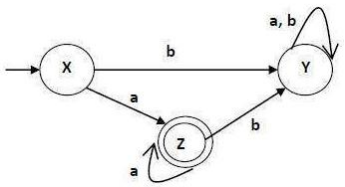
7) Show that L= $\{a^n b^n c^n | n >= 1\}$ is not a CFL

8) Design a PDA for the CFL L= $\{ wcw^R |$ w is a string belongs to $\{0,1\}^*$ and w^R is reverse of w$\}$. Take a string accepted by L and show the instantaneous description (ID) for that string.

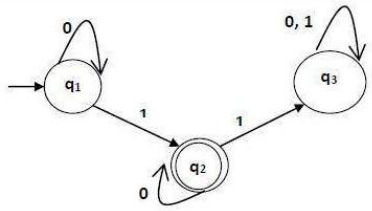
9) Define concept and working principle of PDA .

10) Prove that L = $\{a^i b^i | i \geq 0\}$ is not regular.

11) Construct the complement of the following automata



12) Construct a regular expression for the following automata



13) Find a finite automaton that accepts bit strings such that every sequence of four consecutive characters contains a 1.

14) Let a CFG {N,T,P,S} be N = {S}, T = {a, b}, Starting symbol = S, P = S → SS | aSb | ε. Draw a derivation tree from the CFG for "abaabb"

15) Let any set of production rules in a CFG be X → X+X | X*X |X| a over an alphabet {a}. Write the left most derivation and the right most derivation the string "a+a*a"

16) State pumping lemma for CFL.

17) Check whether the grammar G with production rules −X → X+X | X*X |X| a is ambiguous or not.

18) Write the steps for simplifying a CFG.

19) Find a reduced grammar equivalent to the grammar G, having production rules, P: S → AC | B, A → a, C → c | BC, E → aA | e

20) Write the regular expression for string of a's and b's of even length.

21) Remove unit production from the following − S → XY, X → a, Y → Z | b, Z → M, M → N, N → a

22) Write the regular expression for set of strings consisting of even number of a's followed by odd number of b's.

23) Remove null production from the following − S → ASA | aB | b, A → B, B → b | ∈

24) What is the procedure to convert the NDFA to its equivalent DFA?

25) Write the algorithm for conversion into Chomsky Normal Form.

26) Write the algorithm for conversion into Greibach Normal Form.

27) Convert the following CFG into CNF : $S \rightarrow ASA \mid aB$, $A \rightarrow B \mid S$, $B \rightarrow b \mid \in$

28) Convert the following CFG into CNF: $S \rightarrow XY \mid X_n \mid p$, $X \rightarrow mX \mid m$, $Y \rightarrow Xn \mid o$

29) Find out whether the language $L= \{x^n y^n z^n \mid n \geq 1\}$ is context free or not.

30) Draw the basic structure of Pushdown Automata.

31) Construct a PDA that accepts $L= \{0^n 1^n \mid n \geq 0\}$

32) Construct a PDA that accepts $L= \{ ww^R \mid w = (a+b)^* \}$

33) Write an algorithm to find PDA corresponding to a CFG.

34) Design a top-down parser for the expression "x+y*z" for the grammar G with the following production rules − P: $S \rightarrow S+X \mid X$, $X \rightarrow X*Y \mid Y$, $Y \rightarrow (S) \mid id$

35) Differentiate between Recursive and Recursively Enumerable languages.

36) Design a TM to recognize all strings consisting of an odd number of α's.

37) What is the halting problem of Turing Machine?

38) Describe the Post Correspondence Problem.

39) Find whether the lists M = (abb, aa, aaa) and N = (bba, aaa, aa) have a Post Correspondence Solution?

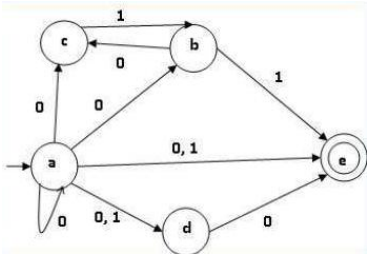
40) Find whether the lists M = (ab, bab, bbaaa) and N = (a, ba, bab) have a Post Correspondence Solution?

41) Describe Kleene Closure with example.

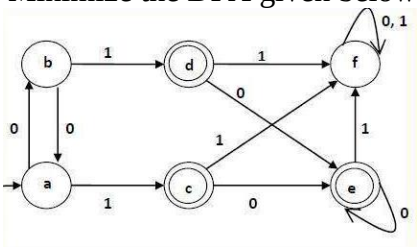
42) Design a Turing Machine that reads a string representing a binary number and erases all leading 0's in the string. However, if the string comprises of only 0's, it keeps one 0.

43) Construct a PDA from the following CFG. G = ({S, X}, {a, b}, P, S) where the productions are −S → XS | ε , A → aXb | Ab | ab

44) Convert the following NFA to DFA



45) Minimize the DFA given below



46) Design a PDA for the CFL L= { wcw^R | w is a string belongs to { 0,1}* and w^R is reverse of w} . Take a string accepted by L and show the instantaneous description (ID) for that string.

47) Convert the following Moore Machine into Mealy Machine

Present State	Next State		Output
	a=0	a=1	
→a	d	b	1
b	a	d	0
c	c	c	0
d	b	a	1

48) Define Moore Machine and Mealy Machine with examples.

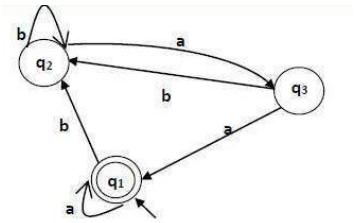
49) Convert the following Mealy Machine to Moore Machine.

Present State	Next State			
	a=0		a=1	
	Next State	Output	Next State	Output
→a	d	0	b	1
b	a	1	d	0
c	c	1	c	0
d	b	0	a	1

50) What is the difference between an Alphabet and an element of a set. Whether Alphabet is an element of a set or it is a set itself?

51) Suppose, L (G) = $\{a^m b^n \mid m \geq 0 \text{ and } n > 0\}$. Find out the grammar G which produces L(G).

52) Construct a regular expression for the following automata.



53) Find a finite automaton that accepts bit strings whose last five bits include a 1.

54) What is the concept of the Union of FA's ?

55) Show that L= $\{a^n b^n c^n \mid n >= 1\}$ is not a CFL.

56) What is the Difference between Nullable and Null production? How to make eliminate Nullable and for Null Productions from the CFG ?

57) What is the formal definition of PDA.

58) Write a regular expression for bit strings representing numbers divisible by 3.

59) Describe the concept of PDA with its block diagram .

60) Define recursive function with example.

61) Design a FA to accept the string that always ends with 00.

62) Differentiate L^+ and L*.

63) What are the features of universal Turing machine ?

64) What is Church's Hypothesis?

65) Construct the CFG for the regular expression (0 + l)*.

66) Convert the NFA into DFA

States/Input	A	B
→p	{q, s}	{q}
*q	{r}	{q, r}
r	{s}	{p}
*s	-	{p}

67) State Halting problem ofTuring machine.

68) What is the difference between DFA and NDFA ?

69) The following grammar generates the language consisting of all strings of even length : S ->AS I A,A -> aalab I ba I bb.
Give left-most and right-most derivations for the following strings :
bbbbbbba
baabab
aaabbb

70) Give the Chomsky Hierarchy of grammar.

71) Show that the context-free gramma G given by productions S → SBS/a, B → b, is ambiguous.

72) Compare PDA with FA.

73) Reduce the grammar S -> aAa|bBb|cCc A->bS|aBC|abD B -> bC C -> aCc|ac D -> dD|bD E -> ab|a

74) Construct a Turing Machine that accepts the set of strings with 11 as substring.

75) Construct a pushdown automata that accepts palindrome strings composed of two alphabets.

76) Show with the help of Myhill Nerode, show that L is a regular language where L={ w|w is a binary string having even number of 0s and even
}

77) Eliminate unit productions from the following grammar G: S -> A|bc A ->B|ca B -> S|ab

78) Show that the language $\{0^n 1^n 2^n\}$ $n \geq 1\}$ is not a context free language.

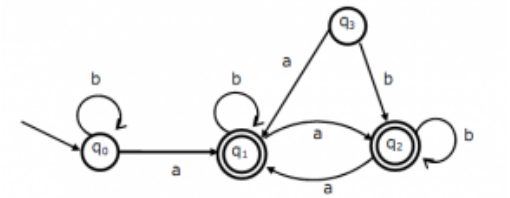
79) Construct a DFA over alphabet {0, 1} that accepts all strings that end in 101.

80) Let L={w (0 + 1)*|w has even number of 1s}, i.e. L is the set of all bit strings with even number of 1s. Write the regular expression that represents L

81) Let w be any string of length n is {0,1}*. Let L be the set of all substrings of w. What is the minimum number of states in a non-deterministic finite automaton that accepts L?

82) Definition of a language L with alphabet {a} is given as following. L= { | k > 0, and n is a positive integer constant} What is the minimum number of states needed in a DFA to recognize L?

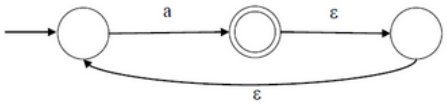
83) Write the regular expression for the following automata



84) Consider the regular language L =(111+11111)*. What is the minimum number of states in any DFA accepting this language.

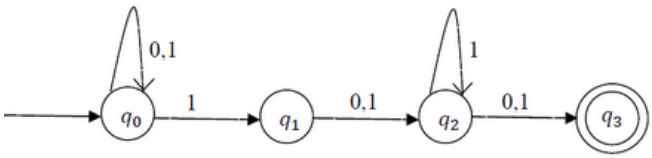
85) Given an arbitrary non-deterministic finite automaton (NFA) with N states, the maximum number of states in an equivalent minimized DFA is at least.

86) What is the complement of the language given by the following automata



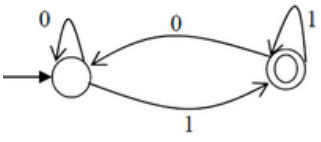
87) Let L be the language represented by the regular expression ∑* 0011∑* where ∑ = {0, 1}. What is the minimum number of states in a DFA that recognizes L (complement of L)?

88) Consider the finite automaton in the following figure.



What is the set of reachable states for the input string 0011?

89) Write the regular expression for the following automata



90) Convert Mealey Machine to Moore Machine

Present state	Next state			
	Input a = 0		Input a = 1	
	state	output	state	output
$\rightarrow q_1$	q_3	0	q_2	0
q_2	q_1	1	q_4	0
q_3	q_2	1	q_1	1
q_4	q_4	1	q_3	0

91) Differentiate between NFA and DFA

92) Build an NFA for the following language: L = { w | w ends in 01}

93) Write the regular expression for the language L = { w ∈ {0, 1}* | w has no pair of consecutive zeros}

94) Write regular expression to denote a language L which accepts all the strings which begin or end with either 00 or 11.

95) Write the regular expression to denote the language L over ? ={ a,b} such that all the string do not contain the substring " ab".

96) Given L1=L(a*baa*) and L2=L(ab*). Write the regular expression corresponding to language L3 = L1/L2 (right quotient)

97) Let L be a set accepted by a nondeterministic finite automaton. The number of states in non-deterministic finite automaton is |Q|. What is the maximum number of states in equivalent finite automaton that accepts L.

98) Given the production rules of a grammar G1 as S1 -> AB | aaB , A -> a | Aa ,B-> b and the production rules of a grammar G2 as S2 -> aS2bS2 | bS2aS2 . State whether G1 and G2 are ambiguous or not.

99) Recognize the CFL for the given CFG.
S-> aB| bA,
A-> a|aS|bAA,
B-> b|bS|aBB

100) Convert the NFA with epsilon moves into an equivalent DFA