Reg. No. : | | | | | | | | | | |

Question Paper Code: 41254

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

Fifth Semester

Computer Science and Engineering

14UCS504 – THEORY OF COMPUTATION

(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Any NFA can be converted to a DFA

   (a) always (b) never
   (c) depending on the NFA (d) depending on the language of NFA

2. What is the minimum number of states in a DFA that recognizes the set of all binary strings which contains four consecutive 1's?

   (a) 6 (b) 5 (c) 4 (d) 3

3. Write the regular expression to denote the language L over $\sum = \{a, b\}$ such that all the string do not contain the substring "ab"

   (a) a^*b^* (b) b^*a^* (c) $(ab)^*$ (d) $(ba)^*$

4. The finite automata accept which of the following language.

   (a) context free language (b) regular language
   (c) context sensitive language (d) all the above

5. How many tuples are needed to represent an instantaneous description of a PDA?

(a) 1 (b) 2 (c) 3 (d) 4

6. The language $L = \{0^m 1^m / m \geq 1\}$ is a

(a) regular language (b) context free language
(c) both (a) and (b) (d) none of these

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 from
(d) none of these

8. Context free grammars are closed under

(a) union (b) kleene star (c) concatenation (d) all the above

9. What is the maximum number of codes is generated to encode a turing machine which consists of four transition function?

(a) 12 (b) 24 (c) 36 (d) 48

10. The diagonalization language L_d is

(a) recursive (b) not recursively enumerable
(c) recursively enumerable (d) both (a) and (c)

PART - B (5 x 2 = 10 Marks)

11. Differentiate DFA and NFA.

12. State the pumping lemma for regular languages.

13. Define the language generated by a PDA.

14. Design a turing machine for computing the function $f(x) = x + 1$.

15. Give some examples of NP-complete problems

PART - C (5 x 16 = 80 Marks)

16. (a) (i) Explain the different forms of proofs with examples. (8)

(ii) Design DFA to check whether the given decimal number is divisible by 3. (4)

(iii) Design a DFA accepting all strings *w* over {0, 1} such that the number of 1's in *w* is 2 mod 4. (4)

Or

(b) (i) Prove that if *L* is accepted by an NFA with ε transitions, then *L* is also accepted by an NFA without *ε* transitions. (8)

(ii) Construct DFA equivalent to the following NFA.
Consider $M = (\{q_0, q_1, q_2, q_3\}, \{0, 1\}, \delta, q_0, \{q_3\})$. δ is defined as (8)

State	Input symbol	
	0	1
q_0	$\{q_0, q_1\}$	$\{q_0\}$
q_1	$\{q_2\}$	$\{q_1\}$
q_2	$\{q_3\}$	$\{q_3\}$
q_3	-	$\{q_2\}$

17. (a) (i) Prove that for every regular expression *r* there exist a NFA with *ε* transition that accepts *L(r)*. (10)

(ii) Show that the language $L = \left\{ \frac{o^{i^2}}{i \geq 1} \right\}$ is not regular. (6)

Or

(b) (i) Construct deterministic finite automata for the regular expression $(a + b)^* ab$. (8)

(ii) State and prove any two closure properties of regular language. (8)

18. (a) (i) Let $S \rightarrow aB/bA$, $A \rightarrow aS/bAA/a$, $B \rightarrow bS/aBB/b$. Show that $S \Rightarrow aaabbabbba$ and construct a derivation tree whose yield is in *"aaabbabbba"*. (8)

(ii) Construct a PDA for the language $L = \left\{ \frac{a^n \ b^{2n}}{n \geq 1} \right\}$. (8)

Or

(b) (i) Convert the context free grammar $S \rightarrow aA$, $A \rightarrow aABC/bB/a$, $B \rightarrow b$, $C \rightarrow c$ into pushdown automata and process the string *"aaabc"*. (8)

(ii) Show that the following grammars are ambiguous.

$\{S \rightarrow aSbS/bSaS/\varepsilon\}$ *and* $\{S \rightarrow AB/aaB, A \rightarrow a/aA, B \rightarrow b\}$. (8)

19. (a) (i) Begin with grammar *S -> 0A0/1B1/BB, A -> C, B -> S/A, C -> S/ε* and simplify using safe order

(1) eliminate ε production (2) eliminate unit production

(3) eliminate useless symbols (4) put the resultant grammar in CNF. (8)

(ii) Show that the language $L = \{a^i\ b^j c^i d^j / i \geq 1$ and $j \geq 1\}$ is not CFL. (8)

Or

(b) (i) Discuss the closure properties of CFL and prove any one of the property. (6)

(ii) Design a turing machine to compute $f(m,n) = m*n, \forall\ m,\ n \in N$. (10)

20. (a) (i) State post correspondence problem. Let $\sum = \{a, b\}^*$. Let *A* and *B* be lists of three strings as given below

$A = \{b, bab^3, ba\}$ $B = \{b^3, ba, a\}$. Does this instance of PCP have a solution? (6)

(ii) Prove that for two recursive language L_1 and L_2, their union and intersection is recursive. (10)

Or

(b) (i) Define universal language L_u. Prove that L_u is recursively enumerable. (8)

(ii) State halting problem. Show that it is undecidable. (8)

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