
ANNA UNIVERSITY – UNIVERSITY DEPARTMENT
B.E (FULL TIME) DEGREE EXAMINATION, APR/MAY 2012

Fifth Semester :: Regulation 2008
Branch: Computer Science & Engineering

(5)

CS9302 – THEORY OF COMPUTATION
(End-Semester Arrear Examination)

Time: Three Hours Max. Marks: 100

Answer **ALL** Questions

Part A ($10 \times 2 = 20$ Marks)

1. What is universal language? Why do we call it so?
2. Prove by induction on $n \geq 1$ that
$$\sum_{i=1}^{n} \frac{1}{i(i+1)} = \frac{n}{n+1}$$
3. Formally define deterministic finite automata.
4. What are the advantages of having a normal form for a grammar?
5. When do you say CFG is ambiguous?
6. Give a recursive definition for regular sets.
7. Which data structure is used in PDA? Is it a part of finite control?
8. What is the use of finite control in Turing Machine?
9. State pumping lemma for regular languages.
10. State two languages, which are not recursively enumerable.

Part B ($5 \times 16 = 80$ Marks)

11. (a) Prove that for any language L recognized by an NFA, there exists a DFA to recognize L.

(b) Construct DFA equivalent to NFA $(\{p, q, r, s\}, \{0, 1\}, \delta, p, \{s\})$, where δ is defined as

δ	0	1
p	$\{p, q\}$	$\{p\}$
q	$\{r\}$	$\{r\}$
r	$\{s\}$	–
s	$\{s\}$	$\{s\}$

12. (a) i. Suppose $L = L(G)$ for some CFG $G = (V, T, P, S)$, then prove that $L - \{\epsilon\}$ is $L(G')$ for a CFG G' with no useless symbols or ϵ-productions.
ii. Find a CFG with no useless symbols equivalent to

$$\begin{array}{lllllll} S & \rightarrow & AB|CA & \quad & B & \rightarrow & AB|BC \\ A & \rightarrow & a & & C & \rightarrow & aB|b \end{array}$$

(OR)

(b) Find Greibach normal form equivalent to the CFG

$$\begin{array}{lll} A_1 & \rightarrow & A_3A_2|A_2A_3 \\ A_2 & \rightarrow & A_3A_3|A_2A_2|a \\ A_3 & \rightarrow & A_2A_2|b \end{array}$$

13. (a) Prove that the languages accepted by PDA using empty stack and final states are equivalent.

(OR)

(b) i. Suppose $L = N(M)$ for some PDA M, then prove that L is a CFL.
ii. Give a CFG for the language $N(M)$ where

$$M = (\{q_0, q_1\}, \{0, 1\}, \{Z_0, X\}, \delta, q_0, Z_0, \Phi)$$

and δ is given by

$$\begin{array}{lllllll} \delta(q_0, 1, Z_0) & = & \{(q_0, XZ_0)\} & \quad & \delta(q_0, \epsilon, Z_0) & = & \{(q_0, \epsilon)\} \\ \delta(q_0, 1, X) & = & \{(q_0, XX)\} & & \delta(q_1, 1, X) & = & \{(q_1, \epsilon)\} \\ \delta(q_0, 0, X) & = & \{(q_1, X)\} & & \delta(q_1, 0, Z_0) & = & \{(q_0, Z_0)\} \end{array}$$

14. (a) i. Design a Turing machine to compute proper subtraction.
ii. Design a Turing machine to recognize the language $\{0^n1^n0^n | n \geq 1\}$

(OR)

(b) i. Design a Turing machine to compute multiplication of two positive integers.
ii. Prove that two-way infinite tape Turing machine and one-way infinite tape Turing Machine are equivalent.

15. (a) Prove that Post Correspondence Problem is undecidable.

(OR)

(b) State and prove Rice's theorem for recursively enumerable index sets.

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