



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – MATHEMATICS

THIRD SEMESTER – NOVEMBER 2015

MT 3964 - FORMAL LANGUAGES AND AUTOMATA

Date : 11/11/2015
Time : 09:00-12:00

Dept. No.

Max. : 100 Marks

ANSWER ALL QUESTIONS

5X20=100

I a) Construct a finite automaton to accept all four digit positive even integers.

[OR]

b) Construct a finite automaton accepting all integers $x \equiv 1 \pmod{3}$. (5)

c) i) Let L be the set of all strings over alphabet $\{0, 1\}$ ending in 11 and containing odd number of 0's. Construct a DFA to accept L.

ii) An NFA has moves $u(q_0, a) = \{q_1\}, u(q_0, b) = w, u(q_1, a) = \{q_1\},$

$u(q_1, b) = \{q_2\}, u(q_2, a) = w, u(q_2, b) = \{q_2\}$. Find an equivalent DFA. (7+8)

[OR]

d) i) Let r be a regular expression. Then prove that there exists an NFA with ϵ - moves that accepts L(r).

ii) Let L be a set accepted by a nondeterministic finite automaton. Then prove that there exists a deterministic finite automaton that accepts L. (9+6)

II a) Define regular sets. Also write any two properties of regular sets.

[OR]

b) State and prove pumping lemma. (5)

c) i) Construct an NFA with ϵ - moves for the regular expression

$(01 + 10)^* + (1(00 + 1))^*$.

ii) Design a DFA that reads strings made up of the letters in the word 'CHARIOT' and recognizes these strings that contain the word 'CAT' as a substring. (8 + 7)

[OR]

d) Minimize the following automaton.

| | | |
|-----------------|---|---|
| | 0 | 1 |
| $\rightarrow A$ | B | F |
| B | G | C |
| * C | A | C |
| D | C | G |
| E | H | F |
| F | C | G |
| G | G | E |
| H | G | C |

(15)

III a) Construct a grammar to generate the set of all palindromes over $\{a, b, c\}$.

[OR]

b) Define elimination of unit productions and give an example. (5)

c i) Construct a grammar which generates all five digit positive even integers.

ii) Construct a context-sensitive grammar to generate $L = \{a^n b^n c^n / n \geq 1\}$. (7+8)

[OR]

d Let G be the grammar with rules $S \rightarrow 0A0/1B1/BB, A \rightarrow C, B \rightarrow S/A, C \rightarrow S/\epsilon$

(i) Eliminate ϵ productions.

(ii) Eliminate unit productions.

(iii) Eliminate the useless symbols.

(iv) Write the grammar in CNF form. (15)

IV a) Define the different types of languages accepted by a pushdown automaton.

[OR]

b) Define left most and right most derivations and give an example. (5)

c) If a language L is accepted by a PDA A by empty stack then prove that there exist a PDA B accepts the same language L by final state.

[OR]

d) Design a PDA TO accepting $L = \{a^n b^{2n} / n \geq 1\}$ by

(i) Empty stack.

(ii) Final state.

(7 + 8)

V a) Discuss about any two properties of a Turing Machine.

[OR]

b) Is it possible that a Turing machine could be considered as a computer of functions from integers to integers? If yes, justify your answer. (5)

c) Design a TM to accept the language $L = \{a^n b^n c^n / n \geq 1\}$. (15)

[OR]

d) Design a Turing Machine to compute

(i) $f(n) = n + 2, n \in N$.

(ii) $f(n) = 2n + 1, n \in N$.

(7 + 8)
