



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – MATHEMATICS

THIRD SEMESTER – APRIL 2017

MT 3964- FORMAL LANGUAGES AND AUTOMATA

Date: 26-04-2017
09:00-12:00

Dept. No.

Max. : 100 Marks

ANSWER ALL QUESTIONS

I a) Design a DFA to accept all positive integers divisible by 5.

[OR]

b) Define a nondeterministic finite automata and give an example. (5)

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

ii) Define regular expressions. Write an NFA with ϵ -moves to accept $(001 + 110)^* + (1^* + 11^*)^*$. (8+7)

[OR]

d) i) Define ϵ closure and give an example

ii) Construct DFA equivalent to the following NFA.

| | 0 | 1 |
|-------------------|----------------|----------------|
| $\rightarrow q_0$ | $\{q_0, q_1\}$ | $\{q_0\}$ |
| $*q_1$ | ϕ | $\{q_1, q_2\}$ |
| q_2 | $\{q_1\}$ | ϕ |

(5+10)

IIa) Prove that $L = \{a^{n^3} / n \geq 1\}$ is not regular.

[OR]

b) Show that a homomorphism of a regular language is regular. (5)

c) i) State and prove any two closure properties of regular languages.

ii) Write regular expressions for the following language over $\{0,1\}$. "The set of all strings containing 000 as a substring". Provide justification that your regular expression is correct. (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 all palindromes over $\{a, b, c\}$.

[OR]

b) Write a grammar to generate all four digit even integers. (5)

c i) Discuss about elimination of ϵ -productions and give an example.

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

[OR]

d i) Eliminate the useless symbols from the grammar with the following production rules $S \rightarrow aA / a / Bb / cC$, $A \rightarrow aB$, $B \rightarrow a / Aa$, $C \rightarrow cCD$, $D \rightarrow ddd$

ii) Convert the grammar with productions $A \rightarrow bAB / \epsilon$, $B \rightarrow BAa / \epsilon$ into CNF. (7+8)

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

[OR]

b) Define leftmost derivations and give an example. (5)

c) If a language L is accepted by a PDA A by final state then prove that there exist a PDA B accepts the same language L by empty stack. (15)

[OR]

d) Design a PDA to accept the set of all strings over $L = \{0^n 1^{2^n} / n \geq 1\}$ by

(1) Empty stack.

(2) Final state. (7+8)

V a) Discuss an ID and moves between the ID's of a Turing Machine.

[OR]

b) Write about multi tape Turing machine. (5)

c) Design a TM to accept $L = \{0^n 1^n 2^n / n \geq 1\}$ (15)

[OR]

d) Design a Turing Machine

(i) to compute $f(n) = 2n$, $n \in N, n \geq 1$.

(ii) to add two positive integers. (7+8)

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