# LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

**M.Sc.** DEGREE EXAMINATION – **MATHEMATICS**

THIRD SEMESTER – NOVEMBER 2017

**MT 3964 - FORMAL LANGUAGES AND AUTOMATA**

Date: 15-11-2017       Dept. No.                    Max. : 100 Marks
Time: 01:00-04:00

ANSWER ALL QUESTIONS

I a)  Construct a finite automaton to accept all strings over {0, 1} ending with 00.          (5)

                        [OR]

  b)  Construct a finite automaton accepting all positive integers divisible by 5.          (5)

  c) i) If L is accepted NFA with $\in$ - moves then show that L is accepted by NFA
       without $\in$ - moves .

    ii) Enumerate the difference between DFA and NFA          .          ( 10+5)

                        [OR]

d)  i) Let r be a regular expression. Then prove that there exists an NFA with
     $\in$ - 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)  Prove that $L = \{ a^p \, / \, p \text{ is a prime number} \}$.          (5)

                        [OR]

  b)  State and prove pumping lemma.          (5)

  c)  i)Construct an NFA with $\in$ - moves for the regular expression
     **( 0\*1\* + 11)\* + (1+101\*)\***.
    ii)Show that **( 0\*1\*)\* = (0+1)\***          (8 + 7)

                        [OR]

  d)  Minimize the following automaton.

|       | 0 | 1 |
|-------|---|---|
| →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 positive three digit even integers .          (5)

                        [OR]

  b)  Prove that every regular language is a context free language.          (5)

c i) Let G be a grammar $S \to aB / bA, A \to a / aS / bAA, B \to b / bS / aBB$. For the
   string *baaabbabba* find leftmost derivation, rightmost derivation and parse tree.

   ii)Construct a context-free grammar to generate $L = \{a^n b^{2n} / n \geq 1\}$ .(10+5)

                    [OR]

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

   i) Eliminate $\in$ 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. (5)
                    [OR]
   b)  Construct a PDA for the grammar $S \to aSb / ab$ by empty stack. (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 accepting $L = \{wcw^R / w \text{ is a string in } (0+1)^*\}$ by

       (i)Empty stack.
       (ii) Final state. (7 + 8)

 V a)  Discuss about multiple tracks of a Turing Machine. (5)
                    [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 perform proper subtraction (15)

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