50 (FLA)

[19-HBPGKOW–M3S(O) 20M]

MCA/MScIT 3rd Semester (Old) Exam., 2019 (W)

FORMAL LANGUAGES AND AUTOMATA

[MCA/MScIT (S3) 11]

Full Marks : 80

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Answer any *five* from the following questions : 2×5=10

(a) Define non-deterministic finite automata.

(b) Write down the steps needed for proving that a given set is not regular.

(c) What is a transition system?

(d) Explain the conventions used to combine Turing machines.

(e) Write down the steps involved in Church's thesis.

(f) What are recursively enumerable languages?

2. Answer any *three* from the following questions : 4×3=12

(a) Construct a context-free grammar which generates palindrome for binary numbers.

(b) Design a Turing machine to accept the language

$$L = \{a^n b^n a^n \mid n \geq 1\}$$

(c) Show that the factorial function is primitive recursive.

(d) What is the problem of computability and decidability?

3. Answer any *three* from the following questions : 6×3=18

(a) Construct a DFA equivalent to the regular expression given below : 6

$$(a^* b + b^* a)^* a$$

(b) Write the regular expression for the following : 2+2+2=6

(i) Set of all strings over $\Sigma = \{0, 1\}$ that has exactly two 0's.

(ii) Set of strings over $\Sigma = \{0, 1\}$ that has at least one pair of consecutive zeros.

(iii) Set of all strings of a's and b's that contains at least two a's.

(c) Why are Turing machines used? What problems cannot be solved by Turing machines? 3+3=6

(d) What is the significance of Turing's thesis? Write the uses of Universal Turing Machine. 3+3=6

(Continued)

4. Answer any *four* from the following questions : 10×4=40

(a) Find all strings of length 5 or less in a regular set represented by the following : 4+3+3=10

(i) $(ab+a)^*(aa+b)$

(ii) (a^*b+b^*a)

(iii) $a^* + (ab+a)^*$

(b) Consider the grammar G with production

$$S \rightarrow aAb$$
$$A \rightarrow aBb$$
$$B \rightarrow bb$$

for the string *aaaabbbb*. Construct the derivation tree. 10

(c) Design a Turing machine that computes the function $f(n) = n-2$, if $n \geq 3$ and $f(n) = 0$ for $n = 0, 1, 2$. 10

(d) Write a note on primitive recursive functions and μ-recursive functions. 10

(e) Explain the closure properties of context-free grammars. 10

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