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[17–HDGKACRM–M3]

MCA/M.Sc IT 3rd Semester Exam., 2017

FORMAL LANGUAGE AND AUTOMATA

[MCA/M.Sc IT (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 regular language.

(b) Write the regular expression for the set of all strings over $\Sigma = \{a, b\}$ that begins with 'a' and ends with 'a'. Give the regular expression for null set.

(c) When is a function said to be computable?

(d) Define tractable decision problem.

(e) Define the meaning of the seven tuples of push-down automata.

(f) Write the meaning of the transition function $\delta(q, \varepsilon) = q$ in a finite automaton.

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

(a) Define grammar. Write the language generated by the grammar

$$G = \{\{S\}, \{a, b\}, S, P\}$$

where the productions are given by $S \rightarrow aSbb|abb|\varepsilon$.

(b) Write the three closure properties of context-free grammar.

(c) Who invented Turing machine? What is the difference between Turing machines and modern computers?

(d) Give the basic difference between DFA and NFA. Define power of an alphabet with examples.

(Turn Over)

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

(a) Describe leftmost and rightmost derivations of a string. Consider the grammar G whose productions are $S \rightarrow AB$, $A \rightarrow aaA|\varepsilon$, $B \rightarrow Bb|\varepsilon$. Find the leftmost and the rightmost derivations for the string *aab*. Also find the language generated by the grammar. 2+3+1=6

(b) Give the necessary and sufficient conditions for a language to be context-free. Briefly describe bottom-up parsing with a suitable example. 2+4=6

(c) Describe in brief Turing decidability and Turing acceptability. Define recursive language. 6

(d) Give the differences between transition diagram and transition table. Explain in brief the working of multihead Turing machine. 6

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

(a) Define context-free grammar. What are its uses? Let

$$G = (\{S, C\}, \{a, b\}, P, S)$$

where P consists of $S \rightarrow aCa$, $C \rightarrow aCa|b$. Find $L(G)$. 4+2+4=10

(b) Draw the following for alphabet $\Sigma = \{a, b\}$: 4+6=10

(i) NFA for all strings having '*abab*' as a substring

(ii) DFA for the language that consists of '*aba*' as a substring and draw the transition table.

(c) Write short notes on any *two* of the following : 5×2=10

(i) Primitive recursive function

(ii) Push-down automata

(iii) Regular expression

(d) Explain Chomsky hierarchy. State the two arguments based on Turing's thesis. 7+3=10

(e) Give the formal definition of parse tree. When is a grammar said to be ambiguous?

Given $G = \{V, T, P, S\}$, where $V = \{S, A, B\}$, $T = \{a, b\}$

P: $S \to aB$ $A \to bAA$

$S \to bA$ $B \to b$

$A \to a$ $B \to bS$

$A \to aS$ $B \to aBB$

Draw a parse tree for the word/string '*abbbaa*'. Also write down the steps of deriving the particular string '*abbbaa*'. 2+1+7=10

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