

Fifth Semester Examination – 2005 Automata Theory

Full Marks – 70

Time – 3 hours

Answer Question No. 1 which is compulsory and any five from the rest.

The figures in the right-hand margin indicate marks.

1. Answer the questions: (2 x 10)
- (a) Define transition system and transition function with example. What do you mean by acceptability of a string by a transition system?
 - (b) Draw a DFA that accepts the four reserved word case, char, const, and continue from C language.
 - (c) Construct an automation M over $\Sigma = \{a, b\}$ which will accept precisely those strings from Σ^* which end in two b's.
 - (d) Define N DFA and acceptability of a string in N DFA system?
 - (e) Construct a context sensitive but not context free grammar, If $G = (\{S\}, \{a\}, \{S \rightarrow SS\}, S)$, find the language generated by G.
 - (f) Define and differentiate between Moore and Mealy machine.
 - (g) Define PUSHDOWN AUTOMATA with example. How a PDA is different from FA.
 - (h) For a given grammar $S \rightarrow (L) | a$
 $L \rightarrow L, | S$
What are the terminals, non-terminals and the start symbol? What language does this grammar generate? Find the height type of grammar which can be applied to the given grammar.
 - (i) Explain CHURCH'S, thesis in the context of Turing Machine.
 - (j) Prove that for any transition function δ for any two input string λ and ω
$$\delta(q, \lambda\omega) = \delta(\delta(q, \lambda), \omega)$$

2.

(a) Prove or disprove the following for regular expression r, s (5)

(i) $(R + s)^* = r^* + s^*$

(ii) $(rs + r)^* r = r(sr+r)^*$

(b) Construct a PDA to accept a given language L by final state (5)

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

3.

(a) Construct a DFA with reduced states equivalent to the regular expression

$$10+(0+11)0^*1. \quad (3)$$

(b) Design a finite automation to test a string to determine whether the string 1101

occurs as a sub string over $\Sigma = \{0,1\}$ (3)

(c) What is phase structure grammar? State and explain with suitable examples

Chomsky classification of grammar. (4)

4.

(a) What is PUMPING Lemma for regular sets? Show that $L = \{ap : p \text{ is a prime}\}$ is not regular. (5)

(b) Construct an optimized DFA equivalent to the NFA $\{ \{P,Q,R,S\}, \{0,1\}, \delta, P, \{P,Q\} \}$, where the transition function given by following table: (5)

	0	1
P	Q, S	Q
Q	R	Q, R
R	S	S
S	Q	P

5.

(a) When DFA is said to be equivalent to a given N DFA, Construct a deterministic automation equivalent to $M = (\{Q_0, Q_1\}, \{0,1\}, \delta, Q_0, \{Q_0\})$. δ is given by the following table (5)

	0	1
Q ₀	Q ₀	Q ₁
Q ₁	Q ₁	Q ₀ , Q ₁

- (b) Let P be the set of all palindromes over {a,b,c} Construct the grammar that generates P. (5)
- 6.
- (a) Define grammar, language, sentence and sentential form. Let $G = (\{S,C\} \{a,b\} P.S)$. Where P consists of $S \rightarrow aCa, C \rightarrow aCa|b$. Find the language $L(G)$. (5)
- (b) Design a FSM that tests a given decimal number as an input string is divisible by 4. (5)
- 7.
- (a) Construct a minimum state automation equivalent to a given automation whose transition table is given below with Q₆ as goal state. (5)

STATES	0	1
$\rightarrow Q_0$	Q ₀	Q ₃
Q ₁	Q ₂	Q ₅
Q ₂	Q ₃	Q ₄
Q ₃	Q ₀	Q ₅
Q ₄	Q ₀	Q ₆
Q ₅	Q ₁	Q ₄
Q ₆	Q ₁	Q ₂

- (b) Find the language generated by the following : (5)
- (i) $S \rightarrow 0S1 \mid 0A1, A \rightarrow 1A \mid 1$
- (ii) $S \rightarrow 0S1 \mid 0A \mid 01B \mid 1 A \rightarrow 0A \mid 0, B \rightarrow 1B \mid 1$

8.

- (a) Prove that the class of regular sets over Σ is the smallest class R containing $\{a\}$ for every $a \in \Sigma$ and closed under union, concatenation and closure. (5)
- (b) Construct a finite state automata that accept the set of natural numbers x which are divisible by 3. (5)
- (c) Construct NFA corresponding the regular expression $a(a+b)^* ab$. (5)

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