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B.Tech  
BCSE 3308

Fifth Semester Examination – 2008

**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 all questions : 2×10
- (a) What is a finite automaton ?
  - (b) List down five different characteristics of an automaton.
  - (c) What is a regular expression ?
  - (d) What is the Non-Deterministic Automaton ?

P.T.O.

- (e) Define the meaning of terminals and non-terminals.
- (f) What is the difference between grammar and language ?
- (g) Write at least two differences between natural language and formal language.
- (h) Distinguish between context free and context sensitive language.
- (i) What do you understand by decidable ?
- (j) Which automata correspond to context free language ?
2. (a) What is the formal definition of a DFA ? How it is different from NFA ? 5
- (b) Prove that for every NFA, if L is the set accepted by NFA, then there exists a DFA which also accepts L. 5
3. (a) Construct a DFA equivalent to  $M = (\{q_0, q_1\}, \{0,1\}, \delta, q_0, \{q_0\})$  where  $\delta$  is defined by its state table as follows : 5

State/Alphabet	0	1
$\rightarrow q_0$	$q_0$	$q_1$
$q_1$	$q_1$	$q_0, q_1$

- (b) Construct DFA for the following regular expressions,

- (i)  $a(ab)^*aa$
- (ii)  $(ab + bb)^*$  5

4. (a) Illustrate with examples that the automaton serves a bridge between the very high-level functional description of a circuit and its logical implementation through transistors, gates and flip-flops. 5
- (b) What is the difference between MOORE and MEALY machines. 5
5. (a) What is the difference between a recursive language and recursively enumerable language ? 5
- (b) Show that the union of two recursively enumerable languages is recursively enumerable and the union of two recursive languages is recursive. 5

6. (a) Let  $f(n) = 4n^3 + 5n^2 + 7n + 3$ . Prove that  $f(n) = O(n^3)$ . 5
- (b) If  $p(n) = a_k n^k + a_{k-1} n^{k-1} + \dots + a_1 n + a_0$  is a polynomial of degree  $k$  over  $Z$  and  $a_k > 0$ , prove that  $p(n) = O(n^k)$ . 5
7. (a) Differentiate between P, NP, NP-Complete and NP-Hard problems with appropriate examples. 5
- (b) Show that P is closed under (a) union, (b) concatenation, and (c) complementation. 5
8. (a) Explain the Chomsky hierarchy along with the corresponding data. 5
- (b) Show that  $L = \{a^n \mid n \geq 1\}$  is not context-free but context-sensitive. 5