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**Question Paper Code : 95310**

5 Year M.Sc. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Fifth Semester

Software Engineering

ESE 055 — THEORY OF COMPUTATION

(Regulations 2010)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define a language and their basic set of operations.
2. Construct an deterministic finite automata for the regular expression  $(aUb)^*a$ .
3. Construct a Left most derivation and parse tree for the string  $w = aaabb$  derived from the following grammar.  
 $S \rightarrow AB/aaB \quad A \rightarrow aA/aB \quad B \rightarrow b$ .
4. Define pushdown automata. State the relation between PDA and context free grammar.
5. Design a turing machine that scans to the right until it finds two consecutive a's and then halts. The alphabets are  $\{a, b, \_, \Delta\}$ .
6. Derive a grammar for the language  $\{0^n 1^n 2^n : n \geq 1\}$ .
7. Prove that if L1 is not recursive and there is a reduction from L1 to L2 then L2 is also not recursive.
8. Give two examples for undecidable problems.
9. When is a turing machine said to be polynomially bounded?
10. Show that P is closed under intersection and concatenation.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Design a deterministic and non deterministic finite automata which accepts the strings defined over alphabet  $\{0, 1\}$  with regular expression  $(00 \cup 11)^* 011$ . Trace for a string of acceptance and state the limitation in NFA. (10)
- (ii) Prove the language  $L = \{n^i : i \geq 1\}$  is not a regular set.. (6)

Or

- (b) Construct a non deterministic finite automata for the regular expression and generate an equivalent deterministic finite automata for the given RE =  $(a \cup b)^* a b (a \cup b)^*$ . Trace for the string  $w = baba$ . (16)
12. (a) Design a pushdown automata for the language of palindrome with alphabets  $\{0, 1, 2\}$  with a middle element I. Trace for the string  $w = 02120$ . (16)

Or

- (b) (i) Find the grammar that generates the following language (8)
- $$L(G) = \{a^m b^n a^n b^m \mid n \geq 0\}$$
- (ii) Consider the CFG  $A \rightarrow aAB \mid bBC \mid a \quad A \rightarrow BA \mid a \quad B \rightarrow cCC \mid b \quad C \rightarrow AB \mid c$ . Describe a pushdown automata for the same. (8)
13. (a) (i) Elaborate on computing with turing machines and show that the initial function are Turing computable. (8)
- (ii) Explain the non deterministic turing machine and its significance with an example. (8)

Or

- (b) (i) Describe in detail the random access turing machine. (10)
- (ii) Discuss the power and configuration of multitape and multidimensional Turing machine. (6)
14. (a) (i) Design a universal turing machine and discuss on the enumeration sets. (8)
- (ii) Discuss with two problems / applications the concept of undecidability problems about Turing machine. (8)

Or

- (b) (i) What is halting problem? Why halting problem is considered to be undecidable problem? (8)
- (ii) Distinguish recursive and recursively enumerable languages and state any two theorems associated with the two languages. (8)
15. (a) Explain in detail independent set and SATISFIABILITY problem. (16)

Or

- (b) Explain in detail the P and NP problems. Explain where a traveling salesman problem is applicable. (16)