



# Theoretical Computer Science

DECEMBER 18

Computer Engineering (Semester 5)

**Total marks: 80**

**Total time: 3 Hours**

## INSTRUCTIONS

(1) Question 1 is compulsory.

(2) Attempt any **three** from the remaining questions.

(3) Draw neat diagrams wherever necessary.

**1.a.** Explain Chomsky Hierarchy. (5 marks)

**1.b.** Differentiate between PDA and NPDA. (5 marks)

**1.c.** Define regular expression and give regular expression for

i) set of all strings over  $\{0,1\}$  that end with 1 has no substring 00 (5 marks)

**1.d.** Explain Halting Problem. (5 marks)

**2.a.** Design a finite state machine to determine ternary number (base 3) is divisible 5. (10 marks)

**2.b.** Give the definition of Pumping Lemma for regular language and prove that following language is not regular .

$L = \{a^m b^{m-1} \mid m > 0\}$  (10 marks)

**3.a.** Construct PDA accepting the language  $L = \{a^2 n b^n \mid n \geq 0\}$  (10 marks)

**3.b.** Consider the following grammar

$S \rightarrow iCtS \mid iCtS e S \mid a$

$C \rightarrow b$

For the string 'ibtacibta' find the following:



- i) Leftmost derivation
- ii) Rightmost derivation
- iii) Parse tree
- iv) Check if above grammar is ambiguous. (10 marks)

**4.a.** Construct TM to check well-formedness of parenthesis. (10 marks)

**4.b.** Convert following CFG and CNF

$S \rightarrow ASA | aB$

$A \rightarrow B | S$

$B \rightarrow b | \epsilon$  (10 marks)

**5.a.** Convert  $(0+1)(10)^*(0+1)$  into NFA with  $\epsilon$ -moves and obtain DFA. (10 marks)

**5.b.** Construct Moore and mealy machine to convert each occurrence of 100 by 101. (10 marks)

**Write short note on any four:** (20 marks)

**6.a.** Closure properties of context free language (5 marks)

**6.b.** Applications of regular expression and finite automata (5 marks)

**6.c.** Rice's Theorem. (5 marks)

**6.d.** Moore and Mealy Machine. (5 marks)

**6.e.** Universal Turing Machine. (5 marks)