### 

# [4658] – 605

Seat No.

### T.E. (Info. Tech.) (Semester – I) Examination, 2014 THEORY OF COMPUTATION (2012 Course)

#### Time : 3 Hours

Max. Marks : 70

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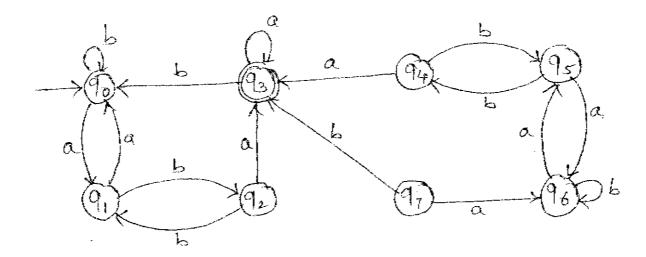
Instructions : 1) Neat diagrams must be drawn wherever necessary.

- 2) Black figures to the **right** indicate **full** marks.
- *3)* Assume suitable data, if **necessary**.
- 1. a) Write the formal definition of the following :
  - i) Finite Automata
  - ii) E-closure

#### b) Using pumping lemma for the regular sets prove the language

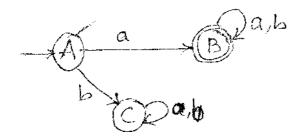
$$L = \left\{ a^{i^2} | i \ge | \right\} \text{ is not regular.}$$
 OR

2. a) Construct the minimum state automation equivalent to the transition diagram given as below :



P.T.O.

b) Construct Regular Expression for the following transition diagram using Arden's theorem. 4



3. a) Construct the parse trees for the strings using specified derivation for the given grammar G.

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

$$\mathsf{P} = \{\mathsf{S} \to \mathsf{aB}, \mathsf{S} \to \mathsf{bA}\}$$

A  $\rightarrow$  a, A  $\rightarrow$  aS, A  $\rightarrow$  bAA

 $\mathsf{B} \to \mathsf{b}, \mathsf{B} \to \mathsf{bS}, \mathsf{B} \to \mathsf{aBB} \}$ 

Strings :

- i) aaabbb (rightmost derivation)
- ii) aababb (rightmost derivation).
- b) Describe CFG, Chomsky Normal Form and Greibach Normal Form, with suitable examples.

OR

4. a) Remove Unit-productions from the given grammar.

$$\mathsf{P} = \{ \mathsf{S} \rightarrow \mathsf{ABA} | \mathsf{BA} | \mathsf{AA} | \mathsf{AB} | \mathsf{A} | \mathsf{B}$$

$$A \to aA|a$$

$$B \rightarrow bB|b$$

- b) Define ambiguous grammar.
  - 1)  $S \rightarrow 0S|S|1S0S| \in$
  - 2) S  $\rightarrow$  AA
    - $\mathsf{A} \to \mathsf{a}\mathsf{A}\mathsf{b}|\mathsf{b}\mathsf{A}\mathsf{a}| \in$

Consider above grammars. Test whether these grammars are ambiguous.

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5.	a)	Construct a PDA that accepts the following language using CNF.	
		$L = \left\{ a^{2n}   n > 0 \right\}.$	8
	b)	Write formal definition of PDA. Explain its elements. What are different types of PDA ? What are the applications of PDA ?	8
		OR	
6.	a)	Design a PDA accepting $\left\{a^n b^m a^n \middle  m, n \ge 1\right\}$ simulate a PDA for the string "aabaa".	8
	b)	Define post machine. Explain its elements. Show that the post machine is more powerful that PDA.	8
7.	a)	Design a TM which accepts all strings of the form $a^n b^n$ for $n \ge 1$ and rejects all other strings. Draw the transition diagram. Simulate TM for some string.	10
	b)	Write short notes on :	
		1) Universal Turing Machine	
		2) Multi-tape Turing Machine.	8
		OR	
8.	a)	Design a TM to add two unary numbers.	8
	b)	Design a TM that recognizes a string containing aba as a substring.	6
	c)	Write a short note on Non deterministic Turing Machine.	4
9.	a)	Show that for two recursive languages $L_1 \& L_2$ , each of the following is recursive.	
		i) $L_1 \cup L_2$ ii) $L_1 \cap L_2$	8
	b)	Define decidability. How to prove the given language is undecidable ? List some undecidable problems.	8
		OR	
10.	a)	Write a short note on halting problem of a Turing machine.	8
	b)	Explain the following : i) Recursive sets ii) Turing reducibility.	8

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