[4658] – 155

Seat No.	

T.E. (Computer) (Semester – I) Examination, 2014
THEORY OF COMPUTATION
(2008 Pattern)

Time : 3 Hours | Max. Marks : 100

Instructions : *1) Answers to the **two** Sections should be written in **separate** answer books.*
*2) Assume **suitable** data **wherever** necessary.*

SECTION – I

1. a) Show by the principle of mathematical induction that $n^4 - 4n^2$ is divisible by 3 for all $n > 0$. **6**
   b) Construct a NFA that accept the set of strings in $(0 + 1)^*$ such that some two 0's are separated by string whose length is 2i, for some $i >= 0$. **6**
   c) Define with notations and suitable examples the following terms : **4**
      i) Kleene's Closure
      ii) Transitive Closure.

OR

2. a) Construct DFA equivalent to given NFA. **6**

	€	a	b	c
→p	∅	p	q	r
q	p	q	r	∅
*r	p	r	∅	p

   b) Let L be a language. From the definition that $L^+ \subseteq L^*$. Under what circumstances are they equal ? Give examples for justification. **6**
   c) Differentiate between DFA and NFA. Give suitable examples. **4**

3. a) Consider the two regular expressions **6**
   $r = 0^* + 1^*$
   $s = 01^* + 10^* + 1^*0 + (0^* 1)^*$
      i) Find a string corresponding to s but not to r.
      ii) Find a string corresponding to both r and s.
      iii) Find a string in {0, 1}* corresponding to neither r nor s.

P.T.O.

b) Let L = $\{0^n 1^n \mid n >= 0\}$. Show that L is not regular. **6**

c) Explain the application of regular expressions in Unix with a suitable example. **4**

OR

4. a) Convert the following Regular Expression to an equivalent DFA **8**

R = (1 + 10)*0.

b) Explain the operators in regular expressions based on their precedence rules. **4**

c) Give Regular Expression for the following languages **4**

i) For Σ = {a, b}, set of all strings with at most two 'a's

ii) L = {ε, a, b, aa, ab, ba, bb}

5. a) Describe the language generated by each of these grammars. Justify your answer with an example. **10**

i) $S \rightarrow a\ S\ a \mid b\ S\ b \mid \varepsilon$

ii) $S \rightarrow a\ S\ a \mid b\ S\ b \mid a \mid b$

iii) $S \rightarrow a\ S\ b \mid b\ S\ a \mid \varepsilon$

iv) $S \rightarrow SS \mid bS \mid a$

v) $S \rightarrow aA \mid a\ ;\ A \rightarrow aA \mid bA \mid \varepsilon$

b) What do you mean by Type-3 grammars ? Give appropriate examples. What are the sub-types of Type-3 grammars ? Which computational model can be converted to Type-3 grammars ? **8**

OR

6. a) Convert the following grammar to Greibach Normal Form : **12**

$S \rightarrow aAB \mid \wedge$

$A \rightarrow bC$

$B \rightarrow b$

$C \rightarrow c$

b) Consider the following productions : **6**

$S \rightarrow aB / bA$

$A \rightarrow a / aS / bAA$

$B \rightarrow b / bS / aBB$

Derive the string 'aababbaabbba' using leftmost derivation and also draw the parse tree. Is the given grammar ambiguous ?

SECTION – II

7. a) Design a push down automaton for the accepting palindrome strings over Σ = {a, b}. **6**

   b) Construct a PDA equivalent to the following CFG : **6**

   $S \rightarrow 0AA$

   $A \rightarrow 0S/1S/0$

   c) Two-stack PDA is more powerful than one-stack PDA. Comment and justify with suitable examples. **4**

OR

8. a) Consider the PDA with following moves; obtain its equivalent CFG. **8**

   $(q_0,a,Z_0) = (q_0,AZ_0)$,
   $(q_0,a,a) = (q_0,AA)$,
   $(q_0,b,a) = (q_1,\varepsilon)$,
   $(q_1,b,a) = (q_1,\varepsilon)$,
   $(q_1,\varepsilon,Z_0) = (q_1,\varepsilon)$

   b) Design a push down automaton to recognize the language generated by the following grammar : **8**

   $S \rightarrow S+S \mid S*S \mid 4 \mid 2$

   Show the acceptance of the input string 2 + 2*4 by this PDA.

9. a) Design a Turing Machine to accept the language L = $\{0^n1^n \mid n >= 1\}$. **8**

   b) Explain the following : **8**
   i) Universal Turing Machines
   ii) Multi-track Turing Machines.

OR

10. a) Construct Post Machine for the language $\{a^nb^{2n} \mid n >= 0\}$. **6**

    b) Design a Turing Machine to add two unary numbers. **6**

    c) Write a short note on halting problem in Turing Machines. **4**

11. a) Define recursive and recursively enumerable languages. **10**

    Prove that if a language L and its complement ~L, are both recursively enumerable, then L is recursive.

    b) What is Post Correspondence Problem ? Explain with example. **8**

OR

12. a) Show that if L1 and L2 are recursive languages, then L1 $\cap$ L2 and L1 $\cup$ L2 are also recursive. **8**

    b) Explain complexity classes P and NP problems. Give examples. **6**

    c) Show that infinite recursively enumerable set has an infinite recursive subset. **4**

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