Total No. of Questions : 10]

SEAT No. :

P2513

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# [5253]-542

## T.E. (I.T.)

## THEORY OF COMPUTATION

## (2015 Patern)

*Time : 2½ Hours]* *[Max. Marks : 70*

***Instructions to the candidates:***

1) ***Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Assume suitable data, if necessary.***

***Q1)*** a) Design Moore machine for divisibility by 3 tester for binary number. **[6]**

b) Discuss Applications of FA & regular expressions. **[4]**

OR

***Q2)*** a) Using Pumping lemma, Prove that $L = \{O^{i^2} / i \text{ is an integer, } i \geq 1\}$ is not-regular. **[6]**

b) Design Finite Automata to accept strings ending with 00 or 11. **[4]**

***Q3)*** a) Simplify the following grammar **[5]**

$$S \rightarrow a \mid Xb \mid aYa$$

$$X \rightarrow Y \mid \in$$

$$Y \rightarrow b \mid X$$

b) Write an equivalent left-linear grammar for the right-linear grammar, which is defined as : **[5]**

$$S \rightarrow 0A \mid 1B$$

$$A \rightarrow 0C \mid 1A \mid 0$$

$$B \rightarrow 1B \mid 1A \mid 1$$

$$C \rightarrow 0 \mid 0A$$

***P.T.O.***

OR

***Q4)*** a) Check whether or not the following grammar is ambiguous; if it is ambiguous, remove the ambiguity and write an equivalent unambiguous grammar. **[6]**

$$S \rightarrow aS \mid aSbS \mid \in$$

b) Write Short Note on Chomsky Hierarchy. **[4]**

***Q5)*** a) Construct PDA that accepts language. **[8]**

$$L = \{ a^n b^m c^n \mid m, n \geq 1\}$$

b) Construct PDA to check for well formedness of paranthesis. Write ID for i) (( ) ( )) ii) (( )) **[8]**

OR

***Q6)*** a) Construct Post Machine which accepts the string over $\Sigma = \{a, b\}$ containing odd length & the element at the centre as 'a'. **[8]**

Write simulation for the string abbabba

b) Convert the following CFG into CNF & construct PDA for the same. **[8]**

$$S \rightarrow 0A1 \mid 0BA$$

$$A \rightarrow S01|0$$

$$B \rightarrow 1B|1$$

***Q7)*** a) Design a TM that multiplies two unary numbers. **[10]**

Write simulation for the strings.

11 & 111

b) Compare FA and TM. **[4]**

c) Define Recursive languages & Recursively enumerable languages with example **[4]**

OR

***Q8)*** a) Design TM to find 2's complement. **[6]**

b) Construct a TM to compute **[10]**

$f(a, b) = a - b$ where $a > b$

$= 0$ where $a \leq b$

c) Explain Multitape TM **[2]**

***Q9)*** a) Prove that, following are decidable languages **[10]**

i) $A_{CFG} = \left\{ \langle G, w \rangle \middle| \begin{matrix} \text{where G is a CFG that} \\ \text{generates string w} \end{matrix} \right\}$

ii) $E_{CFG} = \left\{ \langle G, w \rangle \middle| \begin{matrix} \text{where G is a CFG and} \\ L(G) = \phi \end{matrix} \right\}$

b) Write short note on NP completeness with examples. **[6]**

OR

***Q10)***a) Prove that, **[8]**

$HALT_M = \left\{ \langle M, w \rangle \middle| \begin{matrix} \text{M is TM \& M halts} \\ \text{on input w} \end{matrix} \right\}$ is undecidable.

b) Write short notes on : **[8]**

i) PCP

ii) Measuring complexity