

Total No. of Questions : 8]

SEAT No. :

PE-2517

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[6583]-43

**T.E. (Computer/Computer Science & Engineering(Data Science)/  
Computer Science)**

**THEORY OF COMPUTATION  
(2019 Pattern) (Semester - V) (310242)**

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates :

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

**Q1) a)** Give Context Free Grammars for the following languages and show the derivation for given string [12]

- i)  $L = \{ w \in \{a,b\}^* | w \text{ is string of starting with 'a' and ending with 'b' } \}$   
show the derivation for “ababab”
- ii)  $L = a^n b^{2n}$  where  $n \geq 1$ . Show the derivation for “aabbabb”
- iii)  $RE = (0+1)^*$  Show the derivation for “0110”

**b)** Simplify the following grammar as [5]

- i) Eliminate Useless production

$S \rightarrow aAa|bBb| \epsilon$

$A \rightarrow C|a$

$B \rightarrow C|b$

$C \rightarrow CDE| \epsilon$

$D \rightarrow A|B|ab$

- ii) Eliminate Unit Production

$S \rightarrow 0A | 1B | C$

$A \rightarrow 0S | 00$

$B \rightarrow 1 | A$

$C \rightarrow 01$

OR

P.T.O.

**Q2) a)** The regular grammar is also called a right-linear grammar. But Every language generated from a left-linear grammar is regular. Why? Prove that Every language generated from a left-linear grammar is regular with the following grammar examples. [8]

i)  $G = (\{S, A\}, \{0, 1\}, \{S \rightarrow A01, A \rightarrow 10\}, S)$

ii)  $G = (\{S, A\}, \{0, 1\}, \{S \rightarrow A1, A \rightarrow A0|\epsilon\}, S)$

**b) i)** Show the derivation tree for string 'aabbbb' with the following grammar. [3]

$S \rightarrow AB | \epsilon$

$A \rightarrow aB$

$B \rightarrow Sb$

**ii)** Construct a derivation tree for the string aabbabba for the CFG given by, [3]

$S \rightarrow aB | bA$

$A \rightarrow a | aS | bAA$

$B \rightarrow b | bS | aBB$

**iii)** Check whether the given grammar G is ambiguous or not. [3]

$A \rightarrow AA$

$A \rightarrow (A)$

$A \rightarrow a$

**Q3) a) i)** Construct PDA for the given CFG and test whether  $010^4$  is acceptable by this PDA.

$S \rightarrow 0BB$

$B \rightarrow 0S | 1S | 0$

**ii)** Construct PDA for the given CFG and test whether 'aaabb' is acceptable by this PDA.

$S \rightarrow aSb$

$S \rightarrow a | b | \epsilon$

[10]

**b)** Draw a PDA for the CFG given below :

$S \rightarrow aSb$

$S \rightarrow a | b | \epsilon$

Show the simulation of string acceptable by above CFG using PDA transitions

[8]

OR

- Q4) a)** Give a PDA for the following language [10]  
 $L = \{ \text{the set of strings over alphabet } \{a,b\} \text{ with exactly twice as many } a\text{'s as } b\text{'s} \}$  give the demonstration for the string “abaabbaaaaab”
- b) Design a PDA for detection of palindrome over  $\{a, b\}$  for even and odd length both. [8]

- Q5) a)** Construct a TM for the language  $L = \{0^n 1^n 2^n\}$  where  $n \geq 1$  Show simulation for “001122” [10]
- b) Write short notes on : [8]
- Halting Problem of Turing Machine
  - Representation of Turing Machine
  - Multi-tape Turing Machine
  - Instantaneous Description of a Turing Machine

OR

- Q6) a)** Construct TM for the addition function for the unary number system. And show the simulation [9]  
 For example  
 $2 + 3$   
 i.e.  $11 + 111 = 11111$
- b) Draw FA and Corresponding TM With for language L of the following description  $L = \{x \in \{a, b\}^* \mid x \text{ ends with } aba\}$  [9]

- Q7) a)** What Minimum spanning tree problem? Prove that finding MST by using Kruskal’s algorithm is in class P. [5]
- b) What is post correspondence problem? Why is post correspondence problem undecidable? Explain PCP with following instance of the set of the strings A and B [12]

	A	B
1.	1	111
2.	10111	10
3.	10	0

OR

Q8) a) Define the Class P and Class NP and Problem with their example in detail. [8]

b) Find whether the following lists have a Post Correspondence, if yes give the sequence [9]

i)  $M = (abb, aa, aaa)$  and  $N = (bba, aaa, aa)$

ii)  $M = (B, A, CA, ABC)$  and  $N = (CA, AB, A, C)$

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