Total No. of Questions : 8]

SEAT No. :

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# [6180]-46A
## T.E. (Computer Engineering)
## THEORY OF COMPUTATION
## (2019 Pattern) (Semester - I) (310242)

*Time : 2½ Hours]* *[Max. Marks : 70*

***Instructions to the candidates :***

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

***Q1)*** a) Check whether the string *10010* is a member of the language generated by following grammar by using Cocke-Younger-Kasami Algorithm- **[9]**

$S \rightarrow AB|BC$

$A \rightarrow BA|0$

$B \rightarrow CC|1$

$C \rightarrow AB|0$

b) Obtain grammar to generate the following language : **[8]**

$L = \{w : n_a(w) \bmod 2=0 \text{ where } w \in \{a, b\}^*\}$

i.e. Language of a and b in which number of number of a's in the string is either zero or in multiple of 2 only.

OR

***Q2)*** a) **[9]**

$S \rightarrow aB|bA$

$A \rightarrow a|aS|bAA$

$B \rightarrow b|bS|aBB$

Derive using Leftmost Derivation and Rightmost Derivation:

i) bbaaba ii) aaabbb.

Draw parse tree for the same.

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

b) Find context Free Grammar generating each of these languages. **[8]**

i) L1={$a^i b^j c^k$ such that i = j+k where I, j, k > = 1}

ii) L2={$a^i b^j c^k$ such that j = i+k where I, j, k > = 1}

***Q3)*** a) Construct a PDA equivalent to following CFG **[10]**

i)

$X \rightarrow 0$

$X \rightarrow 0X$

$X \rightarrow 1XX$

$X \rightarrow XX1$

$X \rightarrow X1X$

ii) $S \rightarrow BD|BC$

$D \rightarrow SC$

$C \rightarrow AA$

$B \rightarrow 0$

$A \rightarrow 1$

b) Design a PDA for a language L={$a^n b^{2n}$|n > =1} **[8]**

OR

***Q4)*** a) Construct a PDA accepting the language $L=\{a^n b^m a^n \mid n,m>=0\}$ by null store. **[6]**

b) Design a PDA for a language L={$XcX^r$|X€{a,b}* and string $X^r$ is the reverse of string X}. **[6]**

c) Obtain a PDA to accept the language -

$L=\{w|w\in\sum^*, \sum=\{a,b\} \text{ and } n_a(w)=n_b(w)\}$ by final state **[6]**

***Q5)*** a) Design a Turing machine for well formed parenthesis. **[6]**

b) Design a TM that accepts all strings over {1,0} with even number of 0's and even number of 1's. **[8]**

c) Construct TM that recognizes language over alphabet 0,1 such that string ends in 10. **[4]**

OR

*Q6)* a) Construct a TM to accept the language over {0,1} containing the substring 001. **[6]**

b) Design a TM to multiply a unary number by 2. **[8]**

c) Design Turing Machine for l's Complement. **[4]**

*Q7)* a) What is post correspondence problem? Explain PCP with following instance of the set of the strings A and B. **[8]**

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

b) State and explain with suitable example **[9]**

i) Decidable Problem

ii) Undecidable Problem

iii) Church-Turing Thesis.

OR

*Q8)* a) What is reducibility in Computability Theory ? Explain in detail, the polynomial - time reduction approach for proving that a problem is NP-Complete. **[8]**

b) Explain with suitable example and diagrams **[9]**

i) Halting problem of TM

ii) Multitape TM

iii) Universal TM

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