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Total Pages : 05

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B.Tech. EXAMINATION, 2022

Semester IV (CBCS)

THEORY OF COMPUTATION

CS-404

Time : 3 Hours *Maximum Marks : 60*

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt *Five* questions in all, selecting *one* question from each Sections A, B, C and D. Q. No. **1** is compulsory.

(Compulsory Question)

1. (a) Represent the following set by a regular expression $\{1^{2n} \mid n \geq 0\}$ and describe the following regular expression 0(0 + 1)*01 in a set representation format. **2**

(b) Find all strings of length 4 or less for the following regular expression $a(a^*b + b^*a)^*b$ and design a DFA for the regular expression $(0 + 10)^*$. **2**

(c) Differentiate between DFA and NDFA. **2**

(d) Consider a grammar G whose productions are $S \rightarrow 0S/\wedge$, what will be the language of this grammar. **2**

(e) Define PDA and Context Free Grammar. **2**

(f) Differentiate between DPDA and NPDA. **2**

(g) Show the left most derivation for the string $a * a + a$ for the following grammar : **2**

$E \rightarrow E + E / E * E / (E) / a$

(h) Define TM and differentiate between PDA and TM. **2**

(i) Define Non-deterministic TM. **2**

(j) Differentiate between recursive and recursive enumerable languages. **2**

Section A

2. (a) Prove that $L = \{ww^r \mid w \in (a + b)^*\}$ is not regular. **5**

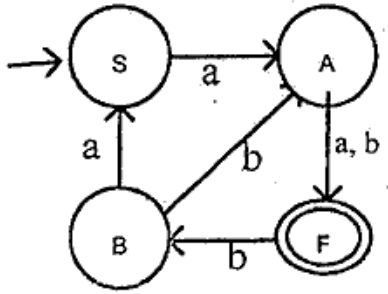
(b) Design a DFA for the following regular expression P = 0(01)*1 + 1(10)*0. **5**

3. Minimize the following DFA M = $(\{q^0, q^1, q^2, q^3, q^4, q^5, q^6\}, \{a, b\}, \delta, q^0, \{q^6\}$ where δ is given as :
$\delta(q^0, a) = q^0$, $\delta(q^0, b) = q^3$, $\delta(q^1, a) = q^2$, $\delta(q^1, b) = q^5$, $\delta(q^2, a) = q^3$, $\delta(q^2, b) = q^4$, $\delta(q^3, a) = q^0$, $\delta(q^3, b) = q^5$, $\delta(q^4, a) = q^0$, $\delta(q^4, b) = q^6$, $\delta(q^5, a) = q^1$, $\delta(q^5, b) = q^4$, $\delta(q^6, a) = q^1$, $\delta(q^6, b) = q^3$. **10**

Section B

4. (a) Define Grammar and its types i.e. Regular, CFG, CSG and Phrase Structure Grammar. **5**

(b) Find the regular expression for the Finite Automata given in the figure below using Arden's Theorem. **5**



5. Write short notes on any *two* of the following : **10**

(a) Halting Problem of TM

(b) Decidability and undecidability

(c) PCP.

Section C

6. (a) Design a TM for deciding the language $M = \{0^r 1^r 2^r \mid r \geq 1\}$. **5**

(b) Design a PDA which will recognize the elements of the following set $\{0^r 1^r \mid r \geq 0\}$. **5**

7. (a) Convert the following NDFA into DFA. **5**

State	Input	
	0	**1**
q^0 (Starting State)	q^1, q^2	q^1
q^1	q^3	q^2
q^2 (Final State)	q^2	q^1
q^3	q^2	q^4
q^4	q^3	q^4

(b) Convert the following Melay Machine into Moore machine : **5**

Present State	Next State			
	Input = 0		Input = 1	
	State	Output	State	Output
S1	S3	0	S2	0
S2	S1	1	S4	0
S3	S2	1	S1	1
S4	S4	1	S3	0

Section D

8. (a) Convert the following CFG into CNF : **5**

$S \rightarrow aAD$, $A \rightarrow aB$, $A \rightarrow bBE$, $B \rightarrow b$, $D \rightarrow d$, $E \rightarrow e$.

(b) Convert the following CFG into GNF : **5**

$S \rightarrow AA$, $S \rightarrow a$, $A \rightarrow SS$, $A \rightarrow b$.

9. (a) Prove that the following grammar is ambiguous : **5**

$S \rightarrow aB$, $S \rightarrow ab$, $A \rightarrow a$, $A \rightarrow aAB$, $B \rightarrow b$, $B \rightarrow ABb$

(b) Consider the following production :

$S \rightarrow aB$, $S \rightarrow bA$, $B \rightarrow bS$ $B \rightarrow aBB$, $B \rightarrow b$, $A \rightarrow aS$, $A \rightarrow a$, $B \rightarrow bAA$

For the string "*aaabbabbba*" find :

(i) Left most derivation

(ii) Right most derivation. **5**