Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2019

CA5CO13 Theory of Computation

Programme: MCA Branch/Specialisation: Computer Application

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. To define finite automata number of tuples required are: **1**
(a) 2 (b) 3 (c) 4 (d) 5

ii. Complementation of Regular Language is: **1**
(a) Regular (b) Not Regular
(c) Context free (d) None of these

iii. If $\Sigma = \{0,1\}$ then ϕ^* will be equivalent to: **1**
(a) ε (b) ϕ (c) Σ (d) None of these

iv. Type 2 grammar is best described as: **1**
(a) Phrase structured (b) Context sensitive grammar
(c) Context free grammar (d) Regular Grammar

v. PDA is more powerful than **1**
(a) Turing machine (b) Finite automata
(c) Both (a) and (b) (d) None of these

vi. Which operation can be applied on stack? **1**
(a) PUSH (b) POP
(c) Both (a) and (b) (d) None of these

vii. Which of the following cannot be a possibility of a TM while it processes an input? **1**
(a) Enters accepting state
(b) Enters non-accepting state
(c) Enters infinite loop and never halts
(d) None of these

P.T.O.

viii. X is a simple mathematical model of a computer. X has unrestricted and unlimited memory. X is a FA with Read-Write head. X can have an infinite tape divided into cells, each cell holding one symbol. Name X? **1**

(a) Push Down Automata (b) Non deterministic Finite Automata
(c) Turing machines (d) None of these

ix. PCP abbreviates for: **1**

(a) Post Correspondence problem
(b) Pre-Correspondence problem
(c) Past correlated problem
(d) None of these

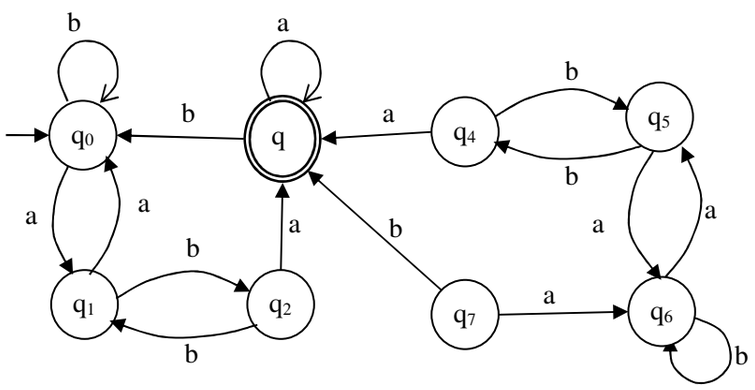
x. Which of the following problems is undecidable? **1**

(a) Membership problem for CFGs
(b) Ambiguity problem for CFGs
(c) Finiteness problem for FSAs
(d) Equivalence problem for FSAs

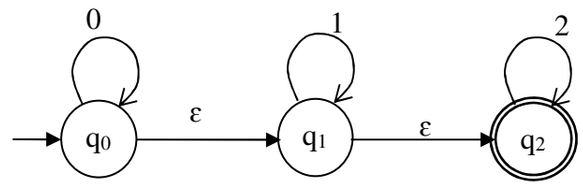
Q.2 i. Define Finite Automata. **2**

ii. Design a DFA over $\sum = \{a, b\}$ accepting strings whose decimal equivalent is completely divisibly by 3. **3**

iii. Construct the minimum state automata for the following transition diagram: **5**



OR iv. Find equivalent NFA without ε move. **5**



Q.3 i. Give CFG for following language $L = \{a^{n+2}\, b^n \mid n >= 0\}$ **2**

ii. Eliminate useless symbols, ∈-productions and unit productions for the following grammar: S→0A0 | 1B1 | BB, A→C, B→S | A, C→S | ∈ **8**

OR iii. Given the context-free grammar G, find a CFG G' in Chomsky Normal Form. G : S → AaA | CA | BaB A → aaBa | CDA | aa | DC B → bB | bAB | bb | aS C → Ca | bC | D D → bD | ε, ε represents null. **8**

Q.4 i. Define PDA. **3**

ii. Design PDA for $\{a^n c b^n \mid n \geq 1\}$ **7**

OR iii. Construct a PDA from the following CFG. **7**
G = ({S, X}, {a, b}, P, S)
where the productions are -
S →XS | ε , A→ aXb | Ab | ab

Q.5 i. Define TM. **4**

ii. Design a Turing machine to reverse the string over alphabet {0, 1}. **6**

OR iii. Write short note on **6**
(a) TM as language acceptors. (b) TM as Transducers

Q.6 Attempt any two:

i. Differentiate between classes P and NP. **5**

ii. Write a short note on PCP. **5**

iii. What is decidability? How to prove that the given language is undecidable? **5**

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Marking Scheme
CA5CO13 Theory of Computation

Q.1	i.	To define finite automata number of tuples required are: (d) 5	**1**
	ii.	Complementation of Regular Language is: (a) Regular	**1**
	iii.	If $\Sigma = \{0,1\}$ then ϕ^* will be equivalent to: (a) ε	**1**
	iv.	Type 2 grammar is best described as: (c) Context free grammar	**1**
	v.	PDA is more powerful than (b) Finite automata	**1**
	vi.	Which operation can be applied on stack? (c) Both (a) and (b)	**1**
	vii.	Which of the following cannot be a possibility of a TM while it processes an input? (d) None of these	**1**
	viii.	X is a simple mathematical model of a computer. X has unrestricted and unlimited memory. X is a FA with Read-Write head. X can have an infinite tape divided into cells, each cell holding one symbol. Name X? (c) Turing machines	**1**
	ix.	PCP abbreviates for: (a) Post Correspondence problem	**1**
	x.	Which of the following problems is undecidable? (b) Ambiguity problem for CFGs	**1**
Q.2	i.	Define Finite Automata. Definition of all tuples	**2**
	ii.	Design a DFA over $\sum = \{a, b\}$	**3**
	iii.	Construct the minimum state automata Stepwise marking	**5**
OR	iv.	Find equivalent NFA without ε move. Stepwise marking	**5**
Q.3	i.	Give CFG for following language $L = \{a^{n+2}\, b^n \mid n >= 0\}$	**2**
	ii.	Eliminate useless symbols Stepwise marking	**8**
OR	iii.	Find a CFG G' in Chomsky Normal Form. Stepwise marking	**8**
Q.4	i.	Define PDA. Definition of all tuples	**3**
	ii.	Design PDA for $\{a^n c b^n \mid n \geq 1\}$ Logic 2 marks Design of all tuples 5 marks	**7**
OR	iii.	Construct a PDA from the following CFG. Stepwise marking	**7**
Q.5	i.	Define TM. Definition and explanation of all tuples	**4**
	ii.	Design a Turing machine to reverse the string over alphabet {0, 1}. Stepwise marking	**6**
OR	iii.	Write short note on (a) TM as language acceptors. 3 marks (b) TM as Transducers 3 marks	**6**
Q.6		Attempt any two:	
	i.	Differentiate between classes P and NP. At least five differences 1 mark for each (1 mark *5)	**5**
	ii.	Write a short note on PCP.	**5**
	iii.	Decidability 2 marks To prove that the given language is undecidable 3 marks	**5**

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