Q.5	i.	Explain Push Down Automata.	**3**
	ii.	Design PDA for the following CFL. $L = \{ a^m b^n c^{n+m} \mid n,m>=0 \}$	**7**
OR	iii.	Prove that the following languages are not CFL using Pumping lemma theorem. (a) $L = \{ a^n b^n c^n \mid n>= 0\}$. (b) $L = \{ a^P \mid p$ is prime number $\}$.	**7**
Q.6		Attempt any two:	
	i.	Explain different types of Turing machine in detail.	**5**
	ii.	Design Turing machine for the following language $L = \{ a^n b^{2n} c^n \mid n >=0 \}$	**5**
	iii.	Write down closure properties of Recursive and Recursive Enumerable Language.	**5**

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Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Engineering

End Sem (Even) Examination May-2019

CS3CO10 Theory of Computation

Programme: B.Tech. Branch/Specialisation: CSE

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.	Consider the languages L1 = Ø and L2 = {a}. Which one of the following represents L1.($L2^*$ U $L1^*$). (a) {ε} (b) a* (c) Ø (d) None of these	**1**
	ii.	A minimum state deterministic finite automaton accepting the language L={w | w ε {0,1,2} *, N0(w) mod 2 = 0 or N1(w) mod 4 = 1 or N2(w) mod 3 = 2} has _____ final state. Note: Na(w) means number of a's in string w. (a) 1 (b) 18 (c) 24 (d) None of these	**1**
	iii.	Which of the following language is not regular? (a) $L = \{ a^n b^m \mid n>=0$ and m >=0$\}$ (b) $L = \{ a^n b^n \mid 0<= n < =100\}$ (c) $L = \{ a^n b^m \mid n > m\}$ (d) None of these	**1**
	iv.	Let A and B be language over Σ = {0,1} represented by the regular expressions (0+1*)* and (0+1)*, respectively. Which of the following is true? (a) A is subset of B (b) B is subset of A (c) A and B both represent same set of strings. (d) A and B both are incomparable.	**1**
	v.	Consider the following grammar S ---> aS/Sa/a Suppose string "aaa" is generated by the above grammar. How many parse tree exist for the string "aaa"? (a) 2 (b) 4 (c) 8 (d) 16	**1**

P.T.O.

vi. If L1 is a context free language and L2 as a regular language, which of the following is/are true? **1**

P. L1 - L2 is not context free

Q.L1 ∩ L2 is context free

R.~L1 is context free

S.~L2 is regular

(a) P and Q (b) Q and R (c) Q and S (d) P and S

vii. Which of the following statement is/are False? **1**

S1: NPDA and DPDA is equal in power.

S2: NPDA is more powerful than DPDA.

(a) S1 only (b) S2 only

(c) Both (a) and (b) (d) None of these

viii. Consider a Context free Grammar G is in CNF form. The number of derivation steps required to generate string w of length n from grammar G is _____. **1**

(a) n (b) 2n-1 (c) 2n + 1 (d) Depends on G.

ix. Which of the following is true for the language L = { a^p | p is prime number }? **1**

(a) L is not accepted by Turing Machine

(b) L is accepted by Finite state automata.

(c) L is accepted by PDA.

(d) None of these

x. If L and L' are recursively enumerable, then L is **1**

(a) Recursively enumerable (b) Recursive

(c) Context free (d) Context sensitive.

Q.2 i. Write down any three closure properties of Regular Language? **3**

ii. Find out regular expression for complement of L = { w | w ε (a,b)* , Na(w) mod 2 = 0 and Nb(w) mod 2 = 0 }. **7**

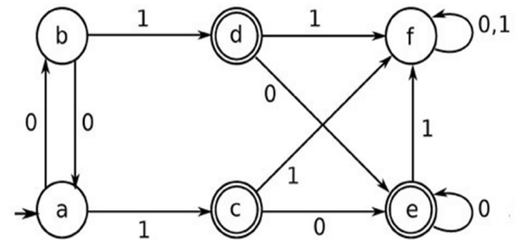
Note: Na(w) means number of a's in string w.

OR iii. (a) Design Melay machine to find two's complement of binary number. **7**

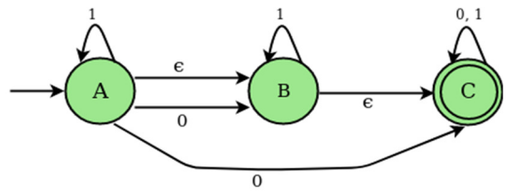
(b) Design Moore machine to find two's complement of binary number.

Q.3 i. Explain Finite State Automata. Write down main difference between NFA and DFA. **4**

ii. Design Minimized DFA for the following DFA. **6**



OR iii. Design DFA for the following NFA with ε. **6**



Q.4 i. Simplify the following context free grammar **4**

G = { S --> AB / CD

A ---> aA / ε

B ---> BC / b

C ---> cC / c

E ---> ED / f

}

ii. Convert the following grammar to GNF form. **6**

G = { S ---> AA / bB / a

A ---> SS / bAab / b

B ---> Bb / ε

}

OR iii. How many substring of string "aabbc" is generated by following context free grammar. **6**

G = { S ---> AB / BC

A ----> AB / a

B ----> BC / b

C -----> CB / c

}

Note : Use CYK algorithm to find the result.

P.T.O.

Marking Scheme
CS3CO10 Theory of Computation

Q.1 i. Consider the languages L1 = Ø and L2 = {a}. Which one of the following represents L1.($L2^*$ U $L1^*$). **1**

(c) Ø

ii. A minimum state deterministic finite automaton accepting the language L={w | w ε {0,1,2} *, N0(w) mod 2 = 0 or N1(w) mod 4 = 1 or N2(w) mod 3 = 2} has _____ final state. **1**

Note: Na(w) means number of a's in string w.

(b) 18

iii. Which of the following language is not regular? **1**

(c) L = { $a^n b^m$ | n > m}

iv. Let A and B be language over Σ = {0,1} represented by the regular expressions (0+1*)* and (0+1)*, respectively. Which of the following is true? **1**

(c) A and B both represent same set of strings.

v. Consider the following grammar **1**

S ---> aS/Sa/a

Suppose string "aaa" is generated by the above grammar.

How many parse tree exist for the string "aaa"?

(b) 4

vi. If L1 is a context free language and L2 as a regular language, which of the following is/are true? **1**

P. L1 - L2 is not context free

Q.L1 ∩ L2 is context free

R.~L1 is context free

S.~L2 is regular

(c) Q and S

vii. Which of the following statement is/are False? **1**

S1: NPDA and DPDA is equal in power.

S2: NPDA is more powerful than DPDA.

(a) S1 only

viii. Consider a Context free Grammar G is in CNF form. The number of derivation steps required to generate string w of length n from grammar G is _____. **1**

(b) 2n-1

ix. Which of the following is true for the language L = { a^p | p is prime number }? **1**

(d) None of these

x. If L and L' are recursively enumerable, then L is **1**

(b) Recursive

Q.2 i. Any three closure properties of Regular Language **3**

1 mark for each (1 mark * 3)

ii. Find out regular expression for complement **7**

DFA for L 2 marks

Complement of DFA 1 mark

Regular expression of complemented DFA 4 marks

OR iii. (a) Melay machine to find two's complement of binary number. **7**

3.5 marks

(b) Moore machine to find two's complement of binary number.

3.5 marks

Q.3 i. Finite State Automata 2 marks **4**

Main difference between NFA and DFA

Any four 0.5 mark for each (0.5 mark * 4) 2 marks

ii. Design Minimized DFA **6**

Stepwise 1 mark for each correct step (1 mark * 6)

OR iii. Design DFA **6**

Stepwise 1 mark for each correct step (1 mark * 6)

Q.4 i. Simplify the following context free grammar **4**

Remove useless production 1 mark

Remove null production 1 mark

Remove unit production 2 marks

ii. Convert the following grammar to GNF form. **6**

CFG to GNF

Stepwise 1 mark for each correct step (1 mark * 6)

OR iii. How many substring of string "aabbc" is generated by following context free grammar. **6**

For correct result 1 mark

1 mark for each step of CYK algorithm. (1 mark *5)

Q.5 i. Push Down Automata. **3**

	ii.	Design PDA for the following CFL.		**7**
		1 mark for each correct step	(1 mark * 7)	
OR	iii.	Prove languages are not CFL using Pumping lemma theorem.		**7**
		(a) L = { $a^n b^n c^n$ | n>= 0}.	3.5 marks	
		(b) L = { a^P | p is prime number }.	3.5 marks	
Q.6		Attempt any two:		
	i.	Types of Turing machine		**5**
		Any 5 types 1 mark for each	(1 mark * 5)	
	ii.	Design Turing machine for the following language		**5**
		1 mark for each step	(1 mark *5)	
	iii.	Closure properties of Recursive any five properties		**5**
		0.5 mark for each (0.5 mark * 5)	2.5 marks	
		Closure properties of REL any five properties		
		0.5 mark for each (0.5 mark * 5)	2.5 marks	

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