	ii.	Simplify the following context free grammar G = { S --> aAB / DCD A ---> baA / ε B ---> bCe / b / ε C ---> cCf / c E ---> ED / f / ε }	**6**
OR	iii.	Convert the following grammar to CNF form. G = { S ---> AaA / bB / a A ---> aSS / bAab / b B ---> aBb / ε }	**6**
Q.5	i.	Explain deterministic Push Down Automata.	**3**
	ii.	Design Push down automata for the following CFL. L = { $a^n b^n c^m$ | n,m>=1 }	**7**
OR	iii.	What is Pumping lemma theorm? Check the following languages are CFL or not using pumping lemma. (a) L = { $a^i b^i c^i$ | i>= 1}. (b) L = { a^{x+1} | x is prime number }.	**7**
Q.6		Attempt any two:	
	i.	Write down any five closure properties of Recursive Language.	**5**
	ii.	Design Turing machine for the following language. L = { $a^n b^{2n} c^{2n}$ | n >=0 }	**5**
	iii.	What is Turing machine? Write down difference between deterministic and non-deterministic turing machine.	**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-2022

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.	Given the language L = {ab, aa, baa}, which of the following strings are in L*? I. abaabaaabaa II. aaaabaaaa III. baaaaabaaaab IV. baaaaabaa (a) I, II and III (b) II, III and IV (c) I, II and IV (d) I, III and IV	**1**
	ii.	Which one of the following languages over the alphabet {0,1} is described by the regular expression: (0+1)*0(0+1)*0(0+1)*? (a) The set of all strings containing the substring 00. (b) The set of all strings containing at most two 0's. (c) The set of all strings containing at least two 0's. (d) The set of all strings that begin and end with either 0 or 1.	**1**
	iii.	Which of the following is regular language? (a) L = { $a^n b^m$ | n>=1 and m >=1} (b) L = { $a^n b^n$ | n>=100} (c) L = { $a^n b^m$ | n > m} (d) None of these	**1**
	iv.	According to Arden's Theorem if P and Q be two regular expressions and R is any state, then R = Q + RP has a unique solution that is- (a) R = PQ* (b) R = QP* (c) R =P+ QP* (d) None of these	**1**

P.T.O.

v. Which one of the following is FALSE? **1**
(a) There is unique minimal DFA for every regular language.
(b) Every NFA can be converted to an equivalent PDA.
(c) Complement of every context-free language is recursive.
(d) Every nondeterministic PDA can be converted to an equivalent deterministic PDA.

vi. If L1 and L2 is regular languages and L3 is CFL then which of the following is true? **1**
(a) (L3 – L1) ⋃ L2 is context free
(b) (L3 ∩ L2) ⋃ L1 is not context free
(c) ~L1 ⋃ L2 is context free
(d) None of these

vii. A PDA machine configuration (p, w, y) can be correctly represented as: **1**
(a) (current state, unprocessed input, stack content)
(b) (unprocessed input, stack content, current state)
(c) (current state, stack content, unprocessed input)
(d) None of these

viii. Consider a Context free Grammar G is in GNF form. The number of derivation steps required to generate string w of length 50 from grammar G is _____. **1**
(a) 50 (b) 99 (c) 101 (d) Depends on G

ix. Halting problem of Turing Machine is- **1**
(a) Always Decidable
(b) Always Undecidable
(c) Decidable in case of recursive languages
(d) None of these

x. If set A is set of recursive language and B is set of recursive enumerable language, then- **1**
(a) A is a subset of B (b) B is a subset of A
(c) A and B are the same set (d) A and B are disjoint sets

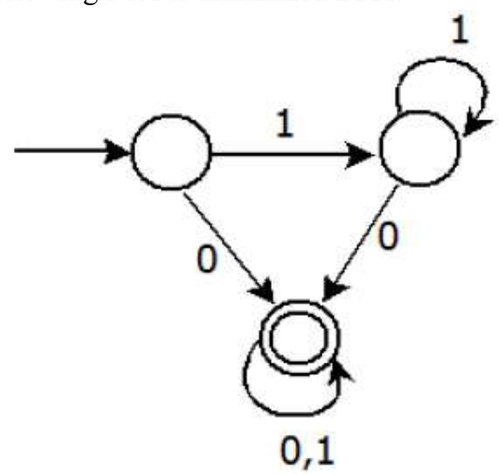
Q.2 i. What is Arden's theorem? **3**

ii. Explain different closure properties of Regular Language with the help of example. **7**

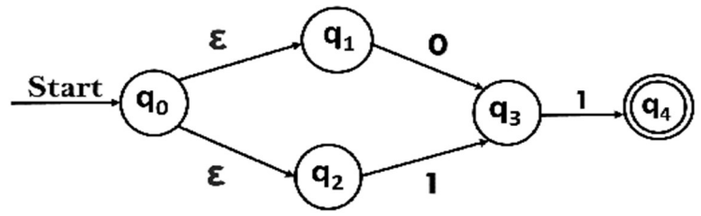
OR iii. Design Melay and Moore machine to find one's and two's complement of binary number. **7**

Q.3 i. Write down main difference between NFA with null, NFA without null and DFA. **4**

ii. Covert the following FSA to minimized DFA. **6**



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



Q.4 i. Check the given string is generated by the following context free grammar or not using CYK algorithm. **4**
String = aabbc
G = { S ---> BC / AB
A ----> AAB / a
B ----> BbC / b
C -----> cCB / c
}

Marking Scheme
CS3CO10 Theory of Computation

Q.1	i.	Given the language L = {ab, aa, baa}, which of the following strings are in L*? I. abaabaaabaa II. aaaabaaaa III. baaaaabaaaab IV. baaaaabaa (c) I, II and IV	**1**
	ii.	Which one of the following languages over the alphabet {0,1} is described by the regular expression: (0+1)*0(0+1)*0(0+1)*? (c) The set of all strings containing at least two 0's.	**1**
	iii.	Which of the following is regular language? (a) L = { $a^n b^m$ | n>=1 and m >=1}	**1**
	iv.	According to Arden's Theorem if P and Q be two regular expressions and R is any state, then R = Q + RP has a unique solution that is- (b) R = QP*	**1**
	v.	Which one of the following is FALSE? (d) Every nondeterministic PDA can be converted to an equivalent deterministic PDA.	**1**
	vi.	If L1 and L2 is regular languages and L3 is CFL then which of the following is true? (a) (L3 – L1) ⋃ L2 is context free (c) ~L1 ⋃ L2 is context free	**1**
	vii.	A PDA machine configuration (p, w, y) can be correctly represented as: (a) (current state, unprocessed input, stack content)	**1**
	viii.	Consider a Context free Grammar G is in GNF form. The number of derivation steps required to generate string w of length 50 from grammar G is _____. (a) 50	**1**
	ix.	Halting problem of Turing Machine is- (c) Decidable in case of recursive languages	**1**
	x.	If set A is set of recursive language and B is set of recursive enumerable language, then- (a) A is a subset of B	**1**
Q.2	i.	Definition — 2 Marks Equation — 1 Mark	**3**
	ii.	At least 7 closure properties with example.	**7**
OR	iii.	one's complement Melay + Moore machine — 3.5 Marks Two's complement Mealy + Moore machine — 3.5 Marks	**7**
Q.3	i.	At least 4 difference (NFA with null, NFA without null and DFA) — 1 Mark each (1 Mark*4)	**4**
	ii.	Minimized DFA/ diagram table — 2 Marks Converting steps — 4 Marks	**6**
OR	iii.	DFA/ diagram table — 2 Marks Converting steps — 4 Marks	**6**
Q.4	i.	CNF form — 2 Marks Final Solution — 2 Marks	**4**
	ii.	Remove useless symbol — 2 Marks Remove unit production — 2 Marks Remove Є production — 2 Marks	**6**
OR	iii.	Simplification steps — 2 Marks CNF conversion steps — 4 Marks	**6**
Q.5	i.	PDA definition — 1 Mark PDA types — 2 Marks	**3**
	ii.	Diagram/solution steps/rules — 7 Marks	**7**
OR	iii.	Theorem. — 2 Marks (a) — 2.5 Marks (b) — 2.5 Marks	**7**
Q.6		Attempt any two:	
	i.	5 closure properties of Recursive Language. — 1 Mark each (1 Mark*5)	**5**
	ii.	TM definition — 1 Mark Solution steps(diagram/table/rules) — 4 Marks	**5**
	iii.	TM definition — 2 Marks At least 3 difference — 1 Mark each (1 Mark*3)	**5**