OR iii. (a) Check whether the grammar is ambiguous or not- **6**
S -> SS|AB , A -> Aa|a , B -> Bb|b
(b) What do you mean by left recursion? How it can be removed? Explain with example.

Q.5 i. Explain push down automata with its 7 tuple. **3**

ii. Design push down automata which accept the language **7**
$L=\{a^n b^n c^m \mid$ where n>=1 and m>=1 $\}$

OR iii. Give NPDA which simulates the following grammar where S is starting symbol- **7**
$S \rightarrow aBB|cDD$
$B \rightarrow cD|aS$
$D \rightarrow dD|d$

Q.6 Attempt any two:

i. Explain decidability and recursive enumerable languages **5**

ii. Design turing machine to accept the language L={ WCW |wϵ(a,b)} **5**

iii. Design turing machine to accept the language $L=\{ WW^R |w\epsilon(a,b)\}$ **5**

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

Enrollment No.....

Faculty of Engineering

End Sem Examination Dec-2023

IT3CO33 Theory of Computation

Programme: B.Tech. Branch/Specialisation: IT

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. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. Which of the following is correct? **1**
Statement 1: ε represents a single string in the set.
Statement 2: Φ represents the language that consists of no string.
(a) Statement 1 and 2 both are correct
(b) Statement 1 is false but 2 is correct
(c) Statement 1 and 2 both are false
(d) There is no difference between both the statements, ε and Φ are different notation for same reason

ii. Which of the following is a correct statement? **1**
(a) Moore machine has no accepting states
(b) Mealy machine has accepting states
(c) We can convert Mealy to Moore but not vice versa
(d) All of these

iii. Transition function of NDFA maps- **1**
(a) Σ * Q -> Q
(b) Q * Q -> 2^{Σ}
(c) Σ * Σ -> Q
(d) Q * Σ -> 2^{Q}

iv. Finite automata require minimum _____ number of stacks. **1**
(a) 1 (b) 0
(c) 2 (d) None of these

v. Which of the following statement is false? **1**
(a) Context free language is the subset of context sensitive language
(b) Regular language is the subset of context sensitive language
(c) Recursively enumerable language is the super set of regular language
(d) Context sensitive language is a subset of context free language

vi. Production Rule: aAb->agb belongs to which of the following category? **1**
(a) Regular Language
(b) Context free Language
(c) Context Sensitive Language
(d) Recursively Enumerable Language

vii. A DPDA is a PDA in which: **1**
(a) No state p has two outgoing transitions
(b) More than one state can have two or more outgoing transitions
(c) At least one state has more than one transitions
(d) None of these

viii. Which of the following does not have left recursions? **1**
(a) Chomsky Normal Form
(b) Greibach Normal Form
(c) Both (a) and (b)
(d) All of these

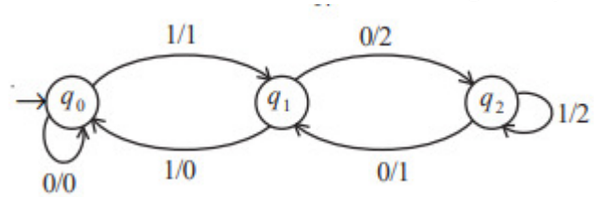
ix. A language L is said to be _____ if there is a turing machine M such that L(M)=L and M halts at every point. **1**
(a) Turing acceptable (b) Decidable
(c) Undecidable (d) None of these

x. Turing machine can be represented using the following tools: **1**
(a) Transition graph (b) Transition table
(c) Queue and Input tape (d) All of these

Q.2 i. Write the closure properties of Regular languages. **2**

ii. Write regular expression which accepts all the string starting and ending with same symbol. **3**

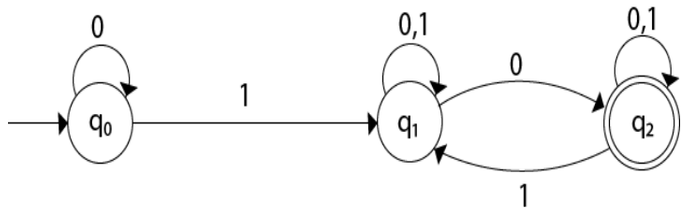
iii. Construct Moore machine for the following Mealy machine: **5**



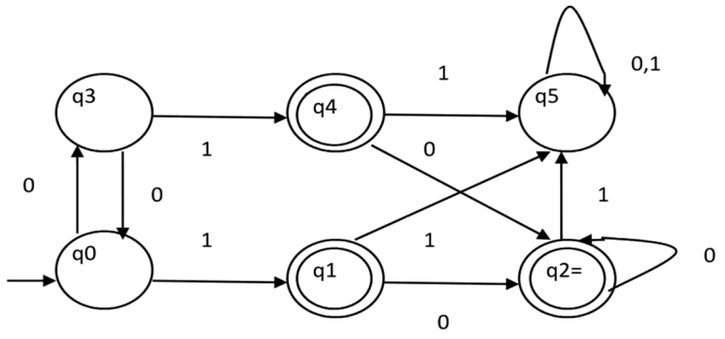
OR iv. Design Deterministic finite automata which recognize all the languages L={n_a(w)mod2=2 and n_b(w)mod3=1 | w ϵ (a,b)} **5**

Q.3 i. State and prove Arden's Theorem. **4**

ii. Convert the following NDFA to DFA- **6**



OR iii. Consider the given below DFA and construct minimized DFA and draw trasition table for minimized DFA **6**



Q.4 i. Explain Chomsky classification of grammar. **4**

ii. Convert the following grammar to Greibach Normal Form- **6**
S → XA|BB
B → b|SB
X → b
A → a

Marking Scheme
Theory of Computation (T) - IT3CO33 (T)

Q.1	i)	a) Statement 1 and 2 both are correct	**1**
	ii)	a) Moore machine has no accepting states	**1**
	iii)	d) $Q * \Sigma \rightarrow 2^Q$	**1**
	iv)	b) 0	**1**
	v)	d) Context sensitive language is a subset of context free language	**1**
	vi)	c) Context Sensitive Language	**1**
	vii)	a) No state p has two outgoing transitions	**1**
	viii)	b) Greibach Normal Form	**1**
	ix)	b) decidable	**1**
	x)	d) All of the mentioned	**1**

Q.2	i.	Each property	(0.5 Mark*4)	**2**
	ii.	RE	(As per explanation)	**3**
	iii.	Conversion	(As per explanation)	**5**
OR	iv.	DFA	(As per explanation)	**5**

Q.3	i.	Statement	1 Mark	**4**
		Proof	3 Marks	
	ii.	Conversion	(As per explanation)	**6**
OR	iii.	Minimization	5 Marks	**6**
		Transition table	1 Mark	

Q.4	i.	Classification	(As per explanation)	**4**
	ii.	Conversion	(As per explanation)	**6**
OR	iii.	a) Conversion	3 Marks	**6**
		b) 1 mark for each question	(1 Mark*3)	

Q.5	i.	Definition	(As per explanation)	**3**
	ii.	PDA construction	(As per explanation)	**7**
OR	iii.	Converting CFG to NDPDA	(As per explanation)	**7**

Q.6				
	i.	Decidability	2.5 Marks	**5**
		Recursive enumerable languages	2.5 Marks	
	ii.	TM construction	(As per explanation)	**5**
	iii.	TM construction	(As per explanations)	**5**

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