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Q.5	i.	Define recursively enumerable and recursive language with example.	3	02	05	04	03
	ii.	Construct a Turing Machine for the following function- $f(w)=wcw^R$ where $w^R$ is the reverse of string $w$ over the input alphabets $(a,b)$ .	7	03	08	04	01
OR	iii.	Construct a Turing Machine to accept the language. $L=\{a^n b^n c^n, n \geq 0\}$ over the alphabet $(a,b,c)$ .	7	03	09	04	01
Q.6		Attempt any two:					
	i.	Briefly explain the Church Turing Thesis.	5	02	07	05	01
	ii.	What is the significance of the classes P, NP, NP-hard and NP complete in the broader context of computational complexity?	5	02	04	05	03
	iii.	State Cook's theorem with suitable example.	5	02	03	05	01

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Total No. of Questions: 6

Total No. of Printed Pages:4

Enrollment No.....



Faculty of Engineering  
End Sem Examination Dec 2024

CB3CO22 Formal Language & Automata Theory

Programme: B.Tech.

Branch/Specialisation: CSBS

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.

		Marks	BL	PO	CO	PSO
Q.1	i.	A regular language over an alphabet $\Sigma$ is one that cannot be obtained from the basic languages using the operation- (a) Union (b) Concatenation (c) Kleene* (d) All of these	1	02	04	01
	ii.	A Language for which no DFA exist is a_____. (a) Regular language (b) Non-regular language (c) May be regular (d) Cannot be said	1	02	05	01
	iii.	Which of the following statement is false? (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	1	01	04	02
	iv.	Which among the following cannot be accepted by a regular grammar? (a) L is a set of numbers divisible by 2 (b) L is a set of binary complement (c) L is a set of string with odd number of 0 (d) L is a set of $0^n 1^n$	1	01	07	02

P.T.O.

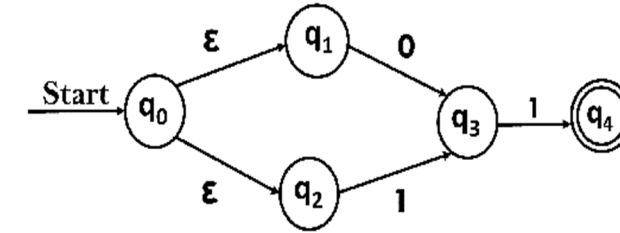
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- v. The transition a Push down automaton makes is additionally dependent upon the: **1** 01 08 03 01  
 (a) stack (b) input tape  
 (c) terminals (d) None of these
- vi. If the PDA does not stop on an accepting state and the stack is not empty, the string is: **1** 02 03 03 01  
 (a) Rejected  
 (b) Goes into loop forever  
 (c) Both (a) and (b)  
 (d) None of these
- vii. Turing machine can be represented using the following tools: **1** 01 02 04 03  
 (a) Transition graph  
 (b) Transition table  
 (c) Queue and Input tape  
 (d) All of these
- viii. Which of the following a turing machine does not consist of? **1** 01 08 04 01  
 (a) Input tape (b) Head  
 (c) State register (d) None 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** 02 06 05 03  
 (a) Turing acceptable  
 (b) Decidable  
 (c) Undecidable  
 (d) None of these
- x. Decidable can be taken as a synonym to: **1** 01 03 10 01  
 (a) Recursive  
 (b) Non recursive  
 (c) Recognizable  
 (d) None of these

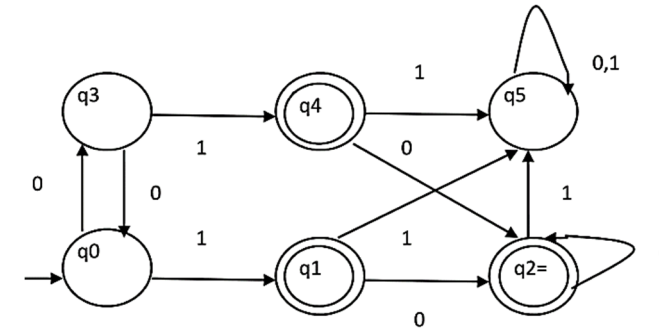
- Q.2 i. Draw a DFA that accepts a language L over input alphabets  $\Sigma = \{0, 1\}$  such that L is the set of all strings starting with '00'. **2** 03 03 01 03
- ii. Explain Unrestricted grammar as per the Chomsky Hierarchy of grammars with example. **3** 01 05 01 01

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- iii. Convert the NFA with  $\epsilon$  into its equivalent DFA- **5** 02 08 01 01



- OR iv. Minimize the given DFA- **5** 03 08 01 01



- Q.3 i. Write the statement of Arden's theorem. **2** 01 03 02 01  
 ii. Explain the term ambiguity with suitable example. **2** 01 04 02 01  
 iii. Convert the given CFG into CNF. **6** 02 05 02 01

$S \rightarrow aAD$   
 $A \rightarrow aB / bAB$   
 $B \rightarrow b$   
 $D \rightarrow d$

- OR iv. Explain pumping lemma for regular language with example. **6** 02 03 02 03

- Q.4 i. Define PDA and its tuples. **3** 01 08 03 03  
 ii. Construct a PDA equivalent to the following context free grammar. **7** 03 05 03 03

$S \rightarrow 0B B$   
 $B \rightarrow 0S / 1S / 0$   
 Test whether 010000 is in N (PDA).

- OR iii. Design a PDA for the language- **7** 03 06 03 01  
 $L = \{a^n b^{2n} \mid n > 0\}$

**Marking Scheme**  
**CB3CO22 Formal Language and Automata Theory**

Q.1	i)	<b>d) All of the mentioned</b>	<b>1</b>
	ii)	<b>b) Non-Regular Language</b>	<b>1</b>
	iii)	<b>d) Context sensitive language is a subset of context free language</b>	<b>1</b>
	iv)	<b>d) L is a set of <math>0^n1^n</math></b>	<b>1</b>
	v)	<b>a) stack</b>	<b>1</b>
	vi)	<b>c) Both (a) &amp; (b)</b>	<b>1</b>
	vii)	<b>d) All of the mentioned</b>	<b>1</b>
	viii)	<b>d) none of the mentioned</b>	<b>1</b>
	ix)	<b>b) decidable</b>	<b>1</b>
	x)	<b>a) recursive</b>	<b>1</b>
Q.2	i.	For Complete DFA (2 Marks)	<b>1</b>
	ii.	Definition of Unrestricted grammar (1 Mark) Example (2 Marks)	<b>3</b>
	iii.	Table with epsilon (1 Marks) NFA to DFA conversion (2 Marks) Final diagram or table without epsilon (2 Marks)	<b>5</b>
OR	iv.	Table conversion (2 Marks) Complete conversion with transition diagram (3 Marks)	<b>5</b>
Q.3	i.	For complete statement (1 Mark) Equations (1 Mark)	<b>2</b>
	ii.	Definition of ambiguity (1 Mark) Example (1 Mark)	<b>2</b>
	iii.	As per valuer's choice (step marking may be use) CFG into CNF conversion 6 (Marks)	<b>6</b>

		Elimination of useless production 1Mark Elimination of E-production 1Mark Elimination of unit production 1Mark Converting remaining production / proper CNF 3mark	
OR	iv	As per valuer's choice (step marking may be use) Pumping lemma (3) example (3)	<b>6</b>
Q.4	i.	Definition of PDA (1 Mark) Proper Tuple explanation (2 Marks)	<b>3</b>
	ii.	As per valuer's choice (step marking may be use) PDA construction (4Marks) testing string(4Marks)	<b>7</b>
OR	iii.	As per valuer's choice (step marking may be use) Table (3Marks) transition diagram (4Marks)	<b>7</b>
Q.5	i.	Definition (1 Mark) Example (2 Mark)	<b>3</b>
	ii.	As per valuer's choice (step marking may be use) Table (3) Diagram (4)	<b>7</b>
OR	iii.	As per valuer's choice (step marking may be use) Table (3) Diagram (4)	<b>7</b>
Q.6		Attempt any two:	
	i.	Definition of Church thesis (2 Marks) Proof and example (3 Marks)	<b>5</b>
	ii.	Definition (2 Marks) Logic of complexity (3 Marks)	<b>5</b>
	iii.	Theorem statement (2 Marks) Proof and Example (3 Marks)	<b>5</b>

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