

Enrollment No.....



Faculty of Engineering
End Sem (Even) Examination May-2022
CA5EL49 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. $|x| = \underline{\hspace{1cm}}$? 1
 (a) 0 (b) 1 (c) 2 (d) 3
- ii. The smallest finite automata which accept the language $\{x \mid \text{length of } x \text{ is divisible by } 3\}$ has $\underline{\hspace{1cm}}$ states: 1
 (a) 1 (b) 2 (c) 3 (d) 4
- iii. Which of the following grammars are in Chomsky Normal Form? 1
 (a) $S \rightarrow AB|BC|CD, A \rightarrow 0, B \rightarrow 1, C \rightarrow 2, D \rightarrow 3$
 (b) $S \rightarrow AB, S \rightarrow BCA|0|1|2|3$
 (c) $S \rightarrow ABa, A \rightarrow aab, B \rightarrow Ac$
 (d) All of these
- iv. The number of steps to form "aab" from $A \rightarrow aA|a|b$: 1
 (a) 2 (b) 3 (c) 4 (d) None of these
- v. The language accepted by a Push down Automata: 1
 (a) Type0 (b) Type1 (c) Type2 (d) Type3
- vi. A push down automata is said to be $\underline{\hspace{2cm}}$ if it has atmost one transition around all configurations. 1
 (a) Non regular (b) Finite
 (c) Deterministic (d) Non-deterministic
- vii. In definition of TM $T = (Q, \Sigma, \Gamma, q_0, \delta)$ what Γ represents? 1
 (a) Tape symbols (b) Input symbol
 (c) Transition function (d) Initial State
- viii. Halting state of Turing machine are- 1
 (a) Start and stop (b) Accept or reject
 (c) Start and reject (d) Reject and allow

P.T.O.

[2]

- ix. _____ is the class of decision problems that can be solved by deterministic polynomial algorithms? **1**
 (a) NP (b) P (c) Hard (d) Complete
- x. Which of the following statements are currently known to be true? **1**
 (a) $P=NP$ (b) $NP \subseteq P$ (c) $P \subseteq NP$ (d) All of these
- Q.2 i. Construct DFA over $\Sigma=\{a,b,c\}$ to accept string. Which starts and ends with different character. **2**
 ii. Show that $L = \{a^n b^n \mid n \geq 1\}$ is not regular using pumping lemma. **3**
 iii. What is Mealy Machine? How Finite Automates can be converted into Moore Machine? Explain with the help of example. **5**
- OR iv. Construct an NFA with epsilon move corresponding to the regular expression $(a+b)^* abab (a+b)^*$. Convert it to a DFA and Minimize it. **5**
- Q.3 i. Define a Parse tree with an example. **2**
 ii. Convert the following CFG into GNF **8**
 $S \rightarrow AB/abc$
 $A \rightarrow aA/bc/b$
 $B \rightarrow bBca/ba/c$
 also Identify the number of production rules.
- OR iii. Consider the following productions: **8**
 $S \rightarrow aB/bA$, $A \rightarrow aS/bAA/a$, $B \rightarrow bS/aBB/b$
 for the string $a^3 b^2 ab^3 a$,
 find,
 (a) The leftmost derivation (b) The right most derivation
 (c) Parse tree (d) Is grammar ambiguous?
- Q.4 i. How to construct an equivalent PDA of a context free grammar? **3**
 ii. Construct a PDA that accept the language generated by the following grammar: **7**
 $S \rightarrow aB$
 $B \rightarrow bA/b$
 $A \rightarrow aB$
- OR iii. Construct the PDA for the following example: **7**
 (a) $a^n b^n \mid n \geq 1$ (b) $a^n b^{2n} \mid n \geq 1$

[3]

- Q.5 i. Design a Turing Machine for the language $\{L(G) = a^n b^n c^n \mid n \geq 1\}$. **4**
 ii. Define a Turing machine. Give a block diagram with specified function of each part of it. Design a Turing machine to accept the language $L = \{0^n 1^n 2^n 3^n \mid n \geq 1\}$. **6**
- OR iii. Explain Turing machine halting problem and describe various types of Turing Machine. **6**
- Q.6 Write short note on any two: **5**
 i. Undecidable Problem **5**
 ii. NP Hard **5**
 iii. P and NP Classes **5**

Marking Scheme CA5EL49 Theory of Computation

Q.1	i.	lcl = ____?	1
		(a) 0 1 Mark	
	ii.	The smallest finite automata which accept the language {x length of x is divisible by 3} has ____states:	1
		(c) 3 1 Mark	
	iii.	Which of the following grammars are in Chomsky Normal Form?	1
		(a) $S \rightarrow AB BC CD$, $A \rightarrow 0$, $B \rightarrow 1$, $C \rightarrow 2$, $D \rightarrow 3$ 1 Mark	
	iv.	The number of steps to form "aab" from $A \rightarrow aA a b$:	1
		(b) 3 1 Mark	
	v.	The language accepted by a Push down Automata:	1
		(c) Type2 1 Mark	
	vi.	A push down automata is said to be _____ if it has atmost one transition around all configurations.	1
		(c) Deterministic 1 Mark	
	vii.	In definition of TM $T = (Q, \Sigma, \Gamma, q_0, \delta)$ what Γ represents?	1
		(a) Tape symbols 1 Mark	
	viii.	Halting state of Turing machine are-	1
		(b) Accept or reject 1 Mark	
	ix.	_____ is the class of decision problems that can be solved by deterministic polynomial algorithms?	1
		(b) P 1 Mark	
	x.	Which of the following statements are currently known to be true?	1
		(c) $P \subseteq NP$ 1 Mark	
Q.2	i.	Construct DFA over $\Sigma = \{a, b, c\}$	2
		Diagram 2 Marks	
	ii.	$L = \{a^n b^n n \geq 1\}$ is not regular using pumping lemma.	3
		Diagram 2 Marks	
		Description 1 Mark	
	iii.	Mealy Machine	5
		Definition 1 Mark	
		Conversion process 2 Marks	
		Example. 2 Marks	
OR	iv.	NFA	5
		Designing NFA with full move 2 Marks	
		Conversion DFA to MDFA 3 Marks	

Q.3	i.	Parse tree	2
		Definition 2 Marks	
	ii.	Convert the CFG into GNF	8
OR		Conversion 6 Marks	
		Identification 2 Marks	
	iii.	(a) The leftmost derivation	8
		(b) The right most derivation	2 Marks
		(c) Parse tree 2 Marks	
Q.4		(d) Is grammar ambiguous 2 Marks	
	i.	Construct an equivalent PDA of a context free grammar?	3
		Proof 3 Marks	
	ii.	PDA	7
		PDA design 7 Marks	
OR	iii.	PDA design	7
		(a) $a^n b^n n \geq 1$ 3.5 Marks	
		(b) $a^n b^{2n} n \geq 1$ 3.5 Marks	
Q.5	i.	Turing Machine	4
		TM design 4 Marks	
	ii.	Turing machine	6
		Definition 1 Mark	
		Block diagram 2 Marks	
OR		TM design 3 Marks	
	iii.	Halting Problem	6
		Types 3 Marks	
Q.6			
	i.	Undecidable Problem	5
		Definition 3 Marks	
		Example 2 Marks	
	ii.	NP Hard	5
		Definition 3 Marks	
		Problem 2 Marks	
	iii.	P and NP Classes	5
		Brief definition 5 Marks	
