COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Government of Maharashtra.)

END Semester Examination

Programme: B.Tech. | **Semester: IV**

Course Code: CT-16011 | **Course Name: Theory of Computation**

Branch: Computer Engineering & IT | **Academic Year:2018-19**

Duration: 3 Hrs | **Max Marks: 60**

Student PRN No.

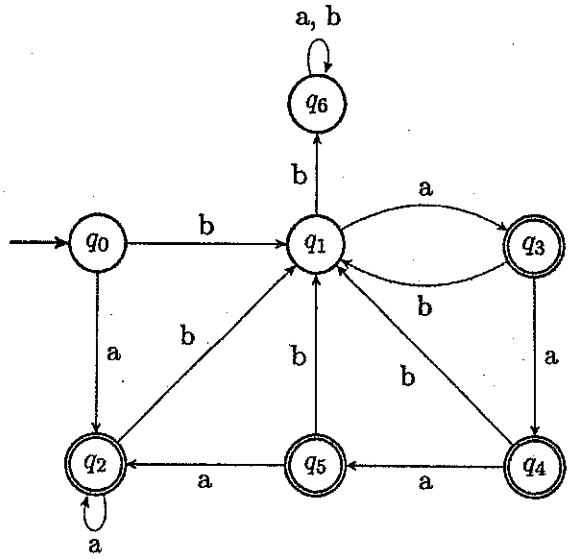
Instructions:

1. Figures to the right indicate the full marks.
2. Mobile phones and programmable calculators are strictly prohibited.
3. Writing anything on question paper is not allowed.
4. Exchange/Sharing of stationery, calculator etc. not allowed.
5. Write your PRN Number on Question Paper.
6. Formal definitions and diagrams to the right indicates full marks

			Marks	CO	PO
Q 1	a	Let $\Sigma = \{0,1\}$ and let $D = \{ w \mid w$ contains an equal number of occurrences of the substrings 01 and 10$\}$. Thus $101 \in D$ because 101 contains a single 01 and a single 10, but $1010 \notin D$ because 1010 contains two 10s and one 01. Show that D is a regular language.	06	2, 3	1, 4, 6, 9, 11
	b	The working of a vending machine can be simulated by a finite automaton. Give four more examples of application of finite automaton in real life. Explain in brief.	06	2	
Q 2	a	Show by giving an example that if M is an NFA that recognizes language C, swapping the accept and non-accept states in M doesn't necessarily yield a new NFA that recognizes the complement of C. Is the class of languages recognized by NFAs closed under complement? Explain your answer.	06	1	1, 9, 11

	b	Consider language, ADD = {x = y + z | x, y and z are binary integers, and x is the sum of y and z} and Σ = { 0, 1, +, = }. Show that ADD is not regular.	06	1	
Q 3	**a**	Give a context-free grammar that generates the language $A = \{a^i b^j c^k \mid i = j \text{ or } j = k \text{ where } i, j, k \geq 0\}$. Is your grammar ambiguous? Why or why not? If its ambiguous represent it in CNF.	06	2	1, 4, 6, 9, 11
	b	Design a Push Down Automata accepting languages either by final state or empty stack for following languages. i. $L = \{ a^n b^m \mid n \leq m \leq 2n \}$. ii. $L = \{ a^{2n} b^{3n} \mid n \geq 0 \}$.	06	3	
Q 4	**a**	Design a Turing Machine to compare length of two strings of 1's, separated by a '0', for inequality. For example, if a=111 and b=11 are two strings then tape content will be 111011 and the machine will halt in $q_>$. Where $q_>$ is accept state for a > b and $q_<$ is accept state for a < b.	06	3	1, 4, 6, 9, 11
		OR			
	a	Show that the following languages are context free: i. $L = \{xx^R yy^R zz^R \mid x, y, z \in \{a, b\}^*\}$ ii. N = M ∩ R, where $M = \{a^n b^m \mid n \geq m\}$ and R = {(a ∪ b)* | there is an odd number of a's and an even number of b's}.	06	1, 2	

b Describe the maximal set of distinguishable strings of the language of the following Finite Automata. 06 3, 4



Q 5 **a** Robustness of a mathematical objects like proofs, definitions, algorithms, methods, etc is measured by its invariance to certain changes. Prove that Turing machine is robust to following variation. 06 4 1, 6, 9, 11

b Consider the language containing unreachable states of a Turing Machine, 06 1

UselessState = { <M, q> | M is a Turing machine, q is a state of M, for every input string w, the computation of M on input w never visits state q}

Prove that languages UselessState is Decidable.