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PES University, Bangalore **UE18CS254**
(Established under Karnataka Act No. 16 of 2013)

END SEMESTER ASSESSMENT (ESA) B.TECH. IV SEMESTER-May 2020

UE18CS254- Theory of Computation

Time: 3 Hours **Answer All Questions** **Max Marks: 100**

1	a	Construct a DFA for the set of strings over alphabet {0,1,2} that do not have two consecutive identical symbols That is, strings of L are any string in {0,1,2}* such that there is no occurrence of 00, no occurrence of 11, and no occurrence of 22.	6
	b	For the given automata a) say which states are accessible and which or not b) list the equivalence classes of the collapsing relation $\approx$ defined as $p \approx q \Leftrightarrow \forall x \varepsilon \Sigma^* (\delta(p,x) \varepsilon F \Leftrightarrow \delta(q,x) \varepsilon F)$ c) give the automaton obtained by collapsing equivalent states and removing inaccessible states	6
	c	Give state diagram of NFA for the language $1^*(001^+)^*$ with three states	4
	d	Convert the above NFA to DFA	4
2	a	Write regular expressions for the following languages: 1. Set of strings of a's and b's of that are of odd length 2. Set of binary strings where the number of 0's is odd and whose number of 1's are even 3. Set of binary strings which at least 3 0's	6
	b	Convert the following automaton to regular expression:	6

	a	b
→1	1	4
2	3	1
*3	4	2
*4	3	5
5	4	6
6	6	3
7	2	4
8	3	1

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			0	1
		→ q0	q1	q0
		*q1	q2	q1
		*q2	q1	q2
		q3	q1	q2
	c	Write regular grammars for the following languages: 1. Set of binary strings not containing consecutive 0's 2. Set of strings of a's and b's with odd number of a's and exactly two b's		6
	d	Is the following language regular? Justify $L = a^*a^nb^nb^*$, $n \geq 0$		2
3	a	Construct a Context Free Grammar for the language, $L = \{0^i1^j2^k \mid i+j \geq 2k\}$ Draw a parse tree for the string "0001122".		6
	b	Construct PDA for the language L = {w ∈ {a, b}* : the first, middle, and last characters of w are identical}.		7
	c	Convert the following CFG to PDA S → aA A → aABC | bB | a B → b C → c Show how aaabc is accepted.		7
4	a	Convert the following grammar to CNF: S → AdS | AdB | λ A → aA | λ B → bB		6
	b	Here is a context-free grammar: S -> AS | SB | 0 A -> BA | AS | 1 B -> SB | BA | 0 Apply CYK algorithm to the above grammar and check whether the string 01100 belongs to language or not		7
	c	Prove that the language is not context free $L = \{(ab)^na^nb^n \mid n>0\}$		7
5	a	Construct a Turing machine to separate a given string into two equal halves by finding the midpoint of the given string and inserting a blank at that point.		8
	b	In the table below is an instance of Post's Correspondence Problem:		8

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		<table><tr><th>Index</th><th>First string</th><th>Second string</th></tr><tr><td>1</td><td>00</td><td>001</td></tr><tr><td>2</td><td>0101</td><td>11</td></tr><tr><td>3</td><td>101</td><td>01</td></tr><tr><td>4</td><td>01</td><td>010</td></tr></table>There is no Turing-machine algorithm to decide whether or not there is a solution to PCP. But you're smarter than a Turing machine. Figure it out for this instance. (a) Either give a sequence of indexes that is a solution, or prove that no solution exists (b) Does your ability to answer (a) imply that human beings are able to solve problems that Turing machines cannot solve? You assume you have answered correctly (a) even if you did not.Explain briefly	
	c	Show that if a language L and its complement are recursively enumerable, then both are actually recursive.	4