MODEL QUESTION PAPER 2

Finite Automata and Formal Languages

(Theory of Computation: A Problem-Solving Approach)

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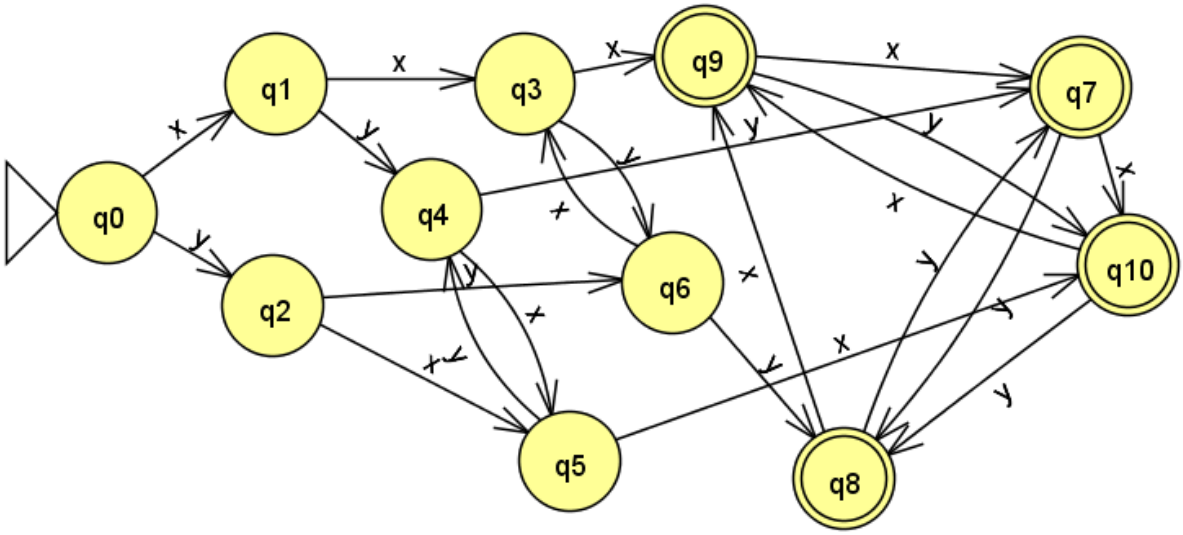
Answer any 2 questions from each of Parts A and B and any 1 question from Part C

Time: 3 Hrs Max Marks: 100

		Part A	
1.	a)	Define the terms *grammar* and *language* and explain with one example each.	04
	b)	Construct a deterministic finite automaton that accepts all strings over {0, 1} except those containing 011.	08
	c)	Show that the language $L = \{abwba\}$, where w is any string over the alphabet $\{a, b\}$, is regular.	08
2.	a)	Write an algorithm for reducing the number of states in a deterministic finite automaton.	06
	b)	Minimize the following automaton. 	08
	c)	State and explain the *Myhill-Nerode Theorem*.	06
3.	a)	Construct a regular expression to accept all binary strings containing any of these patterns: 011 or 010 or 100.	06
	b)	Convert the above RegEx to an equivalent non-deterministic automaton and simplify the resulting automaton.	10
	c)	What is the use of λ–transitions in a non-deterministic automaton?	04
		Part B	
4.	a)	Show that the language of all strings over $\{a, b, c\}$ with either equal numbers of a and b or equal numbers of b and c is not a regular language.	08
	b)	Show that the above language is a context-free language.	08
	c)	Is this language deterministic? Is it ambiguous?	04
5.	a)	Prove that there exists a non-deterministic pushdown automaton whose language is the same as that of any given context-free grammar.	08
	b)	Convert the following grammar to Greibach Normal Form: $S \rightarrow aXY$, $X \rightarrow bYbb$, $Y \rightarrow X \mid \lambda$	08
	c)	What are Simple grammars? How are they useful?	04
6.	a)	Prove that the language *ww* over the alphabet {0, 1} is not context-free.	10
	b)	Construct a context-sensitive grammar for $a^n b^n c^n$, $n \geq 0$. Show how it can derive the string *aaabbbccc*.	10
		Part C	

7.	a)	Write the Chomsky Hierarchy and explain it in detail.	10
	b)	Design a Turing machine that accepts all palindromes over $\{a, b\}$.	10
8.	a)	What are primitive-recursive functions and μ–recursive functions? Explain each with an example.	06
	b)	Explain the terms: P, NP, NP-Complete and NP-Hard. Give suitable examples.	06
	c)	Prove that the Halting Problem of Turing machines is undecidable.	08