



Automata and Formal Languages (CS-2010)

Improvement Mid-Semester Examination- 2021

School of Computer Engineering

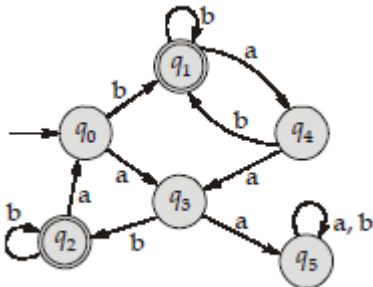
KIIT deemed to be University, Bhubaneswar

Time : 1 hour

Full Marks: 20

(Answer any four questions including question number 1)

1.		
a)	Consider the following regular expressions. $r1 = a^*b$ $r2 = \epsilon$ Let $r3 = r1.r2$ and $r4 = r1+r2$ Select the correct option. 1. Both $r3$ and $r4$ will not contain ϵ . 2. $r3$ will not contain epsilon while $r4$ will contain ϵ . 3. Both $r3$ and $r4$ will contain ϵ . 4. $r3$ will contain ϵ while $r4$ will not.	[1]
b)	Consider the following statements: $S1: (ab)^*a = a(ba)^*$ $S2: (a+b)^*ab(a+b)^*+b^*a^* = (a+b^*)^*$ Select the correct option. 1. Both $S1$ and $S2$ are false 2. Both $S1$ and $S2$ are true 3. $S1$ is true, while $S2$ is false 4. $S1$ is false, while $S2$ is true	[1]
c)	The length of the shortest string not in the language over $\Sigma = \{0,1\}$ for regular expression $0^*1^*(10)^*0^*$ is ____.	[1]
d)	The minimum number of states required for DFA that accept the language: $L = \{a^n \mid n \text{ is multiple of 3 but not multiple of 5}\}$ are ____.	[1]
e)	Which of the following language generated by given grammar? $S \rightarrow aA \mid bB \mid \epsilon$ $A \rightarrow bC \mid aS$ $B \rightarrow aC \mid bS$ $C \rightarrow aB \mid bA$ 1. $L = \{w : n_a(w) \text{ and } n_b(w) \text{ both are even}\}$ 2. $L = \{w : n_a(w) \text{ and } n_b(w) \text{ both are odd}\}$ 3. $L = \{w : n_a(w) \text{ or } n_b(w) \text{ are even}\}$ 4. $L = \{w : n_a(w) \text{ or } n_b(w) \text{ are odd}\}$	[1]

2)	Convert the following NFA to the equivalent DFA: <table><tr><td>δ</td><td>λ</td><td>a</td><td>b</td><td>c</td></tr><tr><td>$\rightarrow q_0$</td><td>q1</td><td>q1</td><td>\emptyset</td><td>\emptyset</td></tr><tr><td>q1</td><td>\emptyset</td><td>\emptyset</td><td>q2</td><td>{q1,q4}</td></tr><tr><td>q2</td><td>\emptyset</td><td>\emptyset</td><td>\emptyset</td><td>q3</td></tr><tr><td>q3</td><td>q5</td><td>\emptyset</td><td>\emptyset</td><td>q3</td></tr><tr><td>q4</td><td>\emptyset</td><td>\emptyset</td><td>q3</td><td>\emptyset</td></tr><tr><td>*q5</td><td>\emptyset</td><td>\emptyset</td><td>\emptyset</td><td>\emptyset</td></tr></table>	δ	λ	a	b	c	$\rightarrow q_0$	q1	q1	\emptyset	\emptyset	q1	\emptyset	\emptyset	q2	{q1,q4}	q2	\emptyset	\emptyset	\emptyset	q3	q3	q5	\emptyset	\emptyset	q3	q4	\emptyset	\emptyset	q3	\emptyset	*q5	\emptyset	\emptyset	\emptyset	\emptyset	[5]
δ	λ	a	b	c																																	
$\rightarrow q_0$	q1	q1	\emptyset	\emptyset																																	
q1	\emptyset	\emptyset	q2	{q1,q4}																																	
q2	\emptyset	\emptyset	\emptyset	q3																																	
q3	q5	\emptyset	\emptyset	q3																																	
q4	\emptyset	\emptyset	q3	\emptyset																																	
*q5	\emptyset	\emptyset	\emptyset	\emptyset																																	
3)a)	Design a NFA with four states for the following languages $L=\{x^n :n\geq 0\} \cup \{y^n x:n\geq 1\}$	[1.5]																																			
b)	Consider the following DFA: <div></div> <p>Minimize the above DFA and draw the minimized DFA.</p>	[3.5]																																			
4)a)	Design a DFA for the following languages on $\Sigma=\{a,b,c\}$ $L=\{a^m b^n c^p : m \geq 0, n \geq 0, p \geq 0\}$	[2.5]																																			
b)	From the identities of RE, Prove that : i) $(1 + 100^*) + (1 + 100^*)(0 + 10^*)(0 + 10^*)^* = 10^*(0 + 10^*)^*$ ii) $10 + (1010)^* (\lambda + (1010)^*)= 10 + (1010)^*$	[2.5]																																			
5)a)	Find CFG for the following language: i) $L= \{a^m : m=2*i + 5*j \text{ for } i, j \geq 0\}$ ii) $L = \{a^m b^{m+n} c^n \mid m > 0, n \geq 0\}$	[2]																																			
b)	State Pumping Lemma for Regular languages. Prove that language of palindromes over $\{a,b\}$ is not regular using Pumping lemma.	[3]																																			