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G. H. Raisoni College of Engineering and Management, Pune.

(An Autonomous Institution)

S.Y.B.Tech (Computer/IT) (Term-IV)

ESE Summer -2018(2016 Pattern)

THEORY OF COMPUTATION(BCOL303)

[Time: 03Hours] **[Max. Marks- 60]**

Instructions to the candidates:

1) ***All questions compulsory.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Assume suitable data, if necessary.***

Q.1 ***a)*** Which two of the following four regular expressions are equivalent? (ε is the empty string).(i) $(00)^*(\varepsilon + 0)$(ii) $(00)^*$(iii) 0^*(iv) $0(00)^*$ [2]

A) (i) & (ii) B) (ii) & (iii) C) (i) & (iii) D) (iii) & (iv)

b) The number of states in the minimal deterministic finite automaton corresponding to the regular expression $(0 + 1)^*(10)$ is ____________ [2]

A) 2B) 3C) 4D) 5

c) Which of the following languages are context-free? [2]

$L_1 = \{a^m b^n a^n b^m \mid m, n \geq 1\}$

$L_2 = \{a^m b^n a^m b^n \mid m, n \geq 1\}$

$L_3 = \{a^m b^n \mid m = 2n+1\}$

A) L_1 and L_2 only B) $L_1$and L_3 only

C) L_2 and L_3 only D) L_3 only

d) Let L1 be a recursive language. Let L2 and L3 be languages that are recursively enumerable but not recursive. Which of the following statements is not necessarily true? [2]

A) L2−L1is recursively enumerable

B) L1−L3 is recursively enumerable

C) L2∩L3 is recursively enumerable

D) L2∪L3 is recursively enumerable

e) Let δ denote the transition function and $\hat{\delta}$ denote the extended transition function of the ∈−NFA whose transition table is given below: [2]

δ	∈	a	b
$\rightarrow q_0$	$\{q_2\}$	$\{q_1\}$	$\{q_0\}$
q_1	$\{q_2\}$	$\{q_2\}$	$\{q_3\}$
q_2	$\{q_0\}$	ϕ	ϕ
q_3	ϕ	ϕ	$\{q_2\}$

Then $\hat{\delta}$(q2,aba) is

A) ϕ B) $\{q_0, q_1, q_3\}$ C) $\{q_0, q_1, q_2\}$ D) $\{q_0, q_2, q_3\}$

f) Consider the regular expression 0 * (10 *) which is similar to the same set as
A) 0 + (0 + 10) *B) (0 +1) * 10 (0 + 1) *
C) (1 * 0) * 1*D) None of the above [2]

Q.2 *a)* Design FA which accepts only those strings which always ends with "aa" over $\Sigma = \{a,b\}$. [4]

b) Construct a FSM that reads strings made up of letters in word "CHARIOT" and recognizethose string that contain "CAT" as a substring. [4]

Q.3 *a)* Show that $L= \{a^n b^{2n} \mid n > 0\}$ is non regular by Pumping Lemma. [4]

b) Convert the following NFA into equivalent DFA
$M = (\{q0, q1\}, \{0, 1\}, \delta, q0, \{q1\})$ where δ is : $\delta(q0,0) = \{q0, q1\}$, $\delta(q0,1) = \{q1\}$, $\delta(q1,0) = \Phi$, $\delta(q1,1) = \{q0, q1\}$ [4]

Q.4 *a)* Consider the following grammar $S \rightarrow aAS|a$, $A \rightarrow SbA|SS|ba$
Derive the string aabbaa using
i)Leftmost derivation
ii) Rightmost derivation [4]

b) Convert the following CFG to CNF$G = (\{S, A, B\}, \{a, b, \varepsilon\}, P, \{S\})$
$P = \{ S \rightarrow ABA, A \rightarrow aA, A \rightarrow \varepsilon, B \rightarrow bB, B \rightarrow \varepsilon \}$ [4]

Q.5 *a)* Construct a TM that will recognize strings containing equal number of 0's and 1's. [4]

b) Define Recursive Languages and Recursively Enumerable Languages. [4]

Q.6 *a)* Design a PDA to accept the language $L=\{w \mid w \in (a+b)^* \text{ and } n_a(w)=n_b(w)\}$ [4]

b) Define PDA i) Through Final State ii) Through Empty Stack [4]

or

c) Show that for two recursive languages L1 & L2, each of the following is recursive.i) $L1 \cup L2$ ii) $L1 \cap L2$ [4]

Q.7 *a)* What is Contextual Grammar and how it is differ from CFG? [4]

b) What is Graph Grammar explain with production rules? [4]

or

c) How Graph Grammar is used to achieve parallel computation? [4]

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