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(November)

COMPUTER SCIENCE

(General)

Course : 101

(Theoretical Foundation of Computer Science)

Full Marks : 80

Pass Marks : 32

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. (a) State True or False :

1

The concatenation of two regular expressions R_1 and R_2 , written as R_1R_2 , is also regular expression.

(b) Find all strings of length 5 or less in the regular set represented by the following :

2

$$a^* + (ab + a)^*$$

(c) Write regular expression for the following language :

2

The set of all strings of 0's and 1's ending in 00.

(2)

2. (a) State True or False :

If L is the set accepted by NDFA, then there exists a DFA which also accepts L .

- (b) Give the definition of Moore machine.

- (c) Answer any two from the following :

6×2=12

- (i) Construct a minimum state automaton equivalent to the automaton M whose transition table is given below :

State	Input	
	0	1
$\rightarrow q_0$	q_1	q_5
q_1	q_6	q_2
(q_2)	q_0	q_2
q_3	q_2	q_6
q_4	q_7	q_5
q_5	q_2	q_6
q_6	q_6	q_4
q_7	q_6	q_2

- (ii) Construct an NFA accepting $\{ab, ba\}$, and use it to construct a DFA accepting the same set of strings.

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(Continued)

(3)

- (iii) Construct a Mealy machine which is equivalent to the Moore machine given below :

Present State	Next State		Output
	$a = 0$	$a = 1$	
$\rightarrow q_0$	q_1	q_2	1
q_1	q_3	q_2	0
q_2	q_2	q_1	1
q_3	q_0	q_3	1

3. (a) State True or False :

1

Regular grammar is type-0 grammar.

- (b) What is the highest type number that can be applied to the following grammar?

2

$$S \rightarrow Aa, A \rightarrow c \mid Ba, B \rightarrow abc$$

- (c) Define phrase-structure grammar. What is a recursively enumerable set?

3+2

- (d) Answer any one from the following :

7

- (i) Construct a grammar that generates the language

$$L = \{a^j b^n c^n \mid n \geq 1, j \geq 0\}$$

- (ii) Construct a grammar that generates the language

$$L = \{0^m 1^{2m} \mid m \geq 1\}$$

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(Turn Over)

(4)

4. (a) State True or False :

$(P+Q)^* = (P^*Q^*)^*$, where P and Q are regular expressions.

(b) Define regular expression.

(c) Prove that

$$(1+00^*1) + (1+00^*1)(0+10^*1)^*(0+10^*1) = 0^*1(0+10^*1)^*$$

(d) Answer any two from the following :

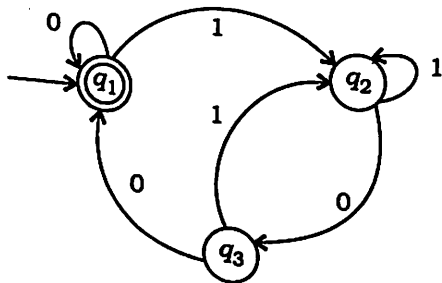
6×2=12

(i) Construct an FA equivalent to the regular expression

$$(0+1)^*(00+11)(0+1)^*$$

(ii) Show that $L = \{a^p \mid p \text{ is a prime}\}$ is not regular.

(iii) Consider the transition diagram given below and find a regular expression which is accepted by the same :



(5)

22

5. (a) What is context-free grammar? 1

(b) Define parse tree for a CFG. 2

(c) Answer any two from the following :

6×2=12

(i) Reduce the following grammar to Greibach normal form :

$$S \rightarrow AA \mid a, S \rightarrow AA \mid b$$

(ii) Show that $L = \{a^n b^n c^n \mid n \geq 1\}$ is not context-free but context-sensitive.

(iii) Reduce the following grammar to Chomsky normal form :

$$S \rightarrow aAD, A \rightarrow aB \mid bAB,$$

$$B \rightarrow b, D \rightarrow d$$

6. (a) Give the formal definition of push-down automaton. 3

(b) Construct a p.d.a. A equivalent to the following context-free grammar :

$$S \rightarrow 0BB, B \rightarrow 0S \mid 1S \mid 0$$

Test whether 010^4 is in $N(A)$.

4+3
