DHARMSINH DESAI UNIVERSITY, NADIAD
FACULTY OF TECHNOLOGY
B.TECH. SEMESTER V [Information Technology]
SUBJECT: (IT 511) Theory of Automata and Formal Languages

Examination	**: First Session**	**Seat No.**	**:**
Date	**: 30/07/2018**	**Day**	**:Monday**
Time	**: 11:45 to 1:00**	**Max. Marks**	**: 36**

INSTRUCTIONS:

1. Figures to the right indicate maximum marks for that question.
2. The symbols used carry their usual meanings.
3. Assume suitable data, if required & mention them clearly.
4. Draw neat sketches wherever necessary.

Q.1 Do as directed. **[12]**

(a) State the alphabet Σ for the following languages : **[02]**
(i) L = {ε, 0, 1, 00, 01, 10, 11, 000, 001, 010, 011, . . .}
(ii) L = {a, aa, aaa, . . .}

(b) Determine the cardinality of the following languages over the alphabet Σ = {0, 1} (That is, are they finite, infinite and countable, or infinite and uncountable). Prove your answers . **[02]**
(i) Σ^{0} (ii) 2^{Σ}

(c) Give NFAs with the specified number of states recognizing each of the following languages. In all cases, the alphabet is Σ = {0, 1}. **[02]**
i) The language $0^{*}1^{*}0^{*}0$ with three states.
ii) The language {ε} with one state.

(d) The language of all words (made up of a's and b's) with at least two a's **can not** be described by which of the following regular expression? **[02]**
i) a(a+b)a(a+b)(a+b)ab (ii) (a+b)aba(a+b) (iii) baba(a+b) (iv) none of the given

(e) Let S and T be language over ={a,b} represented by the regular expressions (a+b*)* and (a+b)*, respectively. Which of the following is true?Justify. **[02]**
(i) S is subset of T (ii) T is a subset of S
(iii) S equal to T (iv) S intersection T=Ø

(f) If L1 and L2 are regular languages _______________ is/are also regular language(s). **[01]**
[L1 + L2 / L1L2 / L1* / All of the mentioned]

(g) To examine whether a certain FA accepts any words, it is required to seek the paths from ------- state. [Final to initial / Final to final/ initial to final /Initial to initial] **[01]**

Q.2 Attempt Any Two of following questions. **[12]**

(a) Let x be a string and let x^{rev} be " the same" string but backwards. Prove that $(xy)^{rev} = y^{rev} x^{rev}$ for arbitrary strings x, y over an alphabet Σ , using mathematical induction . **[06]**

(b) State and prove Kleene's theorem part1 . **[06]**

(c) Consider following two Deterministic Finite Automato (DFA) M1 and M2 on languages L1 and L2 respectively, with Σ = {0, 1}. **[06]**
M1 is formally defined as :-
M1 = (Q, Σ, δ, q 0 , F) with Q = {q0 , q1 , q2 , q3 }, Σ = {0, 1}, F = {q1 , q2 } and δ being given in the Table1. And the transition diagram of M2 is shown in Figure1.

δ	0	1
q0	q1	q3
q1	q3	q2
q2	q3	q2
q3	q3	q2

Table 1

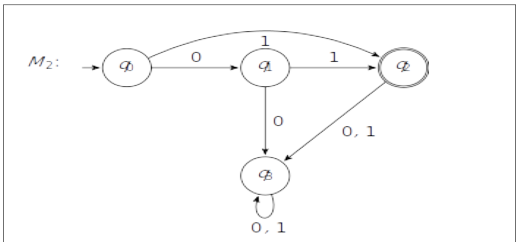

Figure1

Now answer following questions:
i) Describe language recognized by M2 ,using formal notation.
ii) Prove that L1 ∪ L 2 is also a regular language ,by giving a resultant DFA .

Q.3 Attempt following questions

(a) **[06]**

Table 2

q	δ(q,a)	δ(q,b)
1	{1,2}	{1}
2	{3}	{3}
3	{4}	{4}
4	{5}	Ø
5	Ø	{5}

For the NFA described by Table 2, having starting state –1 and Accepting state-5 , answer following questions.

i) Draw a transition diagram.
ii) Calculate δ*(q,"aba").Show all the intermediate steps clearly.

(b) Construct NFA-null for (10 + 0)*(1* + 0)* using kleene's theorem. **[06]**

OR

Q.3

(a) **[06]**

Table 3

q	δ(q,^)	δ(q,a)	δ(q,b)
1	Ø	{2}	Ø
2	{3}	{2}	Ø
3	Ø	{4}	{3,4}
4	{5}	{4}	{2}
5	Ø	Ø	Ø

Consider NFA-null described in Table3 .The start state is 1 and accepting state is 5.
Now answer following questions with reference to it.
i) For the strings "aba" and "aaabbb" identify whether NFA-^ would accept it or not?
ii) Find regular expression correspond to given NFA-^.

(b) For the Finite automaton given in Table3, convert given NFA- ^ to NFA and then resultant NFA to FA. **[06]**

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