Exam.Code:0917
Sub. Code: 33437

2076
B.E. (Computer Science and Engineering)
Fifth Semester
CS-504: Theory of Computation

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Section.

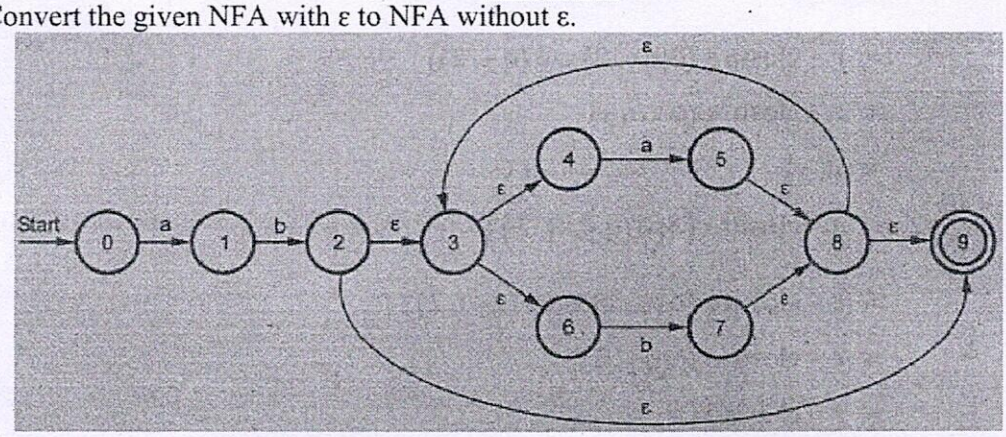
x-x-x

1. Answer the following:
   a) Give the formal definition of the language accepted by a deterministic finite automaton.
   b) Give the definition of Pumping Lemma for Regular Languages.
   c) What is kleen's closure? Find (11)*.
   d) Find the regular expression consisting of all strings over {0, 1} starting with any number of 0's, followed by one or more 1's, followed by one or more 0's, followed by single 1 and ending in any string of 0's and 1's.
   e) Give the formal definition of PDA.
   f) Give the formal definition of Turing Machine.
   g) Define Type 2 grammar. Give its example also.
   h) Explain an Instantaneous Description of a Turing Machine.
   i) Explain Chomsky Normal Form.
   j) Define NP and P classes.

(10x1=10)

Section A:

2. a) Convert the given NFA with ε to NFA without ε.



   b) Consider the transition table given below for the nondeterministic finite automata. Prove that the strings recognized are (a+a(b+aa)*b)*a(b+aa)*a.

Σ / Q	a	b
q_1	$\{q_1, q_2\}$	-
q_2	$\{q_3\}$	$\{q_2, q_1\}$
q_3	$\{q_2\}$	-

(04+06)

P.T.O.

3. a) Construct a minimum state Automaton equivalent to a DFA whose δ are given below.

Σ / Q	a	b
→q_0	q_1	q_3
q_1	q_4	q_2
q_2	q_1	q_5
q_3	q_0	q_4
q_4	q_4	q_4
q_5	q_2	q_4

b) Convert the regular expression r = (a + b)*(aa + bb)(a + b)* to deterministic finite automata. (05+05)

4. a) Convert the following CFG to GNF

$A_1 \rightarrow A_2 A_3$
$A_2 \rightarrow A_3 A_1|b$
$A_3 \rightarrow A_1 A_2|a$

b) Let G be the grammar S→aB|bA, A→aS|a|bAA, B→bS|b|aBB.
For the string aaabbabbba find (i) leftmost derivation (ii) rightmost derivation (iii) parse tree (iv) Is the grammar unambiguous? (06+04)

Section B:

5. a) Convert the following CFG to GNF
E → E+T|T, T → T* F|F, F → (E)|a

b) Construct a CFG which accepts N(A) where A = ({q_0,q_1}, {0,1}, {X, Z_0}, δ, q_0, Z_0, ∅}.
δ is given by

$\delta(q_0, 0, Z_0) = \{(q_0, XZ_0)\}$, $\delta(q_1, 1, X) = \{(q_1, \epsilon)\}$,
$\delta(q_0, 0, X) = \{(q_0, XX)\}$, $\delta(q_1, \epsilon, X) = \{(q_1, \epsilon)\}$,
$\delta(q_0, 1, X) = \{(q_1, \epsilon)\}$, $\delta(q_1, \epsilon, Z_0) = \{(q_1, \epsilon)\}$. (05+05)

6. a) Design a PDA for the language L = $\{0^n 1\ 2^{2n} \mid n>1\}$ by final state method.

b) Design a Turing machine to recognize the language $\{0^n 1^n \mid n>=1\}$. Compute the sequence of execution for string 00111 of given language. (04+06)

7. Write a short note on the following:

a) Halting problem.

b) Recursive and recursively enumerable languages. (05+05)

x-x-x