(Pages : 4) **10654**

Reg. No. : ....

Name : ....

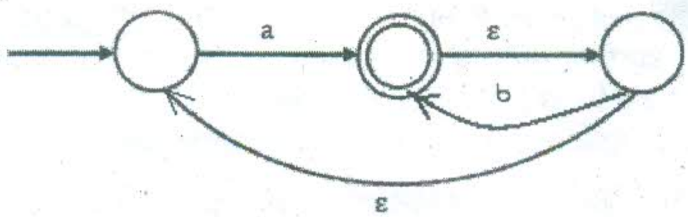
Fourth Semester B.Tech. Degree Examination, February 2016
(2013 Scheme)
13.406 : FORMAL LANGUAGES AND AUTOMATA THEORY (R)

Time : 3 Hours Max. Marks : 100

PART – A

Answer **all** questions.

1. What is the complement of the language accepted by the NFA shown below ? Assume $\Sigma = \{a\}$ and ε is the empty string. 4



2. Let $L = \{w \in (0 + 1)^* \mid w$ has even number of 1s$\}$, i.e. L is the set of all bit strings with even number of 1s. Write the regular expression to represents L ? Justify the correctness of the answer by showing one example. 4

3. Which language is generated by the grammar G given by the productions. 4

   $S \rightarrow aSa \mid aBa$

   $B \rightarrow bB \mid b$

4. Explain why the grammar given below is ambiguous. 4

   $S \rightarrow 0A \mid 1B$

   $A \rightarrow 0AA \mid 1S \mid 1$

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

5. What is Universal Turing machine ? Explain. 4

(5×4=20 Marks)

P.T.O.

PART – B

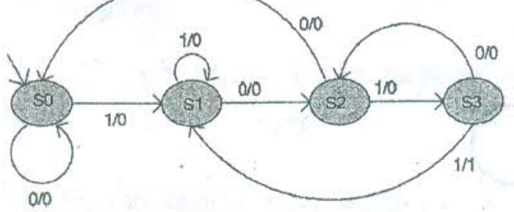
Answer **any one full** question from **each** Module.

Module – 1

6\. a) Discuss in detail the fundamental capabilities and limitations of computers interms of automata, computability and complexity theory. 10

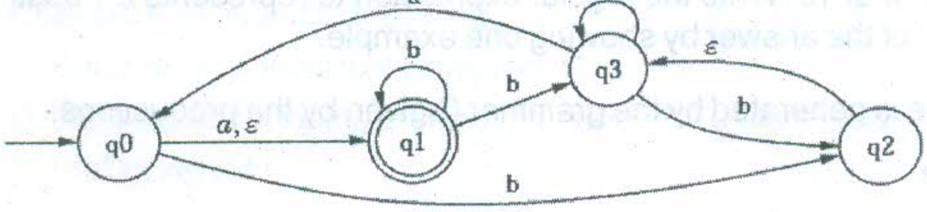
b) Design a DFA to accept all the binary words except the empty string. 2

c) In the following Mealy state machine, assuming that X is the input and Y is the output of the FSM, convert the state machine to a Moore machine. Note : Transitions are of the form X/Y. 8

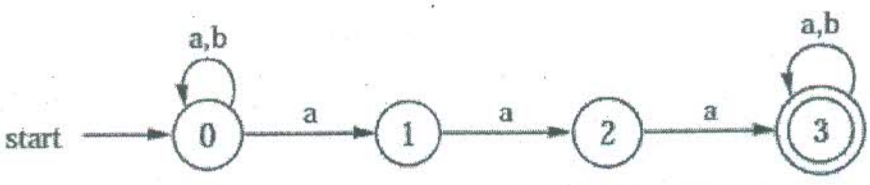


OR

7\. a) Convert the NFA given below to an equivalent DFA by subset construction. 8



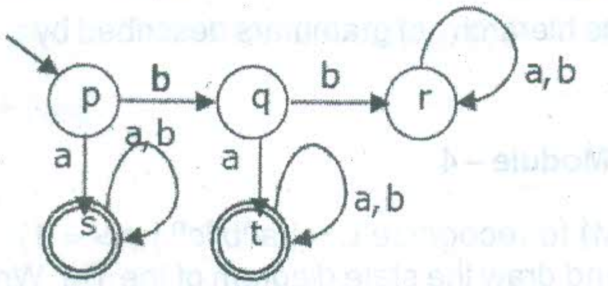
b) Apply the state elimination algorithm on the NFA M given below to obtain the regular expression representing the language accepted by it. 10



c) Given an arbitrary Non-deterministic Finite Automaton (NFA) with N states. What is the maximum number of states in an equivalent minimal DFA ? 2

Module – 2

8. a) For the given Deterministic Finite Automation (DFA) D with alphabet $\Sigma = \{a, b\}$, design a valid minimal DFA which accepts the same language as D. **8**



b) Show that regular languages are closed under *homomorphism*. **6**

c) Show that set $\{0^{2n} 1^n\}$ is not regular using pumping lemma. **6**

OR

9. a) Using the base knowledge of designing DFAs and closure properties, design an automation to accept all the strings $w \in \{a, b\}^*$: w contains an even number of a's and an odd number of b's and all a's come in runs of three. Clearly show the construction procedure by writing all the steps formally. **7**

b) Convert regular expression ((ab)|(ba))* into a DFA by applying the direct conversion algorithm. **8**

c) Design a complement DFA for the regular expression (00+1)*. **5**

Module – 3

10. a) Construct a non-deterministic pushdown automata to accept the following language

$L = \{0^n 1^{2n} \mid n \geq 0\}$. **8**

b) Obtain a grammar in Chomsky Normal Form (CNF) equivalent to the given grammar G with productions as shown below :

$S \rightarrow aAbB$

$A \rightarrow aA \mid a$

$B \rightarrow bB \mid b$. **7**

c) Show that context-free languages are closed under *union* operation. **5**

OR

11. a) Using the pumping lemma prove that the language below is not context-free. 8

$L = \{a^i b^{2i} a^i \mid i >= 0\}$

b) Construct a grammar for the language containing strings of at least two a's over the alphabet $\Sigma = \{a, b\}$. Show the derivations for the input string *babaa*. 8

c) With a neat diagram, explain the hierarchy of grammars described by *Noam Chomsky*. 4

Module – 4

12. a) Design a Turing Machine (TM) to recognize $L = \{ a^n b^n c^n \mid n >= 1\}$. Explain the design strategy and draw the state diagram of the TM. Write the computation sequence for the input *aaabbbccc*. 10

b) Prove that a language L is recursive if and only if L and L' are recursively enumerable. 6

c) What do you mean by Multidimensional Turing Machine ? Explain. 4

OR

13. a) Explain the concept of reducing one problem to another and the need for such a reduction in computability theory. 4

b) Design a Turing machine to add two given integers. Draw the state diagram and the transition table of the TM. Write computation sequence for an input of your own choice. 7

c) Write short note on the following :

i) Recursively enumerable languages. 3

ii) Importance of Halting problem and Church Turing Thesis. 3

iii) NDTM vs DTM. 3

(4×20=80 Marks)
