(Pages : 4) **3316**

Reg. No. : .....

Name : .....

Fourth Semester B.Tech. Degree Examination, May 2015
(2013 Scheme)
13.406 : FORMAL LANGUAGE AND AUTOMATA THEORY

Time : 3 Hours Max. Marks : 100

PART – A

Answer **all** questions.

1. Design one DFA to accept all words in binary. Verify the correctness of the machine by showing computation sequence for a particular input. 4

2. Explain four differences between NFAs and DFAs. 4

3. Write a grammar to recognize all the odd length palindromes over the alphabet $\Sigma = \{a, b\}$. 4

4. Let L_1 be a recursive language. Let L_2 and L_3 be languages that are recursively enumerable but not recursive. Which of the following statements is not necessarily true ? Justify your answer. 4
   a) $L_2 - L_1$ is recursively enumerable
   b) $L_1 - L_3$ is recursively enumerable
   c) $L_2 \cap L_1$ is recursively enumerable
   d) $L_2 \cup L_1$ is recursively enumerable

5. What do you mean by Recursively enumerable languages ? Explain. 4

(5×4=20 Marks)

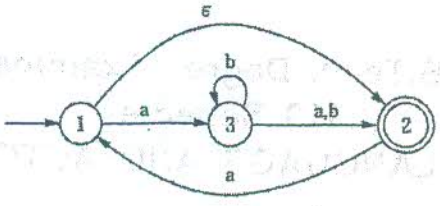
PART – B

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

Module – 1

6. a) Consider the set of strings on $\Sigma = \{0,1\}$ in which, every substring of 3 symbols has at most two zeros. For examples, 001110 and 011001 are in the language, but 100010 is not. All strings of length less than 3 are also in the language.Design a DFA to recognize the language. Verify the correctness of the designed model by writing computation sequence for 00111111010. 8

b) Convert the NFA given below to an equivalent DFA using subset construction algorithm. 6



c) What do you mean by a Moore machine ? Explain with an example. 6

OR

7. a) Construct a Moore machine that determines whether an input string contains an even or odd number of 1s. The machine should give 1 as output if an even number of 1s are in the string and 0 as output if an odd number of 1s are in the string. 9

b) Construct a DFA which accepts the following language : 7
$L = \{w \mid w \in \Sigma^*$ and w contains the substring 0101$\}$. Formally define all the components of the DFA. Show the computation sequence for an input of your own choice.

c) Compare one way finite automata with two way finite automata. 4

Module – 2

8. a) Which of the following regular expressions are ambiguous ? 6

i) $a(ab)^*cd^* \cup a(ababcb^*)^*a^*$ $aab^*(ab)^* \cup ab^* \cup a^*bba^*$

b) Show that the set of palindromes over {0, 1} is not regular using pumping lemma. 6

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

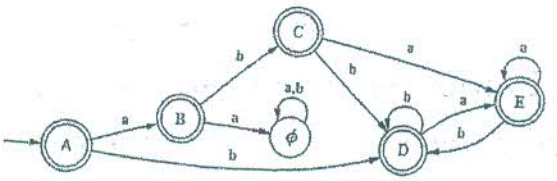
OR

9. a) Using closure properties, determine if the give language L is regular or non regular.

$L = \{w \mid w \in \{0,1\}^*$ and $|w|_0 = |w|_1\}$, where $|w|_0$ denotes the number of 0's in the string w. 8

b) What are decision algorithms for regular set ? Explain. 4

c) Minimise the DFA given below : 8



Module – 3

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

$L = \{1^n 0^n \mid n > 0\} \cup \{0^n 1^{2n} \mid n \geq 0\}$

Verify the correctness of the construction showing computation sequence for an input of your own choice.

b) With examples, define following terms with respect to the Pushdown Automata. 4

a) Configuration of PDA
b) Computation of PDA
c) Language accepted by PDA
d) Transition function of PDA

c) Show that the problem of determining whether a CFG generates all string in 1^* is decidable. 6

OR

11. a) Find a CFG that generates the language 7

$L(G) = \{a^n b^m c^m d^{2n} \mid n \geq 0, m > 0\}$.

b) Obtain a grammar in Chomsky Normal Form (CNF) equivalent to the grammar G with productions P given by 9

$S \rightarrow ABa$

$A \rightarrow aab$

$B \rightarrow AC$

c) Explain with example, the procedure to find CFG without *epsilon* productions. 4

Module – 4

12. a) Design a Turing Machine (TM) that increments a binary number appearing on its input tape. Draw the state diagram and transition table of the designed TM. Write the computation sequence for an input. 7

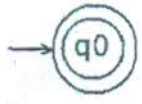
b) Can we simulate a Turning Machine using a PDA P with two stacks ? Formally explain your views on this question. 6

c) Show that every recursive language is recursively enumerable. 7

OR

13. a) Design a Turning Machine that accepts the set of all even palindromes over {0, 1}. Draw the state diagram and the transition table of the TM. Write the computation sequence for an input of your own choice. 8

b) The machine given below has no transitions. Is it a legal TM ? Explain your views on this question. 3



c) Write note on the following :

i) Universal Turing Machines 3

ii) Decidable and Undecidable problems 3

iii) Variants of Turing machines. 3

(4×20=80 Marks)