

**II B. Tech II Semester Regular Examinations, April/May - 2016**  
**FORMAL LANGUAGES AND AUTOMATA THEORY**  
 (Computer Science and Engineering)

Time: 3 hours

Max. Marks: 70

- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)  
 2. Answer **ALL** the question in **Part-A**  
 3. Answer any **THREE** Questions from **Part-B**
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**PART -A**

1. a) Construct a finite automata that accepts  $\{0,1\}^+$ . (4M)
- b) List out the properties of recursive and recursively enumerable language. (4M)
- c) Differences between DFA and NFA with examples. (4M)
- d) What is a regular set? Give examples for it. (3M)
- e) How to remove Ambiguity from grammars? Explain with an example. (4M)
- f) Define universal Turing machine and universal language. (3M)

**PART -B**

2. a) Construct a finite state automata that accepts the language  $\{a^i b^j c^k / i, j, k > 0\}$ . (8M)
- b) What is a Finite state machine? Give the mathematical representation of FSM. (8M)  
Explain each component.
3. a) Show that the language  $L = \{a^n b^n c^n : n \geq 0\}$  is not context free. (8M)
- b) Briefly explain about various operations on Strings with suitable examples. (8M)
4. Define the DFA and regular expression. DFA accepts all strings corresponding to the expression  $1^*0(0+11)^*$ . Also explain how to convert DFA to regular expression by eliminating states. (16M)
5. a) Convert the following regular expression into NFA with  $\epsilon$  transition. (8M)  
i)  $1^*0+1101$  ii)  $(0+1)^*$
- b) Give the properties of regular expressions and state and prove Arden's theorem. (8M)
6. Remove all  $\epsilon$  and unit production rules from the following CFG (16M)  
 $S \rightarrow AaA / CA / BaB$   
 $A \rightarrow aaBa / CDA / aa / DC$   
 $B \rightarrow bB / bAB / bb / aS$   
 $C \rightarrow Ca / bc / D$   
 $D \rightarrow bD / A$
7. a) Design a Turing machine that accepts the language  $L = \{ WW^R / W \in (0+1)^* \text{ and } W^R \text{ is reverse of } W \}$  (10M)
- b) What is post correspondence problem? Explain with an example. (6M)

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**PART -A**

1. a) Construct a finite automaton that accepts  $\{0,1\}^*$  (4M)
- b) Write any one application of CFG with example. (4M)
- c) What are the differences between DFA and NFA? (4M)
- d) Obtain the regular expression to accept strings of a's , b's and c's such that fourth symbol from the right is a and ends with b. (4M)
- e) Differentiate Chomsky and Gueibach normal forms (3M)
- f) Role of Checking of symbols in a Turing machine. (3M)

**PART -B**

2. a) Construct a finite state automata that accepts those strings over  $\{a,b\}$  that contain aaa as substring. (8M)
- b) What is an Automaton? Give its classification. Give the applications of automata in real world. (8M)
3. a) Write detail note on recursive enumerable languages with an example. (6M)
- b) Compare and contrast between regular grammar and unrestricted grammar with example. (10M)
4. a) Convert the regular expression  $(ab+aba)^*$  to a NFA. (8M)
- b) Construct a Non Deterministic Finite automaton (NFA) with  $\epsilon$ -moves for the regular expression  $(10+11)^*00$ . (8M)
5. a) Briefly explain how to convert regular expression into Automata with an example. (8M)
- b) Mention the differences between DFA, NFA and e-NFA. (8M)
6. a) Construct a Greibach Normal Form grammar equivalent to the following CFG (8M)  
 $S \rightarrow AA / 0$   
 $A \rightarrow SS / 1$
- b) Prove that the following grammar of arithmetic expression is ambiguous. (8M)  
 $E \rightarrow E+E / E * E / (E) / (id)$
7. a) Draw a transition diagram for Turing machine and explain it in detail. (6M)
- b) Design a Turing machine to accept the set of all palindrome over  $\{0,1\}^*$ . Draw a transition diagram for the Turing machine of the above. (10M)

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**PART -A**

1. a) Components of finite state automata. (4M)
- b) Give three examples of context sensitive grammar which are not context-free. (3M)
- c) Advantages and disadvantages of N DFA. (4M)
- d) What is Two-way DFA? Give its advantages of DFA. (4M)
- e) Show that the language  $L = \{ a^n b^n / n \geq 1 \}$  is unambiguous. (4M)
- f) When do you say that a Turing machine accepts a string? (3M)

**PART -B**

2. a) Construct a finite state automata that recognizes all possible strings over the alphabet  $\{0,1\}$  ending with two consecutive zeros. (8M)
- b) Construct a finite state automata with  $\epsilon$ -transition for the regular expression  $r=01^*+10$  (8M)
3. a) Show that the union of two recursive languages is recursive and the union of two recursive enumerable languages is also recursively enumerable. (8M)
- b) Explain the properties of recursive and recursively enumerable language in detail with an example. (8M)
4. a) Construct a DFA to accept the language  $L = \{ w/w \text{ has both an even number of } 0\text{'s and even number of } 1\text{'s} \}$ . (8M)
- b) Explain the steps in the design of NFA with  $\epsilon$ -moves from NFA. (8M)
5. a) Construct a finite state automata equivalent to the regular expression  $(0+1)^*(00+11)(0+1)^*$  (8M)
- b) Explain the algorithm for optimization of DFA with suitable example. (8M)
6. a) Consider the CFG with the following production rules: (8M)
  - $S \rightarrow aB / bA$
  - $A \rightarrow bAA / aS / a$
  - $B \rightarrow aBB / bS / b$
 Give the right most derivation and draw derivation tree for the string *abbaab*
- b) Find a Greibach normal form grammar equivalent to the following CFG. (8M)
  - $S \rightarrow ASB / AB$
  - $A \rightarrow a$
  - $B \rightarrow b$
7. Design a Turing Machine which can multiply two positive integers. (16M)

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**PART -A**

1. a) Draw a diagram for finite automata which represents a bank. (4M)
- b) What are context sensitive languages? Write one example. (3M)
- c) Draw a NFA which accepting the set of all strings whose second last symbol is 1. (4M)
- d) List the four components used to form a context free grammar. (4M)
- e) Chomsky normal form Vs Griebach normal form. (4M)
- f) Give examples of an undecidable problem. (3M)

**PART -B**

2. a) .Define the following terms, with an example for each: (8M)  
 i) String ii) Alphabet iii) Powerset iv) Language
- b) Construct a finite state automata with  $\epsilon$ -transition for the regular expression  $(ab+aba)^*$  (8M)
3. a) Show that any non trivial property of the recursively enumerable language is undecidable. (8M)
- b) Define pumping lemma. How it is used in context free languages? (8M)
4. a) For the regular expression given below, obtain an NFA without  $\epsilon$ -moves. (8M)  
 $(0+1)^*(00+11)$
- b) Discuss about equivalence of NFA and DFA. (8M)
5. a) Prove that regular sets are closed under union and complementation. (8M)
- b) Construct an NFA equivalent to the regular expression  $10+(0+11)0^*1$  (8M)
6. a) Design a Moore machine that accepts all strings of 0's and 1's treated as binary integer number return a remainder 1 when divided by 3. (8M)
- b) Convert the following grammar into Chomsky Normal Form. (8M)  
 $S \rightarrow aB / bA$   
 $A \rightarrow bAA / aS / a$   
 $B \rightarrow aBB / bS / b$
7. Design A Turing Machine to recognize the language  $\{1^n 2^n 3^n / n \geq 1\}$ . (16M)