

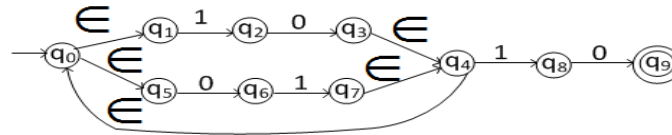
II B.Tech II Semester(R09) Regular Examinations, April/May 2011
FORMAL LANGUAGES & AUTOMATA THEORY
 (Computer Science & Engineering)

Time: 3 hours

Max Marks: 70

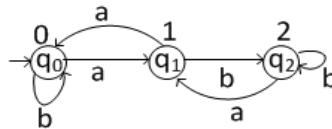
Answer any FIVE questions
All questions carry equal marks
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- Define an NFA. Draw the transition graph of NFA that accepts the language generated by the regular expression $(10+01)^*1(0+1)$. Process the string 100111 on the machine.
 - Define DFA. Draw the transition graph of the DFA that accepts the language generated by the regular expression $(a+b)^*ba$. Process the string abba.
- Define NFA- ϵ . Convert the following NFA- ϵ into it's equivalent NFA.



Process the string 101010 on both the machines.

- Define Moore and Melay machines. Convert the following Moore machine into its equivalent Melay machine.



- Construct an NFA- ϵ that recognizes the language generated by the regular expression $(11+01)^*10(0+1)^*$. Process the string 111001.
 - State pumping lemma for regular languages. Prove that the language of palindromes over the alphabet $\{a, b\}$ is not regular.
- Define a regular grammar. Find the FA that recognizes the language generated by the following right linear grammar.
 $S \rightarrow OA/1B/1C$
 $A \rightarrow 1A/OC$
 $B \rightarrow 1B/O/1$
 $C \rightarrow OC/O/1A$
 - Define leftmost and right most derivations. Find out the leftmost, right most derivations and draw the corresponding derivation trees for the string $(a+a)^*a$ in the following grammar.
 $E \rightarrow E + T/T$
 $T \rightarrow T * F/F$
 $F \rightarrow (E)/a$
- Eliminate ϵ -productions from the following CFG.
 $S \rightarrow ABBAC$
 $A \rightarrow AB/a/B$
 $B \rightarrow A/CB/AC/b/\epsilon$
 $C \rightarrow d$
 - Convert the following CFG into CNF
 $S \rightarrow ABC/BaB$
 $A \rightarrow Aa/BaC/a$
 $B \rightarrow bBb/a$
 $C \rightarrow aC/bC/c$
- When do you say that a language is recognized or accepted by a PDA? Design a PDA for $L = \{a^1b^jc^k/j \geq i+k \text{ and } i,j,k > 0\}$. Process the string aaabbbbbbcc using instantaneous description.
- Design a TM for recognizing $L = \{xx/x \in \{a,b\}^*\}$. Show the moves of the TM for the string abaaba and abaabb.
- Write short notes on the following:
 - NP hard and NP complete problems.
 - Posts correspondence problem.
 - Linear Bounded Automata.

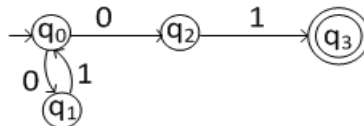
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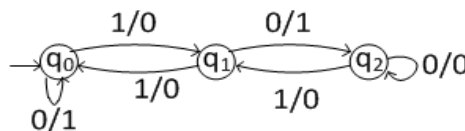
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- Define DFA. Draw the transition graph on transition table for the DFA which recognizes $L = \{x \in \{a, b\}^* / x \text{ ends with } ba\}$. Process the string bbab.
 - Define NFA. Draw the transition graph and transition table of NFA which can recognize $(0+11)^*0(11+00)$.
- Convert the following NFA into its equivalent DFA. Process the string 0101 on both the machines.



- Define Moore and Melay machines. Convert the following Melay machine into equivalent Moore machine.



- Construct an FA which can recognize the language generated by the regular expression $(00+10)^*11(0+1)$. Process the string 10110 on the FA.
 - Write any eight identify roles for regular expression and any four closure properties of regular sets (regular languages).
- Find an FA which can recognize the language generated by the following regular grammar.
 $S \rightarrow 00A/11B$
 $B \rightarrow 01/10$
 $A \rightarrow 0B/1A/1$
 Check the acceptability of 00010.
 - Design a CFG that generates strings over the alphabet $\{a,b\}$ that contain unequal number of a's and b's.
- How do you a eliminate the unit productions from a given CFG? Eliminate the unit productions from the following CFG.
 $E \rightarrow E + T/T$
 $T \rightarrow T * F/F$
 $F \rightarrow (E)/a$
 - Define CNF for CFGs. Convert the following CFG into its equivalent CNF.
 $S \rightarrow abA/bB/aba$
 $A \rightarrow b/aB/bA$
 $B \rightarrow aB/aA$
- Design a PDA for recognizing the language of palindromes over $\{0,1\}$. Process the string 00100.
 - How do you find out PDA that recognizes the language generated by a CFG? Find the PDA which recognizes the language generated by the following CFG.
 $S \rightarrow 01A/1B$
 $A \rightarrow 00A/11B/0/1$
 $B \rightarrow 1A/0B/0$
- What are computable functions? Design a TM for computing the multiplication of two given integers.
 - Discuss about Church's hypothesis.
- Write brief notes on the following:
 - Context Sensitive Languages.
 - Universal Turing Machine.
 - Posts correspondence problem.

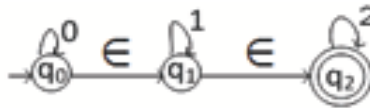
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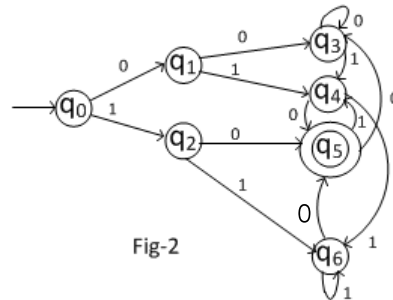
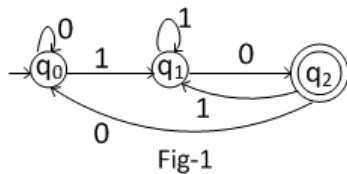
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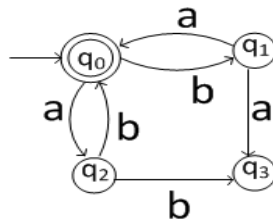
1. (a) Draw the transition graph and transition table of an NFA for accepting the strings generated by the regular expression $(00+11)^*10$. Process the string 001110.
- (b) Design a DFA for accepting the language of strings over $\{0,1\}$ that do not contain 10 as substring. Process the string 0011.
2. (a) Find the NFA equivalent to the following NFA-E. Process the string 0112 on both the machines.



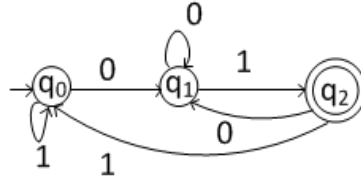
- (b) Check the equality of the following FA'S.



3. (a) Find the regular expression for the language recognized by the following FA.



- (b) State the pumping lemma for regular languages. Prove that the language of all strings over $\{a, b\}$ that contain equal no. of a's and b's is not a regular language.
4. (a) Define a CFG. Find a CFG which generate the strings over the alphabet $\{0,1\}$ and does not contain equal number of 0's and 1's. Find the left most derivation, rightmost derivation and derivation tree for the string 01100.
- (b) Find a right linear grammar generating the language recognized by the following FA.



5. Convert the following CFG into Greibach Normal form
 $E \rightarrow E + T / T$
 $T \rightarrow T * F / F$
 $F \rightarrow lE / a$
6. (a) Define a PDA. Design a PDA for recognizing
 $L = \{x \in \{0, 1\}^* / x = 0^i i^j o^k \text{ and } j = i + k, i, j, k > 0\}$ Process the string 011100 on the PDA.
 (b) Write the procedure for finding a CFG equivalent to a given PDA.
7. Write brief notes on the following:
 (i) Church's hypothesis (ii) Counter machines (iii) Computable functions.
8. Write brief notes on the following:
 (i) Linear bounded automata. (ii) Universal Turing machine. (iii) Post's correspondence problem.

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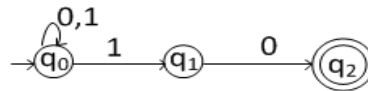
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1. (a) What are various operations that can be performed on languages ? Explain with examples.
 (b) Design a DFA that accepts (recognizes) strings containing even no of a's and odd no of b's. Draw it's transition diagram and transition tables. Process the string ababb.
2. (a) Convert the following NFA into DFA.



Process the string 0010 on both the machines.

- (b) Draw a Moore machine for calculating mod 3 of a given binary number. Find it's equivalent Mealy machine.
3. (a) Write any 8 identify rules for regular expressions.
 (b) Write any 4 closure properties of regular sets.
 (c) Prove that the language of palindromes over {a,b} is not a regular language using pumping lemma.
4. (a) Find a right linear grammar for the language $(0+1)^*10$. Draw the transition diagram of the FA from the grammar designed.
 (b) Design a CFG for the language of non-palindromes over {a,b}. Find the derivations for the strings abad and ababaa.
5. (a) What is meant by ambiguous CFG? Prove that the grammar $E \rightarrow E + E / E * E / a$ is ambiguous.
 (b) Write the procedure for converting a CFG into its equivalent CNF. Convert the following CFG into CNF.
 $E \rightarrow E + T / T$
 $T \rightarrow T * F / F$
 $F \rightarrow (E) / a$
6. (a) Design a PDA for accepting the language of palindromes over {a,b}. Process the string ababa.
 (b) Design a PDA for accepting the language generated by the following CFG.
 $S \rightarrow ab/aA/aB$
 $A \rightarrow aA/a$
 $B \rightarrow bB/b$
7. Design a TM for accepting the strings of language $L = \{x \in \{a,b\}^* / x = yy \text{ for some } y \in \{a,b\}^*\}$ Process the string abab.
8. (a) Write about Chomsky hierarchy of languages.
 (b) Write a brief note of NP hard and NP complete problems.
