SRINIX COLLEGE OF ENGINEERING, BALASORE

DEPARTMENT OF
COMPUTER SCIENCE & ENGINEERING

ASSIGNMENT ON

FORMAL LANGUAGE AND AUTOMATA THEORY

FORMAL LANGUAGE IAND AUTOMATA THEORY

ASSIGNMENT- I

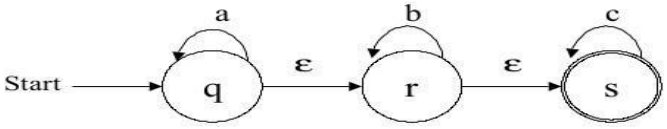
1. a) Consider the below finite automata and check the strings are accepted or not

States (Q)	Input Alphabtes	
	0	1
→q0	q1	q3
q1	q0	q2
(q2)	q3	q1
q3	q2	q0

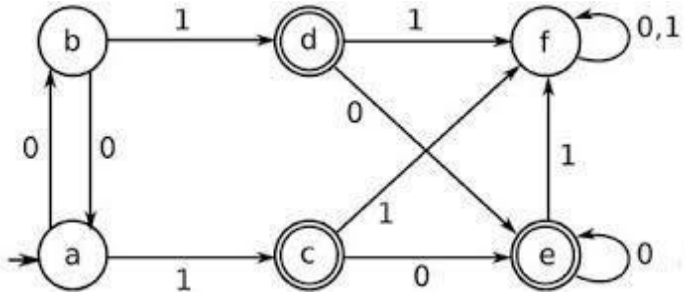
(i) 1110 (ii) 0001 (iii) 1010 [L2,2+2+2M]

b) Define NFA. What are the differences between DFA & NFA? [L2,4M]

2. Convert the following NFA with ε moves to DFA without ε moves. [L2,10M]



3. Minimize the following finite automata. [L3,10M]



4. Convert the following Mealy machine into its equivalent Moore machine. [L2,10M]

Present State	I/P=0		I/P=1	
	Next State	O/P	Next State	O/P
→ A	C	0	B	0
B	A	1	D	0
C	B	1	A	1
D	D	1	C	0

5. a) Write about relations on sets. [L1,2M]
   b) Define Grammar? What are the tuples? [L1,2M]
   c) Define Finite Automaton. [L2,2M]
   d) Show that (0*1*)* = (0+1)*. [L3,2M]
   e) Define Mealy machine and Moore machine. [L2,2M]
6. a) Discuss Chomsky's Hierarchy of formal languages. [L1,5M]
   b) Explain briefly about DFA and NFA? [L1,5M]

7. a) Define Moore machine? Construct Mealy machine corresponding to Moore machine? [L2,5M]

States (Q)	Next States		Output
	I/P=0	I/P=1	
→q1	q1	q2	0
q2	q1	q3	0
q3	q1	q3	1

   b) Prove i) R=(1+00*1) + (1+00*1) (0+10*1)* (0+10*1)* = 0*1(0+10*1)*
   ii) R= $\epsilon+1^*(011)^*(1^*(011)^*)^*=(1+011)^*$ [L3, 21/2+21/2M]
8. Write down procedure for Myhill- Nerode theorem with a given example. ('*' means final states). [L2, 10M]

Present State	Next State	
	I/P=a	I/P=b
→ A	B	F
B	A	F
C	G	A
D	H	B
E	A	G
*F	H	C
*G	A	D
*H	A	C

9. a) Define relations on set and explain its property with an example [L1,3M]

b) Define NFA and DFA. Construct DFA for the given NFA [L2,7M]

	Next state	
	0	1
→ q0	q0,q1	q0
q1	q2	q1
q2	q3	q3
(q3)	-	q2

10. a) List out the identities of Regular expression. [L3,4M]

b) From the identities of RE, prove that

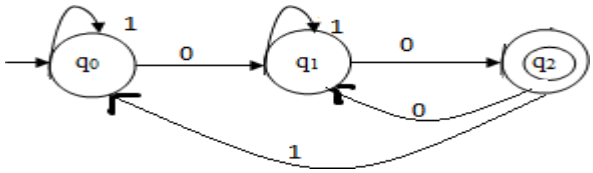
i) 10+(1010)*[^+(1010)*]=10+(1010)* [L3,2M]

ii)(0+011*)+(0+011*)(01+0100*)(01+0100*)*=01*(010*)* [L3,2M]

c) Define finite automata? Explain detail about the tuples. [L2,2M]

ASSIGNMENT- II

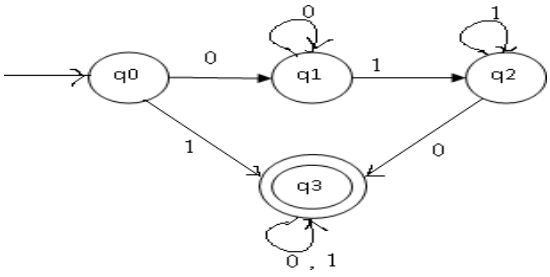
1. a) Construct an equivalent FA for the given regular expression (0+1)*(00+11)(0+1)* [L1,5M]
   b) State Arden's theorem and construct the regular expression for the following FA using Arden's theorem. [Ll,5M]
2. Explain about Arden's theorem, for constructing the RE from a FA with an example. [L1,10M]



3. a) List out the identities of Regular expression. [L1,4M]
   b) From the identities of RE, prove that [L2,6M]
      i) 10+(1010)*[^+(1010)*]=10+(1010)*
      ii)(0+011*)+(0+011*)(01+0100*)(01+0100*)*=01*(010*)*
4. a) Consider the below finite automata and check the strings are accepted or not [L3,6M]

States (Q)	Input Alphabtes	
	0	1
→q0	q1	q3
q1	q0	q2
(q2)	q3	q1
q3	q2	q0

   (i) 1110 (ii) 0001 (iii) 1010
   b) Construct an equivalent FA for the given regular expression (0+1)*(00+11)(0+1)* [L3,4M]
5. a) Prove R=Q+RP has unique solution, R=QP* [L1,3M]
   b) Explain about the Arden' theorem, for constructing the RE from a FA with an example [L1,7M]

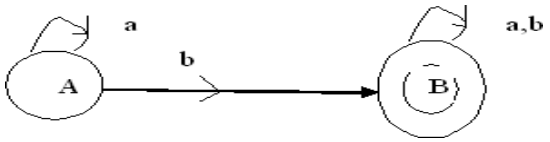


6. Explain how equivalence between two FA is verified with an example. [L2,10M]
7. Prove that the language L= $\{a^n b^n \mid n>=1\}$ is not regular using pumping lemma with procedure. [L2,10M]

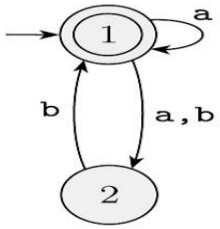
8. a) Construct an equivalent FA for the given regular expression (0+1)*(00+11)(0+1)* [L3,5M]

b) State Arden's theorem and construct the regular expression for the following FA using Arden's theorem.

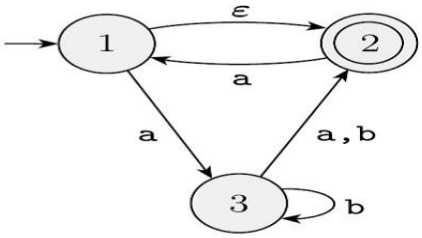
[L3,5M]



9. a)Write the process of equivalence two FA's? Find whether the equivalence two FA's or not.[L3,7M]



(a)



(b)

b) List out the identities of Regular expression. [L3,3M]

10. Prove that the language L= $\{a^m b^n c^n \mid n>=1\}$ is not regular using pumping lemma. [L3,10M]

ASSIGNMENT- III

1. Write the procedure and Eliminate left recursion from the following Grammar [L2,10]
   E→E+T/T
   T→T*F/F
   F→(E)/id
2. a) Explain about derivation and parse trees? Construct the string 0100110 from the Leftmost and Rightmost derivation.
   S→0S/1AA
   A→0/1A/0B
   B→1/0BB [L2,5M]
   b) Find the parse tree for generating the string 11001010 from the given grammar.[L2,5M]
   S→1B/0A
   A→1/1S/0AA
   B→0/0S/1BB
3. a) Define Ambiguous grammar. [L2,4M]
   b) Remove Left recursion from the grammar S→Sab/T
   T→Tcd/F
   F→Fa/G [L2, 6M]
4. a) Explain Left recursion and Left factoring. [L3,4M]
   b) Perform left factor from the grammar A→abB/aB/cdg/cdeB/cdfB [L3, 6M]
5. Simplify the following context free grammar. (Here, Λ stands for epsilon (ϵ)). [L4,10M]
   S→TU|V
   T→aTb|Λ
   U→cU| Λ
   V→aVc|W
   W→bW| Λ
6. Convert the following grammar into Greibach normal form. [L4,10M]
   S→AA/a
   A→SS/b
7. a) Write the process for Convert the grammar into CNF? [L3,4M]
   b) Convert the following grammar into CNF. [L3, 6M]
   S→bA/aB A→bAA/aS/a B→aBB/bS/a.
8. a) What is linear grammar? Explain in detail with example. [L3,4M]
   b) Explain the closure properties of context free languages. [L3, 6M]
9. a)Remove the unit production from the grammar
   S→AB,A→E,B→C,C→D,D→b,E→a [L3,4M]
   b) Remove ϵ productions from the grammar
   S→ABaC, A→BC, B→b/ ϵ, C→D/ ϵ, D→d [L3, 6M]
10. a) Write about Decision problems for CFLs with example? [L3,5M]
    b) What is the differentiate between CFG and Regular Language? [L3, 4M]

ASSIGNMENT- IV

1. a) Construct a PDA which recognizes all strings that contain equal number of 0's and 1's. [L2, 6M]
   b) A PDA is more powerful than a finite automaton. Justify this statement. [L2, 4M]
2. Construct PDA from the following Grammar.
   S→ aB
   B→ bA/b
   A→ aB [L2, 10M]
3. Construct PDA from the following Grammar
   S→0BB
   B→0S/1S/0 [L2, 10M]
   Show an ID for the string 010000 is generated for PDA?
4. Construct a CFG equivalent to the following PDA. [L2,10M]
   PDA={(p, q), (0, 1), δ, p, q, (Z, X)}, where p is initial state, q is final state.
   δ is defined as δ(p,0,Z)=(p,XZ), δ(p,0,X)=(p,XX), δ(p,1,X)=(q,ϵ), δ(p,1,X)=(p,ϵ), δ(p,ϵ,Z)=(p,ϵ). [L3,10M]
5. a) Construct an equivalent PDA for the following CFG [L3,7M]
   S→aAB | bBA
   A→bS | a
   B→ aS | b
   b) Explain the informal introduction and formal definition of PDA. [L2, 3M]
6. a) Define Instantaneous description (ID) in PDA. [L2,5M]
   b) Explain about the graphical notation of PDA. [L2, 5M]
7. a) Write the process for convert PDA into an equivalent CFG. [L4,4M]
   b) Convert the following PDA into an equivalent CFG. [L4, 6M]
   $\delta(q_0,a_0,z_0)\rightarrow(q_1,z_1z_0)$
   $\delta(q_0,b,z_0)\rightarrow(q_1,z_2z_0)$
   $\delta(q_1,a,z_1)\rightarrow(q_1, z_1z_1)$
   $\delta(q_1,b,z_1)\rightarrow(q_1, \lambda)$
   $\delta(q_1,b,z_2)\rightarrow(q_1,z_2z_2)$
   $\delta(q_1,a,z_2)\rightarrow(q_1, \lambda)$
   $\delta(q_1, \lambda,z_2)\rightarrow(q_1, \lambda)$ // accepted by the empty stack.
8. a) Define push down automata? Explain acceptance of PDA with empty stack. [L2,5M]
   b) Define Instantaneous description (ID) in PDA. [L2, 5M]
9. a) Explain about the graphical notation of PDA. [L2,4M]
   b) Construct an equivalent PDA for the following CFG. [L3, 6M]
   S→aAB | bBA
   A→bS|a
   B→aS | b.
10. Explain Deterministic Push down Automata with example? [L2, 12M]

ASSIGNMENT- V

1. Construct a Turing machine which multiplies two unary numbers. [L1,10M]
2. Construct a Turing machine for Language $L=a^n{}_b{}^n$,where n>0 [L1,10M]
3. Construct a Turing machine that recognizes the language $L=\{a^nb^n, n>1\}$. Show an ID for the string 'aabb' with tape symbols. [L2,10M]
4. Explain conversion of regular Expression to TM with example. [L3,10M]
5. Explain the various types of Turing machine. [L3,10M]
6. Explain Universal turing machine [L3,10M]
7. a)Design a multi head Turing Machine for checking whether a binary string is a palindrome or not. Show the ID for 1001. [L3,6M]
   b) Write about Universal TM. [L3, 4M]
8. Explain in detail about variations of the TM? [L3,10M]
9. Construct a Turing machine that recognizes the language $a^nb^nc^n$. [L3,10M]
10. a) Define PCP. Verify whether the following lists have a PCP solution. [L3,7M]
    $\binom{abab}{ababaaa}, \binom{aaabbb}{bb}, \binom{aab}{baab}, \binom{ba}{baa}, \binom{ab}{ba}, \binom{aa}{a}$.
    b) Describe linear bounded automaton. [L3,3M]