Question Bank.

BE 3/4 CSE Sem I Sec I, II, III. Sub: ALC

UNITS I & II

1. Prove the equivalence of DFA and NFA.

2. Define FA, DFA, NFA, Regular Expressions, CFG. Give application

3. Differentiate between NFA and DFA.

4. Construct the following:

I & Reg Exps:

1. All strings of a's and b's where the first and the last symbols are different.
2. $L = \{ w : n_a(w) \bmod 3 = 0 \text{ where } w \in (a,b)^* \}$
3. All strings of 0's and 1's not having 2 consecutive zeros.
4. All strings of 0's and 1's containing not more than 3 zeros.
5. $L = \{ a^{2n} b^{2m} \mid n \geq 0, m \geq 0 \}$
6. All strings of 0's and 1's not containing 101 as a substring.
7. $L = \{ a^n b^m \mid m+n \text{ is even} \}$
8. All strings such that the 4th symbol from right end is
9. different from the left most symbol.
10. All strings that do not end with 01.
10. All strings of 0's and 1's where last 2 symbols are same.

II DFA

1. DFA to accept all strings of a's and b's where each string starts with 'a' and ends with 'ab'.
2. DFA for language $L = \{ w \mid w \text{ does not contain substring } 110 \}$
3. All strings of a's and b's containing ~~ab~~ a's that are multiple of 2's.
4. All strings with at least one 'a' and followed by exactly 2 b's

5. All strings of 0's and 1's with at most 2 consequitive 1's.
6. All strings of a's and b's where no. of a's is divisable by 2 and no. of b's is divisable by 3.
7. $L = \{ w : |w| \bmod 3 = 0 \}$
8. All strings of 0's and 1's whose 5th symbol from the left ~~right~~ end is 1.
9. All strings of 0's and 1's containg 0101 as a substring.
10. All strings of a's and b's where the first and the last symbols are different.

III
NFA

1. Obtain an NFA for $L = \{a^n b^m \mid n, m \geq 1\}$
2. NFA for any no. of a's followed by any no. of b's, followed by any no. of c's.
3. NFA for strings containing 3rd symbol from the left-end is 1 and 2nd symbol from left end is 0.
4. Strings containg a pair of 1's followed by a pair of 0's.
5. Strings ending in 1 but not containing 00.

IV.
CFG

1. CFG for generating all integers.
2. CFG for a set of palindromes over $\{0,1\}$
3. CFG for strings containing equal no. of a's and b's.
4. CFG for even no. of a's.
5. CFG for different first and last symbol over $\{0,1\}$
6. CFG for balanced parenthesis
7. CFG for 'C' identifier.
8. CFG for $0^*1(0+1)^*$
9. CFG for $L = \{a^n b^{n+1} \mid n \geq 0\}$
10. CFG for all strings of a's and b's with 'aa' in between.

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5. Convert the following:

I RE to ∈-NFA.

1. $(a+b)^* ab (a^* + b^*)$

2. $1(1+10)^* + 10(0+01)^*$

3. $10 + (0+11)0^*1$

II ∈-NFA to NFA without ∈'s.

1.

	∈	a	b	c
→ p	∅	{p}	{q}	{r}
q	{p}	{q}	{r}	∅
* r	{q}	{r}	∅	{p}

2.

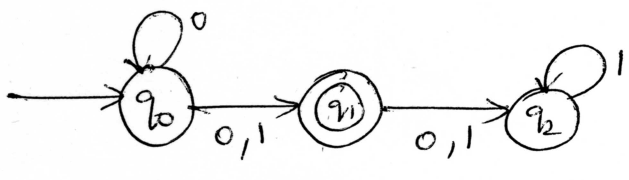
	∈	a	b	c
→ p	{q, r}	∅	{q}	{r}
q	∅	{p}	{r}	{p, q}
* r	∅	∅	∅	∅

III NFA without ∈ to DFA.

1.

	0	1
→ p	{p, q}	{p}
q	{r}	{r}
r	{s}	∅
* s	{s}	{s}

2.

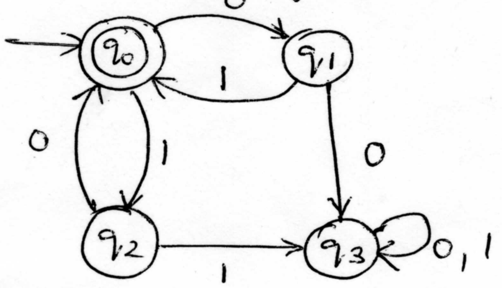


3.

	0	1
→ q_0	{q_0, q_1}	{q_0}
q_1	∅	{q_2}
q_2	∅	{q_3}
* q_3	{q_3}	{q_3}

IV NFA/DFA to Reg Exps.

1.



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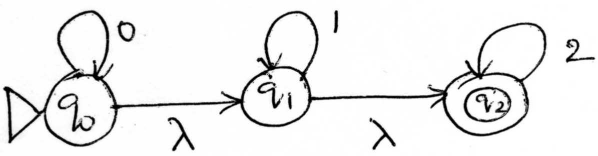


3. FA for 1. $a.(a+b)^* b.b$

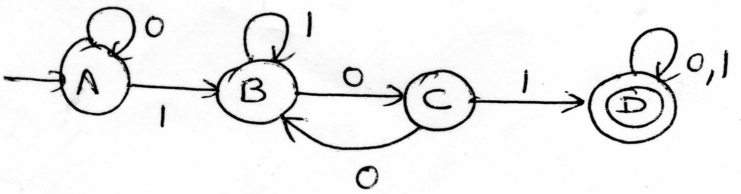
2. $L(ab(a+ab^*(a+aa))$

3. $(0^* 1^*)^*$

4. $10 + (0+11)0^*1$

5. $(0^*1^*)^* 11$

4.



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6. a) State and prove pumping lemma for Regular languages. Give applications.

b) Apply the lemma to the following languages.

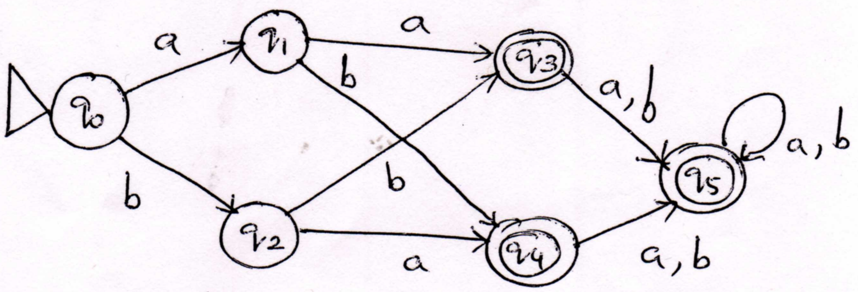
1. $L = \{ ww^R \mid w \in \{0,1\}^* \}$ is not regular.

2. $C = \{ w \mid w$ has equal no. of 0's and 1's $\}$

3. $L = \{ 0^i \mid i$ is a prime no. $\}$ is not regular.

7. State My-Hill Nerode theorm and minimize the given FA.

1.



2:

	a	b
→ A	B	E
B	C	D
* C	H	I
* D	I	H
E	F	G
* F	H	I
* G	H	I
H	H	H
I	I	I

3.

	0	1
→ A	B	E
B	C	F
* C	D	H
D	E	H
E	F	I
* F	G	B
G	H	B
H	I	C
* I	A	E

4.

	0	1
→ q_1	q_2	q_3
q_2	q_3	q_5
* q_3	q_4	q_3
q_4	q_3	q_5
* q_5	q_2	q_5

8. a) State and discuss properties of Regular languages.

b) What is the language accepted by : $S \to aCa$; $C \to aCa \mid b$

9. Give the leftmost derivations, right most derivations and parse trees for the following: (5)/(4)

a) $S \to iCtS \mid iCtSeS \mid a$, $C \to b$ $w =$ 'ibtibtaea'

b) $E \to E+T \mid T$, $T \to T \times F \mid F$, $F \to (E) \mid a$

$w =$ is any derivable string.

c) $A \to 0BA \mid 0$, $B \to A1B \mid AA \mid 10$, $w =$ '001100'

d) $S \to S+S \mid S*S \mid a \mid b$ $w =$ '$a*b+a*b$'.

e) $S \to aB \mid bA$, $A \to a \mid aS \mid bAA$, $B \to b \mid bS \mid aBB$

$w =$ 'aaabbabbba'

f) $S \to aAS \mid a$, $A \to SbA \mid SS \mid ba$ $w =$ '$a^r b^r a^r$'

10. What is Ambiguity in grammars. Define Inherent Ambiguity. Are the following grammars ambiguous?

1. $S \to AB$, $A \to Aa \mid \epsilon$, $B \to ab \mid bB \mid \epsilon$

2. Verify if the above grammars: (b), (f) are ambiguous or not.

3. $S \to S(S) \mid \epsilon$

4. $S \to aS \mid aSbS \mid \epsilon$

5. CFG for palindrome.

XI. a) Define PDA? What are its applications? What are the languages accepted by a PDA? What is the ID of a PDA? What is a DPDA?

b) Design PDA's for the following languages.

1. $L = \{ 0^n 1^n \mid n \geq 0 \}$
2. $L = \{ ww^R \mid w \in \{0,1\}^* \}$
3. Equal no. of a's and b's over the alphabet $(a+b)^+$
4. The set L of all non palindromes over $\{a, b\}$
5. $L = \{ N_a(x) > N_b(x) \mid x \in (a,b)^* \}$

XII. a) Construct a PDA equivalent to the CFGs.

1. $S \rightarrow 0BB$, $B \rightarrow 0S$, $B \rightarrow 1S$, $B \rightarrow 0$
2. $S \rightarrow aB \mid bA$, $A \rightarrow a \mid aS \mid bAA$, $B \rightarrow b \mid bS \mid aBB$

b) How can a PDA be converted to a grammar? Explain the methodology with the help of an example.

1. $\delta(q_0, a, Z) = (q_0, AZ)$; $\delta(q_0, a, A) = (q_0, A)$
   $\delta(q_0, b, A) = (q_1, \epsilon)$; $\delta(q_1, \epsilon, Z) = (q_2, \epsilon)$
2. Given $P = (\{p, q\}, \{0,1\}, \{X, Z_0\}, \delta, q, Z_0)$ and δ is given as below, convert the PDA to a CFG.
   $\delta(q, 1, Z_0) = \{q, XZ_0\}$; $\delta(q, 1, X) = \{q, XX\}$
   $\delta(q, 0, X) = \{p, X\}$; $\delta(q, \epsilon, Z_0) = \{(q, \epsilon)\}$
   $\delta(p, 1, X) = \{p, \epsilon\}$; $\delta(p, 0, Z_0) = \{(q, Z_0)\}$

XIII. a) Define Moore and Mealy machines.

b) Differentiate between Moore and Mealy Machines.

XIV. a) Design Moore Machines for;

1. To detect 3 or more 1's and when they are detected the output is 1.

2. To recognize the no. of occurances of "aab" in a string.

b) Design Mealy Machines for;

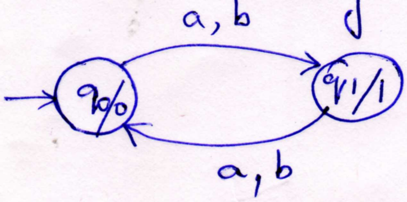
1. To detect 3 or more 1's and when they are detected the output is 1.

2. To recognize the no. of occurances of aa or bb.

XV. Convert the following:

a) Moore to Mealy:

1.



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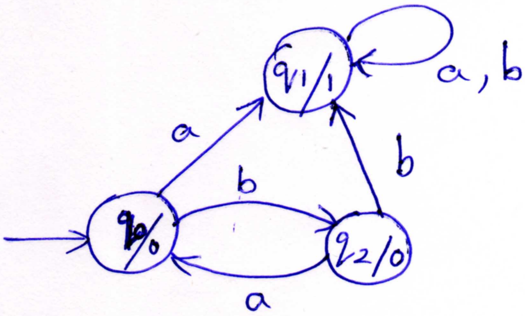
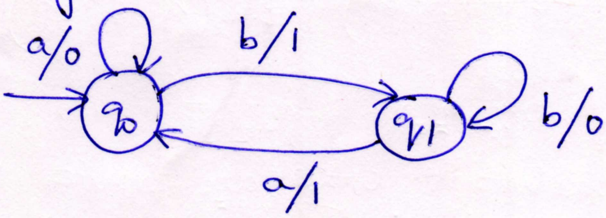


b) Mealy to Moore:

1.



2.