B.Sc(V), Odd Semester Examination, 2021-22
Subject: Theory of computation
Date: 26/11/2021, Time: 10:00 am – 12:00 pm
Total Marks: 70

Attempt any 14 questions. Marks: 14 X 5 = 70

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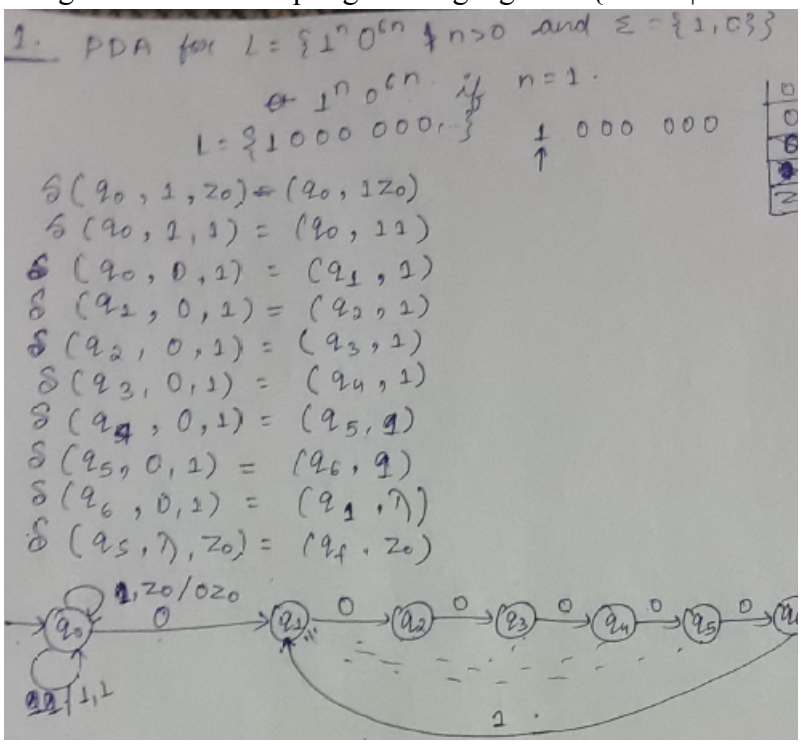
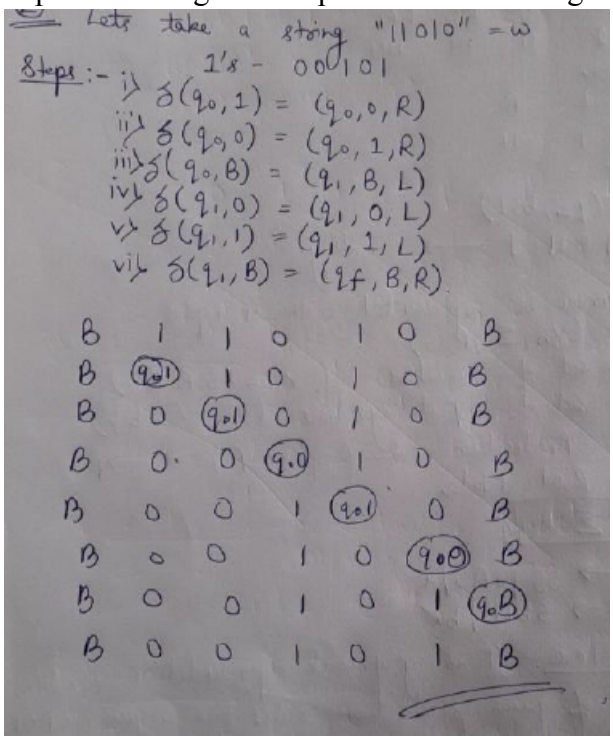
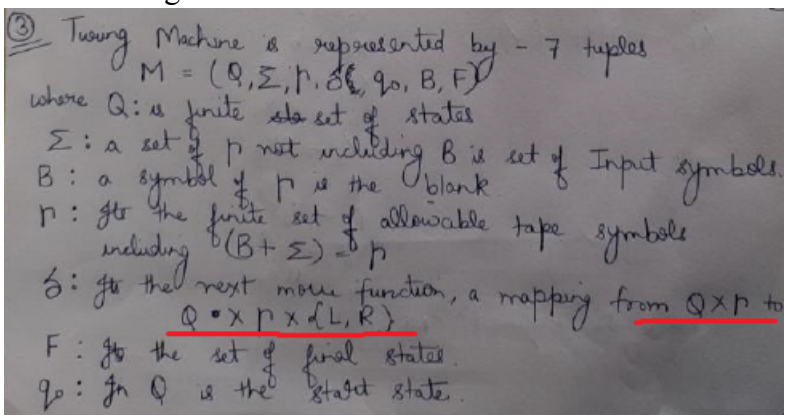
1. Design a PDA for accepting the language L = { $1^n 0^{6n}$ | where n > 0 and ∑={1,0}}



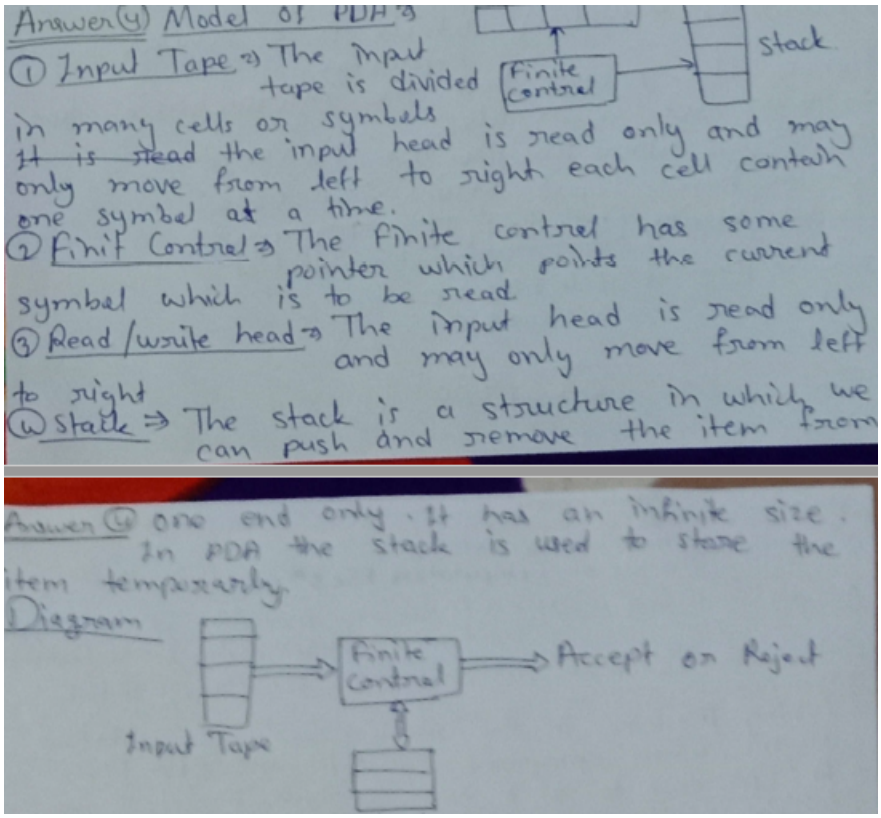
2. Design a Turing machine to find 1's complement of binary number. Write the sequence of steps for finding 1's complement of the string "11010"



3. Define Turing machine.



4. Describe the model of a PDA.



Under Finite control write $\delta \rightarrow (Q \times \{\Sigma \cup \lambda\} \times \Gamma^* = (Q, \Gamma^*)$

5. Show that the intersection of two regular set is regular with example.

6. Use pumping lemma to show that the language L= $\{ a^{2^n} \mid$ where n >0$\}$ and $\sum$={a} is not regular.

Ans-6) $L = \{a^{2^n} \mid n > 0\}$ $\Sigma = \{a\}$ is not regular

Step1 → Let L be a regular language so we can be able to design DFA with n states.

Step2 → $w \in L$ $|w| > n$ $w = xyz$ $|xy| \leq n$ $|y| > 0$

$w = a^{2^n}$ $|w| = 2^n \geq n$

$w = a^{2^n} = xyz$ such that $|xy| \leq n$ $|y| > 0$

y can be Null $|y| \leq n$ max length of y can be n and minimum length of y is 1

Step3 - $|xy^2z| = |xyz| + |y| = 2^n + 1 > 2^n$

$|xy^3z| = |xyz| + |y| = 2^n + n < 2^n + 1$ for $n \geq 1$

$2^n < |xy^2z| < 2^n + 1$

$\therefore xy^2z \notin L$

OR

(Answer no-6)

$L = \{a^{2^n} \mid n > 0\}$

Solution -

Step I Initially assume L is regular

Step II $L = \{a, a^4, a^6, a^8, a^{20} \ldots\}$

$w = a^4 = \frac{aa}{x} \frac{a}{y} \frac{a}{z}$ total $w = 4$

$|xy| \leq n$ $|y| = 1 \geq 1$

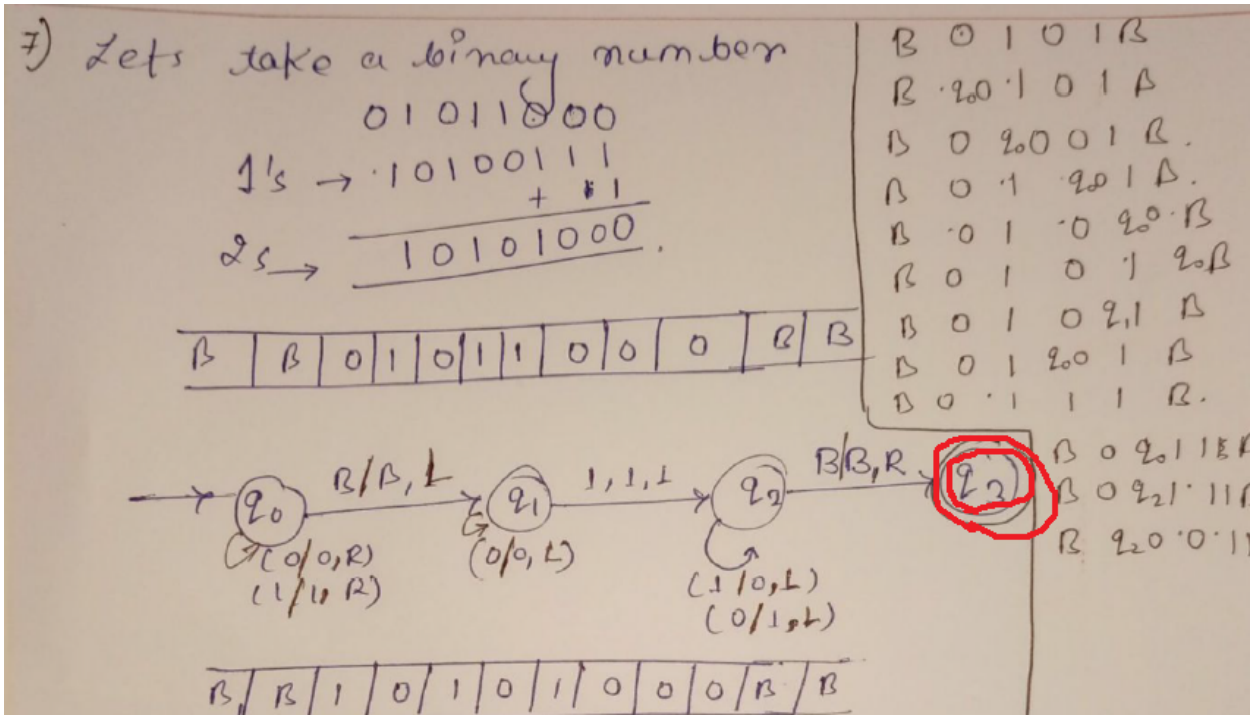
$3 \leq 4$ this not null

Step III $i = 2$ $w = \frac{aa}{x} \cdot \frac{a}{y} \frac{a}{z}$

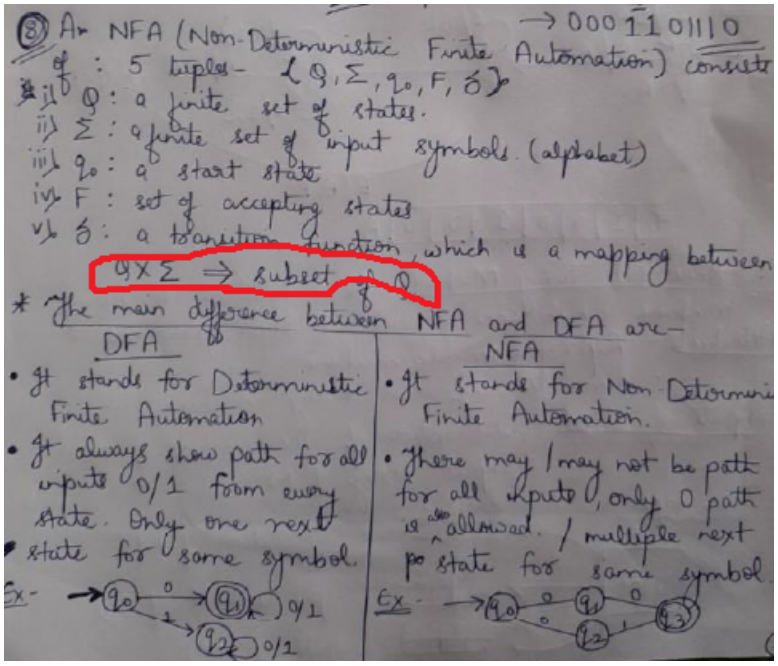
$w' = aaaaa = a^5 \notin L$

So the language $L = \{a^{2^n} \mid n > 0\}$ is not regular

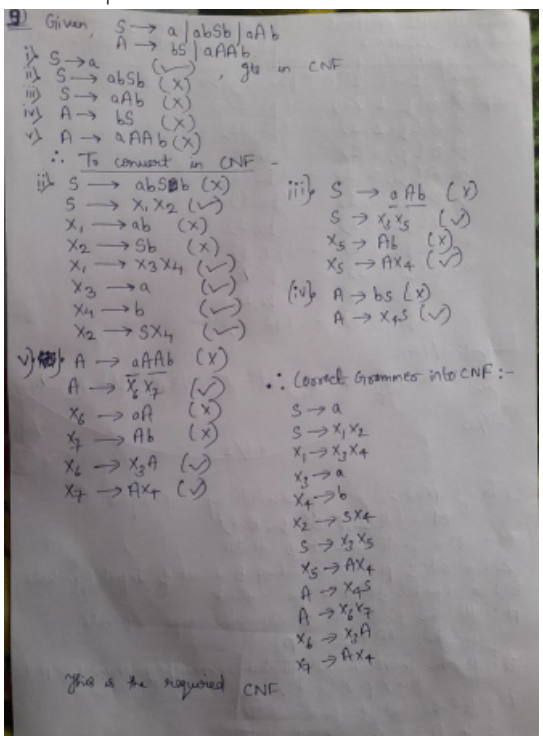
7. Design Turing machine for finding 2's Complement of a binary number.



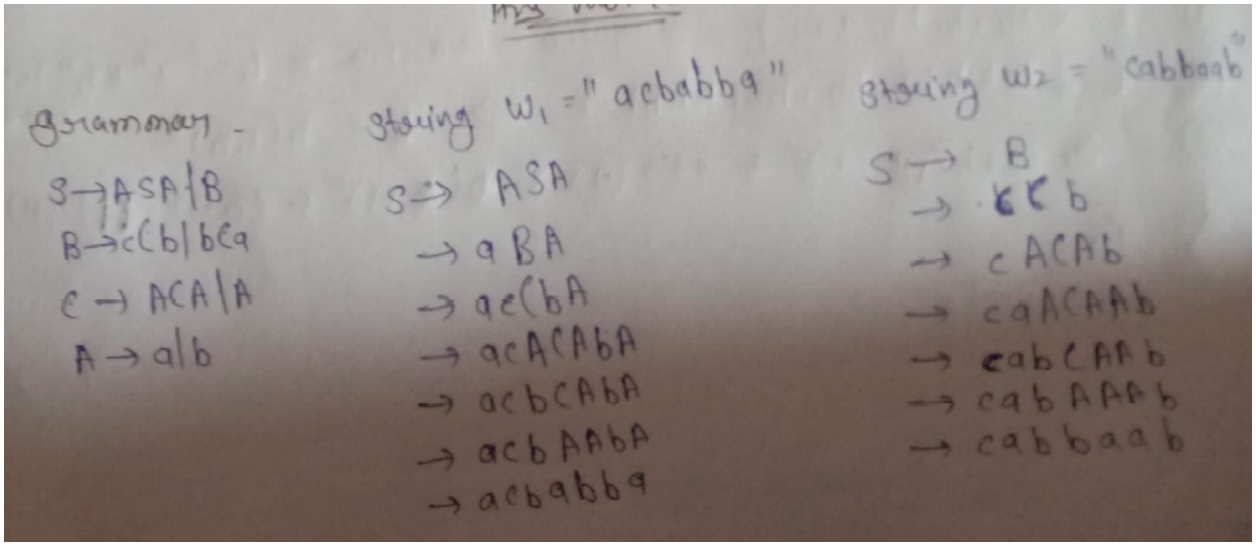
8. Define NFA . Write the main difference between DFA and NFA.



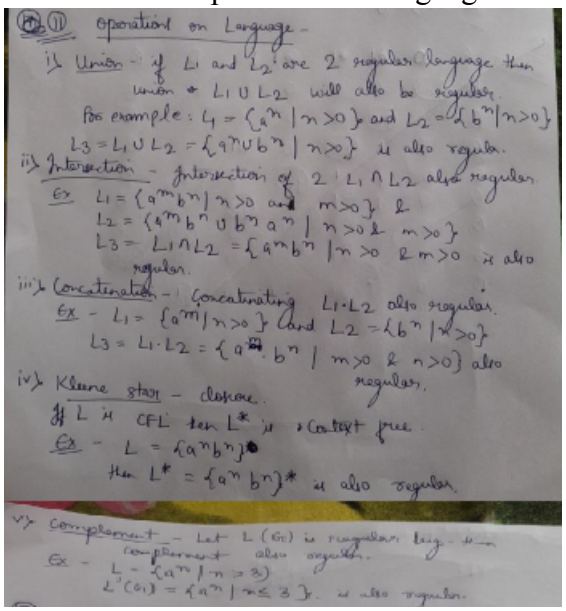
9. Convert the following grammar into Chomsky Normal Form
   S→a | abSb| aAb
   A→b S | aAAb



10. Construct any two strings of length 7 from the following grammar
    S→ ASA | B
    B→cCb | bCa
    C→ACA | A
    A→ a | b

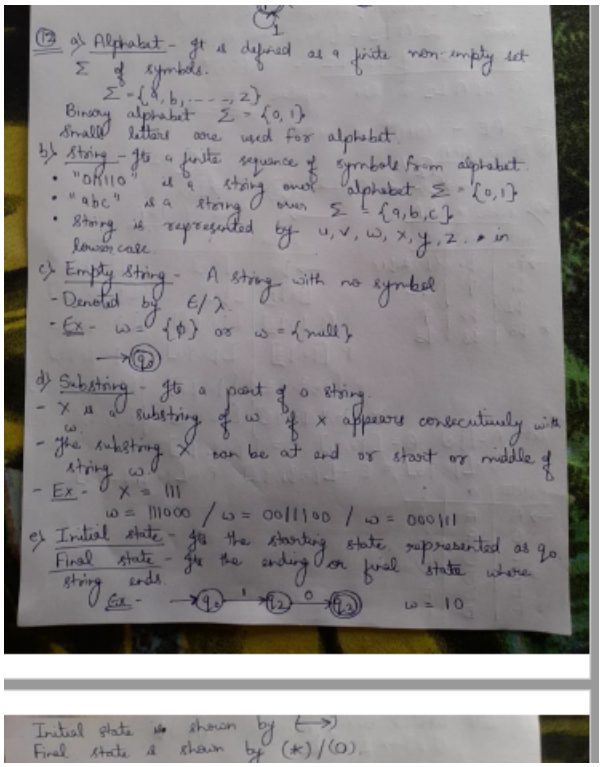


11. Describe basic operations on language with example.

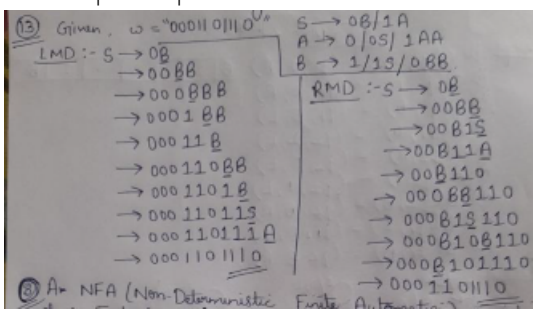


12. Define the following with example.

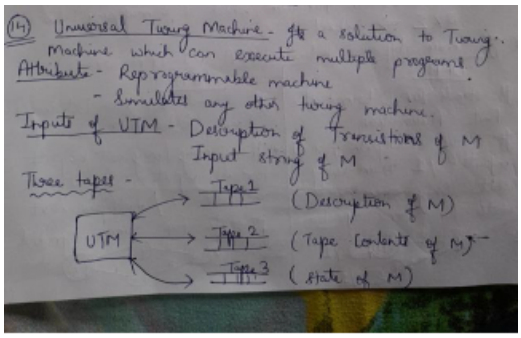
    a) Alphabets b) String c) empty string d) substring e) Initial and final state

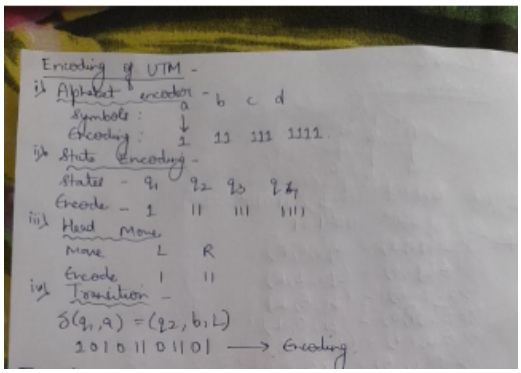


13. Derive the string " 0001101110" using left most and right most derivation from the grammar
S→0B | 1A
A→0S | 1AA | 0
B→1S | 0BB | 1



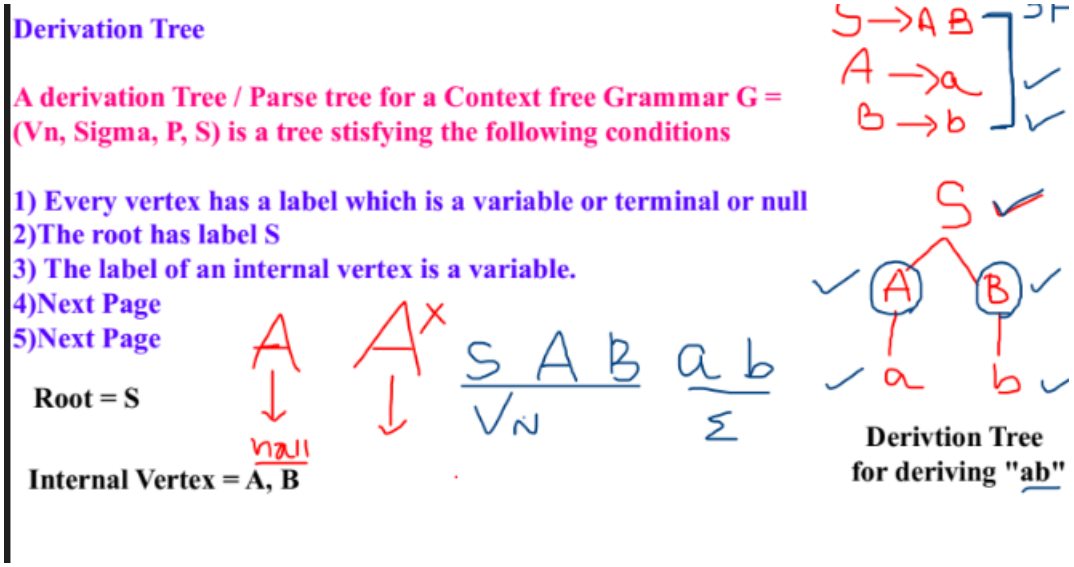
14. Write a brief note on Universal Turing machine.





d (q1,a)=(q2,b,L) , d(q2,b)=(q3,c,R),…
10101101101 00 1101101110111011

15. Define and give example of each of the following
    a) Grammar
    b) Derivation Tree



A grammar is represented with 4 tuples

(Vn , Sigma, P, S)

Vn= Capital letters= Set of variables

Sigma= Small letters= Set of input symbols/ terminal symbols / non variables

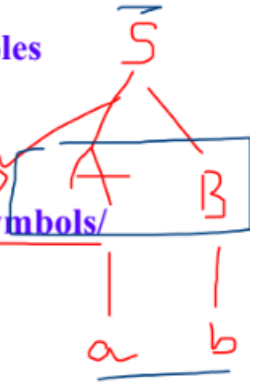
P= production rule of the form alpha->Beta

Vn intersection sigma = phi

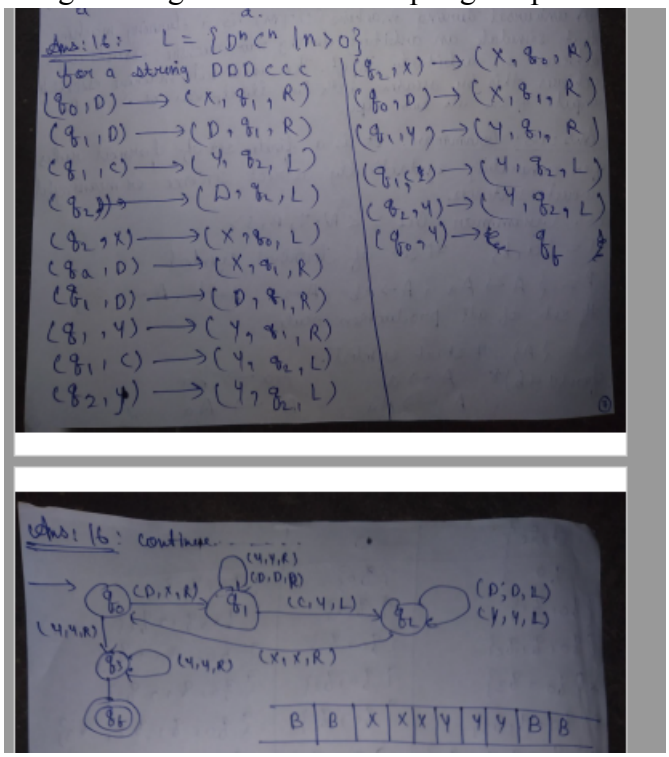
S= special variable called starting symbol

S->AB
A->a
B->b

$(V_n \cap \Sigma) = \phi$



16. Design Turing machine for accepting the pattern L={ D^nC^n | n >0}



17. Represent the following by regular expression

(a) L={ab, b, bb, aaa} where ∑={a,b}
(b) L={b, bbb, bbbbb, bbbbbbb…..} where ∑={b}
(c) All binary strings with 00 or 11 as substring where ∑ = {0, 1}
(d) All Strings containing exactly one a and one b where ∑= { a,b}
(e) All strings starting with 1 and ending with 0 where ∑ = {0, 1}

Answer No. 17

(a) $ab + b + bb + aaa$

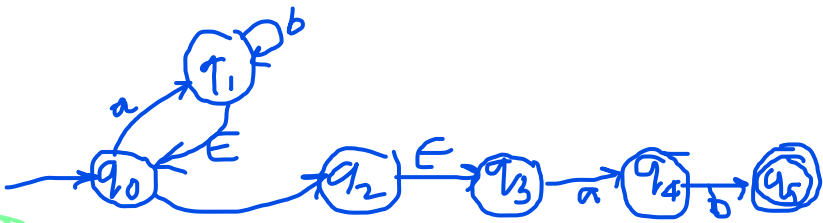
(b) $b(bb)^*$

(c) $(0+1)^*(00+11)(0+1)^*$

(d) $ab + ba$

(e) $1(0+1)^*0$

18. Draw NFA for the following

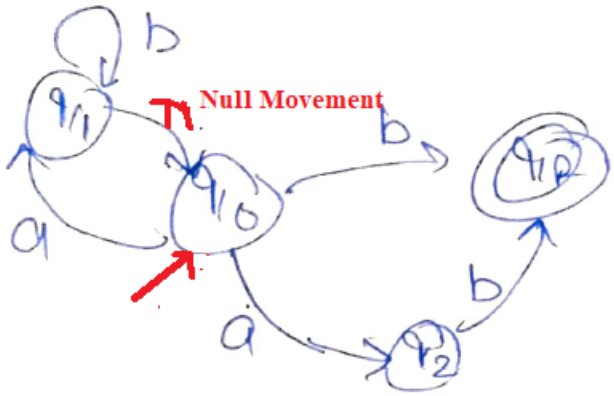


a) NFA for (ab*)*b+ ab

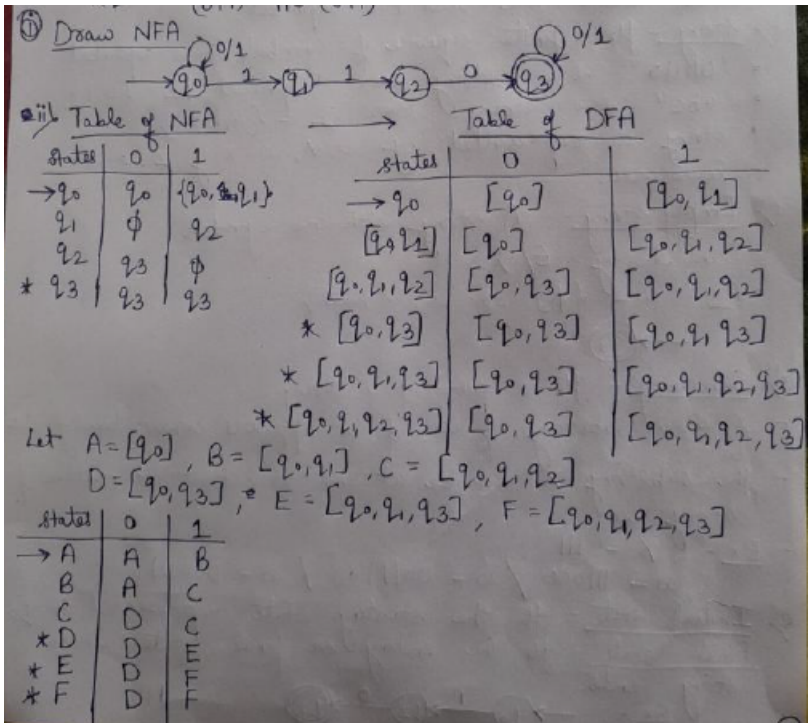
b) All strings of 0's and 1's whose 2nd and 3rd symbol from right is always "1" where ∑={0,1}

b)

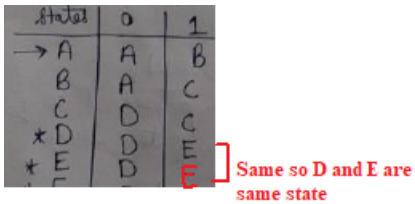
a)



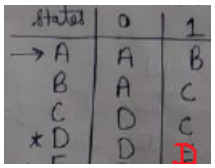
19. Design DFA for accepting the substring "110" where ∑={0,1}



Extra Calculation: AS last two rows are same E and F are same state.



Final Table



with 4 state only

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