Department of CSIT, GGV, Blaspur, 2021_22(Odd Semester)
Unit Test-II, B.Sc(CS) – V Semester, Subject: TOC, Max Mark: 30, Duration: 1 hour

Note: Question number 1 (Section A) is compulsory. Attempt any three questions from the remaining (Section B).

Section A : Question 1 **2X6**

i) Describe different moves of Turing Machine.

- One move (denoted by |---) in a TM does the following:

$$\delta(q, X) = (p, Y, R/L)$$

  - q is the current state
  - X is the current tape symbol pointed by tape head
  - State changes from q to p

Right Move

- $\delta(q, Xi) = (p, Y, R)$ is same as:

$X_1 X_2 \ldots X_{i-1}\ \mathbf{q}\ X_i X_{i+1} \ldots X_n \vdash X_1 X_2 \ldots X_{i-1}\ Y\ \mathbf{p}\ X_{i+1} \ldots X_n$

- $\delta(q\ Xi) = (p\ Y\ L)$ same as:

$X_1 X_2 \ldots X_{i-1}\ \mathbf{q}\ X_i X_{i+1} \ldots X_n \vdash X_1 X_2 \ldots \mathbf{p} X_{i-1} Y\ X_{i+1} \ldots X_n$

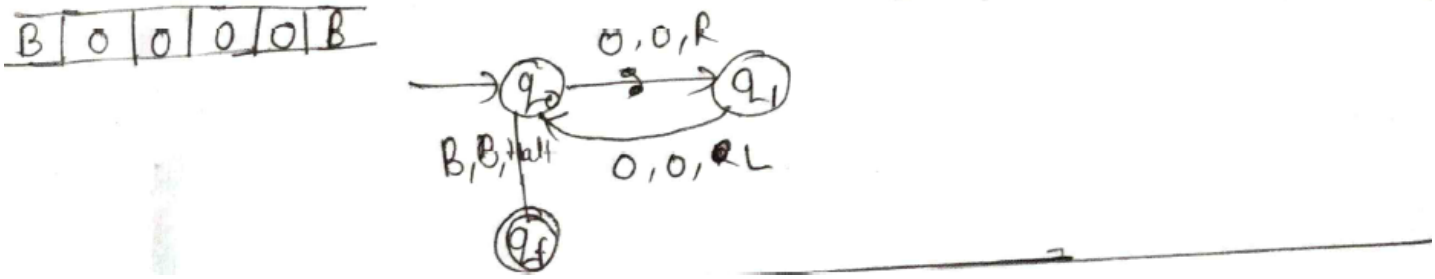
ii) Define PDA.

ii) PDA is represented by 7 tuples :-
$M = \{Q, \Sigma, \delta, q_0, q_f, Z_0, P\}$
where,
① Q = set of states
② Σ = set of input symbols
③ δ = Mapping function which is used for moving from current state to next state
④ q_0 = initial state
⑤ q_f = Final state
⑥ P = set of stack symbol i.e input symbol with Z_0 symbol
$(P = Z_0 + \Sigma)$

⑦ Z_0 = initial stack symbol which is in P.
Also, ⑧ $\delta : (Q, \Sigma, P) = \delta(Q, P^*)$

ii) Design Turing machine to accept even number of 0's only.

iii) even no. of 0's only $L = (00, 0000 \ldots\ldots)$



iv) Write enoding for the two transitions (q3,c) = (q2, b,R) and (q1,a)=(q3,b,L) for Universal Turing Machine.

iv) Given, ① $\delta(q_3, c) = (q_2, b, R)$ ② $\delta(q_1, a) = (q_3, b, L)$
Encoding -
No of states = 2 ie q_3 and q_2 and q_1
where $q_3 \rightarrow 111$, $q_2 \rightarrow 11$, $q_1 \rightarrow 1$
Move = L and R
where $L \rightarrow 1$, $R \rightarrow 11$
Alphabet encoding = a, and b and c
where $a \rightarrow 1$, $b \rightarrow 11$, $c \rightarrow 111$

① $\delta(q_3, c) = (q_2, b, R)$
⇒ 1110111011011 ——①

② $\delta(q_1, a) = (q_3, b, L)$
⇒ 1010111011011 ——②

On combining ① & ②
1110111011011 00 1010111011011

v) What is recursive enumerable language?

Definition:

A language is **recursively enumerable** if some Turing machine accepts it

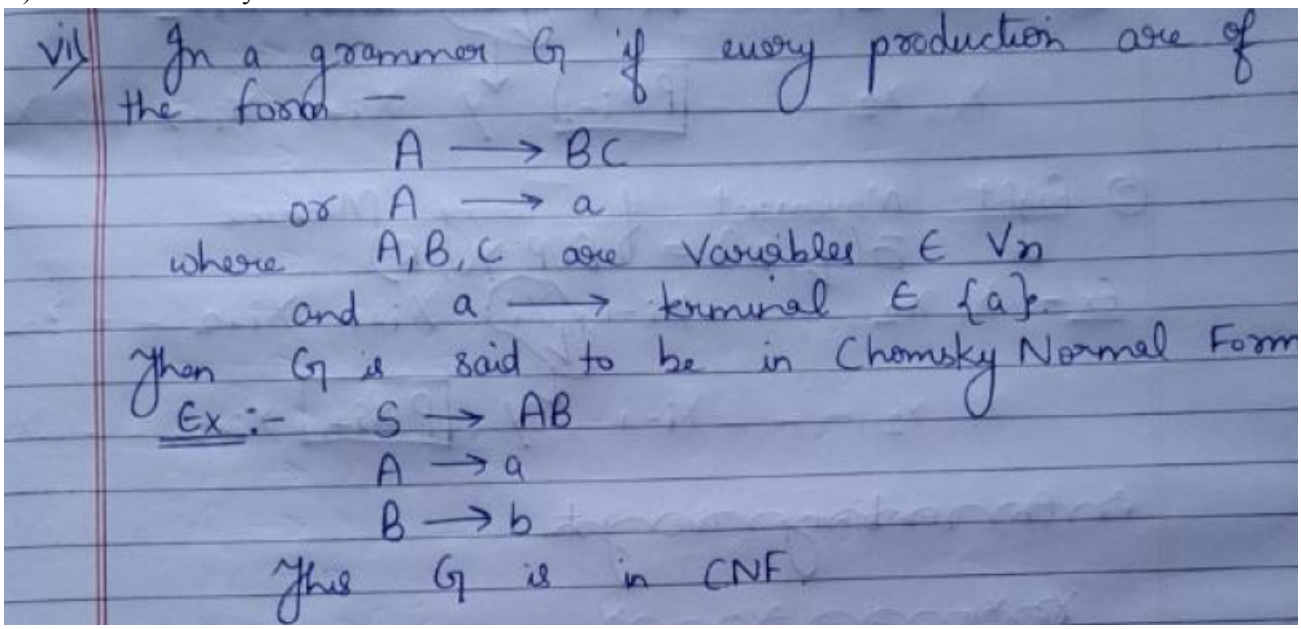
Let L be a recursively enumerable language and M the Turing Machine that accepts it

For string w:

if $w \in L$ then M halts in a final state

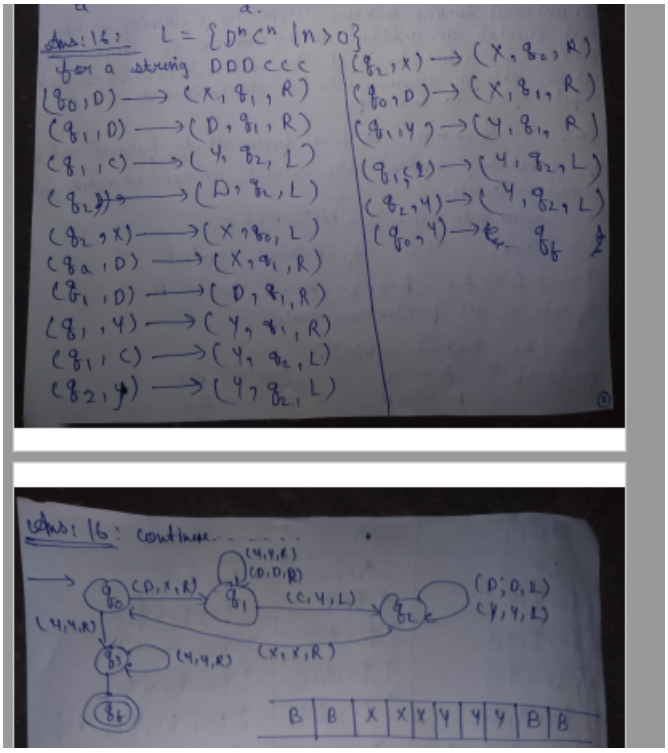
if $w \notin L$ then M halts in a non-final state or loops forever

vi) What is Chomsky Normal Form?

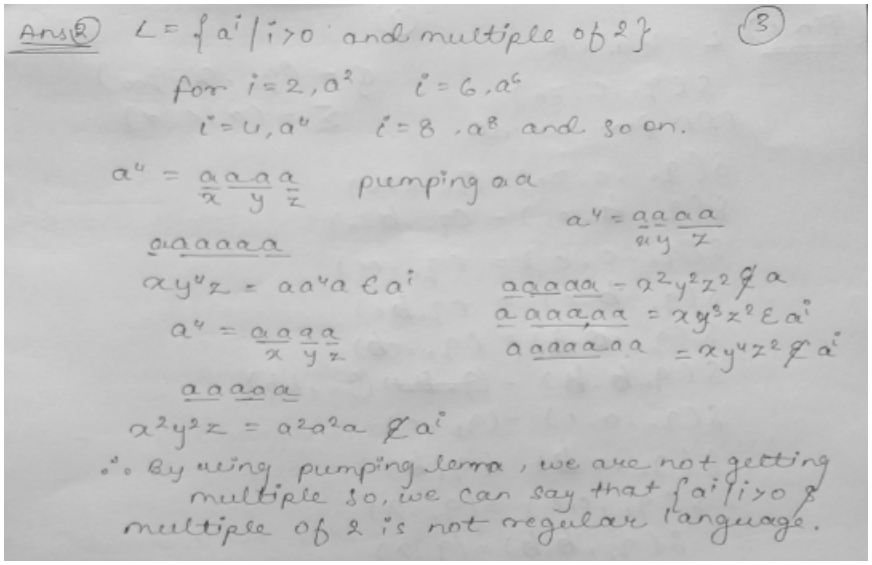


Section B **3X6**

Q-1 Design Turing Machine for the language L= $\{C^nD^n \mid n > 0\}$ Only reverse C with D in the following answer

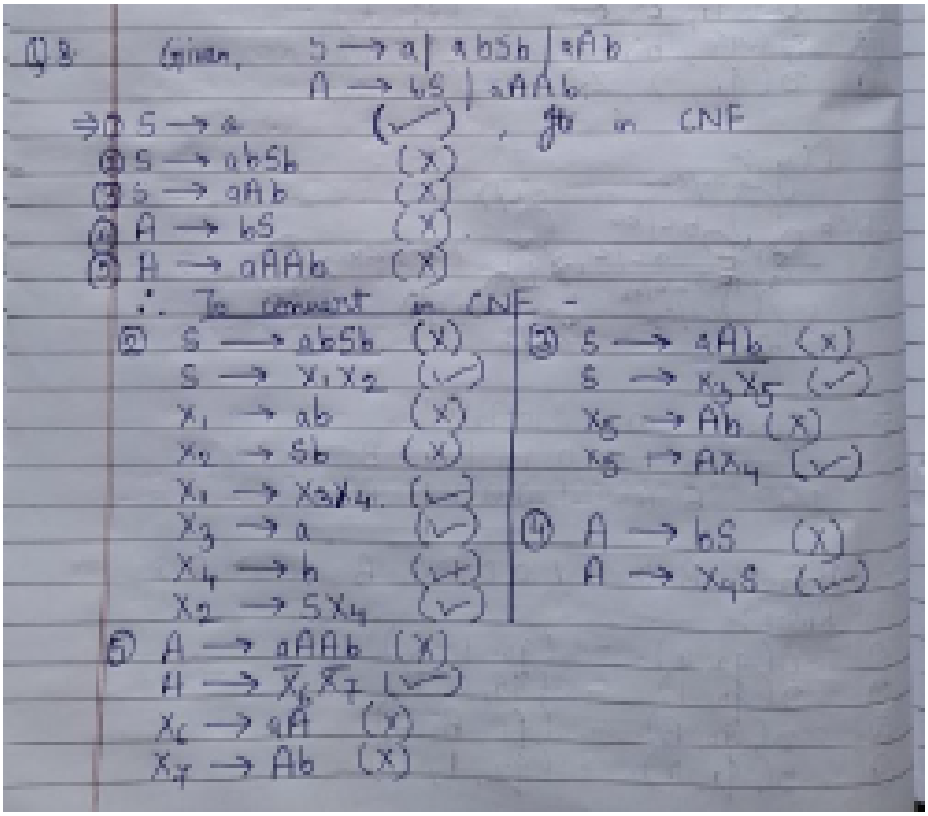


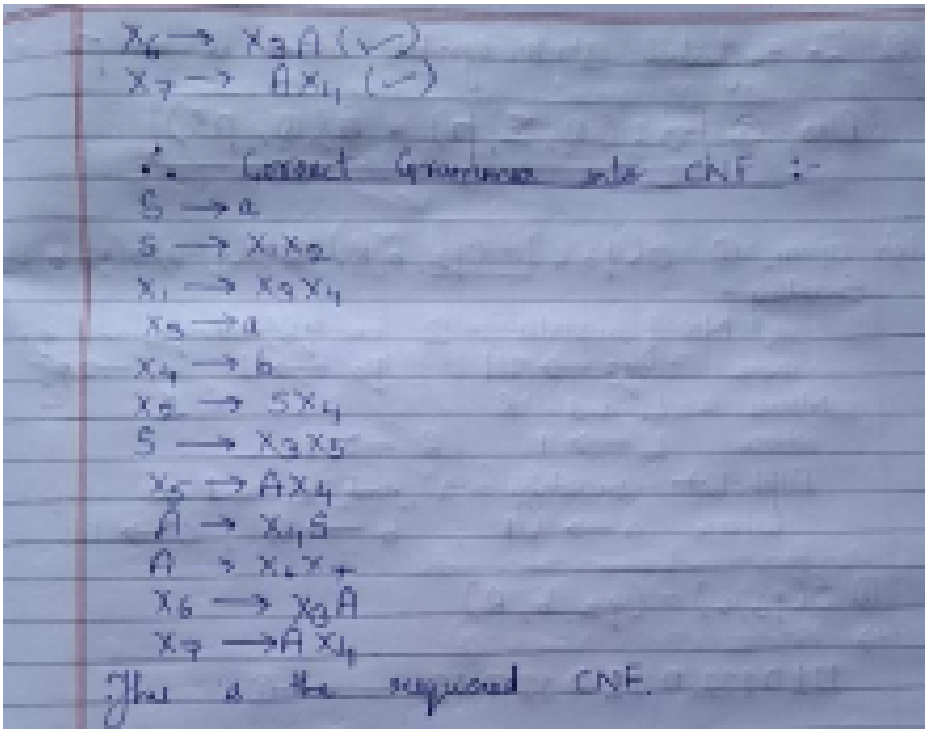
Q2 Check the language L= { a^i | i > 0 and multiple of 2 }regular or not using Pumping Lemma



Q3 Reduce the following Grammar into Chomsky Normal Form.

S→ a | abSb | aAb
A→bS | aAAb





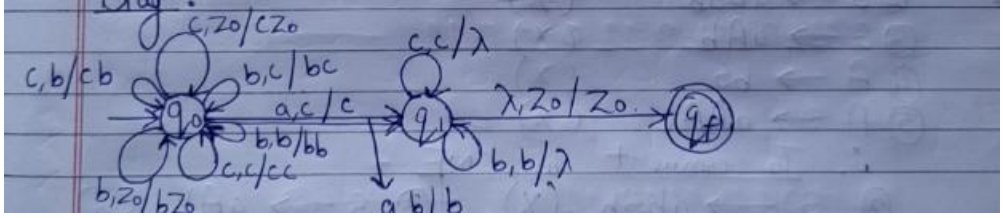
Q4 Design a Push Down Automaton for the language L={W a W_R | W ϵ { c,b} and a is a terminal symbol.

Q.4. Given, $L = \{ W a W_R \mid W \in \{c, b\}^* \text{ and } a \text{ is a terminal symbol} \}$

Rules :- Taking an ex : ccbbb a bbbcc, W = ccbbb

① $\delta(q_0, c, Z_0) = (q_0, cZ_0)$
② $\delta(q_0, b, Z_0) = (q_0, bZ_0)$
③ $\delta(q_0, c, c) = (q_0, cc)$
④ $\delta(q_0, b, c) = (q_0, bc)$
⑤ $\delta(q_0, c, b) = (q_0, cb)$
⑥ $\delta(q_0, b, b) = (q_0, bb)$
⑦ $\delta(q_0, a, c) = (q_1, c)$
⑧ $\delta(q_0, a, b) = (q_1, b)$
⑨ $\delta(q_1, c, c) = (q_1, \lambda)$
⑩ $\delta(q_1, b, b) = (q_1, \lambda)$
⑪ $\delta(q_1, \lambda, Z_0) = (q_f, Z_0)$

Diag :-



Q5. Find the 2's Complement of the number " 1001110" using Designing of Turing Machine for 2's Complement system.