—: Assignment 5 :-

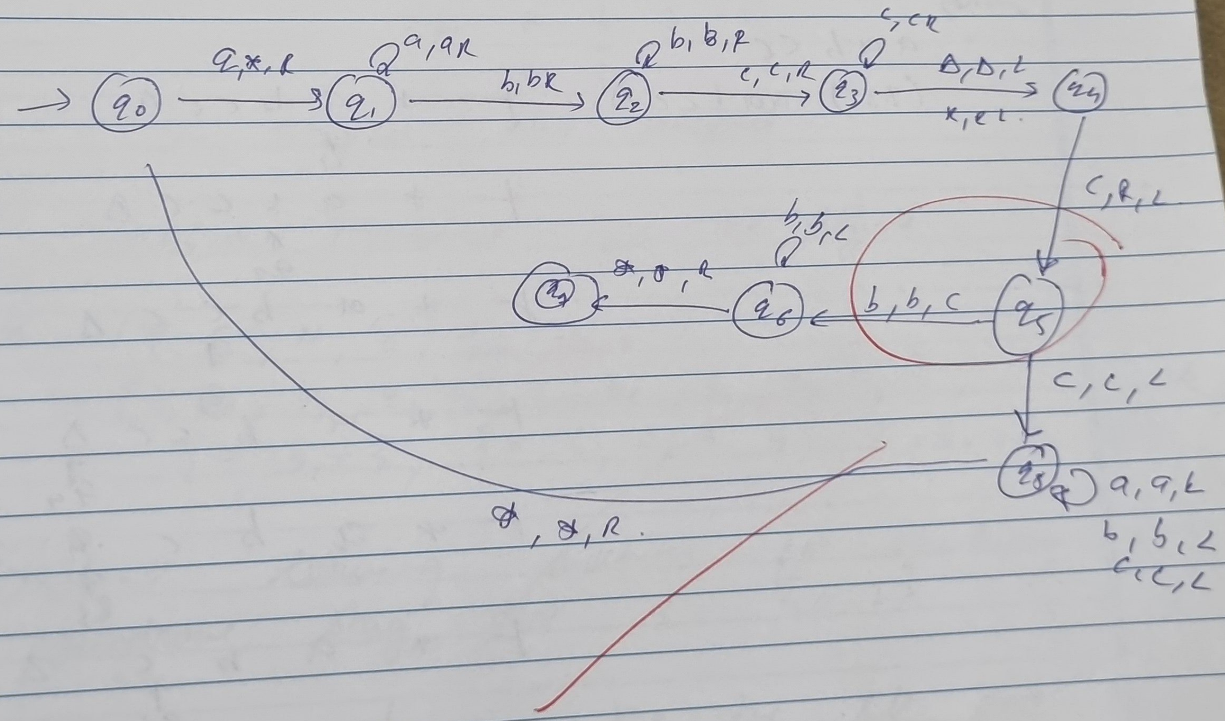
Q1) Design Turning Machine for recognizing the following language.

$L = \{ a^n b^m c^n \mid m, n >= 1 \}$.

logic:

we mark a with * and its corresponding c (starting from end of the string) with & if 'b' come following by '*' on the left after changing 'c' to '&' we accept the string.

Language L = { aabcc, abc, aaabbccc, abbc ... }



Transition table

	a	b	c	⊔	&	Δ
q_0	$q_1, *, R$					
q_1	q_1, a, R	q_2, b, R	q_3, c, R		$q_4, 4, L$	q_n, Δ, L
q_2		q_2, b, R	q_3, c, R			
q_3			$q_5, 8, L$			
q_4		q_6, b, L	q_6, c, L			
q_5		q_6, b, L		$q_7, * R$.		
q_6						
(q_7)				$q_0 *, R$		
q_8	q_8, a, L	q_8, b, L	q_8, c, L			

Step

aabcc

(q_0) aabccΔ $\vdash$ * a b c c Δ

q_1

$\vdash$ * a b c c Δ

q_2

$\vdash$ * a b c c Δ

q_3

$\vdash$ * a b c c Δ

q_4

$\vdash$ * a b c & Δ

q_5

$\vdash$ * a b c & Δ

q_4

$\vdash$ * * b c & Δ

q_0

$\vdash$ * * b c & Δ.

q_2

⊢ * * b q_4 a Δ

⊢ * * b a a Δ (q_4)

⊢ * * b a a Δ (q_0)

⊢ * * b a a Δ (q_0)

⊢ * * b a a Δ (q_7)

Accepted.

ii) ab

(q_0) abΔ ⊢ * b Δ (q_1)

⊢ * b Δ (q_2)

∴ trapped Not accepted.

∴ Turning Machine can be defined

$M = (Q, \Sigma, \Gamma, \delta, q_0, \Delta, F)$

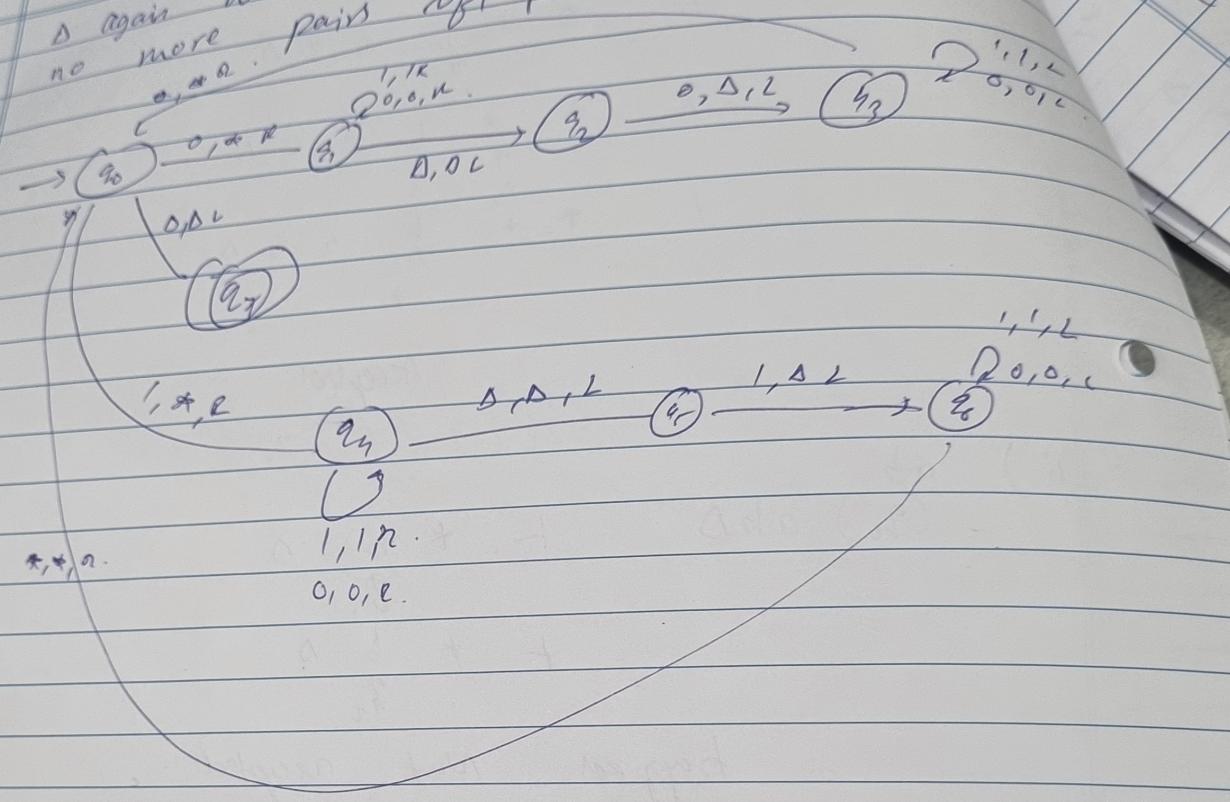
$= \{\{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8\},$

$\{a, b, c\}, \{a, b, c, *, \&\}, \delta, q_0, \Delta, \{q_7\}\}.$

Q2. Construct turning machine for checking even palindrome string over $\Sigma = \{0, 1\}$.

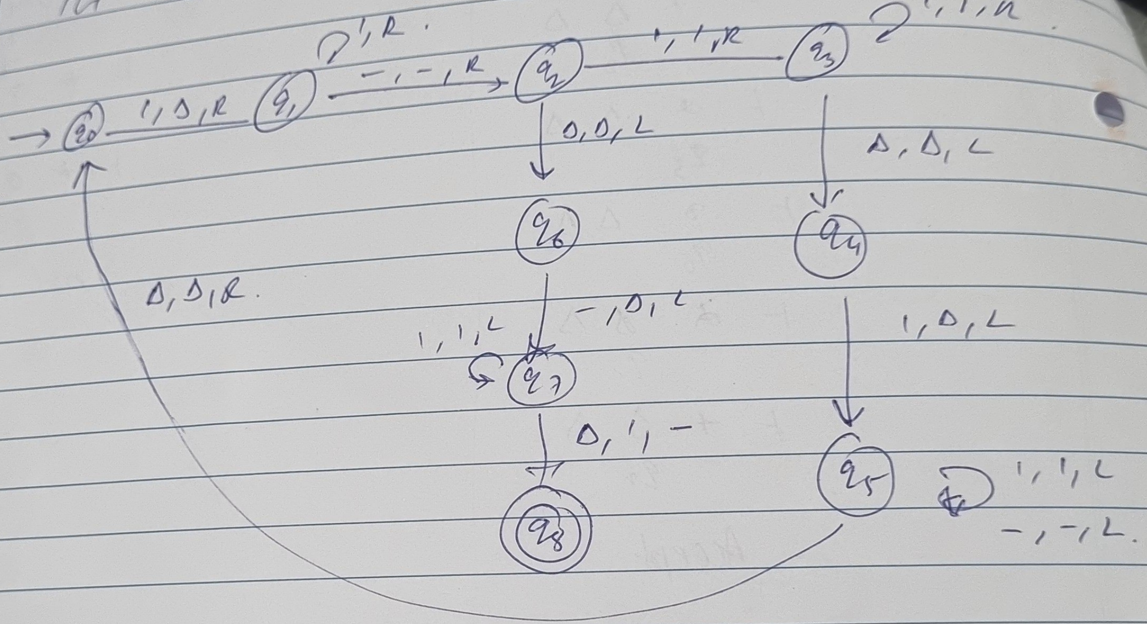
logic. we keep marking the left part of palindrome with * & search for its corresponding match on the other end of the.

Δ again we keep doing this until we have no more pairs left, then we accept.



	0	1	*	Δ
q_0	$q_1, *, R$	$q_4, *, R$		q_7, Δ, L
q_1	$q_1, 0, R$	$q_1, 1, R$		q_2, Δ, L
q_2	$q_3, 1, L$			
q_3	$q_3, 0, R$	$q_3, 1, R$	$q_0, *, R$	
q_4	$q_4, 0, R$	$q_4, 1, R$		q_5, Δ, L
q_5		q_6, Δ, L		
q_6	$q_6, 0, L$	$q_6, 1, L$	$q_0, *, R$	

& the 1's on the right side OR ...
... as Δ two, as we work the ...
on the left side we will find that
the character after immediately after '–' is
then we move to left once, change
the last Δ to 1, and stop.



Simulation 1111 – 11 = 11

(q_1) 1111 – 11Δ ⊢ Δ111 – 11 Δ (q_1)

⊢ Δ111 – 11 Δ (q_2)

⊢ Δ111 – 11 Δ (q_3)

⊢ Δ111 – 11 Δ (q_3)

$\vdash \Delta 111 - 11 \Delta$

q_4

$\vdash \Delta 111 - 1 \Delta\Delta$

q_5

$\vdash \Delta 111 - 1 \Delta\Delta$

q_0

$\vdash \Delta\Delta 11 - 1\Delta\Delta$

q_1

$\vdash \Delta\Delta 11 - 1\Delta\Delta$

q_3

$\vdash \Delta\Delta 11 - \Delta\Delta\Delta$

q_5

$\vdash \Delta\Delta 11 - \Delta\Delta\Delta$

q_6

$\vdash \Delta\Delta\Delta 1 - \Delta\Delta\Delta$

q_4

$\vdash \Delta\Delta\Delta 1 - \Delta\Delta\Delta$

q_2

$\vdash \Delta\Delta\Delta 1\Delta\Delta\Delta\Delta$

q_8

$\vdash \Delta\Delta 11\Delta\Delta\Delta$

q_8

$\therefore$ final ans = 11

Transition Table

	1	−	Δ
q_0	q_1, Δ, R	$q_2, -, R$	q_6, Δ, L
q_1	$q_1, 1, R$		q_4, Δ, L
q_2	$q_3, 1, R$		
q_3	$q_3, 1, R$		q_0, Δ, R
q_4	q_5, Δ, L	$q_5, -, L$	
q_5	$q_5, 1, L$	q_7, Δ, L	
q_6			$q_8, 1, -$
q_7	$q_7, 1, L$		
q_8			

TM can be defined as

$M = (Q, \Sigma, N, \delta, q_0, \Delta, F)$
$= (\{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8\}, \{1, -\}, \{1, -, \Delta\}$
$\delta, q_0, \Delta, \{q_8\})$

Q4) Define TM & Explain different variants of TM

→ Turing Machine.

A TM is a finite automata that can read write & erase symbols on infinity long tape. The tape is divided into square & each sequence contains a sysbol

Mathematical definition.

$TM = (Q, \Sigma, N, \delta, q_0, \Delta, F)$.

$Q \Rightarrow$ set of states.

$\Sigma \Rightarrow$ set of i/p.

$N \rightarrow$ set of symbols on tape.

δ → Transition function
q_0 → initial state.
Δ → End of string.
F → final states.

Variants of TM:-

i) Multiple-tape TM: A k tape Turing Machine (for some k≥0) has k tapes & one tape head that reads & writes all of them one by one

ii) Two way infinite tape TM: inf. tape of two way TM is unbounded in both direction left & right.

iii) Multi tape TM: It has multi tape & is controlled by a single head TM multi tape TM is diff. than K-tape TM but expressive power is the same.

iv) multi-tape multi-head TM: It has multiple tapes & head per tape has its ocean head

v) Multi-dimensional tape TM: The head in can move in up, down, left right direction in the if.

vi) multi-head TM: A multi head TM contains multiple heads all of them move read & write independtly.

vii) Non-Deterministic TM: It has a single one way infinite tape for a given state & i/p symbol has at least one choice to move finite no of choices for.

not move, each choice has several choices of the path that it might follow. a given I/P string. It is equivalent to deterministic TM.

All variants can be simulated using different less complex variants.