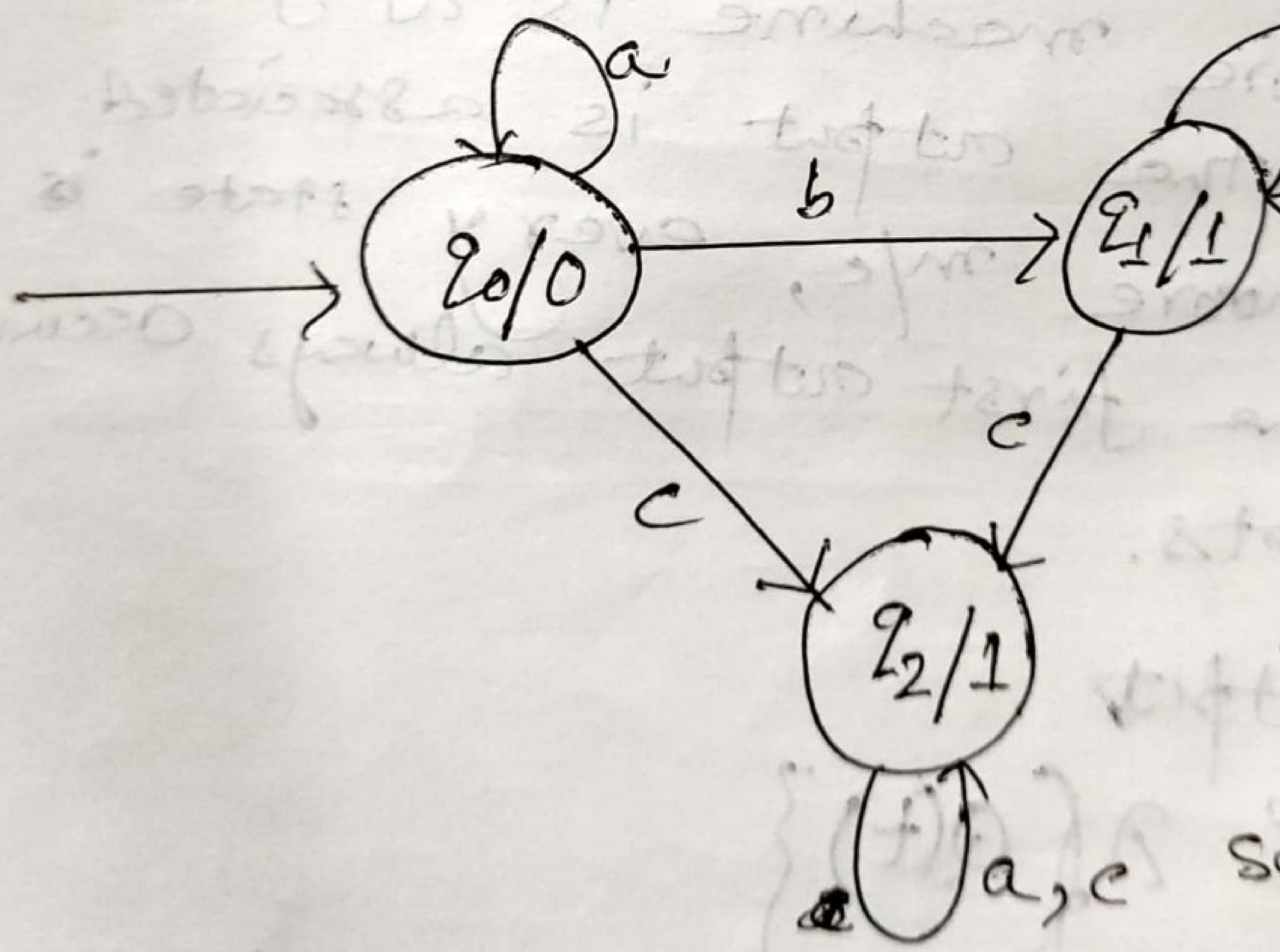
$Z(t) = \lambda \{ Q(t) \}$ and obtain

Representation of Moore M/c.

$Q \backslash \Sigma$	Next state INPUT a	b	c	output Γ
q_0	q_0	q_1	q_2	0
q_1	q_1	q_1	q_2	1
q_2	q_2	–	q_2	1



Let |w

$\xrightarrow{\text{start}} \overset{(0)}{q_0} \xrightarrow[\text{input}]{a}$

$\xrightarrow[\text{input}]{c} \overset{(1)}{q_2}$

So, $|w'| =$

Note: So, if the length of input st

the length of output state will be

Representation of MEALY m/c.

Q \ Σ	For input x=0		For input x=1	
	state	output	state	output
q_1	q_3	0	q_2	0
q_2	q_1	1	q_4	0
q_3	q_2	1	q_1	1
q_4	q_4	1	q_3	0

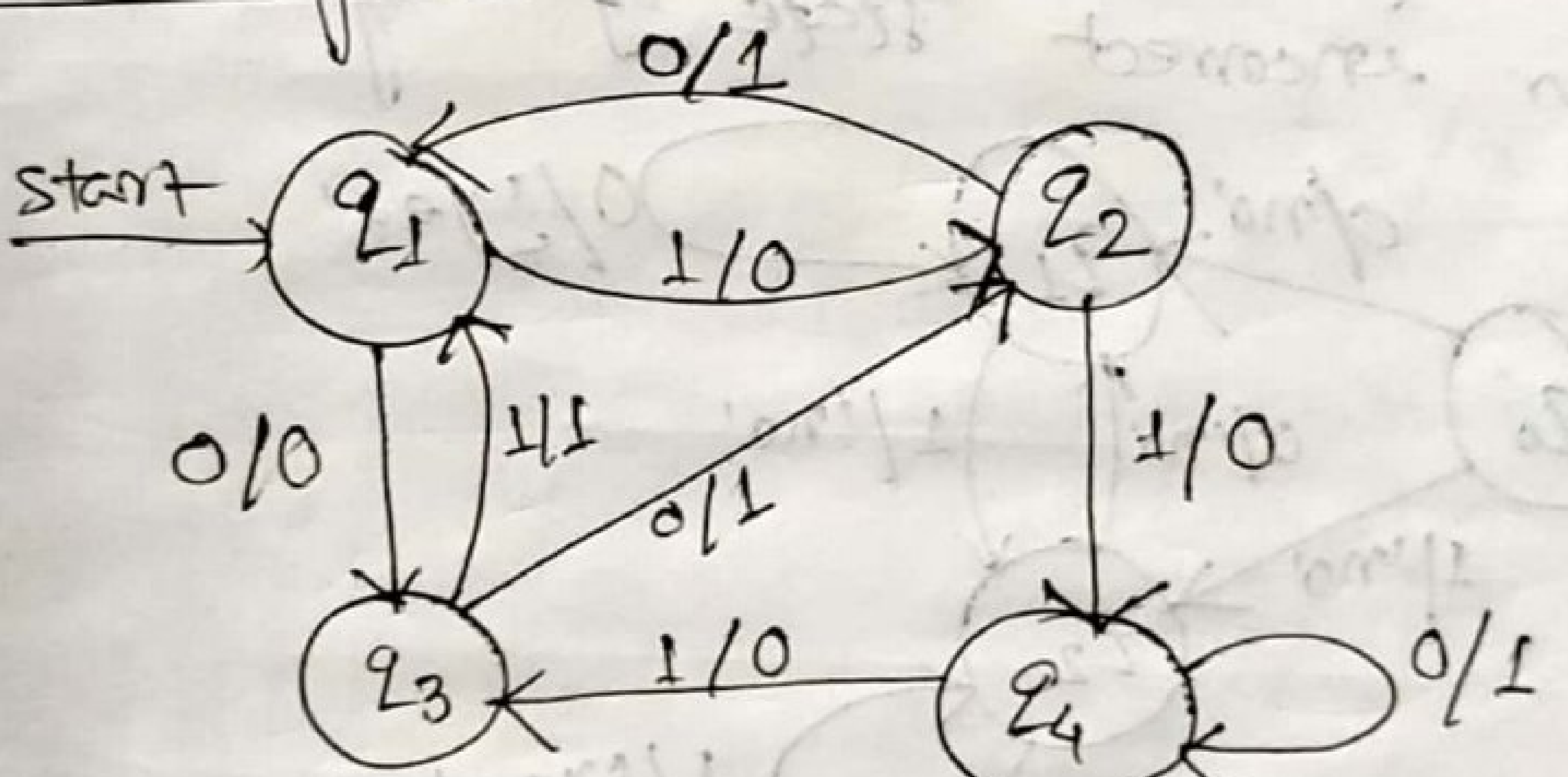
$\Sigma = \{0, 1\}$

$\Gamma = \{0, 1\}$

$Z(t) = \lambda(Q(t), x(t))$

$Q = \{q_1, q_2, q_3, q_4\}$

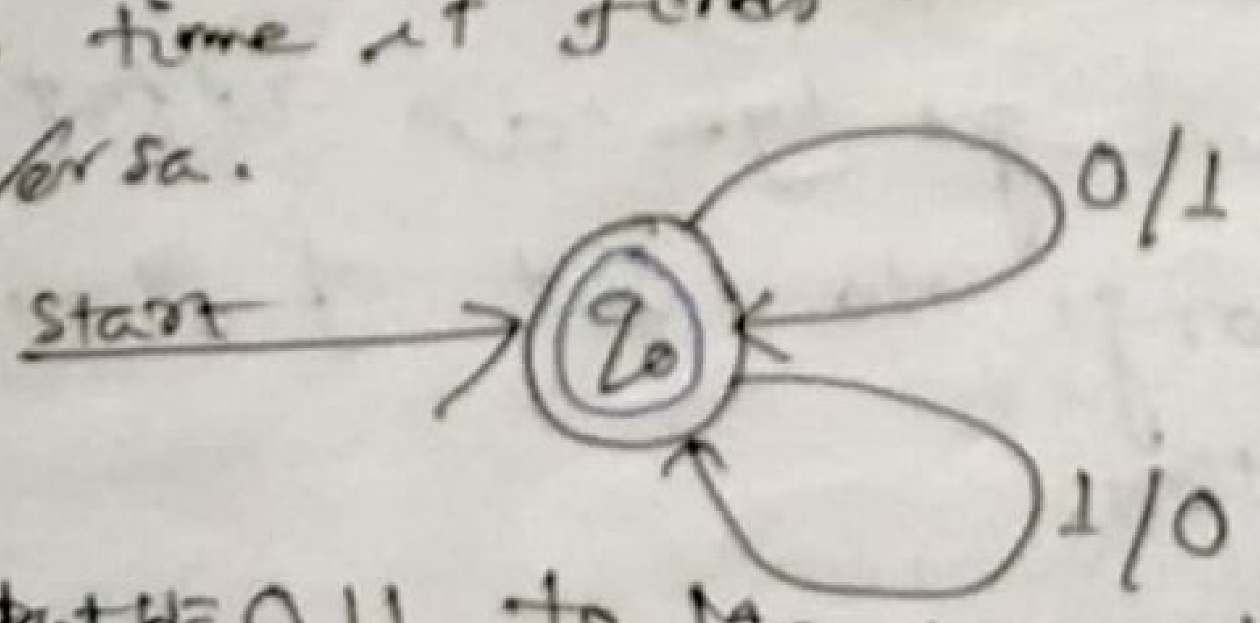
Transition diagram



Here the length of input string is same as length of output string. $|W| = |W'|$

Q. Design a mealy m/c to print out 1's complement of an input bit string.

Soln → Here the m/c produces an output character 1, when each time it finds an input character 0 and vice versa.



$Q = \{q_0\}$

$\Sigma = \{0, 1\}$

For input W = 011 to Me, we get 100 which is 1's complement of W.

06/06/14

2012

10(a). Define Mealy machine and Moore Machine.

Solu^n^: **Mealy Machine:**

Definition: In a deterministic machine, the next state $S(t+1)$ is determined uniquely by the present state $q(t)$ and the present input $x(t)$. Thus,

$$\boxed{S(t+1) = \delta(q(t), x(t))} \quad \text{①}$$

where δ is a state transition function.

The value of the output function $Z(t)$ is a function of the present state $q(t)$ and present input $x(t)$. Thus,

$$\boxed{Z(t) = \lambda(q(t), x(t))} \quad \text{②}$$

where λ is the output function.

A machine with properties ① and ② is called a mealy machine.

General definition: A mealy machine is a six tuple where $(Q, \Sigma, \Delta, \delta, \lambda, q_0)$, where

i) Q is a finite set of states;

ii) Σ is the Input alphabet;

iii) Δ is the output alphabet;

iv) δ is the transition function $\Sigma \times Q$ into Q;

v) λ is the output function mapping $\Sigma \times Q$ into Δ; and

vi) q_0 is the initial state.

#

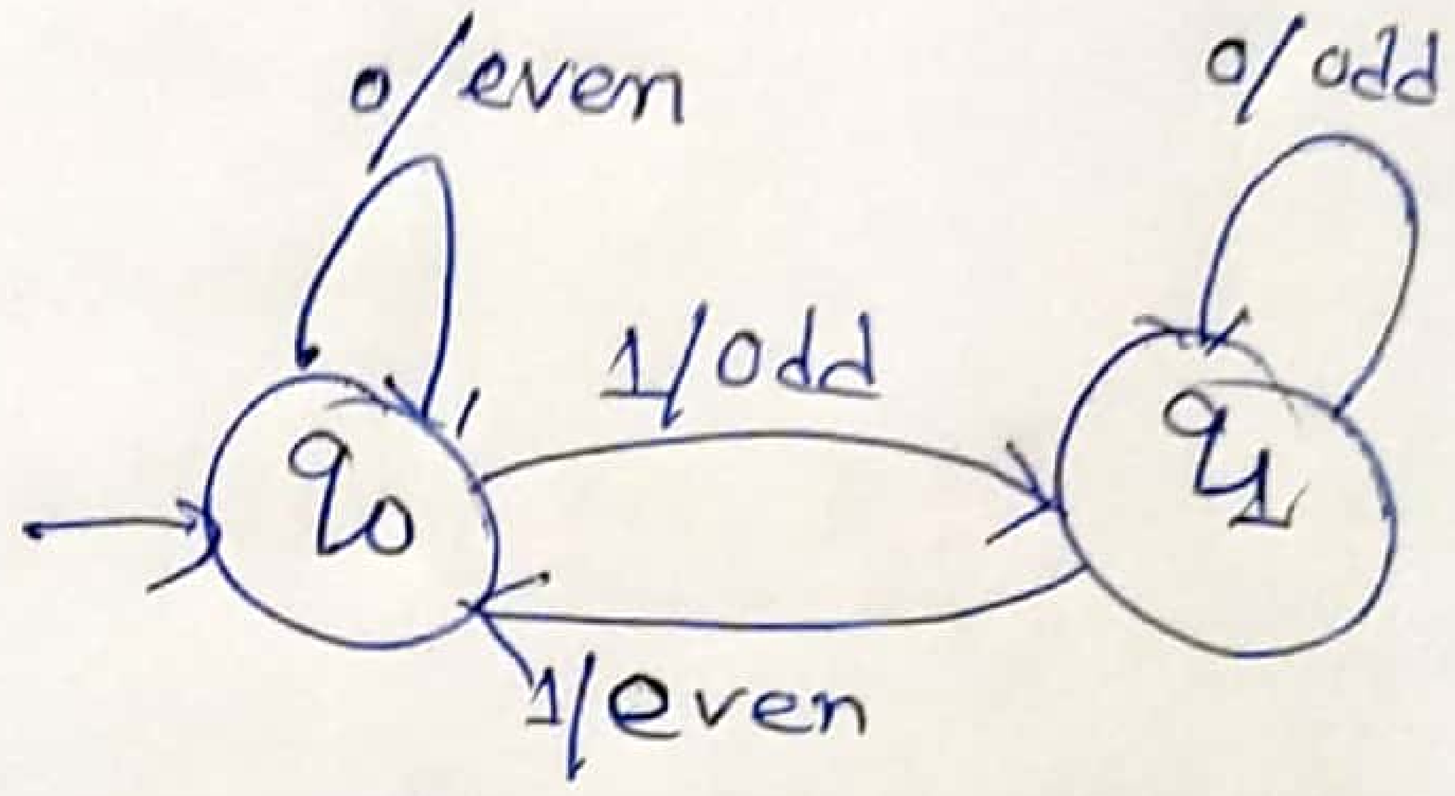
Q. Design a Mealy M/c which can give output even or odd according to the total number of 1's encountered is even or odd. $\Sigma = \{0, 1\}$.

Solⁿ: We require two states q_0 & q_1.

$q_0 \longrightarrow$ denotes even no. of 1's and

$q_1 \longrightarrow$ " odd " " 1's.

Q \ Σ	0	o/p	1	o/p
$\rightarrow q_0$	q_0	even	q_1	odd
q_1	q_1	odd	q_0	even



<MEALY MACHINE>

To check let us take a binary string

0 1110

$\delta(q_0, \underline{0}1110) \longrightarrow$ o/p $\rightarrow$ Even

$0\ \delta(q_0, \underline{1}110) \longrightarrow$ o/p $\rightarrow$ odd

$01\ \delta(q_1, \underline{1}10) \longrightarrow$ o/p $\rightarrow$ Even

$011\ \delta(q_0, 10) \longrightarrow$ o/p $\rightarrow$ odd

$0111\ \delta(q_1, 0) \longrightarrow$ o/p $\rightarrow$ odd

$\therefore$ $\boxed{0\ 1110\ q_1}$ This string

Example :

i) Binary adder, shift register are its examples.

ii)

Mealy machine				
Present state	Next state			
	a = 0		a = 1	
	State	Output	State	Output
$\rightarrow q_1$	q_3	0	q_2	0
q_2	q_1	1	q_4	0
q_3	q_2	1	q_1	1
q_4	q_4	1	q_3	0

For input string : 0011

State transition : $q_1 \rightarrow q_3 \rightarrow q_2 \rightarrow q_4 \rightarrow q_3$

Output string : 0100

Moore Machine :

\# Definition : A machine in which the output function is dependent only on the present state and is independent of the current Input, i.e

$$z(t) = \lambda(q(t))$$

is called a moore machine.

2009 10(a)

\# General definition : A moore-machine is a six tuple $(Q, \Sigma, \Delta, \delta,$

Solu

\#

$\lambda, q_0)$ where

i) Q is a finite set of states;
ii) Σ is the input alphabet;
iii) Δ is the output alphabet;
iv) δ is the transition function mapping $\Sigma \times Q$ into Q;
v) λ is the output function mapping Q into Δ; and
vi) q_0 is the initial state.

Example:

i)

Moore Machine			
Present state	Next state (δ)		Output
	a=0	a=1	λ
$\rightarrow q_0$	q_3	q_1	0
q_1	q_1	q_2	1
q_2	q_2	q_3	0
q_3	q_3	q_0	0

For Input string : 0111

State transition : $q_0 \rightarrow q_3 \rightarrow q_0 \rightarrow q_1 \rightarrow q_2$

Output string : 00010.

10(a). Compare and contrast Mealy and Moore Machines.

Solⁿ: # Contrast :

	Characteristics	Mealy Machine	Moore Machine
1.	Output length	If the length of the input string is n, output's length is also n.	If the length of the input string is n, output string's length is $n+1$.
2.	Output dependency	Output of the machine depends on both the present input and the present state of the machine.	Output of the machine depends on the present state only.
3.	Convenient use.	Less convenient in automata theory.	More convenient in automata theory.
4.	Representation in the transition diagram.	If the output associated with a state q is x, then q/x is marked on the edge transition.	If the output associated with a state q is x, then q/x is marked inside the state circle of the diagram.
		$q_1 \xrightarrow{a/x} q_2$	$q_1/x \xrightarrow{a} q_2/y$
5.	Acceptance	Can't accept null sequence	Can accept null sequence.

Comparison :

Both Mealy and Moore machines are a 5-tuple $(Q, \Sigma, \Delta, \delta, \lambda, q_0)$ where :

i) Q is a finite set of states;

ii) Σ is an input alphabet;

iii) Δ is the output alphabet;

iv) δ is the transition function $\Sigma \times Q$ into Q ;

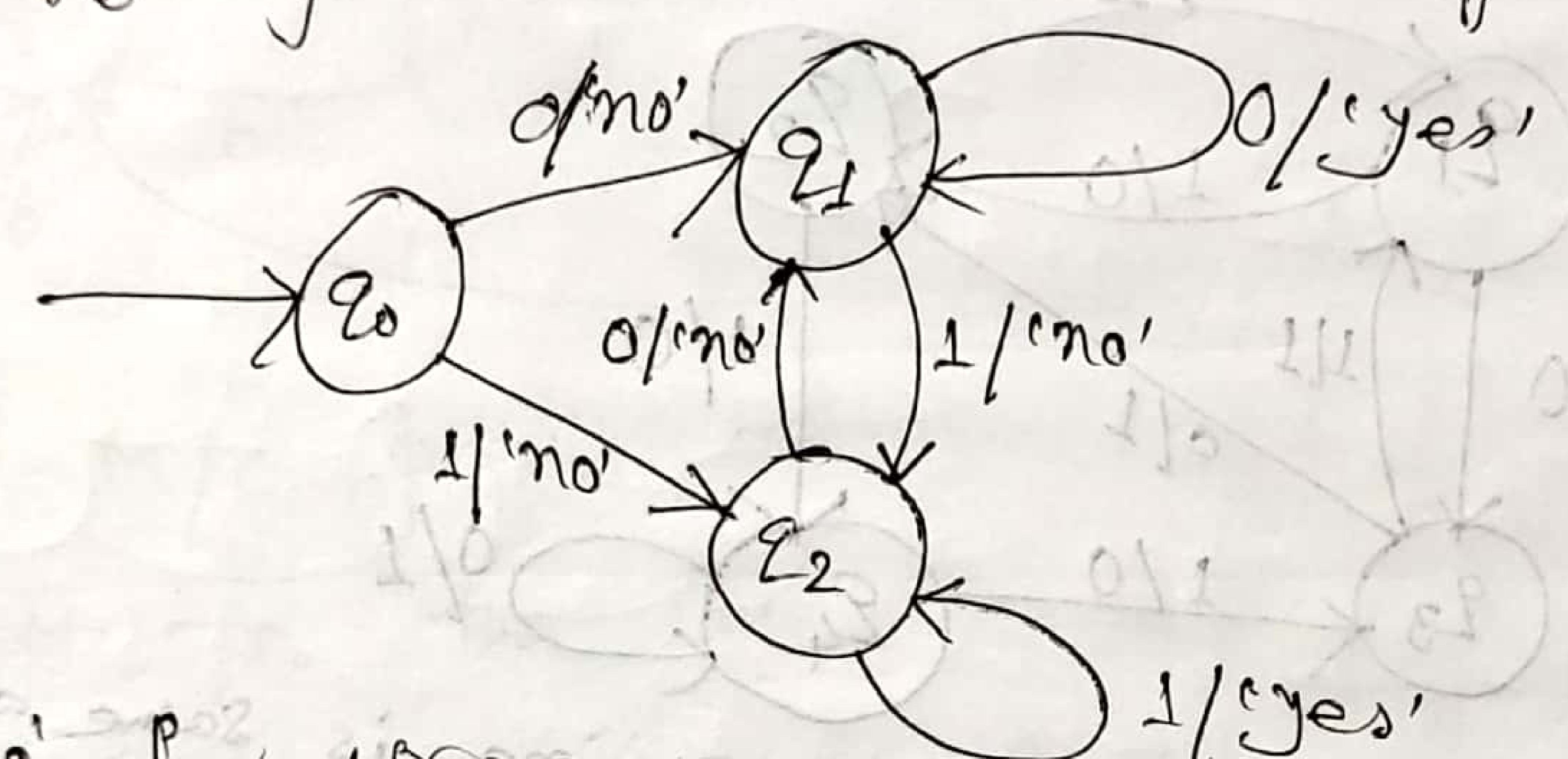
v) λ is the output function mapping

- $\Sigma \times Q \rightarrow \Delta$ in case of mealy machine.
- $Q \rightarrow \Delta$ in case of moore machine; and

vi) q_0 is the initial state.

Q. Design a Mealy m/c for regular Expression $(0+1)^*(00+11)$ i.e. strings that ends either by 00 or 11, taking any input before them.

Soln: Here set of strings either end with 00 or end with 11, like 00, 11, 1011, 010100 etc. Here 'yes' for correct regular Expression acceptance or 'no' for incorrect state of reg. expression.



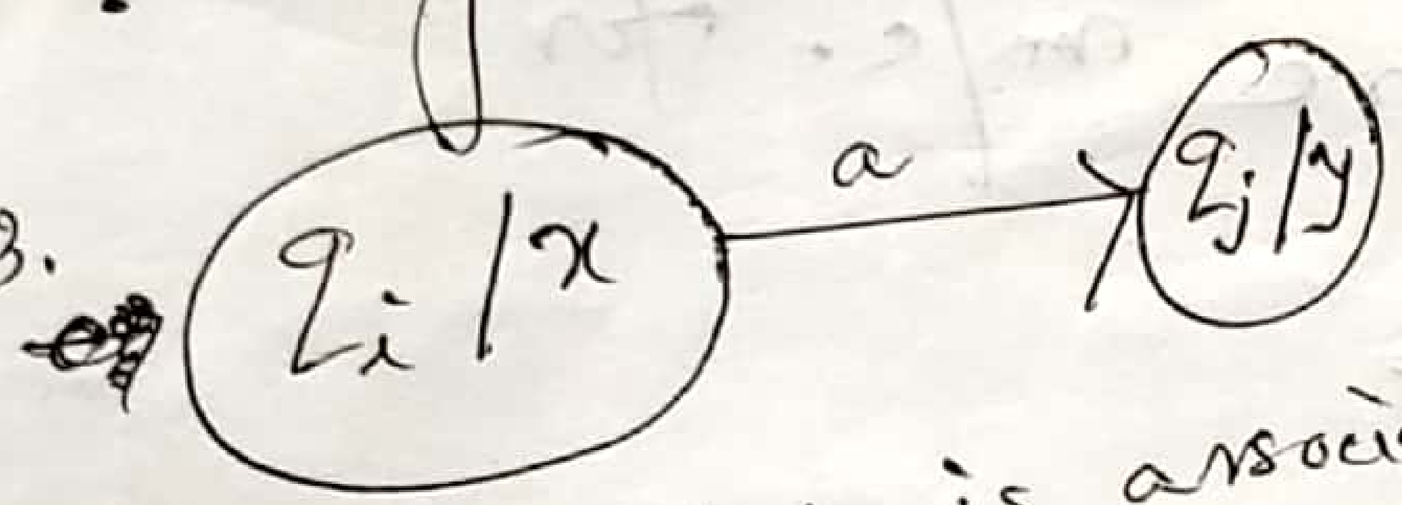
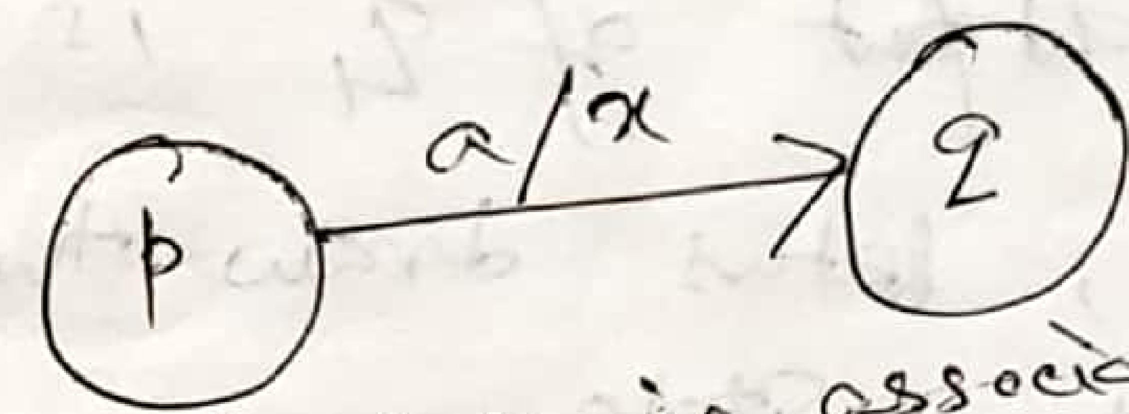
'no' for wrong state
'yes' " correct state that is desired.

For eg: $\boxed{W = 01100}$

$q_0 \xrightarrow{0/'no'} q_1 \xrightarrow{1/'no'} q_2 \xrightarrow{1/'yes'} q_2 \xrightarrow{0/'no'} q_1 \xrightarrow{0/'yes'} q_1$

When we pass last input symbol '0' from the state q_1, we get 'yes' as output, so the string belongs to set of strings of regular expression.

Difference betn Moore & Mealy machine

Moore m/c	Mealy m/c
1. Its output depends only on present state i.e. $\boxed{Z(t) = \lambda(Q(t))}$.	Its output depends on the input transition and present state i.e. $\boxed{Z(t) = \lambda(Q(t), x(t))}$.
2. If input string of length be n, then the output string is of length $(n+1)$.	Here both the length of input & output string is same.
3.  Here output is associated with the current state and becomes encircled in Moore m/c.	 Here output is associated with the edge transition labelled with input a and output x is written as a/x in Mealy m/c.

Conversion from Mealy to Moore m/c :-

PS	Next state: Input a=0, state	Input a=0, output	Input a=1, state	Input a=1, output
q_1	q_3	0	q_2	0
q_2	q_1	1	q_4	0
q_3	q_2	1	q_1	1
q_4	q_4	1	q_3	0

Step1: See for the next state for each state say q_i. Consider the no. of different outputs for each q_i.

q_0 is the initial state.

Step2: Split each output associated with each next state column for the input state in moore m/c. Say q_{20} & output 0

q_{21} & output 1.

Similarly q_{40} & output 0

q_{41} & output 1.

Other two states q_1 & q_3 have not been splitted. The output of q_1 is 1 and for q_3 it is 0.

So, let us draw the moore m/c for each state. Moore m/c

PS	Next state a=0	a=1	output
$\rightarrow q_1$	q_3	q_{20}	1
q_{20}	q_1	q_{40}	0
q_{21}	q_1	q_{40}	1
q_3	q_{21}	q_1	0
q_{40}	q_{41}	q_3	0
q_{41}	q_{41}	q_3	1

As $\lambda(q_1) = 1$, so, m/c produces output 1 with ~~out~~ ϵ input. It is not accepted. To avoid this we use one initial state q_0 with output 0.

Final Moore M/C.

PS	Next State a=0	a=1	output
→q_0	q_3	q_{20}	0
q_1	q_3	q_{20}	1
q_{20}	q_1	q_{40}	0
q_{21}	q_1	q_{40}	1
q_3	q_{21}	q_1	0
q_{40}	q_{41}	q_3	0
q_{41}	q_{41}	q_3	1

Moore to MEALY CONVERSION :-

PS	Next state a=0	a=1	output
q_0	q_3	q_1	0
q_1	q_1	q_2	1
q_2	q_2	q_3	0
q_3	q_3	q_0	0

Moore M/C.

PS	Next state a=0	output	a=1	output
q_0	q_3	0	q_1	1
q_1	q_1	1	q_2	0
q_2	q_2	0	q_3	0
q_3	q_3	0	q_0	0

Mealy M/C