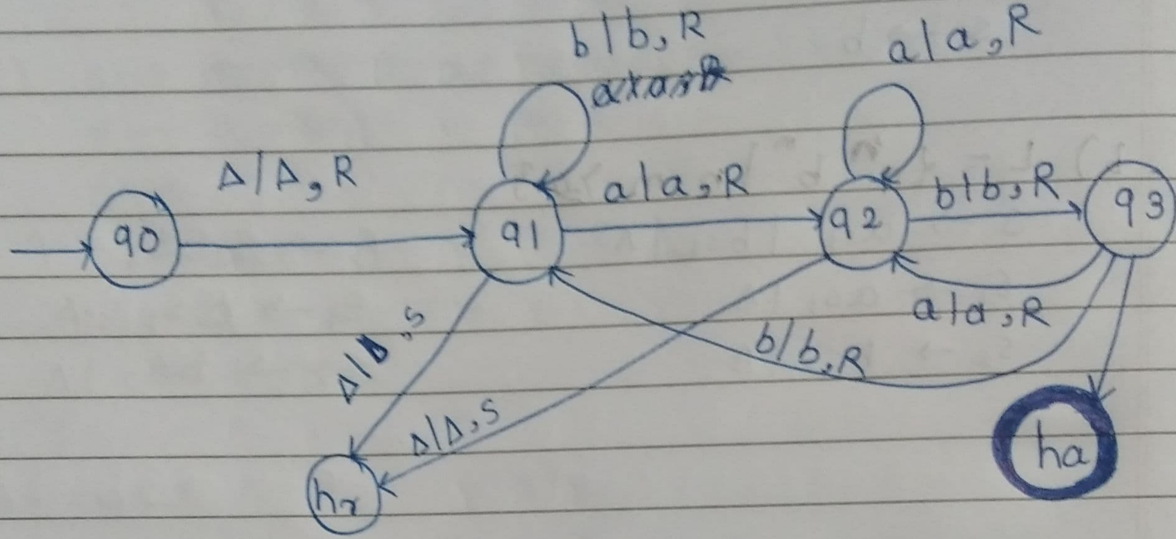
Tutorial No 9

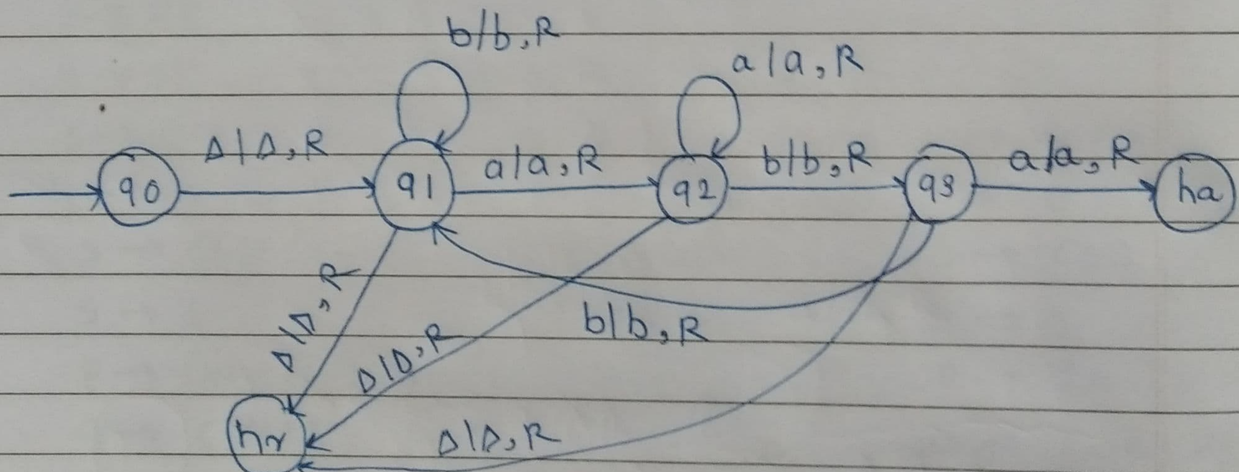
20UCS303

Q.2)

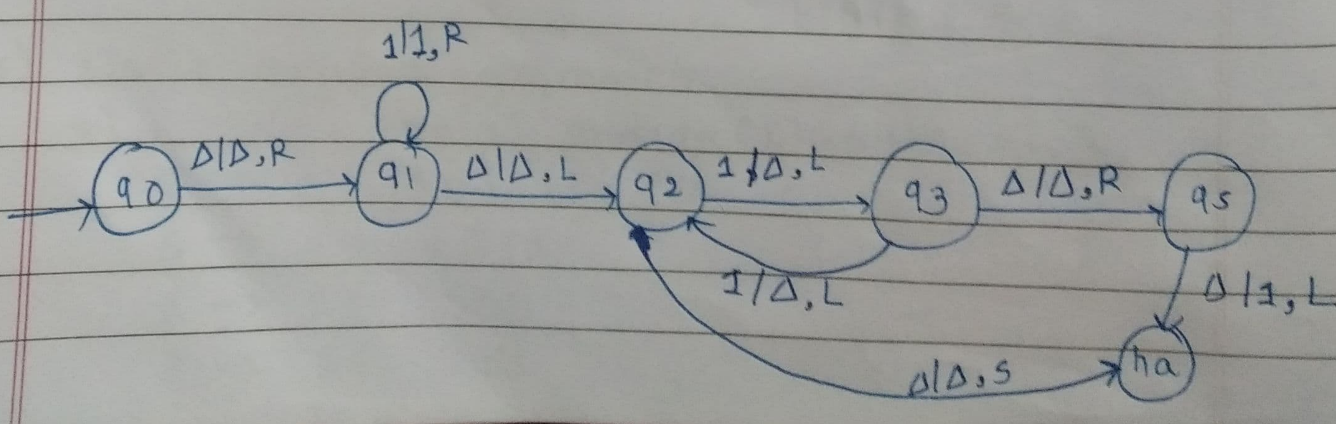
d) (a+b)* ab



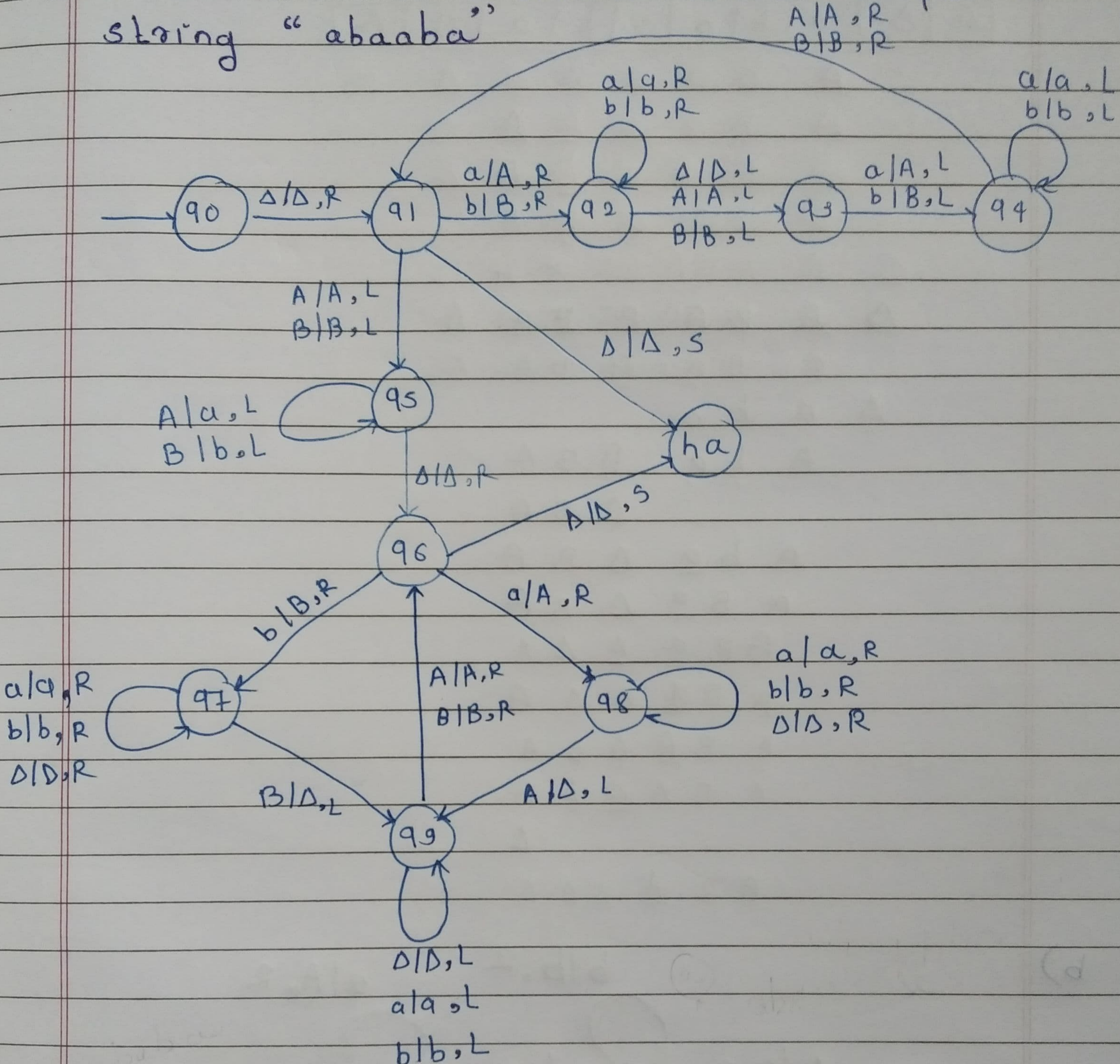
e) (a+b)* aba (a+b)*



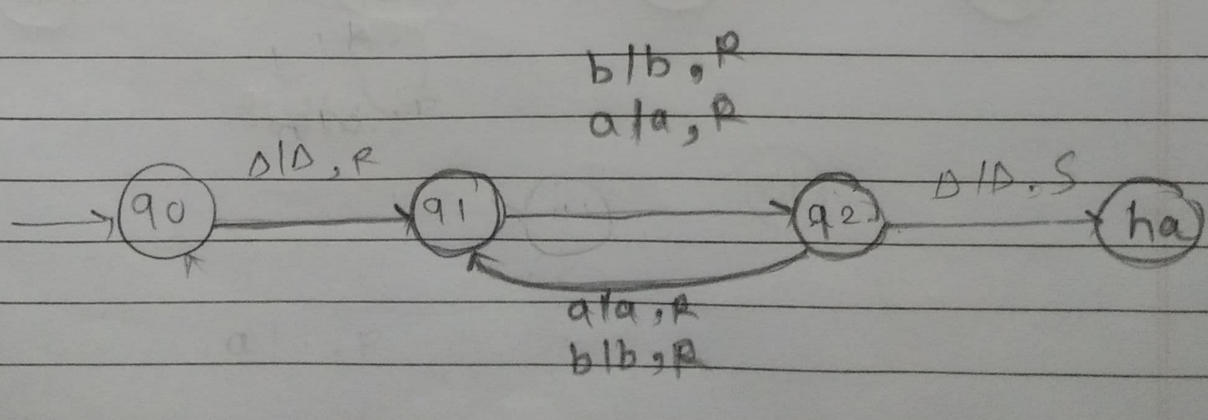
f) Turing machine to compute N mod 2



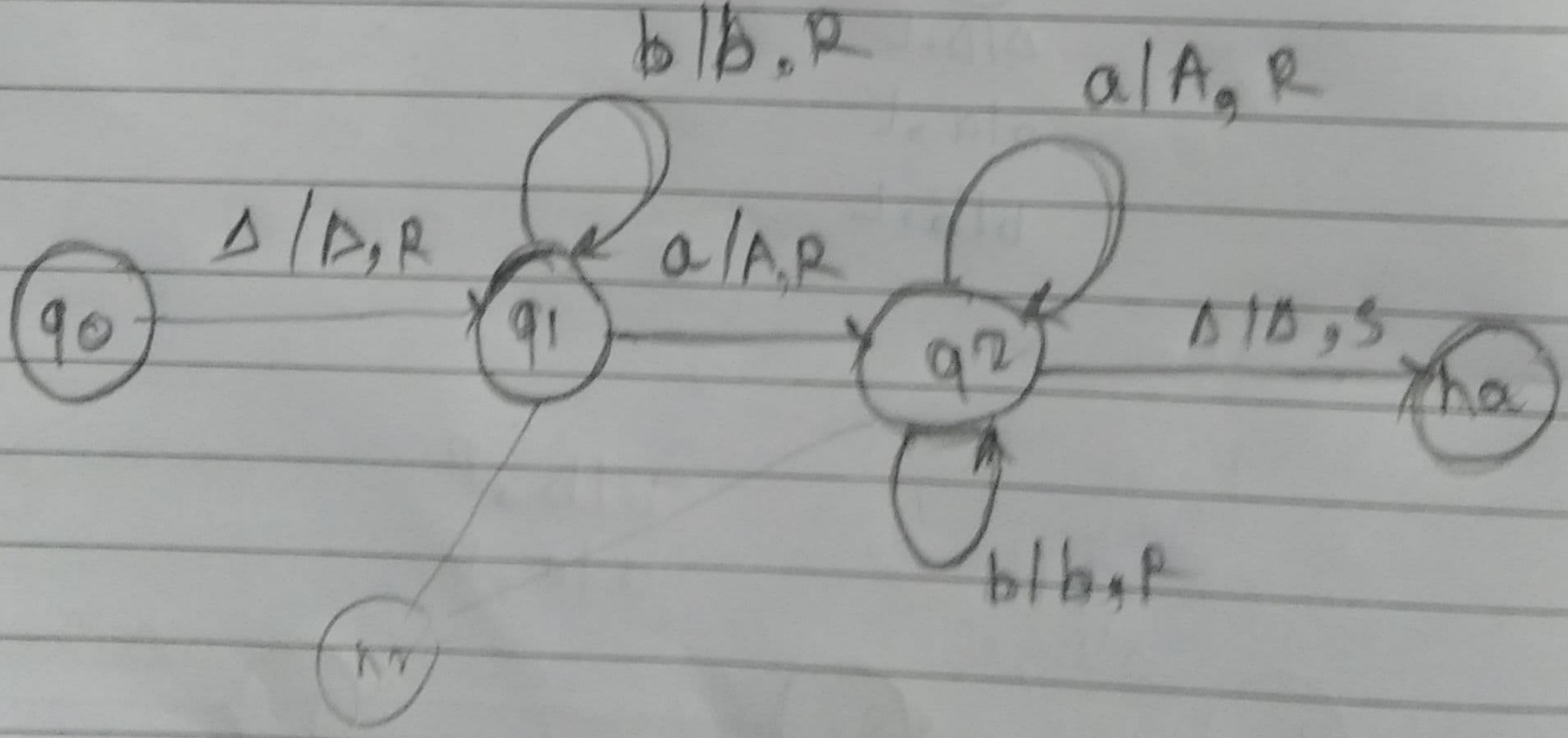
c) L = {xx | x ∈ Σ* } and show that acceptance of string "abaaba"



a)



b)



Q1)

1) Define following Terms :

a) Turing Machine :

- A Turing Machine (TM) is a mathematical model which consists of an Infinite length tape divided into cells on which input is given.
- A Turing machine (TM) is a 5-tuple $T = (Q, \Sigma, \Gamma, q_0, \delta)$, where,
  - Q - is a finite set of states, assumed not to contain h_a or h_r, the two halting states (the same symbols will be used for the halt state of every TM);
  - Σ and Γ are finite sets, the input and tape alphabets, respectively, with $\Sigma \subseteq \Gamma$; Γ is assumed not to contain Δ, the blank symbol;
  - q_0, the initial state, is an element of Q;
  - $\delta : Q \times (\Gamma \cup \{\Delta\}) \rightarrow (Q \cup \{h_a, h_r\}) \times (\Gamma \cup \{\Delta\}) \times \{R, L, S\}$ is a partial function (that is, possibly undefined at certain points).

2) Acceptance of a String in Turing Machine :

- If $T = (Q, \Sigma, F, q_0, \delta)$ is a Turing machine, and $x \in \Sigma^*$, x is accepted by T if, starting in the initial configuration corresponding to input x, T eventually reaches an accepting configuration. In other words, x is accepted if there exist $y, z \in (\Gamma \cup \{\Delta\})^*$ and $a \in \Gamma \cup \{\Delta\}$ so that

$$(q_0, \underline{\Delta} x) \vdash_T^* (h_a, y\underline{a}z)$$

- The language accepted by T is the set $L(T)$ of input strings accepted by T

5) Configuration ~~and~~ of Turing Machine

- A configuration of a Turing Machine is an ordered triple $(x, q, k) \in \Sigma^* \times K \times N$, where

1) x denotes the string on the tape, 2) q denotes the ~~M~~ machine's current state.

3) k denotes the position of the machine on the tape.

4) The string x is required to begin with Δ and end with $\sqcup$.

5) The position k is required to satisfy $0 \le k < |x|$.

4) Computing a function by Turing Machine.

- ~~Let~~ A Turing Machine can handle a function of several variables as well. If the input is to represent the k-tuple $(x_1, x_2, \ldots x_k) \in (\Sigma^*)^k$, the only change required is to relax slightly the rule for the input to a TM, and to allow the initial tape to contain all k strings, separated by blanks.

- Let $T = (Q, \Sigma, \Gamma, q_0, \delta)$ be a Turing Machine, and let f be a partial function on Σ^* with value in Γ^*. We say That T computes f if for every $x \in \Sigma^*$ at which f is defined,

$$(q_0, \underline{\Delta} x) \vdash_T^* (h_a, \underline{\Delta} f(x))$$

and no other $x \in \Sigma^*$ is accepted by T.

- If f is partial function on $(\Sigma^*)^k$ with value in Γ^*, T computes f if for every k-tuple $(x_1, x_2, \ldots x_k)$ at which f is defined,

$$(q_0, \underline{\Delta} x_1 \Delta x_2 \Delta \ldots \Delta x_k) \vdash_T^* (h_a, \underline{\Delta} f(x_1, x_2, \ldots x_k))$$

and no other input that is a k-tuple of strings is accepted by T. For two alphabets Σ_1 and Σ_2 and a positive integer k, a partial function $f: (\Sigma_1^*)^k \longrightarrow \Sigma_2^*$ is Turing-computable, or simply computable, if there is a Turing Machine computing f.

Q3

show encoding of "Turing machine to accept odd length strings".