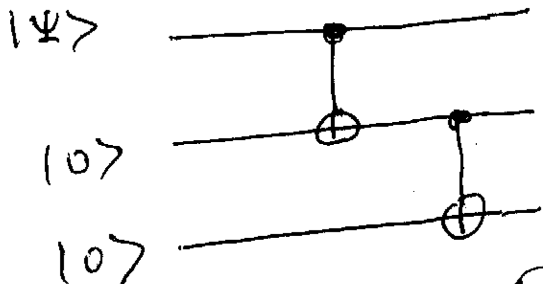
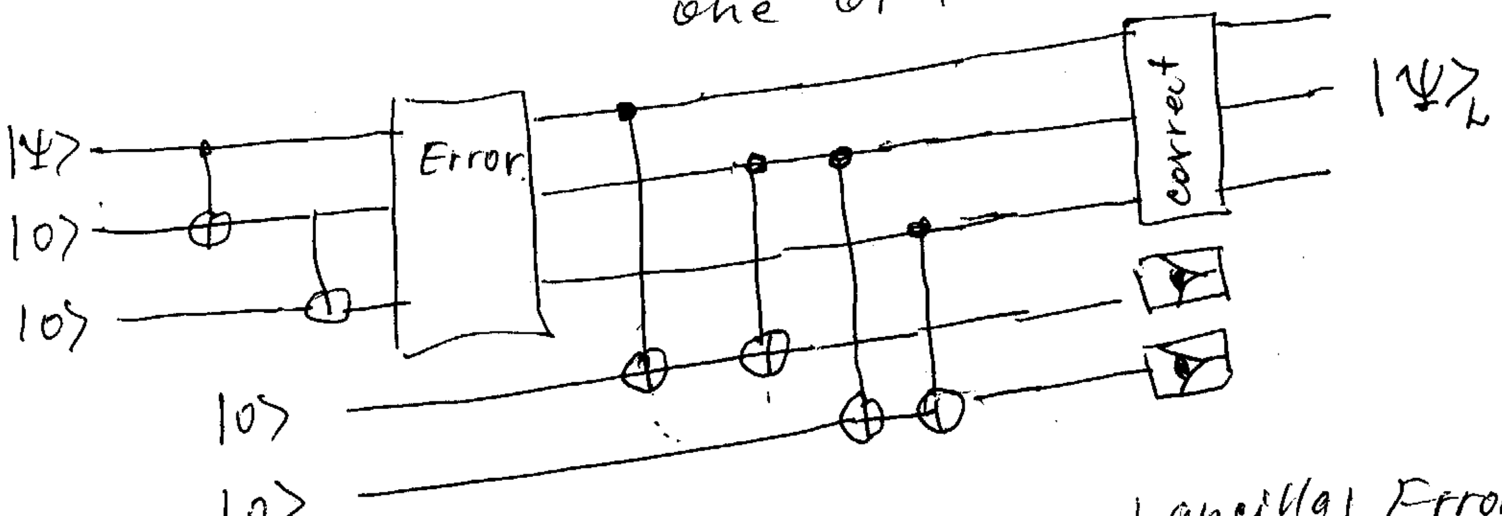
Quantum algorithm to prepare $|\Psi\rangle_L$ ①

$$\alpha|0\rangle + \beta|1\rangle \longrightarrow \alpha|0\rangle_L + \beta|1\rangle = \alpha|000\rangle + \beta|111\rangle$$



$$|\Psi\rangle_L = \alpha|000\rangle + \beta|111\rangle$$

Quantum circuit to encode & correct a single bit-flip occurs on one of three Qubits.

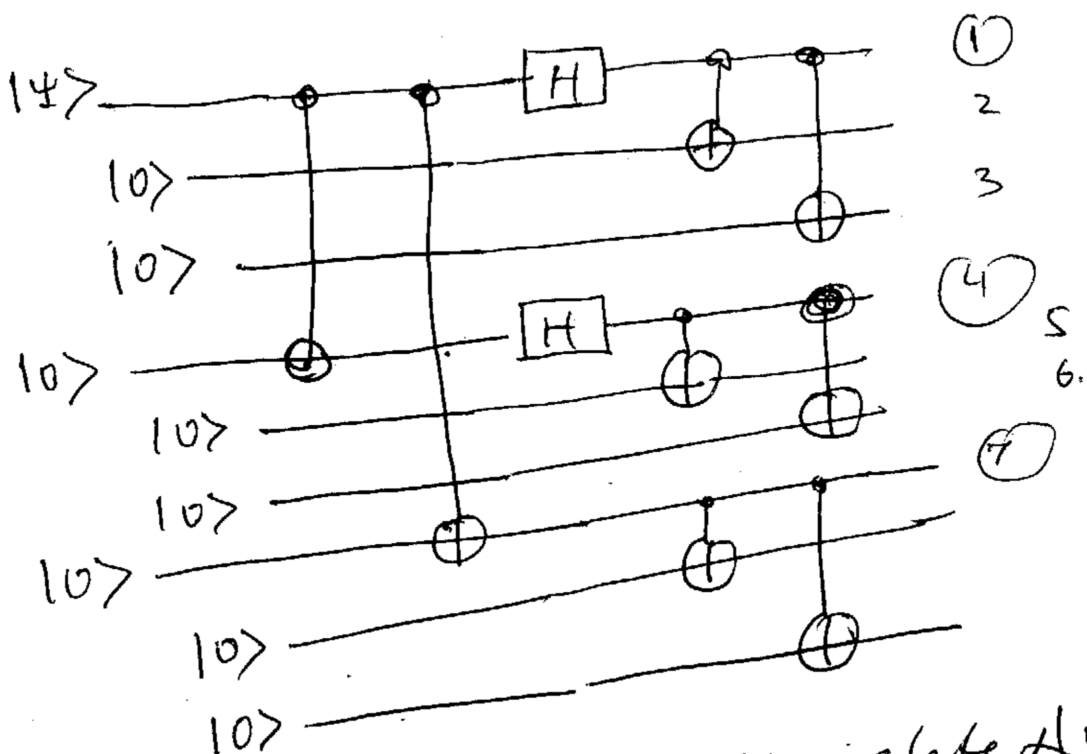


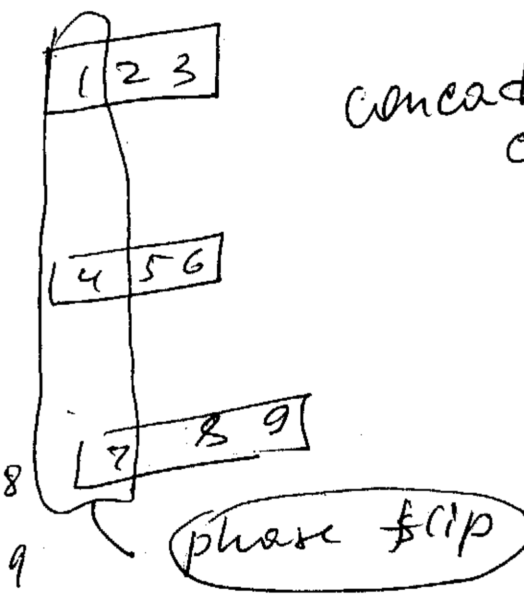
State	ancilla	Error Location
$\alpha|000\rangle|00\rangle + \beta|111\rangle|00\rangle$	00	No error.
$\alpha|100\rangle|10\rangle + \beta|011\rangle|10\rangle$	10	Qubit 1
$\alpha|010\rangle|11\rangle + \beta|101\rangle|11\rangle$	11	Qubit 2
$\alpha|001\rangle|01\rangle + \beta|110\rangle|01\rangle$	01	Qubit 3

PHASE flip error is similar to the bit flip error in the basis $|+\rangle, |-\rangle$

Qubit incoded in $\alpha|+\rangle + \beta|-\rangle$

$$|\Psi\rangle = \alpha|+\rangle_L + \beta|-\rangle_L = \alpha|+++\rangle + \beta|---\rangle$$

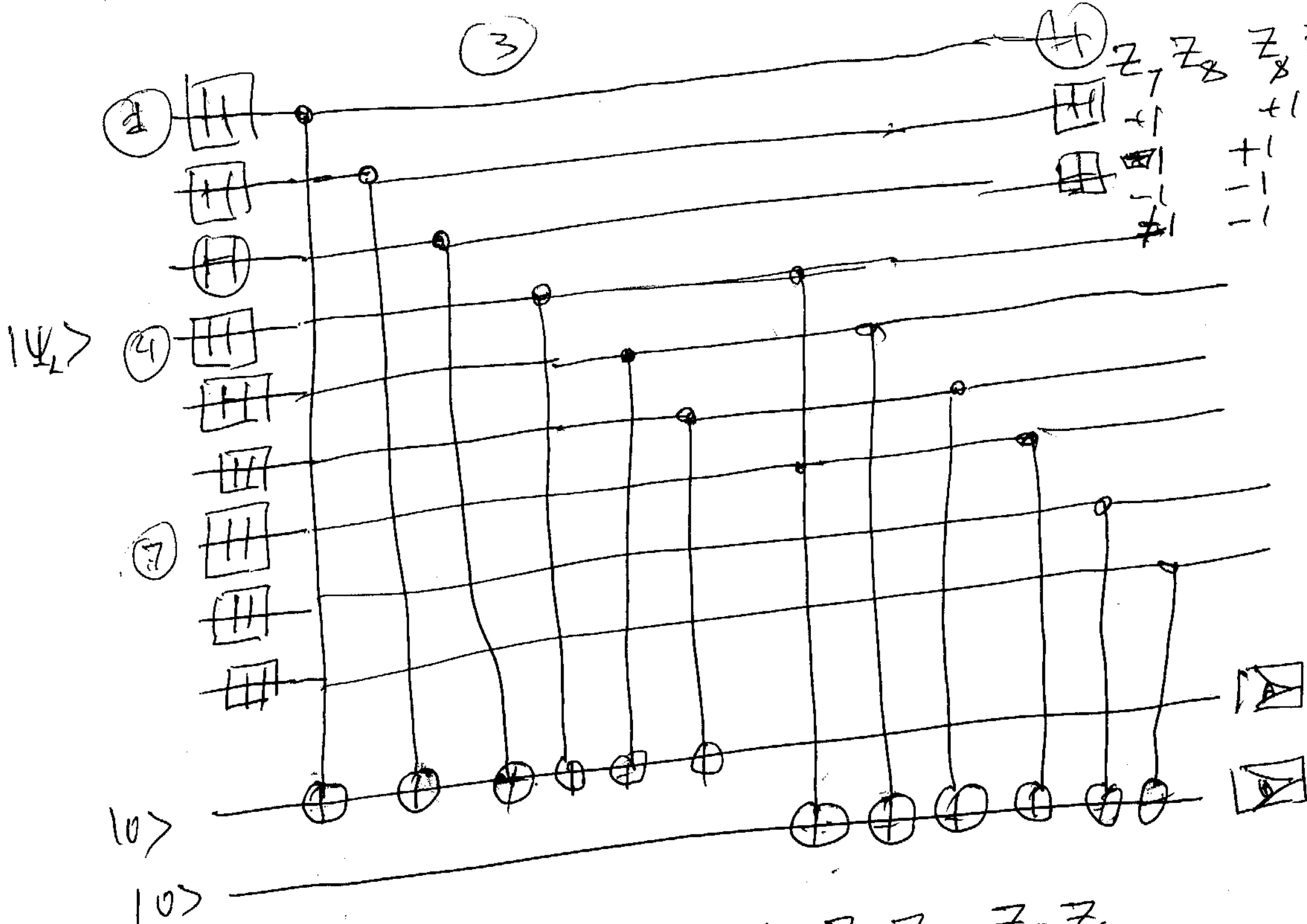




concadenated code

H-gate perfoms this state $\alpha|000\rangle + \beta|111\rangle$ to

$$\alpha\left(\frac{1}{\sqrt{2}}\right)^3\left(|000+|111\rangle\right)^{\otimes 3} + \beta\left(|000\rangle - |111\rangle\right)^{\otimes 3}$$



$Z_7 Z_8$	$Z_8 Z_9$	
+1	+1	No
-1	+1	7 Qubit
-1	-1	8
+1	-1	9 flip

$Z_1 Z_2$	$Z_2 Z_3$	Error
+1	+1	No error
-1	+1	Q_1 has flip
-1	-1	Q_2 has flip
+1	-1	Q_3 has flip

$Z_4 Z_5$	$Z_5 Z_6$	
+1	+1	No err
-1	+1	4 qubit flip
-1	-1	5 qubit flip
+1	-1	6 qubit flip