

Quantum assignment 1

CS 682

January 2024

1 Task 1

- i. Create a swap circuit without utilizing the built-in swap function. Show its action on the input state $|0\rangle|+\rangle$, and then show the resulting output. (5)
- ii. Verify the output of the previous question by using the state-vector simulator. (3)
- iii. Measure both qubits using classical registers. (2)

2 Task 2

- i. Create Entangled State $\frac{|01\rangle+|10\rangle}{\sqrt{2}}$. (5)
- ii. Verify using a state-vector simulator that the circuit works. (2)
- iii. Apply the CNOT operation on the above entangled state, where the second qubit is the control bit. (3)
- iv. Is the final state still entangled? Write your answer in your Jupyter notebook. Measure both qubits. (5)
- v. Simulate the entire circuit 100 times and show the output as a histogram. (5)

3 Task 3

- i. Without direct interaction between x and z , create a circuit for the operation $x, y, z \rightarrow x, y, z \oplus (x \oplus y)'$. Here x' denotes the complement of x . (15)
- ii. Show the action of the circuit as matrix. (5)