

Homework 1

PHY 414: Introduction to Quantum Computing

Note: Please submit HW before Monday's class on June 21. Submit a scanned copy in pdf form contain all the paper work of three problems and a single Notebook for all three problems.

Problem 1: Using CNOT gate and single-qubit gates, construct a circuit to implement arbitrary controlled rotations around x axis $CR_x(\theta)$. Implement this gate in qiskit and compare with their gate `crx(theta, control qubit index, target qubit index)`.

Problem 2: In our class, we developed a teleportation circuit to transfer state of a qubit from S to B, if both the A and the B has $|\psi\rangle^{00}$ Bell state shared between them. Work out the circuit if both qubits had $|\psi\rangle^{01}$ Bell state instead of 00. Implement the circuit on Notebook and verify.

Problem 3: Using phase kickback, construct a circuit of $3 + 1$ qubits that gives a negative sign at the output multiplied with the same input if the input of first three qubits is 000, 010, 111, 101 and gives the same output as input if the input is 001, 011, 100, 110. Implement the circuit in qiskit and verify.