Topics and Problems to Chapter 4 – Quantum Computation

1. Single qubit operations and their matrices
2. Bloch Sphere interpretation of single qubit operations
3. Examples of single-qubit equivalent transformations, proves using matrices
4. Hadamard gate and its role
5. Z-Y Decomposition for a single qubit
6. 2-qubit controlled operations: Controlled-Pauli, Controlled-Not, Controlled-Phase, Controlled-Square-Root-of-Not, Controlled-Hadamard, etc Generalization to controlled N-qubit operations. Matrices and Identities. Use in Synthesis
7. Be able to explain two different realizations of arbitrary 3-qubit permutation gate using 2-qubit primitives
8. Realization of N-qubit Controlled operations in quantum circuits.
9. Measurement in quantum circuits.
10. Know at least 4 systems of universal quantum gates.
11. Approximating quantum circuits
12. Quantum Computational Complexity
13. Simulation of Quantum Systems