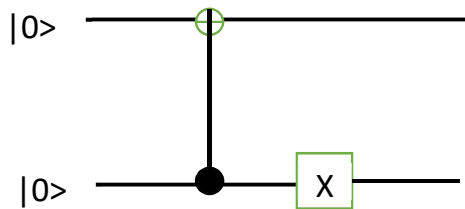# Unit-4 Quantum Computing

Model Questions

1. Explain the set up and theory of Stern-Gerlach experiment with suitable diagrams.
2. With a diagram, explain the production and detection of linearly polarised light.
3. With a diagram, explain production and detection of circularly polarised light and elliptically polarised light.
4. Explain quantum superposition principle with the help of single particle quantum interference.
5. What are the basic differences between classical and quantum computing?
6. Compare classical information and quantum information.
7. What is a qubit? Explain the distinction between a bit and a qubit.
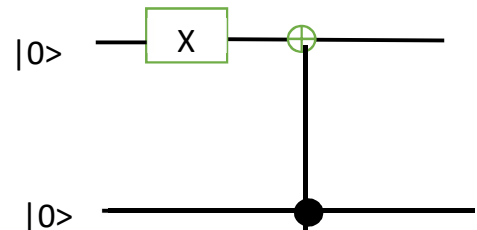8. Explain how Bloch sphere is used to represent a qubit.

Practice Problems

1. A state, in terms of three orthonormal basis vectors $|\phi_1>, |\phi_2>$ and $|\phi_3>$ is given by $|\psi> = \frac{1}{\sqrt{15}}|\phi_1> + \frac{1}{\sqrt{3}}|\phi_2> + \frac{1}{\sqrt{5}}|\phi_3>$. Determine its normalization constant.
2. Find the constant "a" so that the states $|\psi> = a|\phi_1> + 5|\phi_2>$ and $|\chi> = 3a|\phi_1> - 4|\phi_2>$ are orthogonal; consider $|\phi_1>, and |\phi_2>$ to be orthonormal.
3. Consider two states $|\psi> = i|\phi_1> + 3i|\phi_2> - |\phi_3>$ and $|\chi> = |\phi_1> - i|\phi_2> + 5i|\phi_3>$ where $|\phi_1>, |\phi_2>$ and $|\phi_3>$ are orthonormal.
   Calculate, (a) $<\psi|\psi>$ (b) $<\chi|\chi>$ (c) $<\psi|\chi>$ (d) $<\chi|\psi>$
4. Obtain the state produced by these quantum circuits.