1. **Number and title of course:** CS C191 – Quantum Information Science and Technology

2. **Course objectives:** Introduction to quantum physics from a computational and information viewpoint. Leading into the design of quantum algorithms, the requirements for physical implementation of quantum computers.

3. **Topics Covered:**
   - Qubits, measurements, Hilbert spaces, tensor products
   - Unitary evolution, universal gates, no cloning theorem
   - Bell states, Bell Inequalities, quantum teleportation.
   - Schrodinger equation, Hamiltonians
   - Spin properties, angular momentum
   - Manipulating spins, B-fields
   - Spin precession, spin resonance, 2-slit experiment
   - Entanglement and spins, atomic qubits
   - Photon polarization, photon qubits
   - Reversibility, quantum circuits
   - Quantum fourier transform
   - Quantum factoring algorithm
   - Quantum search and quantum zeno effect
   - Density matrices
   - Implementing quantum computers:
     - Solid state quantum computation
     - Cavity QED.
     - Josephson junction qubits
   - Dirac equation and the origin of spin.

4. **Relationship of course to program objectives:** This course requires students to use their fundamental knowledge of mathematics; science, particularly physics and chemistry; and engineering to understand and analyze basic problems in nanoscience, and their emerging applications in information theory, computing devices, optics, networks, and cryptography.

5. **Prepared by:** Umesh Vazirani (3/2/06)