Course Contents (PHYS524500)

This course is to offer the preliminary knowledge for entering into the field of Quantum Information Science. The contents outlined below should be considered minimally provided. The weights of topics, including new ones, vary yearly.

1. Basics
1.1 Concepts of Computing
1.2 Quantum Physics in Brief
1.3 Quantum Gates
1.4 Imperfect Quantum Clone
1.5 Reviews of Classical Computing
1.6 Elementary Lie Algebras and Lie Groups

2. Simple Quantum Algorithms
2.1 Deutsch's Problem
2.2 Other Problems Related
2.3 Grover's Algorithm for Quantum Search

3. Integer Factorisation
3.1 RSA System
3.2 Shor's Algorithm
3.3 Fast Fourier Transform
3.4 Quantum Fourier Transform

4. Cryptography
4.1 Quantum Key Distribution
4.2 Bennett-Brassard Protocol and others

5. Teleportation
5.1 Quantum Teleportation
5.2 Superdense Coding
5.3 Quantum Secret Sharing

6. Quantum Error Correcting Codes
6.1 Classical Error Correcting Codes
6.2 Calderbank-Shor-Steane Quantum Codes
6.3 Gottesman Stabilizer Codes

7. Quantum Entanglement
7.1 Bell's Inequalities
7.2 Entanglement and Decoherence
7.3 Entanglement and Positive Maps
7.4 Geometry and Topology of Entanglement

References:
Quantum Computing, by Jozef Gruska,
McGraw-Hill, UK (1999);
Quantum Computation and Quantum Information
by Michael A. Nielsen and Isaac L. Chuang,
Cambridge Univ. Press (2000);
and relevant papers in http://xxx.lanl.gov/