Syllabus

Quantum cryptography
- BB84 protocol
- Practical matters in quantum cryptography

Entanglement
- Tensor product spaces
- Remote state preparation
- Quantum nonlocality
- Quantum teleportation and entanglement swapping
- Quantum repeater

Quantum physics of complex systems
- Density operator
- Trace and partial trace
- Bloch sphere
- Decoherence
- Generalized measurements
- Quantum tomography (state, detector, process)

Continuous variables in quantum optics
- Quantization of electromagnetic field
- Harmonic oscillator
- Fock, coherent and thermal states
- Wigner function
- Nonclassicality criteria
- Heisenberg picture
- Phase-space displacement
- Squeezing (one- and two-mode)
- Beam splitter
- Homodyne tomography
- Quantum state engineering

Elements of atomic physics
- Rotating-wave approximation
- Homogeneous and inhomogeneous broadening
- Echoes and Ramsey spectroscopy
- Dressed states
- Master equations for a 2-level atom
- Absorption and refraction in an atomic gas