Detailed writeup on material covered in QMII—2008 fall

1. Scattering theory for spherical symmetric potential
   Plane waves and spherical waves for free particles; Hilbert space; quantum numbers; Square-well potential solutions; Coulomb potential; Runge-Lenz vector and O(4) group. Concept of cross section; classical scattering; Lab vs CM frames; Green function in scattering theory; Integral equation approach; Born approximation; partial wave expansion; resonances; Fano resonance; Coulomb scattering; Modified Coulomb potential; Low-energy collisions and scattering length.

2. Symmetry in Quantum Mechanics
   Symmetry transformation and conservation laws in classical physics; symmetry operation and groups; Rotation; generator; discrete vs continuous groups; Conservation laws in quantum mechanics; Angular momentum; rotation matrices; tensor operators and Wigner-Eckart theorem; Applications;

3. Idential particles
   Fermions vs bosons; spin statistics; applications to molecules; scattering of two identical particles; helium atom; Hartree-Fock theory; density function theory;

   Molecular orbitals and hybrid orbitals; perturbation theory—add-on's.
4. Quantization of fields
   Sound waves; EM waves; applications; Dirac theory