PHYS 4310 Study Guide for Final

Concepts that you should be very familiar with:
What is a wavefunction
What is probability density and how do you calculate it
The Bohr atom
De Broglie Relation
Einstein Relation
The Copenhagen interpretation
The Schrödinger equation
Heisenberg uncertainty relation
What is a stationary state
What does it mean to be orthonormal
What does it mean to be complete
How to assemble a time-dependent wavefunction from the time-independent Schrödinger Equation
The Infinite square well
How the infinite square well scales
The Harmonic oscillator
How the Harmonic oscillator scales
The concept of a wavepacket and a free particle
Fourier transforms
How to obtain energy eigenstates
Difference between bound and scattering states
Meaning of the probability current density
What is a Hilbert space
How to find the inner product of two functions
What does hermitian mean
Incompatible/compatible observables and the commutator
Eigenvalues/eigenfunctions and determinate states
Real space and momentum space
The generalized form of the uncertainty principle
Bra and ket notation
Separation of variables
Quantum numbers
Degeneracy

Tunneling
Bohr formula
How binding energy and the Bohr radius scales with dielectric constant, atomic number, and reduced mass
The hydrogen atom
Translation and rotation operators
Concept of (orbital) angular momentum
Concept of spin (intrinsic angular momentum)
Zeeman splitting
Addition of angular momentum
Bosons and fermions

Specific techniques that you should know how to use:
How to solve the time-independent SE for the infinite well case
How to show orthogonality
How to use raising and lowering operators
How to find expectation values
How to integrate (and differentiate) the Gaussian wavefunction
How to perform a Fourier transform
How to use a delta function
Continuity of wavefunctions
Conversion from real space to momentum space and vice versa
How to use the WKB method
How to use separation of variables
How to show that functions lie within the Hilbert space
How to use orthogonality and completeness to get "weighting coefficients"
How to scale the energy and wavefunctions of the hydrogen atom with reduced mass, atomic number, and dielectric constant
How to use angular momentum and spin raising and lowering operators
How to find the eigenstates of L^2 and L_z
How to find the eigenstates of S^2 and S_z
Expectation values of $\langle S_i \rangle$
How to find the probability of being in spin $|\uparrow\rangle$ and $|\downarrow\rangle$
How to handle multiple spins (*i.e.* $s = 1$ or $\frac{3}{2}$ systems)