Review for Exam 2

Below you will find a list of topics that you will be responsible for knowing for Exam 2 as well as a list of topics that will not be covered. Remember that you are allowed a formula sheet for the test!

Although I've tried to cover everything, anything not explicitly mentioned is your responsibility

Chapter 5

- De Broglie hypothesis (wave particle duality), De Broglie wavelength
- Measurement of particle wavelengths,
    - relativistic vs. non-relativistic (λ/λ_c)
- Wave packets
    - waves in general (period, frequency, wave number, phase and group velocity)
    - uncertainty: $\Delta x\, \Delta k \sim 1$, $\Delta\omega\, \Delta t \sim 1$
    - particle wave packets
- Probabilistic interpretation of wave packets
    - $P(x)\, dx = |\Psi(x)|^2 dx$ $\int |\Psi(x)|^2 dx = 1$
- The uncertainty principle
    - $\Delta x\, \Delta p \geq \hbar/2$, $\Delta E\, \Delta t \geq \hbar/2$

Not covered: Davisson-Germer experiment, consequences of the uncertainty

Chapter 6

- Schrodinger equation in one dimension
    - time dependent solutions
    - time independent solutions
- Infinite square well
    - solutions
    - energies
        - ground state energy
    - probabilities
    - sketching wave functions
- Expectation values and operators
    - computation of expectation values
    - representation of operators
- Simple Harmonic Oscillator
    - potential
    - classical turning points
    - solutions (will give specific solutions on test if needed)
    - energies
        - ground state energy
    - selection rules: $\Delta n = \pm 1$
- reflection and transmission of waves
    - step potential

    - solutions, wavenumbers
        - sketches of wave functions
    - reflection and transmission coefficients

Not covered: finite square well, barrier potentials

Chapter 7

- Schrodinger equation in three dimensions
    - solutions
    - energies
        - degeneracy
- Schrodinger equation in spherical coordinates
    - central potentials
    - separation of variables
    - solutions to spherical equation of the 3DSE
        - spherical harmonics (note: I will give specific solutions on the test)
    - quantization of angular momentum
        - angular momentum operator
        - quantum numbers l,m
        - vector representation of angular momentum
    - solution to the radial equation
        - radial functions (note: I will give specific solutions on the test)
        - energies
        - principle quantum number n
        - degeneracy
    - selection rules
- Hydrogen atom wave functions
    - normalization
    - probabilities $P(r)dr = |\Psi|^2 4\pi r^2 dr$
    - ground and excited states, continuum states
- electron spin
    - spin quantum number
- total angular momentum
    - addition of angular momentum: $\mathbf{J} = \mathbf{L} + \mathbf{S}$

Not covered: magnetic moments, Stern-Gerlach experiment, spin-orbit coupling, Schrodinger equation for two or more particles, ground states of atoms, excited states of atoms