

NERS 311	Current notes	Old notes	
Chapter 1	1	1	Chapter 1: Introduction to the course
	1	-	Chapter 1.1: About the course
	2	-	Chapter 1.2: Modern Physics
	9	-	Chapter 1.3: Some History
	12	-	Chapter 1.4: Review of Classical Physics
	12	-	Chapter 1.4.1: Mechanics
	14	2	Review of 2-body collision kinematics
	21	6	... Example: Billiard balls
	27	9	... Example: Unequal masses
	31	12	... Example: Really sticky billiard balls
	32	14	... Example: Somewhat sticky billiard balls
	34	-	Zero-momentum frame
	35	-	Laboratory/particle-at-rest frame
	38	-	Potential, Total Energy, Angular momentum
	40	-	Chapter 1.6: Significant figures
	42	-	Chapter 1.8: Basic Error Estimation
Chapter 2		16	Chapter 2: Special relativity
		16	Relativistic Kinematics
		21	... Example: Compton Interaction
		24	... Example: Relativistic billiard balls
		27	Relativistic Kinematics (cont)
		27	... Example: Kinematics of positron annihilation
		29	Conservation laws
		29	... The photoelectric effect
		30	... Pair Production
		31	... Bremsstrahlung
		32	A catalog of electron/positron interactions
Chapter 3		33	A catalog of photon interactions
		34	What <u>IS</u> a photon?
		37	Chapter 3: Particle-like Properties of E&M radiation
		37	The particle-like nature of electromagnetic waves
		37	Maxwell's equations
Chapter 4		39	The Photoelectric effect
		41	The Compton effect
		42	Blackbody radiation
		45(1)	Chapter 4: Wave-like properties of particles
		45(1)	Resolving non-relativistic and relativistic physics
		45(1)	...de Broglie's "matter waves"
		47(3)	Wave superposition
		47(3)	...Dirac's delta-function
		48(4)	...Fourier Transforms
		50(6)	... "Classical waves"
		51(7)	...Expectation values
		53(9)	... "Uncertainty relationship for classical waves"
		54	... Example of a wavepacket
		60	... How does a wavepacket move?
		62	... Group velocity

	Current notes	Old notes	
Chapter 5		63	Chapter 5: The Schrödinger Equation
		63	Classical 1-D motion under the influence of a potential
		64	...Demonstration: The harmonic oscillator
		69	...The complete solution to the classical 1-D harmonic oscillator
		71	The transition to Quantum Mechanics
		71	...“Deriving” Schrödinger’s equation
		74	The norm of a solution to Schrödinger’s equation
		75	The probability density
		75	The continuity equation
		76	The probability current density
		80	Properties of solutions to the Schrödinger Equation
		82	Getting $V(x,t)$ from known solutions
		84	General classes of problems
		84	Monoenergetic, steady-state problems
		85	Unbound problems, bound problems
		86	Step-potential scattering
		110	1D bound-state problems
		110	Infinitely deep square well potential
		113	General properties of eigenfunctions
		116	More infinite square well
		121	composite wave functions
		125	Parity
		132	Transition rates
		134	Bound states of the “box” potential
		148	Motivating the use of the harmonic potential
		152	The 1D harmonic potential in Quantum Mechanics
		158	3-Dimensional solutions to the Schrödinger Equation
		158	Migrating from 1D to 3D
		160	Separation of variables
		161	The 3D box potential, parity of solutions
		162	Degeneracy and Parity
		164	The 3D Harmonic Oscillator
		165	Degeneracies for the 3D Harmonic Oscillator
		166	Proof that degenerate levels all have same-parity wavefunctions
Chapter 6		167	Chapter 6: The Rutherford-Bohr Model of the Atom
		167	Basic properties of atoms
		168	The Thomson model of the atom
		170	The Rutherford model of the atom
		171	Rutherford scattering analysis
		174	The Rutherford cross section
		177	Rutherford scattering (con’t)
		179	Distance of closest approach
		182	Analysis of Rutherford’s experiment
		186	Classical cross sections
		189	Example: Disco mirrors (spherical mirror)
		191	Example: Tennis ball against a bowling ball
		195	Center-of-Mass system in Classical Physics
		199	Center-of-Mass system in Quantum Physics
		202	Bohr’s Model of the Atom
		207	Transitions
		208	Deficiencies of the Bohr Model

Chapter 7	210	Chapter 7: The Hydrogen Atom in Wave mechanics
	210	Central Potentials in Quantum mechanics
	212	Spherical Harmonics
	215	The radial equation in 3D (central forces)
	218	The H-atom/Hydrogenic atoms
	219	Central Potentials in Quantum mechanics
	219	The radial equation in 3D (central forces)
	222	The H-atom/Hydrogenic atoms
	225	Radial probability densities in the hydrogen atom
	225	Degeneracy in the hydrogen atom the hydrogen atom
	226	$l = 0$ solutions in 3D
	228	Discussion on the deuteron
	229	Angular momentum, continued
	230	The vector “model” of angular momentum
	232	Pictures of spherical harmonics
	233	Pictures of hydrogenic probability densities
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	240	Approximate solutions to the above
	241	Fermions and Bosons
	243	The Pauli Exclusion Principle
	244	Filling order of atomic orbitals (Madelung’s rules)
	246	The curious case of the good conductors
	248	The periodic table
	249	The exceptions to Madelung’s rules
	250	Atomic transitions, explaining the $\pm 1\ell$ “rule”
	253	Coupling spins
	257	Coupling spins in many-electron atoms - Hund’s rules
	259	Lasers
	261	Classification of lasing/non-lasing systems
	262	Last page of hand-written notes for NERS 311

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Chapter 10	1	Chapter 10: Nuclear Properties
	1	The nucleus, nucleon-nucleon force
	2	The nuclear radius
	3	Measuring the nuclear shape, using electron scattering
	7	The $R = R_0 A^{1/3}$ formula
	8	Extra credit problem
	8	Example: Spherical, homogeneous ball of charge with sharp a radius
	12	Estimating the shift in the 1s electronic binding, due to finite radius
	13	Determination of R_N from shifts in atomic energy levels
	19	Quantum version of the Rutherford Cross section
	22	Transition rates
	23	Coulomb energy stored in the nucleus (discrete distributions)
	24	Coulomb energy stored in the nucleus (continuous distributions)
	25	Working out on heck of an integral
	27	Mirror nuclei
	29	Coulomb self-energy (review)
	32	Mirror nuclei (difference in self-energy)
	33	Nuclear Binding Energy
	35	Neutron/Proton Separation energy
	36	Semi-empirical mass formula
	38	Neutron “excess”
	40	$Z_{\min}$
	40	$\vec{I}$ and Π
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Insert	.7	Electrical Quadrupole moment of an elliptic nucleus
	44	Nuclear Binding Energy (con’t)
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	70	The Shell Model (continued)
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	76	Shell model predictions of excitation levels
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	84	Types of collective structure, vibrational states (phonons)
	86	Quadrupole phonon coupling
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	103	Single parent, two stable daughters
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	113	Series of decays
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	207	General treatment of Classical multipole fields
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