PHYSICS 452/562 − − FALL 2023
ATOMIC PHYSICS AND LASERS

Week # Monday date	Tuesday	Thursday	Reading & Homework
Background in Atomic Physics and Quantum Mechanics.			
I 8/28	Historical Background Classical models	Schrödinger Equation(s) Multiple solutions	vdS & M: Ch. 1, 2.1, 2.2 Problem set #1
II 9/4	Rabi and Bloch view for two-level atom	More on Bloch sphere Dressed atom picture	vdS & M: Ch. 2,; M&E: 9.1-9.3 Prob. set #2
III 9/11	Separate S.E. for H atom	Fine structure Relativity and spin-orbit	vdS & M: Ch. 7, 8.1 - 8.5, 8.A, 8.B Problem set # 3
IV 9/18	Quantum defects Other Atoms	Hyperfine structure	vdS & M: 9.1 - 9.3, 10.1 - 10.3 Problem set # 4
V 9/25	A and B Coefficients Stimulated Emission	Selection Rules Zeeman, Stark & dipole Quantum Transitions, Ω_R	vdS & M: Ch. 3.2.1, 3.3, 3.5, vdS & M: Ch. 11; Problem set #5
VI 10/2	21st Century Revolution in Quantum Mechanics Superposition, Entanglement	**First Mid-term Exam In Class (closed book)**	vdS & M: Ch. 5 *and* M & E: Sec. 3.7 M&E - Ch. 4, prob 4.1 & special
Everything below here is just a space holder. Subject to change.			
Laser Operation and Types of Lasers.			
VII 10/9	**NO CLASS HOLIDAY**	Introduction to Lasers Three and Four levels	M & E, Ch. 1 M & E, Ch. 4, Sec's. 1-12 M & E, prob's. 3.10, 4.1
VIII 10/16	Gain - Rate Eq's Longitudinal Modes,	Gas Lasers: HeNe, CO_2, Ar^+ Single Mode - Lamb dip Begin Tunable & Dye Lasers	M&E, Sec's. 5.8 - 5.11 M&E, 7.1-7.9, espec. 7.5 & Table 7.1 prob's 7.1, 7.3a, 7.4; prove Eq. 7.5.6
IX 10/23	Dye Laser Resolution More About Tunable Lasers Saturated Absorption Spect.	Gaussian Beams and Confocal Resonators Ring Laser Cavities	M&E, 11.3 - 11.11 M & E, prob's. 11.4, 11.7, 11.9
X 10/30	Solid State Lasers Ti:Sapphire, DPSS, and Semiconductor Lasers	I & T dependence for diodes Saturated Abs., Modulators, & Pound-Drever-Hall	M & E, 11.12 - 11.15 no prob's - catch up
XI 11/6	Non-Linear Optics Harmonic Generation	Mode Locked Lasers Pulsed & Freq. Comb	TBA
Applications of Lasers - Nobel Prizes.			
XII 11/13	Fiber Optics & Lasers - Limits to Telecom – Nanofibers	Laser Cooling & Temp. Limit Breaking the Limit	M&E 8.6, 8.7, 14.7
XIII 11/20	Magnetic Traps & Optical Lattices For Neutral Atoms	**NO CLASS THANKSGIVING**	M&E 14.4 - 14.6 prepare for exam
XIV 11/27	Trapping and Confinement Optical Tweezers	**Second Mid-term Exam In Class (closed book)**	M&E All of ch. 14; prob's 14.6, 14.8a, 14.9a,b, 14.11, 14.14, 14.21
XV 12/4	Bose-Einstein Condensation	Resolution Limits	

How the Course is Graded

HOMEWORK

Homework problems will be assigned regularly from either distribution in class (and posting on Blackboard) or taken from the text by Milonni and Eberly. They will be graded only when they're received on paper. The earlier assignments submitted by email overtaxed my printer (it's not a commercial printer) so I will no longer print and grade them. They could be submitted on time by email, followed by paper mailed versions that will be checked against the email and then graded. Any other way of getting the paper version to me is OK.

EXAMS

There will be two exams, currently scheduled for 29 September and 22 November (subject to change). Exams will be given at announced times in the classroom (S-265). Exemptions from this policy can be granted only by the Student Accessibility Support Center (SASC).

GRADES

Grades will be based approximately equally on these two aspects of the course, with a boost given to those students who participate actively in class.