PHYSICS~452/562--~FALL~2023

ATOMIC PHYSICS AND LASERS

Lecture: $T\theta - 11:30 - 12:50$ as of June 28, 2023 Harold Metcalf - S225 - 632-8185 or 8036 Room: Physics S-265 subject to change harold.metcalf@stonybrook.edu Text: van der Straten & Metcalf (Cambridge) find it at https://doi.org/10.1017/CBO9781316106242

Text: Milonni & Eberly, 2nd Edition (Wiley)

Week #	Wholin & Eberry, 2 Edition (v	. 110,)	
Monday	Tuesday	Thursday	Reading & Homework
date	Tuesday	1 Hursuay	rteading & Homework
Background in Atomic Physics and Quantum Mechanics.			
I	Historical Background	Schrödinger Equation(s)	vdS & M: Ch. 1, 2.1, 2.2
8/28	Classical models	Multiple solutions	Problem set #1
II	Rabi and Bloch view	More on Bloch sphere	vdS & M: Ch. 2,; M&E: 9.1-9.3
9/4	for two-level atom	Dressed atom picture	Prob. set #2
III	Separate S.E. for H atom	Fine structure	vdS & M: Ch. 7, 8.1 - 8.5, 8.A, 8.B
9/11	T C C C C C C C C C C C C C C C C C C C	Relativity and spin-orbit	Problem set # 3
IV	Quantum defects	Hyperfine structure	vdS & M: 9.1 - 9.3, 10.1 - 10.3
9/18	Other Atoms		Problem set # 4
V	A and B Coefficients	Selection Rules	vdS & M: Ch. 3.2.1, 3.3, 3.5,
9/25	Stimulated Emission	Zeeman, Stark & dipole	vdS & M: Ch. 11; Problem set #5
'		Quantum Transitions, Ω_R	"
VI	21 st Century Revolution in	First Mid-term Exam	vdS & M: Ch. 5 and M & E: Sec. 3.7
10/2	Quantum Mechanics	In Class (closed book)	M&E - Ch. 4, prob 4.1 & special
	Superposition, Entanglement		
Everything below here is just a space holder. Subject to change.			
Laser Operation and Types of Lasers.			
VII	NO CLASS	Introduction to Lasers	M & E, Ch. 1
10/9	HOLIDAY	Three and Four levels	M & E, Ch. 4, Sec's. 1-12
			M & E, prob's. 3.10, 4.1
VIII	Gain - Rate Eq's	Gas Lasers: HeNe, CO ₂ , Ar ⁺	M&E, Sec's. 5.8 - 5.11
10/16	Longitudinal Modes,	Single Mode - Lamb dip	M&E, 7.1-7.9, espec. 7.5 & Table 7.1
		Begin Tunable & Dye Lasers	prob's 7.1, 7.3a, 7.4; prove Eq. 7.5.6
IX	Dye Laser Resolution	Gaussian Beams and	M&E, 11.3 - 11.11
10/23	More About Tunable Lasers	Confocal Resonators	M & E, prob's. 11.4, 11.7, 11.9
	Saturated Absorption Spect.	Ring Laser Cavities	
X	Solid State Lasers	I & T dependence for diodes	M & E, 11.12 - 11.15
10/30	Ti:Sapphire, DPSS, and	Saturated Abs., Modulators,	no prob's - catch up
	Semiconductor Lasers	& Pound-Drever-Hall	
XI	Non-Linear Optics	Mode Locked Lasers	TBA
11/6	Harmonic Generation	Pulsed & Freq. Comb	
Applications of Lasers - Nobel Prizes.			
XII	Fiber Optics & Lasers - Limits	Laser Cooling & Temp. Limit	M&E 8.6, 8.7, 14.7
11/13	to Telecom – Nanofibers	Breaking the Limit	
XIII	Magnetic Traps & Optical	NO CLASS	M&E 14.4 - 14.6
11/20	Lattices For Neutral Atoms	THANKSGIVING	prepare for exam
XIV	Trapping and Confinement	Second Mid-term Exam	M&E All of ch. 14; prob's 14.6,
11/27	Optical Tweezers	In Class (closed book)	14.8a, 14.9a,b, 14.11, 14.14, 14.21
XV	Bose-Einstein	Resolution Limits	
12/4	Condensation		

(Required Statement)

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Any suspected instance of academic dishonesty will be reported to the Academic Judiciary. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at http://www.stonybrook.edu/uaa/academicjudiciary/

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.