PHYSICS 452/562 – – FALL 2021

ATOMIC PHYSICS AND LASERS

Lecture: Tθ – 11:30 - 12:50 as of August 18, 2021 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 # Monday date	Tuesday	Thursday	Reading & Homework
Background in Atomic Physics and Quantum Mechanics.			
I 8/23	Historical Background Classical models	Schrödinger Equation(s) Multiple solutions	vdS & M: Ch. 1, 2.1, 2.2 Problem set #1
II 8/30	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 9/6	Separate S.E. for H atom (Tom Weinacht)	Fine structure Relativity and spin-orbit	vdS & M: Ch. 7 Problem set # 3
IV 9/13	Atomic Clocks, Ramsey method, Selection Rules	Quantum defects Other Atoms (Eric Jones)	vdS & M: Ch. 8.1 - 8.5, 8.A, 8.B vdS & M: 10.1 - 10.3 Problem set # 4
V 9/20	Hyperfine structure Zeeman, Stark & dipole Quantum Transitions, Ω_R	21st Century Revolution in Quantum Mechanics Superposition, Entanglement	vdS & M: Ch. 3.2.1, 3.3, 3.5, 9.1 - 9.3 vdS & M: Ch. 11; Problem set #5
VI 9/27	A and B Coefficients Stimulated Emission	**First Mid-term Exam In Class (closed book)**	vdS & M: Ch. 5 *and* M & E: Sec. 3.7 M&E - Ch. 10, prob 10.10 & special
Laser Operation and Types of Lasers.			
VII 10/4	Introduction to Lasers Three and Four levels Gain - Rate Eq's	Longitudinal Modes, Single Mode - Lamb dip Saturated Absorption Spect.	M & E, Ch. 1 M & E, Ch. 4, Sec's. 1-12 M & E, prob's. 3.10, 4.1
VIII 10/11	**NO CLASS HOLIDAY**	Gas Lasers: HeNe, CO_2, Ar^+ 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 10/18	Gaussian Beams and Dye Laser Resolution Fabry-Perot Resonators	Confocal Resonators cont'd More About Tunable Lasers Ring Laser Cavities	M&E, 11.3 - 11.11 M & E, prob's. 11.4, 11.7, 11.9
X 10/25	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 11/1	Non-Linear Optics Harmonic Generation	Mode Locked Lasers Pulsed & Freq. Comb	TBA
Applications of Lasers - Nobel Prizes.			
XII 11/8	Fiber Optics & Lasers - Limits to Telecom – Nanofibers	Laser Cooling & Temp. Limit Breaking the Limit	M&E 8.6, 8.7, 14.7
XIII 11/15	Magnetic Traps & Optical Lattices For Neutral Atoms	Trapping and Confinement Optical Tweezers	M&E 14.4 - 14.6 prepare for exam
XIV 11/22	**Second Hour Exam In Class**	**NO CLASS THANKSGIVING**	M&E All of ch. 14; prob's 14.6, 14.8a, 14.6, 14.8a, 14.9a,b, 14.11, 14.14, 14.21
XV 11/29	Bose-Einstein Condensation	Resolution Limits	M&E All of ch. 14; prob's 14.6, 14.8a, 14.6, 14.8a, 14.9a,b, 14.11, 14.14, 14.21

(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 need to 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 6 October and 19 November (subject to change). This is designated as an in-person course but I have accommodated several requests to take the classes remotely. However, exams will be given at announced times in the classroom (P-118). 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.