PHYSICS 452/562 − − FALL 2024
ATOMIC PHYSICS AND LASERS

Lecture: Tθ – 11:30 - 12:50   as of June 18, 2024   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 8/26	Historical Background Classical models	Schrödinger Equation(s) Multiple solutions	vdS & M: Ch. 1, 2.1, 2.2 Problem set #1
II 9/2	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 9/9	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 9/16	Quantum defects Other Atoms	Hyperfine structure	vdS & M: 9.1 - 9.3, 10.1 - 10.3 Problem set # 4
V 9/23	Selection Rules Zeeman, Stark & dipole	A and B Coefficients Stimulated Emission Quantum Transitions, Ω_R	vdS & M: Ch. 3.2.1, 3.3, 3.5, 5.1, 5.2 vdS & M: Ch. 11; Problem set #5
VI 9/30	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
Laser Operation and Types of Lasers.			
VII 10/7	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 10/14	**NO CLASS HOLIDAY**	Gas Lasers: HeNe, CO_2, Ar^+	M&E, Sec's. 5.8 - 5.11
IX 10/21	Molecules & Dye Lasers Ring Cavity	Semiconductor Lasers I & T dependence for diodes	M & E, 11.12 - 11.15, 15.1, 15.2 no prob's - catch up
X 10/28	Solid State Lasers Nd:YAG & Ti:Sapphire,	Gaussian Beams and Confocal Fabry-Perot Resonances,	M&E, 11.3 - 11.11 M&E, 7.1-7.9, espec. 7.5 & Table 7.1 M & E, prob's. 11.4, 11.7, 11.9
XI 11/4	Modulators & Frequency control, Bay, Luther, & White Pound, Drever, Hall Saturation Spectroscopy	Non-Linear Optics Harmonic Generation	M&E 8.6, 8.7, 14.7
Applications of Lasers - Nobel Prizes.			
XII 11/11	Laser Cooling & Temp. Limit Breaking the Limit	Magnetic Traps & Optical Lattices For Neutral Atoms	M&E 14.4, 14.5
XIII 11/18	Bose-Einstein Condensation	Trapping and Confinement Optical Tweezers	M&E 14.4 - 14.6 prepare for exam
XIV 11/25	**Second Mid-term Exam In Class (closed book)**	**NO CLASS THANKSGIVING**	M&E All of ch. 14; prob's 14.6, 14.8a, 14.9a,b, 14.11, 14.14, 14.21
XV 12/2	Frequency comb	Fiber Optics & Lasers - Limits to Telecom – Nanofibers	

How the Course is Graded

HOMEWORK

Homework problems will be assigned regularly from either distribution in class (and posting on Brightspace) or taken from the text by Milonni and Eberly. They will be graded only when they're received on paper. Assignments submitted by email overtax my printer (it's not a commercial printer) so I will not 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 5 October and 23 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.