# 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  
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Text: van der Straten & Metcalf (Cambridge) find it at https://doi.org/10.1017/CBO9781316106242  
Text: Milonni & Eberly, 2nd Edition (Wiley)

### Week # | Monday # | Tuesday | Thursday | Reading & Homework
---|---|---|---|---
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
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, $\Omega_R$ | 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, CO₂, 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  
nor 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, Drexer, Hall Saturation Spectroscopy | Non-Linear Optics Harmonic Generation | M&E 8.6, 8.7, 14.7

### Applications of Lasers - Nobel Prizes.

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 |
(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/aa/academicjudiciary/

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.