**OPTI 544: FOUNDATIONS OF QUANTUM OPTICS, SPRING 2023**

**Homework:** One set roughly every two weeks.

**Midterms:** Mid-March, late April. Exact time and date TBD

**Final:** Thursday May 11, 10:30am-12:30pm

**Grading:** Weekly homework 20%
Midterm exams 40%
Final exam 40%

**Office hours:** Jessen: Tuesdays 2-3:30pm, Thursdays 2-3:30pm. Location: Meinel 604
Ian Marsh (TA): TBD. Location: TBD

**Questions and requests:** email jessen@optics.arizona.edu.

**Text:** There is no designated text for OPTI 544. In the past I have suggested “Lasers”, by P. W. Milonni and J. H. Eberly (ISBN 0471627313) to those who ask for one. This book is a good compilation of semiclassical optical and laser physics, but lacks any serious treatment of Quantum Optics. It is also out of print, though good second-hand copies have so far been easy to find on the web. I provide extensive class notes for the course, and in recent years all but a few students have found those to suffice. Warning: There is a newer book available by Milonni and Eberly called "Laser Physics". It is not the same book and will not be particularly useful for the course so there is no reason to buy it.

Class notes, problem/solution sets, and lectures (slides and video) will be posted online at

https://wp.optics.arizona.edu/opti544/

**Other texts that you may or may not find helpful:**

“Quantum and Atom Optics”, notes by Daniel Steck. Free download at http://atomoptics.uoregon.edu/~dsteck/teaching/quantum-optics/

“Introduction to Quantum Optics”, by G. Grynberg, A. Aspect, and C. Fabre.

“Quantum Optics”, by M. O. Scully and M. S. Zubairy.


Course Outline:
2. Two-level atom and classical electric field. Rabi solutions. Comparison to Lorentz atom.
8. Introduction to Quantum Field Theory. Quantum theory of sound, Phonons.

Prerequisites:
OPTI 570 or similar graduate-level introductory quantum mechanics course. Familiarity with the topics listed under Topics and Activities at this link:

https://wp.optics.arizona.edu/opti570/course-description/

Note: OPTI 511R is not sufficient preparation for OPTI 544.
Lectures 2021 – 2022

1  Jan 13 Start Classical
2  Jan 15
    Jan 18 MLK Day
3  Jan 20
4  Jan 22
5  Jan 25
6  Jan 27 End Classical, start SemiClassical
7  Jan 29
8  Feb 1
9  Feb 3 End 2-level
10 Feb 5 Begin MultiLevel
11 Feb 8
12 Feb 10 End Multilevel HW 2 posted
13 Feb 12 Begin Raman
14 Feb 15 End Raman, Begin Density
15 Feb 17
16 Feb 19 HW 2 Due
17 Feb 22 End Density, begin Rate
18 Feb 24
19 Feb 26 HW 4 posted
20 Mar 1 End Rate, Begin OBE
21 Mar 3
22 Mar 5 End OBE
23 Mar 8 Begin MBE, HW 4 Due
    Mar 10 Reading Day HW 5 posted
    Mar 12 Midterm
24 Mar 15 End MBE
25 Mar 17 Begin Lasers
26 Mar 19
27 Mar 22 HW 5 due HW 6 posted
28 Mar 24 End Lasers
29 Mar 26 Begin Intro FT
30 Mar 29 End Intro Field Theory
31 Mar 31 Begin QED HW6 due
    Apr 2  Reading Day
32 Apr 5 End intro to FT/Begin QED
33 Apr 8 End intro to FT/Begin QED
34 Apr 11 End intro to FT/Begin QED
35 Apr 14 End intro to FT/Begin QED
36 Apr 17 End intro to FT/Begin QED
37 Apr 20 End intro to FT/Begin QED
38 Apr 23 End intro to FT/Begin QED
39 Apr 26 End intro to FT/Begin QED
40 Apr 29 End intro to FT/Begin QED
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>32 Apr 5</td>
<td>End QED</td>
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<td>33 Apr 7</td>
<td>Beamsplitter</td>
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<td>34 Apr 9</td>
<td>Begin SOTF, HW7 due</td>
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<td>35 Apr 12</td>
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<td>36 Apr 16</td>
<td>No lecture, HW8 Posted</td>
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<td>37 Apr 19</td>
<td>End SOTF, Begin QLM</td>
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<td>Apr 21 Reading Day</td>
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<td>38 Apr 23</td>
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<td>39 Apr 26</td>
<td>End QLM, HW8 Due, HW9 posted</td>
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<td>40 Apr 28</td>
<td>Begin WW</td>
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<td>41 Apr 30</td>
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<td>42 May 3</td>
<td>WW, HW9 Due</td>
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<td>43 May 5</td>
<td>Extra day</td>
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<td>May 7 Final Exam 10:30-12:30</td>
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2020: Total: 43 lectures, after losing 4 to travel/Covid/ midterms and gaining 2 from makeups.
2021: Total: 43 lectures, after losing 2 to midterms. 2 makeups?
2022: Total: 43 lectures, after losing 2 to midterms. Makeups? Midterm on April 22