

## EE698Y: Introduction to Quantum Optics (Spring 2023)

**Lecture room and time:** ACES-213 | MW 5:15 pm - 6:30 pm

**Instructor:** Shilpi Gupta | office: ACES-224 | email: ShilpiG@iitk.ac.in | phone: 6231

**Office hour:** ACES-224, Mon 4-5 pm

### Syllabus

The course is aimed at understanding interaction of quantized matter with light. The course will start with semi-classical interaction of electromagnetic field with matter that will include interaction Hamiltonian, transition rates, density matrix and Bloch equations and Rabi frequency. Next, the course will cover quantization of electromagnetic field, classical and non-classical states of light, and finally quantum mechanical interaction of electromagnetic field with matter.

**Prerequisite:** Basic quantum mechanics

Books:

1. R.L. Liboff, Introductory Quantum Mechanics (Addison Wesley). [[Google-book link](#)]
2. A. Yariv, An Introduction to Theory and Applications of Quantum Mechanics (John Wiley & Sons). [[Google-book link](#)]
3. D. J. Griffiths, Introduction to Quantum Mechanics (Pearson Prentice Hall). [[Google-book link](#)]

Video lectures from EE683A:

<https://youtube.com/playlist?list=PLHpy71E0dpoZoUs7EuY430ipwyEMDiBhx>

### References

1. Gerry and Knight, Introduction to quantum Optics, Cambridge, 2005. [partially available as google book]
2. Mark Fox, Quantum Optics: An Introduction, Oxford University press, 2006.
3. Walls and Milburn, Quantum Optics, Springer, 2008 [available as eBook through IITK library]
4. Scully and Zubairy, Quantum Optics, Cambridge, 1997.
5. Milonni and Eberly, Lasers, John Wiley & Sons, NewYork 1988.
6. Allen and Eberly, Optical Resonance and two-level atoms, Dover, 1987.
7. Mandel and Wolf, Optical Coherence and Quantum Optics, Cambridge, 1995.
8. Alan Aspect, "Quantum Optics 1: Single Photons", Coursera
9. Immanuel Bloch and Simon Folling, "Introduction to Quantum Optics", earlier on Coursera

### Marks Distribution

We will follow a continuous evaluation system that will enable steady learning and alleviate dependence of overall grade on a few events.

- Quizzes (bi-weekly): 30%
- Assignments (bi-weekly): 10%
- Midsem exam: 25%

- Endsem exam: 30%
- Weekly Summary: 5%

### **Quizzes**

1. Bi-weekly quizzes every Monday [5 quizzes]:  
Tentative dates- Jan 23, Feb 6, Mar 13, Mar 27, Apr 10
2. Best n-1 out of n quizzes will count towards grade.
3. No makeup option for a missed quiz.

### **Assignments**

1. One problem set every two weeks (~ 5-6 assignments).
2. Solutions need to be prepared in LaTeX and submitted as pdf files
3. Late submissions will not be entertained.

### **Endsem exam: Project**

1. After the midsem exam, you will work on a small research problem based on the course content.
2. The project work will involve deriving analytical expressions, numerical simulations, analyzing results, preparing a brief report with all codes appended, and presenting the project work to rest of the class.
3. Please note that the instructor will ask you to explain your codes.

### **Exams**

1. Exams will cover the entire portion of the syllabus covered till the exam day.
2. There will be no option for missing the exams, except for unavoidable circumstances in which case prior discussion with the instructor is necessary.
3. Revaluation of answer sheets will be done only if correct solution has been marked incorrect. No requests for more/mercy marks will be entertained. If during revaluation, more mistakes are found in the solution, marks can be deducted.

### **Weekly Summary**

Provide minimum of two doubts from the previous week's lectures via mookit.

### **Cheating/Unethical Practices**

Cheating/Unethical means are NOT ACCEPTABLE in any part of the course (quizzes, assignments, project, exams, etc.). Such cases, if any, will be dealt with strict punishment: administrative action and/or lowering of grade by atleast two grade-points.

Assignments: Please feel free to discuss problems with anyone (including google!). But write down the solution yourself and only if you understand it. And, if the lead for the solution came from someone else, please acknowledge the source (remember it is not your own work). Please note that your submissions will be checked for plagiarism and the instructor can ask you to explain what you have submitted.

### **Grading**

No mercy pleas for better grades will be entertained.

### **Communication and Interaction**

1. The communication for the course will happen through emails and mookit. Please feel free to contact the instructor.
2. Please make use of the discussion forum on mookit to discuss your doubts.