

Quantum Optics, IPT5340 (PHYS6840)

Time: W3W4F3 (10:10-12:00 AM, Wednesday; 10:10-11:00 AM, Friday), at Room 104, EECS bldg.

Ray-Kuang Lee¹

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- **Course Description:**

- The field of quantum optics has made a revolution on modern physics, from laser, precise measurement, Bose-Einstein condensates, quantum information process, to the fundamental issues in quantum mechanics.
- Through this course, I want to provide an in-depth and wide-ranging introduction to the fundamental concepts for quantum optics, including physical concepts, mathematical methods, simulation techniques, basic principles and applications.
- Current researches on non-classical state generation, quantum noise measurement, nonlinear quantum pulse propagation, quantum interference, quantum information science, Bose-Einstein condensates, and atom optics would also be stressed.
- Background requirements: Basics of quantum mechanics, electromagnetic theory, and nonlinear optics.

- **Text Books and References:**

1. In-class handouts.
2. Marlan O. Scully, and M. Suhail Zubairy, "*Quantum Optics*", Cambridge (1997).
3. Yoshihisa Yamamoto, Atac Imamoglu, "*Mesoscopic Quantum Optics*", Wiley (1999).
4. D.F. Walls, G.J. Milburn, "*Quantum Optics*", Springer (1995).

- **Teaching Method:**

in-class lectures with discussion and project studies.

- **Syllabus:**

1. A brief review about Quantum Mechanics,
2. Quantum theory of Radiation,
3. Coherent and Squeezed States,
4. Quantum Distribution Theory,
5. Atom-field interaction, semi-classical and quantum theories,
6. Quantum theory of Fluorescence,
7. Cavity Quantum ElectroDynamics (Cavity-QED),
8. Quantum theory of Lasers,
9. Quantum theory of Nonlinear Optics,
10. Quantum Non-demolition Measurement (QND),
11. Quantum theory for Nonlinear Pulse Propagation,
12. Entangled source generation and Quantum Information,
13. Bose-Einstein Condensates (BEC) and Atom Optics,
14. Quantum optical test of Complementarity of Quantum Mechanics,
15. Quantum optics in Semiconductors,
16. Semester reports.

- **Evaluation**

1. Homework $\times 8 - 12$ (weekly or biweekly), 80%, formula derivations, concept explanations, and preview.
2. Semester Report, 20%.

- **Office hours:**

13:30-15:30, Monday at Room 523, EECS bldg.

- **More information:**

<http://mx.nthu.edu.tw/~rkleee>

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