

# Quantum Optics, IPT5340 (PHYS6840)

**Time: T5T6F5** (01:10-03:00 PM, Tuesday; 01:10-02:00 PM, Friday), at Room **106**, EECS bldg.

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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. C. C. Gerry and P. L. Knight, *"Introductory Quantum Optics,"* Cambridge (2005).
3. Mark Fox, *"Quantum Optics - An Introduction,"* Oxford (2006).
4. Marlan O. Scully and M. Suhail Zubairy, *"Quantum Optics,"* Cambridge (1997).
5. Yoshihisa Yamamoto and Atac Imamoglu, *"Mesoscopic Quantum Optics,"* Wiley (1999).

## • Teaching Method:

in-class lectures with discussion and project studies.

## • Syllabus:

1. A brief review about Quantum Mechanics, (02/18, 02/22, 02/26)
2. Quantum theory of Radiation, (02/39, 03/04, 03/07)
3. Coherent and Squeezed States, (03/11, 03/14, 03/18, 03/21)
4. Quantum Distribution Theory, (03/25, 03/28, 04/01, 04/08, 04/11)
5. Atom-field interaction, semi-classical and quantum theories, (04/15, 04/18, 04/22)
6. Quantum theory of Fluorescence, (04/25, 04/29, 05/02)
7. Cavity Quantum ElectroDynamics, Cavity-QED, (05/13, 05/16, 05/20)
8. Quantum theory of Lasers, (05/23, 05/27, 05/30)
9. Quantum theory of Nonlinear Optics, (06/03, 06/06)
10. Quantum Non-demolition Measurement (QND),
11. Quantum theory for Nonlinear Pulse Propagation,
12. Entangled source generation and Quantum Information, (06/10, 06/13)
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  $\times 8$  (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>