Introduction to Quantum Photonics

Course number: 383P

Time: MW 3-4:30pm

Location: BUR 108

Instructor: Linran Fan, linran.fan@utexas.edu

Office location: EER 3.826, MER 2.606A

Office hours: By appointment

General Information

Description

This course will introduce the basic principle of quantum optics and the use of photonic systems for quantum information applications. We will start from the quantization of electromagnetic fields. Then we will introduce common quantum states of light, and corresponding generation methods. The detection and transformation of quantum states of light will also be covered. We will further expand the discussion to hybrid systems where optics interacts with other degrees of freedoms, such as acoustics and microwave fields, at the quantum level. In the end, the basics of quantum communications and quantum sensing with photonic systems will be discussed.

Tentative Course Topics

- Review of quantum mechanics
- Quantization of electromagnetic fields
- Photonics quantum states
- Representation of quantum states
- Coherence and correlation
- Quantum transformation and interference
- Entanglement and Bell Inequalities
- Detection of photonic quantum states
- Review of classical nonlinear optics
- Quantum phenomena with nonlinear optics
- Input-output relation of optical cavities
- Hybrid quantum systems & quantum transduction
- Quantum communications
- Quantum sensing

Prerequisites

Undergraduate quantum mechanics and electromagnetics.

Required Textbook

None.

Suggested Textbooks

- J. Sakurai, *Modern Quantum Mechanics Rev. Ed* (Addison-Wesley, 1994)
- D. F. Walls & G. J. Milburn, *Quantum Optics, Second Edition* (Springer, 2008)
- P. Kok & W. Lovett, *Introduction to Optical Quantum Information Processing* (Cambridge 2010)
- R. W. Boyd, *Nonlinear Optics, Third Edition* (Elsevier 2010)

Grading

- 25% Homework (approximately biweekly)
- 20% Exam I
- 25% Exam II
- 20% Final presentation
- 10% Class Participation.

Add/Drop Policy

An engineering student must have Dean's approval to add/drop after the fourth class day of the semester.

Academic Honesty

Students should submit their own independent solutions to homework and exams. Plagiarism or any form of academic dishonesty (cheating includes, but is not limited to, copying another student's work, copying material directly from a book, article or web site without including appropriate references, falsifying data, doing someone's work) is a violation of University rules and may return a grade of zero for each assignment in which it is detected or may incur even steeper penalties. For University policies see: http://deanofstudents.utexas.edu/conduct/academicintegrity.php

Students with Disabilities

UT provides upon request appropriate academic accommodations for qualified students with disabilities. Disabilities range from visual, hearing, and movement impairments to ADHD, psychological disorders (e.g. depression and bipolar disorder), and chronic health conditions (e.g. diabetes and cancer). These also include from temporary disabilities such as broken bones and recovery from surgery. For more information, contact Office of Disability and Access at (512) 471-6259 [voice], (866) 329-3986 [video phone], ssd@uts.cc.utexas.edu, or http://ddce.utexas.edu/disability.

Mental Health Counseling

Counselors are available Monday-Friday 8am-5pm at the UT's Counseling and Mental Health Center (CMHC) on the 5th floor of the Student Services Building (SSB) in person and by phone (512-471-3515). The 24/7 UT Crisis Line is 512-471-2255.

Accommodations for Religious Holidays

Section 51.911 states that a student shall be excused from attending classes or other required activities, including examinations, for the observance of a religious holy day, including travel for that purpose.

A student whose absence is excused under this subsection may not be penalized for that absence and shall be allowed to take an examination or complete an assignment from which the student is excused within a reasonable time after the absence. University policy requires students to notify each of their instructors as far in advance of the absence as possible so that arrangements can be made. By UT Austin policy, you must notify the instructor of your pending absence at least fourteen days prior to the date of observance of a religious holiday.

Campus Carry

The University of Texas at Austin is committed to providing a safe environment for students, employees, university affiliates, and visitors, and to respecting the right of individuals who are licensed to carry a handgun as permitted by Texas state law. For more information, please see http://campuscarry.utexas.edu/students.

Recommendations Regarding Emergency Evacuation from the Office of Campus Safety and Security (http://www.utexas.edu/safety/)

- Occupants of buildings on The University of Texas at Austin campus are required to evacuate buildings when a fire alarm is activated. Alarm activation or announcement requires exiting and assembling outside.

- Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building.

- Students requiring assistance in evacuation shall inform their instructor in writing during the first week of class.

- In the event of an evacuation, follow the instruction of faculty or class instructors; exit in an orderly fashion and assemble outside.

- Do not re-enter a building unless given instructions by the following: Austin Fire Department, The University of Texas at Austin Police Department, or Fire Prevention Services office.

- Behavior Concerns Advice Line (BCAL): 512-232-5050

- Link to information regarding emergency evacuation routes and emergency procedures can be found at: http://www.utexas.edu/emergency