

國立台灣大學電機工程學系/光電工程學研究所  
(九十七學年度第二學期)

課程名稱: 非線性光學 (Nonlinear Optics)

選修或必修: 選修

學分: 3

修習年級: 研究生及大學部三四年級

教師姓名: 孫啟光(電機二館 319 室)

每週時數: 演講及討論三小時

內容綱要:

Principles of nonlinear optics with emphasis on the fundamental aspects of nonlinear optical theory and techniques. Course will cover: Maxwell's equations and the description of nonlinear processes. Nonlinear polarization, coupled wave equations, phase matching, and propagation. EO effect and nonlinear frequency generation. Third order optical nonlinearities. The quantum mechanical description of nonlinear phenomena. The two level atom, density matrix theory, perturbation theory, and double-Feynman diagram. Applications of nonlinear optical techniques for experimental measurement including Raman spectroscopy, photon echoes, and time-resolved spectroscopy.

評分方法: 作業 40%, 期中考 30%, 期末考 30%

參考書目:

1. Shen, The Principles of Nonlinear Optics
2. Boyd, Nonlinear Optics
3. Yariv, Optical Waves in Crystals
4. Haus, Waves and Fields in Optoelectronics

# 非線性光學

## 課程簡介

### Part 1:

- 2/17 Introduction
- 2/24 Anharmonic oscillator
- Nonlinear  $\chi$
- 3/3 Tensor analysis
- Rotation and transformations
- kDB formalism
- 3/10 Indicatrix,  $r_{ijk}$  tensor
- EO modulator
- 3/17 Wave equation and envelope approximation
- SHG and phase matching
- 3/24 Bandwidth and pulse propagation effects
- Properties of  $\chi^{(2)}$  and  $d_{eff}$  tensor
- 3/31 SHG with depletion
- Sum and difference frequency processes
- Parametric amplifier and oscillator
- 4/7 Third-order nonlinearity
- FWM and solitons
- 4/14 Midterm
- 4/21 Instantaneous polarization
- Harmonic generation with a tightly focused beam

### Part 2:

- 4/28 Quantum Physics and perturbation theory
- 5/5 Atom-field interaction and two level atom
- Fermi-Golden rule and Rabi frequency
- 5/12 Density matrix and linear polarization
- Saturation in two-level atom
- 5/19 Integral equation and steady state
- Raman scattering
- 5/26 Diagrammatic Representation
- Feynman diagram
- 6/2 CLEO Conference
- 6/9 FWM and time-resolved spectroscopy