课程大纲

COURSE SYLLABUS

1.	课程名称(中英文) **Course Title(Chinese and English)**	非线性光学 **Nonlinear Optics**
2.	**课程类别 Course Type**	选修
3.	授课院系 **Originating Department**	电子与电气工程系 Department of Electrical and Electronic Engineering
4.	**课程学时 Credit Hours**	48
5.	**课程学分 Credit Value**	3
6.	授课语言 **Teaching Language**	英语和汉语 English and Chinese
7.	**授课教师 Instructor(s)**	张新海 Zhang Xinhai
8.	先修课程、其它学习要求 **Pre-requisites or Other Academic Requirements**	光学基础，量子力学 Fundamentals of Optics, Quantum Mechanics

9. 教学目标 Course Objectives

本课程的教学目标：

1） 让学生打下非线性光学的坚实基础；
2） 让学生透彻理解非线性光学的基本原理
3） 为学生将来从事非线性光学领域的研究打下基础

The objectives of this course are:

a. To lay the foundation of nonlinear optics for the students;
b. To build the students a thorough understanding of principles of nonlinear optics;
c. To prepare the students for conducting research in the field of nonlinear topics.

10. 教学方法及授课创新点 Teaching Methods and Innovations

采用课堂讲授、课堂讨论和实验室实验相结合的方法。通过课堂讨论激发学生的主动学习的积极性，通过实验室实验加深学生对所学内容的理解以及增强学生的动手能力。

Combining the lectures, discussion, and experiments, inspire the students to learn more actively, enhance the students's understanding of the principles of nonlinear optics and capability of conducting research in this field.

11.	教学内容及学时分配 Course Contents and Course Schedule
	非线性光学性质：线性与非线性光学性质（重点是 $x^{(2)}$ 和 $x^{(3)}$）；线性和非线性介质中波的传播和耦合方程。（5 小时） 二阶非线性光学效应：二次谐波和相位匹配技术; 和频和差频的产生；参量放大和振荡；准相位匹配技术并对光子晶体做介绍。（15 小时） 三阶非线性光学效应：四波相互作用和耦合方程;四波混频和相位共轭；强光束致折射率变化（光克尔效应，自聚焦/散焦，自相位调制）；非线性光学吸收（双光子吸收，可饱和吸收与反饱和吸收）；电光效应，光折变效应。（15 小时） 超快激光器和超快非线性光学：光学脉冲（线性和非线性介质中的短脉冲传播，啁啾脉冲，群速度色散，光学元件）；飞秒激光脉冲的产生和锁模方法；脉冲放大，压缩和测量；实验技术（泵浦探测，超快光克尔门，荧光上转换和条纹相机）。（5 个小时） Nonlinear Optical Susceptibilities: Linear & nonlinear optical susceptibilities (focusing on $\chi^{(2)}$ and $\chi^{(3)}$); Wave propagation and coupling equations in linear and nonlinear media. (5 hours) Second-order nonlinear optical effects: Second harmonic generation and phase matching technology; Sum- and difference-frequency generation; Parametric amplification and oscillation; Quasi-phase matching technique and Introduction to Photonic crystals. (15 hours) Third-order nonlinear optical effects: Four wave interaction and coupling equation; Four-wave-mixing and phase conjugation; Intense beam induced refractive index change (Optical Kerr effect, self-focusing/defocusing, self-phase modulation); Nonlinear Optical Absorption (Two-photon absorption, saturable absorption and reverse saturable absorption); Electro-optic, acousto-optics and photorefractive effects. (15 hours) Ultrafast laser and ultrafast nonlinear optics: Pulsed optics (short pulse propagation in linear and nonlinear media, chirped pulse, group-velocity-dispersion, optical elements); femtosecond laser pulse generation and mode-locking method; pulse amplification, compression, and measurement; experimental techniques (pump-probe, ultrafast optical Kerr gate, fluorescence up-conversion and streak camera). (5 Hours)
12.	课程考核 Course Assessment
	平时作业：10% 期中考核：30% 期末考试：60% Test: 30% Final Examinations: 60% Others: Tutorials 10%
13.	教材及其它参考资料 Textbook and Supplementary Readings
	1. Robert W. Boyd, “Nonlinear Optics”, Boston: Academic Press (2003) (textbook) 2. Y. R. Shen, “The Principles of Nonlinear Optics”, John Wiley & Sons (2003) (Reference)