课程详述

COURSE SPECIFICATION

  以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

  The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	课程名称 Course Title	信息光学基础 Fundamentals of Information Optics
2.	授课院系 **Originating Department**	电子与电气工程系 Department of Electrical and Electronic Engineering
3.	课程编号 **Course Code**	EE 327
4.	课程学分 Credit Value	3
5.	课程类别 **Course Type**	专业选修课 Major Elective Courses
6.	授课学期 **Semester**	秋季 Fall
7.	授课语言 **Teaching Language**	中英双语 English & Chinese
8.	授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师） **Instructor(s), Affiliation & Contact** （**For team teaching, please list all instructors**）	张福才副教授，电子与电气工程系 Email：zhangfc@sustc.edu.cn Fucai ZHANG(Associate Professor) Department of Electrical and Electronic Engineering
9.	实验员/助教、所属学系、联系方式 **Tutor/TA(s), Contact**	待公布 To be announced
10.	选课人数限额(可不填) **Maximum Enrolment** （**Optional**）	

11.	授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other（Please specify）	总学时 Total
	学时数 Credit Hours	32		32		64

12.	先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	EE205 信号和系统 EE205 Signals and Systems
13.	后续课程、其它学习规划 Courses for which this course is a pre-requisite	
14.	其它要求修读本课程的学系 Cross-listing Dept.	物理系 Department of Physics 生物医学工程 Department of Biomedical Engineering

教学大纲及教学日历 SYLLABUS

15.　教学目标 Course Objectives

通过讲述信息光学的基本概念及典型应用，使学生具备以下知识和技能：

- 能够理解信息光学及其应用的基本概念，包括线性空间不变系统，空间和频域分析，基本傅立叶变换及其性质和应用；

- 运用信息光学中常用数学工具的能力，包括卷积、相关、微分、采样。以及光学卷积、增强等技术的实现方法；

- 设计光学系统和进行实验以及分析和解释数据的能力。

- 具有使用操作,变换,频域分析和传递函数等知识,解决信息光学及光学信息处理等方面问题的能力。

To introduce the fundamental principles and concepts of information optics and the methodology of optical information processing. Upon the completion, the students would gain the following knowledges and skills:

- Understand the basic concept of information optics, including linear spatial invariant systems, spatial and frequency domain analysis, basic Fourier transforms and their properties and applications;

- An ability to use the mathematical tools in information optics, including convolution, correlation, differentiation, sampling，as well as implementation methods of optical convolution, enhancement;

- An ability to use Fourier transforms, frequency-domain analysis, and transfer function to solve problems in information optics and optical information processing.

- An ability to design an optical system and conduct experiments, as well as to analyze and interpret data;

16.　预达学习成果 Learning Outcomes

- 使学生掌握线性系统、标量衍射理论等基本理论知识，了解光全息技术和图像的全息显示等前沿领域的原理。

- 具备运用光信息处理技术解决典型光学成像问题的能力，并能思考改进的途径。

- 将光信息处理知识,分析方法应用其它领域。

  After completing this course，the students will be able to

- Master the basic knowledge of linear systems, scalar diffraction theory, and understand the principles of frontier fields

such as holographic microscopy, holographic display, or computational imaging.

- An ability to solve typical optical imaging problems and conceive ways of making improvement.

- An ability to extend the knowledge and skills to other related research fields.

17. 课程内容及教学日历 （如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）
Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

教学内容：

线性系统分析：掌握傅立叶变换及其性质，熟悉几个常用的非初等函数。掌握二维线性系统的分析及用傅立叶分析方法对二维光场进行分析。

标量衍射理论：理解基尔霍夫衍射理论，掌握衍射的角谱理论、理解夫琅和费衍射和菲涅耳衍射。

光学成像系统的频谱分析：掌握透镜的傅立叶变换性质、薄透镜的位相变换作用，相干照明、衍射受限系统的成像分析，掌握衍射受限相干、非相干系统的传递函数及其比较。

空间滤波：掌握空间滤波的基本原理，了解空间滤波应用。

光学全息：理解全息原理及实验装置，了解典型全息图及计算全息的理论基础。

信息光学新进展*：了解全息显微，条纹投影测量以及相干衍射成像等。

Course Contents

- 2D Linear system Fourier analysis
- Scalar diffraction theorem
- Analysis of an optical imaging system in the spectrum domain
- Spatial filtering and its applications
- Holography: holographic microscopy and computer generated hologram
- Case study and recent advances in information optics

课程内容		学时分配	教学周次
傅里叶分析 (6) Fourier analysis	信息光学概述 Introduction to information optics	1	1
	二维傅里叶变换的性质，常用非初等函数（狄拉克函数，梳状函数）的傅里叶变换 The properties of two-dimensional Fourier transform, Fourier transform of non-elementary function (Dirac function, comb function)	2	1
	空间频率和空间频率的局域化 spatial frequency and its localization	1	1
	线性空不变系统，传递函数，二维抽样定理 Linear space invariant system, transfer function, two-	2	2

	dimensional sampling theorem,		
标量衍射理论 (4) Scalar Diffraction Theory	光波的数学描述 Mathematical description of light field	1	3
	基尔霍夫衍射理论，衍射的角谱理论 Kirchhoff diffraction theory, angular spectrum theory of diffraction	2	3
	夫琅禾费衍射，菲涅耳衍射 Fraunhofer diffraction, Fresnel diffraction	1	3
成像系统分析 (10) Analysis of imaging system	透镜的相位调制作用，成像性质，4f 成像系统 Property of lens as a phase modulator or an imaging component, 4-f imaging system	2	4
	相干成像系统谱域分析，阿贝二次成像理论 Spectral domain analysis of coherent imaging system, Abbe's theory of imaging	6	5，6
	非相干成像系统分析 Analysis of incoherent imaging system	2	7
全息 (4) Holographic	全息术的基本原理，同轴全息术，傅里叶全息术 Fundamentals of holography, online and Fourier holography	1	8
	计算全息图，数字全息显微成像 Computer generated hologram, digital holographic microscopy	3	8, 9
实例和最新进展 (8) Examples and latest developments	条纹投影 Fringe projection	4	10, 11
	相干衍射成像 Coherent Diffraction Imaging	4	12,13

实验课的教学日历

序号	实验项目	学时分配	开课起始周次
1	二维傅里叶变换，抽样定理 Two dimensional Fourier transform, 2D sampling theorem	4	2
2	衍射积分的 Fourier 算法，Fresnel 算法，角谱算法 Fourier algorithm, Fresnel algorithm, and angular spectrum algorithm for wave propagation calculation	6	3
3	空间滤波 Spatial filtering	6	7-
4	同轴全息记录与再现 Recording and reconstruction of online hologram	4	9

5	离轴全息记录与再现 Recording and reconstruction of off-axis hologram	4	9
6	计算全息图 Computer generated holograms	4	10
7	条纹投影形貌测量 Fringe projection topography	4	12

18. 教材及其它参考资料 Textbook and Supplementary Readings

1. Introduction to Fourier Optics （Third edition), Joseph W. Goodman, Roberts & Company Publisher ISBN 0-9747077-2-4

2 .傅里叶光学导论（第三版）Joseph W. Goodman 著，秦克诚等译, 电子工业出版社， ISBN 9787121301063

课程评估 ASSESSMENT

19.

评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		10		
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects		40		
平时作业 Assignments		20		
期中考试 Mid-Term Test				
期末考试 Final Exam				
期末报告 Final Presentation		30		

其它（可根据需要改写以上评估方式） **Others (The above may be modified as necessary)**				

20. 　　**记分方式 GRADING SYSTEM**

☑ A. 十三级等级制 **Letter Grading**
☐ B. 二级记分制（通过/不通过） **Pass/Fail Grading**

课程审批 REVIEW AND APPROVAL

21. 　　**本课程设置已经过以下责任人/委员会审议通过**
This Course has been approved by the following person or committee of authority