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**	现代物理技术实验 Physics laboratory III
2.	**授课院系 Originating Department**	物理系 Physics Department
3.	**课程编号 Course Code**	PHY202
4.	**课程学分 Credit Value**	2
5.	**课程类别 Course Type**	专业基础课 Major Foundational Courses
6.	**授课学期 Semester**	春季 Spring
7.	**授课语言 Teaching Language**	中文 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）**	1. 杨珺，工程师，物理系 第一教学楼 333 室 yangj@sustech.edu.cn 0755-8801-8706 Yang Jun, Engineer, Physics Department, Rm333, Lecture Hall I, yangj@sustech.edu.cn 0755-8801-8706 2. 王才林，工程师，物理系 第一教学楼 335 室 Wangcl@sustech.edu.cn 0755-8801-8710 Wang Cailin, Engineer, Physics Department, Rm335, Lecture Hall I, wangcl@sustech.edu.cn 0755-8801-8710 3. 张贤高，工程师，物理系 第一教学楼 332 室 Zhangxg@sustech.edu.cn 0755-8801-8703

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		Rm335, Lecture Hall I, wangxf3@sustech.edu.cn 0755-8801-8711 10. 张欢，工程师，物理系 第一教学楼 337 室 zhangh@sustech.edu.cn 0755-8801-8704 Zhang Huan, Engineer, Physics Department, Rm337,Teaching Building 1, Zhangh@sustech.edu.cn 0755-8801-8704
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	无 NA
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	8		56		64

12.	先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	大学物理 B 上（PHY103B）
13.	后续课程、其它学习规划 Courses for which this course is a pre-requisite	研究型物理实验， Physics Laboratory IV
14.	其它要求修读本课程的学系 Cross-listing Dept.	

教学大纲及教学日历 SYLLABUS

15. **教学目标 Course Objectives**

本课程将涉及现代物理实验技术的综合性、设计性实验。并增加研究性实验项目，使得本课程涉及更加广泛的应用技术领域。

This course includes comprehensive experiments which relate to modern physics technologies. Research related projects are also included in this course, which aims to help students get profound understanding of application fields of modern physics.

16. **预达学习成果 Learning Outcomes**

学生在本层次物理实验中将学习现代物理技术实验的基本科学思想，科学方法，现代技术及其应用，使学生站在课堂眺望前沿，进一步激发学生的兴趣，培养学生实践能力、创新思维、创新能力。

Students can learn the scientific thoughts, methods, modern technologies and applications in this course. We aim to culture the students with abilities of creation and innovation. Students can get in touch of physics frontiers from this course, and their study interests on physics can be motivated.

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.)

教学周 第一周--第十六周

Weeks: 1st-16th

第一周—第二周 (Week 1 and 2)：

绪论：一. 现代物理技术实验课程教学要求 二. 现代物理技术实验思想与方法　　主讲人：邓冬梅

Introduction: 1: Requirements of Physics laboratory III

2：Methology of Physics laboratory III

教学周第三周—第十一周： 学生从十二个实验中选修完成九个实验

Week 3 to 11: Students choose 9 experiments from 12 experiments

实验一、激光散斑的测量

主要内容：1. 用相机记录客观散斑 2. 测量散斑的半径和面内位移。

Experiment 1: Measurement of Laser Speckles

Content: 1. Record objective laser speckles by camera

2. Determine mean size and in-plane translation of laser speckles

实验二、傅里叶光学的空间频谱及空间滤波实验

主要内容：1. 4f 光学系统的空间滤波实验 2. 单透镜系统的空间滤波实验

Experiment 2: The spatial spectrum and filtering based on Fourier optics

Content:1. Spatial filtering with 4f-Optical-System

2. Spatial filtering with simple lens system

实验三、马赫-曾德光纤干涉实验

主要内容: 1.了解马赫曾德干涉仪的原理 2.搭建马赫-曾德光纤干涉仪 3.定性观察环境因素（温度、压力）对干涉条纹的影响。

Experiment 3: Mach-Zehnder interferometer

Content: 1. Understand the principle of the Mach-Zehnder interferometer 2. Build up the Mach-Zehnder fiber

interferometer 3. Qualitatively observe the influence of environmental issues (temperature, pressure) on the interference fringes.

实验四、全息术及其应用

实验内容：1.　　掌握菲涅尔全息照相原理，理解全息照相的本质。2.　学会全息照相的干涉记录和衍射再现的技术手段。

Experiment 4 Holography and its application

Content: 1. Master the principle of fresnel holography and understand its essence.

2. Master the technologies of interference recording and diffraction reconstruction in holography.

实验五、椭圆偏振光法测定介质薄膜厚度及折射率

主要内容：1. 调节椭偏仪光路共轴

2. 确定起偏器、检偏器和波片的起始位置

3. 测量起偏角和检偏角

4. 编程计算薄膜厚度和折射率

Experiment 5: Measurements of thickness and refractive index of thin film by ellipsometer

Content: 1. Adjust ellipsometer to ensure coaxiality

2. Initialize polarizer, analyzer and wave plate

3. Measure polarizer angle and analyzer angle

4. Calculate thickness and refractive index by programming

实验六、钠原子光谱

主要内容：1.光栅单色仪的定标 2.钠光谱的测量 3.根据测量值由同一谱线的波数差计算钠原子光谱各线系的里德伯常数 R 和量子缺。

Experiment 6: Sodium atomic spectrum

Contents: 1.Normalization of grating monochromator

2. Measurement of Sodium spectrum

3. Calculate the Rederburge constant and quantum defect according to the wavenumber difference in each series spectrum.

实验七、光纤基础综合实验

主要内容：1.了解光纤传导原理，熟悉光纤光路调节 2.测量单模及多模光纤的耦合效率，从实验观察单模及多模光纤端面出射的光斑图像 3.单模光纤数值孔径的测量

Experiment 7: Fundamentals of optical fiber

Contents: 1. Understand the principle of light transmission in an optical fiber.

2. Measurement of the coupling efficiency of single- and multi-mode optical fibers, and the observation of their corresponding laser patterns.

3. Measurement of the numerical aperture of a single-mode fiber.

实验八、塞曼效应实验

主要内容：1.调节光路共轴，观察垂直于磁场方向的塞曼谱线分裂 2.区分垂直于磁场方向的塞曼谱线分裂的σ成分和π成分，测量谱线间距，计算电子荷质比 3.将电子荷质比的测量值与理论值相比较，计算相对误差，分析误差来源。4.平行于磁场方向观察谱线的塞曼分裂，观察并记录分裂谱线随磁场的变化。

Experiment 8、 Zeeman effect experiment

Content: 1. Make sure the optical path coaxial and perpendicular to the magnetic field direction, observe the splitting of the Zeeman spectrum in this condition.

2. Based on step 1, find the difference between σ and π spectrum, then measure the circle-spacing of the splitting spectrum, finally, calculate the charge mass ratio .

3. Compare the measurement value with the theoretical value, then calculate the relative error and analysis the source of errors.

4. Make sure the optical path parallel to the magnetic field direction. To investigate the relationship between the splitting of spectral line and the magnetic field changing.

实验九、真空镀膜与薄膜性能检测

实验内容:1 熟练掌握直流溅射沉积技术的基本原理及应用；2 掌握机械泵的结构、性能，利用机械泵获得真空；3 用直流溅射方法，在微晶玻璃制备金膜和银膜。4 利用四探针法测量薄膜样品的电阻率

Experiment： DC sputtering

Content： 1 Understand the principle and applications of DC sputtering technique;

2 Understand the construction, performance and applications of the mechanical pump, and obtain vacuum with mechanical pump;

3 Deposit Au or Ag film on microcrystalline glass substrates by DC sputtering method.

4 Measure the resistivity of the thin film with four probe method.

实验十、核磁共振实验

主要内容：1.熟悉仪器，用扫场法找出 CuSO4 水溶液中 1H 的共振信号 2.测量 1H 的　因子和 g 因子 3.在相同的 B0 下，测出 1H 核和 19F 核的共振频率，并用比较法计算 19F 核的　因子和 g 因子

研究内容：1. 研究共振信号的间距与射频频率的关系。2.比较 FeCl3 水溶液和 CuSO4 水溶液的共振信号，观察顺磁离子对共振信号的影响，并解释之。

Experiment 11: The experiment of nuclear magnetic resonance

Contents: 1.Familar the instrument of nuclear magnetic resonance, and find the resonance signal of 1H in CuSO4 aqueous solution with the sweeping field method.

2.Measure the g factor and factor of 1H.

3.Measure the resonance frequency of 1H and the resonance frequency of 19F with the same B0, and calculate the g factor and ? factor of 19F with the comparison method.

Research contents

1. Investigate the relationship between the gap of resonance signal and the RF frequency.

2. Comparison of the resonance signals of FeCl3 aqueous solution and CuSO4 aqueous solution. Observe and explain the influence of paramagnetic ions on resonance signals.

实验十一、数字全息

主要内容：1.理解光学记录、数字记录、数字再现，光学实时再现； 2.利用软件实现数字记录、数字再现；3.搭建光路，实现光学记录，数字再现；4.将步骤 3 中获得的光学干涉条纹加载到液晶屏上，并利用参考光来实现光学再现；5. 将步骤 1 中的数字记录图像加载于液晶屏，实现光学再现

Experiment 12: Digital Holography

Content：1. Understand the principle of optical/digital recording and its related reconstruction

2. Achieve the digital reconstruction by using digital Fresnel holograms.

3. Build the optical path for recording optical interference patterns and reconstructing its corresponding digital image.

4. Load the interference patterns got in step 3 on a LCD, and use a beam of reference laser to illuminate the screen, so as to get the optical reconstruction image.

5. Load the digital Fresnel hologram got in step 2 to the LCD, and repeat step 4 to achieve optical reconstruction.

实验十二、法拉第效应及其应用

主要内容：1.学习法拉第磁致旋光效应的基本原理。2. 利用消光法测量旋光角, 并测量几种不同材料的维尔德常数。3. 利用法拉第磁致旋光效应，实现磁光调制。

Experiment 14: Faraday effect and its application

Contents: 1. Learning the basic principle of Faraday magneto-optical rotation effect.

2. Using the light extinction method to measure the angle of rotation, and measure the Verdet constant of several

different materials.

3. Achieving the magneto-optical modulation by using magneto-optical rotation effect of Faraday.

教学周第十二周—第十六周：探究性课题项目：

Week 12 to Week 16: Final Projects and defense

第一题：用全息方法制作光栅

Project 1: Gratings fabrication by holography method

第二题：全息透镜的制作与应用

Project 2: Fabrication and application of holography lens

第三题：法拉第效应在通讯技术中的应用与研究

Project 3: Application and investigation of Faraday effect in communication technology

第四题：椭偏法测定 TiO2 纳米薄膜的厚度和折射率

Project 4: Measurement of Thickness and Refractive Index of TiO2 Nano scale film by using Ellipsometer

第五题：研究半导体材料的光吸收谱线并确定其材料特性

Project 5: Investigation of semiconductor material absorption spectrum and its material characteristics

第六题：自建平台实现激光散斑的若干应用

Project 6: Applications of self-build Laser Speckle system

第七题 用小型直流溅射仪制备镀银薄膜，研究制备参数对银薄膜电阻率和应力的影响

Project 7: Silver film deposition by using low DC sputtering， and the study of preparing parameters on resistivity and film stress.

第八题：设计相频滤波器，用纹影法将相位转变为振幅的滤波器，以使人眼能看到透明物体的形状和结构。

Project 9: Designing a schlieren apparatus to identify structures and shapes of transparent objects

第九题： 塞曼效应实验规律及其应用的研究

Project 9: Investigation of Zeeman effect and its application

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

1、《大学物理实验 第二册 第二版》 吴泳华 霍剑青 浦其荣主编， 高等教育出版社

2、《大学物理实验 第三册 第二版》 轩植华 姚焜 张淑贞主编， 高等教育出版社

3、《现代物理技术与研究型实验》主编：何佳清、霍剑清，高等教育出版社

4、网络学习资源：物理实验主页：http://172.18.6.16:8088

大学物理实验选课系统： http://172.18.6.16:9200

大学物理实验预习系统： http:// 172.18.6.16:9202

大学物理实验仿真系统： http://172.18.6.16:8003

Online Resources：

Teaching Center of Physics Experiment： http://172.18.6.16:8088/

Physics Experiment Elective System： http://172.18.6.16:9200

Physics Experiment Preparation System： http:// 172.18.6.16:9202

Physics Experiment Simulation System： http://172.18.6.16:8003

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				
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects		30%		包含答辩（60%）、论文（40%）两项分数 Contain two parts: presentation (60%) and project paper（40%）
平时实验 Experiments		70%		包含预习（15%）、实验（40%）、报告（45%）三项分数 Contain three parts： prelab(15%)、operation （40%）and report(45%)
期中考试 Mid-Term Test				
期末考试 Final Exam				
期末报告 Final Presentation				
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

物理系教学指导委员会
Education Instruction Committee of Physics department