

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	综合物理实验 Physics Laboratory II
2. 授课院系 Originating Department	物理系 Department of Physics
3. 课程编号 Course Code	PHY201-15
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 / 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 (For team teaching, please list all instructors)	<p>1. 曾孝奇, 工程师, 物理系 第一教学楼 332 室 zengxq@sustech.edu.cn Zeng Xiaoqi, Engineer, Department of Physics, Rm332, Lecture Hall 1,</p> <p>2. 陈佶, 工程师, 物理系 第一教学楼 333 室 chenj@sustech.edu.cn CHEN Ji, Engineer, Department of Physics, Rm333, Lecture Hall 1,</p> <p>3. 杨珺, 工程师, 物理系 第一教学楼 333 室 yangj@sustech.edu.cn Yang Jun, Engineer, Department of Physics, Rm333, Lecture Hall 1,</p> <p>4. 邵明珍, 工程师, 物理系 第一教学楼 334 室 shaomz@sustech.edu.cn Shao Mingzhen, Engineer, Department of Physics,</p>

Rm334, Lecture Hall 1,

5. 王才林, 工程师, 物理系
第一教学楼 335 室
wangcl@sustech.edu.cn
Wang Cailin, Engineer, Department of Physics ,
Rm335, Lecture Hall 1,

6. 张贤高, 工程师, 物理系
第一教学楼 337 室
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Zhang Xiangao, Engineer, Department of Physics,
Rm337, Lecture Hall 1,

7. 邓冬梅, 工程师, 物理系
第一教学楼 336 室
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8. 张欢, 工程师, 物理系
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Xu Tingting, Engineer, Department of Physics,
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9. 实验员/助教、所属学系、联系方式

Tutor/TA(s), Contact

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第一教学楼 332 室
wanghong770909@163.com
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Wang Hong, Teaching Assistant, Physics Department,
Rm332,Lecture Hall 1,

10. 选课人数限额(可不填)
Maximum Enrolment
(Optional)

11. 授课方式
Delivery Method

学时数
Credit Hours

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
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	现代物理技术实验, Physics Laboratory III; 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

综合物理实验课程涉及力学、热学、电磁学、光学、近代物理学等各个知识领域,每个实验涉及多个知识领域或多种实验方法和实验技术的综合应用。本课程突出物理实验的设计思想和实验方法。物理实验的设计思想与实验方法是物理学历史的发展中凝练的精华,既反映了各个学科科学思想与方法的共性,也是与各学科相互作用推动科技发展的基础,是培养创新型人才的基础。本课程的教学模式以综合性、设计性、探究性为主。本课程的目的是开拓学生的思路,系统培养学生的科学思想和实验方法,培养学生综合应用知识的科学思维能力和实践能力。

Physics Laboratory II includes experiments of mechanics, thermal physics, optics and advanced physics. Every experiment involves multi-disciplinary methods and technology. This course focuses on the designing idea and technique of the physics experiments, which develops innovative talent of students. The aim of this course is to broaden the thinking mind of students, to train the students of scientific thoughts and methods systematically and to improve the practical ability of multiple utilization of knowledge.

16. 预达学习成果 Learning Outcomes

1. 学生通过本课程系统掌握物理实验的设计思想与实验方法,并能综合应用物理实验思想、方法与知识拓展实验内容、设计新实验、完成探究性、设计性课题实践。为学生进一步完成各学科的学习奠定丰厚的基础。
 2. 培养了学生的科学创新思维、自主学习能力、探究精神、实践能力和创新能力。
1. Students selected for the course will gain the designing idea and technology of physics laboratory and make use of the scientific thoughts, methods and knowledge to broaden the experiment contents, to design new experiment and to finish the course project.
 2. The course will train students in the initiative, independent and innovative ability. It also will improve the exploring spirit and practical ability of students.

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: 绪论课

绪论 第一讲: 物理实验的基本方法 第二讲: 综合性物理实验课程教学要求

Week 1-2: Introduction: 1. Physics Experiment Methods 2. Requirements of Physics Laboratory II

第三周-第十二周 学生轮流完成以下 18 个实验中的 10 个实验

Weeks 3rd – 12th: To do 10 experiments among the 18 experiments below

实验一、 弗朗克-赫兹实验验证分立能级 指导教师： 王才林

实验内容：1、了解弗朗克赫兹实验的设计思想和实验方法 2、测定氩原子的第一激发电位，证明原子能级的存在

Experiment 1、 Discrete energy states verified by Franck-Hertz Instructor: Wang Cailin

Content: 1、 Understanding the strategy and the method of Franck-Hertz experiment. 2、 Verify the discrete energy states via analysis the relationship between I_g and V_{G2K} of Argon

实验二、 压电陶瓷的电致伸缩系数测量 指导教师： 杨珺

实验内容：1.掌握迈克尔逊干涉仪测伸缩系数原理；2.调节迈克尔逊干涉仪；3.测量样品 A 和样品 B 的电致伸缩系数；

Experiment 2 Measure the piezoelectric coefficient of piezoelectric ceramics using Michelson interferometer
Instructor: Yang Jun

Content: 1. Know the principle of measuring the piezoelectric coefficient by Michelson interferometer. 2. Master the operation of Michelson interferometer. 3. Measure the piezoelectric coefficients of samples.

实验三、 用双光栅 Lau 效应测量平板玻璃的折射率 指导教师： 杨珺

实验内容：1.了解 Lau 效应；2.调节分光计，放置双光栅，观察 Lau 效应；3.分别放置标准样品和待测样品，测定分光计的转角。

Experiment 3 Measure the refractive index of a glass plate based the theory of Lau effect in double grating Instructor: Yang Jun

Content: 1. Know the theory of Lau effect in double grating. 2. Master the operation of spectrometer. 3. Observe Lau effect. 4. Measure the refractive index of sample.

实验四、 光速测量 指导教师： 陈佶

实验内容：1.理解拍频法测光速的原理；2.调整光路，直到示波器上看到清晰光滑的两路波形；3.测定光波波长；4.根据频率和波长，计算空气中的光速。

Experiment 4 Measurement of the speed of light Instructor: Chen ji

Content: 1 understand the principles of metering light speed by beat method; 2 adjust the optical path, until clear and smooth two-way waveform appears on the oscilloscope; 3 measure the wavelength of light; 4 according to the frequency and wavelength, calculate the speed of light in the air.

实验五、 霍尔效应 指导教师： 张贤高

实验内容：1. 了解霍尔效应实验原理以及有关霍尔元件对材料要求的知识。2. 学习用“对称测量法”消除副效应的影响，测量并绘制试样的 $V_H- I_S$ 和 $V_H- I_M$ 曲线。3. 确定试样的导电类型、载流子浓度以及迁移率。

Experiment 5 Hall Effect and Magneto-Resistance Effect Instructor: Zhang Xiangao

Content: 1 To understand the experiment principle of Hall effect and the requirement to material utilizing Hall device; 2 To study how to remove the influence of the negative effect by using the Symmetry Measurement Method, and to

measure the VH- I_S and VH- I_M curves; 3 To measure the conductivity ,carrier concentration and charge mobility.

实验六、毫特斯拉计的设计与制作 指导教师：邵明珍

实验内容：1. 了解霍尔效应实验原理以及有关霍尔元件对材料要求的知识。2、以霍尔元件为传感器，设计和制作毫特斯拉计

Experiment 6 Design and make the milli-tesla meter Instructor: Shao Mingzhen

Content: 1、 To understand the experiment principle of Hall effect and the requirement for material of Hall component; 2、 Design and make the milli-tesla meter with the Hall sensor

实验七、 液晶电光效应综合实验 指导教师：王才林 王晓峰

实验内容：1、了解液晶盒的构造 2、理解液晶盒对光的开与关的原理 3、了解液晶盒的电光特性，时间响应特性以及视觉特性。

Experiment 7 The electro-optic effect of liquid crystal Instructor: Wang Cailin /Wang Xiaofeng

Contents: 1. Understand the structure of the liquid crystal device 2. Understand why the liquid crystal device can pervious to light or not 3. Understand the electro-optical properties, the time response and visual features of the liquid crystal device

实验八、 PN 结正向压降温度特性及正向伏安特性的研究 指导教师：邓冬梅 张欢

实验内容：1. 在恒定温度条件下，测量正向电压随正向电流的变化关系，绘制伏安特性曲线。2. 在恒定电流条件下，测绘 PN 结正向压降随温度的变化曲线，确定其灵敏度，估算被测 PN 结材料的禁带宽度。3. 学习指数函数的曲线拟合方法，并计算出玻尔兹曼常数，估算反向饱和电流。

Experiment 8 Research on the temperature-dependent forward voltage and I-V characteristics of PN junctions Instructor: Deng Dongmei /Zhang Huan

Content: 1. Measure the current dependent forward voltage at constant temperature, and plot the I-V curve. 2. Measure the temperature dependent forward voltage. Calculate the sensitivity of PN junctions and evaluate the energy band-gap of this material. 3. Study the exponential curve fitting method, calculate the Boltzmann coefficient, and evaluate the reverse saturation current.

实验九、 光电器件的特性测量及应用研究 指导教师：邓冬梅 张欢

实验内容：1.探究发光二极管的工作原理；2.用光谱仪测量二极管的发光光谱；3.测量发光二极管在不同注入电流下的发光强度、波长以及半高宽，并分析其特点，进而熟悉半导体材料的能带结构；

Experiment 9 Investigation of optoelectric devices and its applications Instructor: Deng Dongmei /Zhang Huan

Content: 1. Investigating the basic principle of LEDs. 2. Measuring the spectrum of LEDs by using spectrometer. 3. Measuring the current-dependent luminance intensity, wavelength and full-width at half maximum values, and analysis the corresponding results, so as to understand the energy band-gap structure of LEDs.

实验十、表面等离激元共振法测液体折射率 指导教师：曾孝奇 徐婷婷

实验内容：1.了解全反射中倏逝波的概念；2.观察表面等离激元共振现象；3.测量反射光强与入射角的关系；

Experiment 10 Measurement of the refractive index of liquid by Surface Plasmon Resonance method Instructor: Zeng Xiaoqi / Xu Tingting

Content: 1. Understand the concept of evanescent wave in total internal reflection. 2. Observe the Surface Plasmon

Resonance phenomenon. 3. Measure the intensity of reflective light vs the incident angle.

实验十一、 偏振光与蔗糖溶液旋光性的观察与研究 指导教师：陈佶

实验内容：1.验证马吕斯定律；2.检验 1/4 波片和 1/2 波片对线偏光的影响；3.测量蔗糖溶液的旋光率，根据旋光率测定未知浓度的蔗糖溶液。

Experiment 11 Observation and research on the polarized light Instructor:Chenji

Content: 1. verify Malus law; 2. examine the effects of the wave plates for linearly polarized beam; 3 measure the optical rotation of sucrose solution, and determine the sucrose solution of the unknown concentration based on optical rotation.

实验十二、 双臂电桥测低电阻实验 指导教师：张贤高

实验内容：1. 了解四端引线法的意义及双臂电桥的结构；2. 学习使用双臂电桥测量低电阻；3. 测量铜棒、铝棒、铁棒的电阻率。

Experiment 12 Resistance Measurement of metal wires by double Kevin bridge circuit Instructor: Zhang Xiangao

1 To understand the method of 4-terminal connections and the structure of double bridge; 2 To learn how to use a double bridge to measure the low resistance; 3 To measure the resistivity of a copper rod, an aluminium rod and an iron rod.

实验十三、 复摆振动的研究 指导教师：张贤高

实验内容：1.掌握复摆振动规律；2.研究复摆的振动周期与悬点(支点)的位置关系,并测定重力加速度 g；3.测定复摆对重心的转动惯量和回转半径。

Experiment 13 Investigation of compound pendulum Instructor: Zhang Xiangao

Content: 1 To master the law of compound pendulum; 2 To study the relationship between the vibration period and the position of fulcrum, and to measure the gravity acceleration; 5 To measure the moment of inertia and radius of gyration.

实验十四、 测量康铜丝的杨氏模量和泊松比 指导教师：曾孝奇 徐婷婷

实验内容：掌握非平衡电桥测量微小电阻变化及泊松比的方法。

Experiment 14 Measurement of the Young's modulus and Poisson's ratio of a constantan wire Instructor: Zeng Xiaoqi / Xu Tingting

Content: Master the method to measure the small change in resistance and the Poisson's ratio of constantan wire by unbalanced bridge.

实验十五、 交流谐振电路特性研究 指导教师：邵明珍

实验内容：1.掌握交流谐振原理；2.正确连接线路并在示波器上观察交流谐振现象；3.测量未知电感和电容。

Experiment 15 Characteristics of the AC resonance circuit Instructor: Shao Mingzhen

Content: 1. Mastering the principle of AC resonance circuit; 2 Connect the wires correctly and observe the phenomenon of AC resonance on the oscilloscope; 3. Measure the unknown capacity and inductance by AC resonance circuit.

实验十六、 介电常数的测量 指导教师：邵明珍

实验内容：1.熟悉 RLC 串联谐振电路及介电常数测量方法；2.运用直接公式法测量压电陶瓷的介电常数；3.运用间接比较

法测量自来水的介电常数。

Experiment 16 Measurement of the dielectric constant Instructor: Shao Mingzhen

Content: 1. Familiar with the method of RLC series resonance circuit to measure the dielectric constant; 2. Measure the dielectric constant of the piezoelectric ceramic with the equation; 3. Measure the dielectric constant of water by the method of comparison.

实验十七、 超声光栅实验 指导教师：陈佶

实验内容：1.理解超声光栅原理；2 在分光计上观察超声衍射现象；3.测定水和酒精的衍射条纹位置，并计算超声速。

Experiment 17 The ultrasonic grating Instructor: Chenji

Experiment: 1 understand the principles of ultrasonic grating; 2 observe ultrasound diffraction on the spectrometer; 3 measure and determine the diffraction pattern of water and alcohol, and calculate the speed of supersonic.

实验十八、 电阻应变式传感器特性的研究 指导教师：王才林 王晓峰

实验内容：1、了解电阻应变片的工作原理 2、根据电路图正确连接电路 3、观察并记录单臂电桥、半桥和全桥电路下输出电压随加载重物质量的变化关系，求出三种情况下的灵敏度

Experiment 18. To investigate the characteristic of resistance strain sensor Instructor: Wang Cailin /Wang Xiaofeng

Contents: 1. Understanding the principle of the resistance strain sensor 2. Correctly connect circuit according to circuit diagram 3. Record the relationship between the voltage and mass of the wheatstone bridge with different resistance strain sensor branches, and then, calculate the sensitivity of different resistance sensor branches respectively.

第 13-16 周 以小组形式进行探究性实验实践，第 16 周成果展示与答辩

课题如下：

1、数字温度计的设计与制作 指导老师：邵明珍、邓冬梅

要求：以 PN 结为温度传感元件，数字电压表头为显示装置，自制测温范围为(0—100 度)的数字温度计。(实验室提供恒流源模块)

2、设计方案研究发光二极管发光机理，并以发光二极管为基本部件搭建应用装置 指导老师：邓冬梅

3、薄膜参数测量方法的研究 指导老师：王晓峰

(要求设计多种方案测量薄膜的特性参数，并对测量方法及其应用进行总结比较)

4、搭建实验装置研究磁致旋光法拉第效应及其应用 指导老师：曾孝奇 陈佶

5.测量与研究压电陶瓷材料压电特性，并搭建一应用装置 指导老师：杨珺 徐婷婷

6.用电阻应变传感器设计与制作便携式电子称(要求:电子称量程为 0-1kg,超载指示) 指导老师：王才林

7. 搭建霍尔效应和磁阻效应的测量装置，并以此为基础搭建实验系统测量电机的转速 (实验室提供:步进电机 直流稳压电源、555 集成电路、数字万用表、电子元件等) 指导老师：张贤高、杨珺

8. 毫特斯拉计的设计与制作 (基于霍尔效应原理搭建测量范围为 0—0.3 特斯拉计 指导老师：张贤高

9. 搭建实验装置研究太阳能电池特性与应用

指导老师：邵明珍

10. 纳米氧化锌薄膜的光电性质测量

指导老师：邓冬梅 张欢

Week 13-16 Exploring Practice Projects for groups of 4 students. Presentation and Defence at week 16.

Projects:

1. Design and making of a digital thermometer Instructors: Shao Mingzhen, Deng Dongmei

Requirement: Use a pn junction as the sensing element, and digital voltmeter as display. The made thermometer could be worked as 0~100°C.

2. Investigating the basic optical properties of LEDs, and making an application apparatus Instructor: Deng Dongmei

3. Investigation of measurement methods of thickness of thin film Instructors: Wang Xiaofeng

4. Setup the equipment to investigate the Faraday Effect and applications Instructor: Zeng Xiaoqi, Chen Ji

5. Research and measure piezoelectric characteristic of the piezoelectric ceramic, and design an application. Instructor: Yang Jun Xu, Tingting

6. Design and make the mini electronic balance with the resistance strain sensor (Requirement: electronic scale range is 0 to 1kg with overloading indicator) Instructor: Wang Cailin

7. To build the measurement device of the Hall effect and the magneto resistance effect, and further to design the experiment to measure the motor speed. Instructor: Zhang Xiangao, Yang Jun

8. To design and build a Tesla meter based on the Holzer effect to measure a magnetic field at the range of 0 -0.3 T Instructor: Zhang Xiangao

9. Setup equipment to investigate the characteristics and application of solar cell Instructor: Shao Mingzhen

10. Measurement of optical and electrical properties of nano-scale ZnO film Instructors: Deng Dongmei/Zhang Huan

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

教材 Textbook :

面向 21 世纪教材：大学物理实验 第一册 第二版 吴泳华 霍剑青 浦其荣主编 高等教育出版社

面向 21 世纪教材：大学物理实验 第二册 第二版 谢行恕 康士修 霍剑青主编 高等教育出版社

大学物理基础与综合性实验 何佳清 霍剑青 主编 高等教育出版社

大学物理实验 Laboratory Experiments In College Physics 王丽香 吕春主编 北京工业大学出版社

网络学习资源：

物理实验教学中心主页：<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（70%）、论文（30%）两项分数 Including presentation (70%) and project paper (30%)
平时实验 Experiments		70%		包含预习（10%），操作（40%）、报告（50%）三项分数 Including prelab (10%), operation (40%) and report(50%)
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

