

# 《普通物理 II（电磁与光）（英文）》课程教学大纲

## 一、课程基本信息

英文名称	General Physics II	课程代码	PHYS1026
课程性质	专业核心课程	授课对象	本科生
学 分	4	学 时	72
主讲教师	冯岩、刘壮	修订日期	2021 年
指定教材	H. D Young and R. A. Freedman, Sear and Zemansky's University Physics with Modern Physics, 12th Edition, Pearson Education, 2008 (chapter 21 - 34).		

## 二、课程目标

### （一）总体目标：

The main goals of this course are: (1) to gain a command of basic electricity & magnetism theory, (2) to develop mathematical and problem solving skills, (3) to gain a command of basic optics. After taking this course, students should be able to: (1) apply various laws (Coulomb's, Faraday's, Ohm's, Lenz's, etc.) to solve problems in electromagnetism; (2) calculate current, potential, resistance, power for simple DC and AC circuits; (3) describe simple electrical components (resistors, capacitors, inductors) and measurement devices (ammeters, ohmmeters); (4) describe the relationship between electricity & magnetism and understand the Maxwell's equations; (5) understand the principles of geometrical optics.

### （二）课程目标：

#### 课程目标 1：

**After taking this course, students should be able to apply various laws (Coulomb's, Faraday's, Ohm's, Lenz's, etc.) to solve problems in electromagnetism and to calculate current, potential, resistance, power for simple DC and AC circuits.**

#### 课程目标 2：

**After taking this course, students should be able to describe simple electrical components (resistors, capacitors, inductors) and measurement devices (ammeters, ohmmeters) and to describe the relationship between electricity & magnetism and understand the Maxwell's equations.**

#### 课程目标 3：

**After taking this course, students should be able to understand the principles of**

geometrical optics.

(要求参照《普通高等学校本科专业类教学质量国家标准》，对应各类专业认证标准，注意对毕业要求支撑程度强弱的描述，与“课程目标对毕业要求的支撑关系表一致”(五号宋体)

(三) 课程目标与毕业要求、课程内容的对应关系 (小四号黑体)

表 1: 课程目标与课程内容、毕业要求的对应关系表 (五号宋体)

课程目标	对应课程内容	对应毕业要求
课程目标 1	1 Electrical charge & electric field 2 Gauss's law 3 Electric potential 4 Capacitance & dielectrics 5 Current & resistance 6 DC circuit 7 Magnetic field & magnetic forces 8 magnetic field & Electromagnetic induction part 1 9 Electromagnetic induction part 2 & Mid-term exam 10 Inductance 11 AC 12 Electromagnetic waves	Being able to apply various laws (Coulomb's, Faraday's, Ohm's, Lenz's, etc.) to solve problems in electromagnetism and to calculate current, potential, resistance, power for simple DC and AC circuits

课程目标 2	1 Electrical charge & electric field 2 Gauss's law 3 Electric potential 4 Capacitance & dielectrics 5 Current & resistance 6 DC circuit 7 Magnetic field & magnetic forces 8 magnetic field & Electromagnetic induction part 1 9 Electromagnetic induction part 2 & Mid-term exam 10 Inductance 11 AC 12 Electromagnetic waves	<p style="text-align: center;"><b>Being able to describe simple electrical components (resistors, capacitors, inductors) and measurement devices (ammeters, ohmmeters) and to describe the relationship between electricity &amp; magnetism and understand the Maxwell's equations.</b></p>
课程目标 3	13 Light propagation 14 Geometric optics & optical instruments	<p style="text-align: center;"><b>Being able to understand the principles of geometrical optics.</b></p>

(大类基础课程、专业教学课程及开放选修课程按照本科教学手册中各专业拟定的毕业要求填写“对应毕业要求”栏。通识教育课程含通识选修课程、新生研讨课程及公共基础课程，面向专业为工科、师范、医学等有专业认证标准的专业，按照专业认证通用标准填写“对应毕业要求”栏；面向其他尚未有专业认证标准的专业，按照本科教学手册中各专业拟定的毕业要求填写“对应毕业要求”栏。)

### 三、教学内容

(具体描述各章节教学目标、教学内容等。实验课程可按实验模块描述)

#### 第一章 Electrical charge & electric field

1.教学目标 Introduction, Coulomb's law, electric-field calculation, electrical dipoles

2.教学重难点 Electric-field calculation

3.教学内容 Definition and application of Coulomb's law, electric-field calculation, electrical dipoles

4.教学方法 Teaching and discussion

5.教学评价 Homework and Quiz

## **第二章 Gauss's law.....**

1.教学目标 Electric flux, Gauss's law & its applications

2.教学重难点 Electric flux concept

3.教学内容 Definition and application of Electric flux, Gauss's law

4.教学方法 Teaching and discussion

5.教学评价 Homework and Quiz

## **第三章 Electric potential**

1.教学目标 Electric potential & the calculations, potential gradient

2.教学重难点 Potential gradient concept

3.教学内容 Definition and application of Electric potential & the calculations, potential gradient

4.教学方法 Teaching and discussion

5.教学评价 Homework and Quiz

## **第四章 Capacitance & dielectrics**

1.教学目标 Capacitors & capacitance, capacitors in series & parallel, energy storage in capacitors, dielectrics

2.教学重难点 Capacitance concept and calculation

3.教学内容 Definition and application of Capacitors & capacitance, capacitors in series & parallel, energy storage in capacitors, dielectrics

4.教学方法 Teaching and discussion

5.教学评价 Homework and Quiz

## **第五章 Current & resistance**

1.教学目标 Current, resistivity, resistance, electromotive force, energy and power in circuit

2.教学重难点 Electromotive force concept

3.教学内容 Definition and application of Current, resistivity, resistance, electromotive force, energy and power in circuit

4.教学方法 Teaching and discussion

5.教学评价 Homework and Quiz

## **第六章 DC circuit**

1. 教学目标 Resistors in series and parallel, Kirchhoff's rule, electrical measuring instruments, RC circuits
2. 教学重难点 Complex circuit calculation
3. 教学内容 Definition and application of Resistors in series and parallel, Kirchhoff's rule, electrical measuring instruments, RC circuits
4. 教学方法 Teaching and discussion
5. 教学评价 Homework and Quiz

## **第七章 Magnetic field & magnetic forces**

1. 教学目标 Magnetic field, field line & magnetic flux, motion of charged particle in magnetic field, torque on a current loop
2. 教学重难点 Charged particle motion calculation
3. 教学内容 Definition and application of Magnetic field, field line & magnetic flux, motion of charged particle in magnetic field, torque on a current loop
4. 教学方法 Teaching and discussion
5. 教学评价 Homework and Quiz

## **第八章 magnetic field & Electromagnetic induction part 1**

1. 教学目标 Various magnetic field sources, Ampere's law & its application, Faraday's & Lenz's laws, motional electromotive force, .Mid-term exam (in class, without review)
2. 教学重难点 Magnetic field calculation
3. 教学内容 Definition and application of Various magnetic field sources, Ampere's law & its application, Faraday's & Lenz's laws, motional electromotive force
4. 教学方法 Teaching and discussion
5. 教学评价 Homework and Quiz

## **第九章 Electromagnetic induction part 2 & Mid-term exam**

1. 教学目标 Induced electric fields, displacement current
2. 教学重难点 Displacement current concept
3. 教学内容 Definition and application of Induced electric fields, displacement current.
4. 教学方法 Teaching and discussion
5. 教学评价 Homework and Quiz

## **第十章 Inductance**

1. 教学目标 Mutual & self-inductance, inductors, RL circuits, LC circuits, LRC series circuits

2.教学重难点 Inductance calculation

3.教学内容 Definition and application of Mutual & self-inductance, inductors, RL circuits, LC circuits, LRC series circuits

4.教学方法 Teaching and discussion

5.教学评价 Homework and Quiz

## **第十一章 AC**

1.教学目标 Phasor & AC, resistance and reactance, LRC circuits, power in AC circuits, resonance in AC circuits, transformers

2.教学重难点 AC complex circuit calculation

3.教学内容 Definition and application of Phasor & AC, resistance and reactance, LRC circuits, power in AC circuits, resonance in AC circuits, transformers

4.教学方法 Teaching and discussion

5.教学评价 Homework and Quiz

## **第十二章 Electromagnetic waves**

1.教学目标 Maxwell's equation & electromagnetic waves, plane electromagnetic waves & light speed, Energy & momentum in electromagnetic waves

2.教学重难点 Understanding the physics of electromagnetic waves

3.教学内容 Definition and application of Maxwell's equation & electromagnetic waves, plane electromagnetic waves & light speed, Energy & momentum in electromagnetic waves

4.教学方法 Teaching and discussion

5.教学评价 Homework and Quiz

## **第十三章 Light propagation**

1.教学目标 Light, reflection & refraction, total internal reflection, polarization, Huygen's principle

2.教学重难点 Understanding the physics of lights

3.教学内容 Definition and application of Light, reflection & refraction, total internal reflection, polarization, Huygen's principle

4.教学方法 Teaching and discussion

5.教学评价 Homework and Quiz

## **第十四章 Geometric optics & optical instruments**

1.教学目标 Reflection & refraction at plane & spherical surfaces, thin lens, cameras, eyes,

magnifier, microscopes & telescopes

- 2.教学重难点 Calculation of combination of lens and mirrors
- 3.教学内容 Definition and application of Reflection & refraction at plane & spherical surfaces, thin lens, cameras, eyes, magnifier, microscopes & telescopes
- 4.教学方法 Teaching and discussion
- 5.教学评价 Homework and Quiz

### Final review

- 1.教学目标 Final review all previous lecture materials
- 2.教学重难点 Basics of various concepts, Derivation of equations and calculation
- 3.教学内容 Final review all previous lecture materials
- 4.教学方法 Teaching and discussion
- 5.教学评价 Homework and Quiz

### Final exam

- 1.教学目标 Final exam
- 2.教学重难点 Key points of this course
- 3.教学内容 Final exam
- 4.教学方法 Teaching and discussion
- 5.教学评价 Exam

## 四、学时分配 (四号黑体)

表 2: 各章节的具体内容和学时分配表 (五号宋体)

章节	章节内容	学时分配
第一章	Electrical charge & electric field	4
第二章	Gauss's law	4
第三章	Electric potential	4
第四章	Capacitance & dielectrics	4

第五章	Current & resistance	4
第六章	DC circuit	6
第七章	Magnetic field & magnetic forces	6
第八章	magnetic field & Electromagnetic induction part 1	4
第九章	Electromagnetic induction part 2 & Mid-term exam	4
第十章	Inductance	4
第十一章	AC	6
第十二章	Electromagnetic waves	4
第十三章	Light propagation	4
第十四章	Geometric optics & optical instruments	8
	Final review	2
	Final exam	2

## 五、教学进度 (四号黑体)

表 3: 教学进度表 (五号宋体)

周次	章节名称	内容提要	授课时数	作业及要求	备注
1	Electrical charge & electric field	Course Introduction, Coulomb's law, electric-field calculation, electrical dipoles	4	Homework & Quiz	
2	Gauss's law	Electric flux, Gauss's law & its applications	4	Homework & Quiz	
3	Electric potential	Electric potential & the calculations, potential gradient	4	Homework & Quiz	



4	Capacitance & dielectrics	Capacitors & capacitance, capacitors in series & parallel, energy storage in capacitors, dielectrics	4	Homework & Quiz	
5	Current & resistance	Current, resistivity, resistance, electromotive force, energy and power in circuit	4	Homework & Quiz	
6	DC circuit	Resistors in series and parallel, Kirchhoff's rule, electrical measuring instruments, RC circuits	6	Homework & Quiz	
7	Magnetic field & magnetic forces	Magnetic field, field line & magnetic flux, motion of charged particle in magnetic field, torque on a current loop	6	Homework & Quiz	
8	magnetic field & Electromagnetic induction part 1	Various magnetic field sources, Ampere's law & its application, Faraday's & Lenz's laws, motional electromotive force	4	Homework & Quiz	
9	Electromagnetic induction part 2 & Mid-term exam	Induced electric fields, displacement current. Exam (without review in class)	4	Homework & Quiz	
10	Inductance	Mutual & self inductance, inductors, RL circuits, LC circuits, LRC series circuits	4	Homework & Quiz	
11	AC	Phasor & AC, resistance and reactance, LRC circuits, power in AC circuits, resonance in AC circuits, transformers	6	Homework & Quiz	
12	Electromagnetic waves	Maxwell's equation & electromagnetic waves, plane electromagnetic waves & light speed, Energy & momentum in electromagnetic waves	4	Homework & Quiz	
13	Light propagation	Light, reflection & refraction, total internal reflection, polarization, Huygen's principle	4	Homework & Quiz	
14	Geometric optics & optical instruments	Reflection & refraction at plane & spherical surfaces, thin lens, cameras, eyes, magnifier, microscopes & telescopes	8	Homework & Quiz	
15	Final review	Final review all previous lecture materials	2	Homework & Quiz	

	Final exam	Final exam	2	Exam	
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## 六、教材及参考书目（四号黑体）

H. D Young and R. A. Freedman, Sear and Zemansky's University Physics with Modern Physics, 12th Edition, Pearson Education, 2008 (chapter 21 - 36).

## 七、教学方法（四号黑体）

General Physics II is a general introduction to electricity and magnetism, as well as basic optics, at the first-year university level, after General Physics I has been taught. Lectures, that contain various forms, such as videos and other media platforms, are taught in English to get the students ready for future researches in world-leading institutions around the world. A Quiz is given after each chapter is taught to make sure all students fully understand the contents from this chapter. After finishing each chapter, one homework is assigned, which should be handed in next week, and then reviewed by the Teaching Assistant.

## 八、考核方式及评定方法（四号黑体）

### （一）课程考核与课程目标的对应关系（小四号黑体）

表 4：课程考核与课程目标的对应关系表（五号宋体）

课程目标	考核要点	考核方式
课程目标 1	Being able to apply various laws (Coulomb's, Faraday's, Ohm's, Lenz's, etc.) to solve problems in electromagnetism and to calculate current, potential, resistance, power for simple DC and AC circuits	Homework & Quiz
课程目标 2	Being able to describe simple electrical components (resistors, capacitors, inductors) and measurement devices (ammeters, ohmmeters) and to describe the relationship between electricity & magnetism and understand the	Homework & Quiz

	Maxwell's equations.	
课程目标 3	Being able to understand the principles of geometrical optics.	Homework & Quiz

## (二) 评定方法 (小四号黑体)

### 1. 评定方法 (五号宋体)

Homework: 13%, Quiz: 32%, Midterm: 20%, and Final Exam: 35%

### 2. 课程目标的考核占比与达成度分析 (五号宋体)

表 5: 课程目标的考核占比与达成度分析表 (五号宋体)

考核占比 课程目标	平时	期中	期末	总评达成度
课程目标 1	45%	20%	35%	(例: 课程目标 1 达成度 = {0.3 x 平时目标 1 成绩 + 0.2 x 期中目标 1 成绩 + 0.5 x 期末目标 1 成绩} / 目标 1 总分。按课程考核实际情况描述)
课程目标 2	45%	20%	35%	
课程目标 3	45%	20%	35%	

## (三) 评分标准 (小四号黑体)

课程 目标	评分标准				
	90-100	80-89	70-79	60-69	<60
	优	良	中	合格	不合格
	A	B	C	D	F
课程 目标 1	Excellent at applying various laws (Coulomb's, Faraday's, Ohm's, Lenz's, etc.) to solve problems in electromagnetism and to calculate current, potential, resistance, power for	Good at applying various laws (Coulomb's, Faraday's, Ohm's, Lenz's, etc.) to solve problems in electromagnetism and to calculate current, potential, resistance, power for	Relatively good at applying various laws (Coulomb's, Faraday's, Ohm's, Lenz's, etc.) to solve problems in electromagnetism and to calculate current, potential, resistance, power for	Can apply various laws (Coulomb's, Faraday's, Ohm's, Lenz's, etc.) to solve problems in electromagnetism and to calculate current, potential, resistance, power for simple DC and	Cannot apply various laws (Coulomb's, Faraday's, Ohm's, Lenz's, etc.) to solve problems in electromagnetism and to calculate current, potential, resistance, power for

课程 目标	评分标准				
	90-100	80-89	70-79	60-69	<60
	优	良	中	合格	不合格
	A	B	C	D	F
	simple DC and AC circuits	simple DC and AC circuits	for simple DC and AC circuits	AC circuits	for simple DC and AC circuits
课程 目标 2	Excellent at describing simple electrical components (resistors, capacitors, inductors) and measurement devices (ammeters, ohmmeters) and to describe the relationship between electricity & magnetism and understand the Maxwell's equations	Good at describing simple electrical components (resistors, capacitors, inductors) and measurement devices (ammeters, ohmmeters) and to describe the relationship between electricity & magnetism and understand the Maxwell's equations	Relatively good at describing simple electrical components (resistors, capacitors, inductors) and measurement devices (ammeters, ohmmeters) and to describe the relationship between electricity & magnetism and understand the Maxwell's equations	Can describe simple electrical components (resistors, capacitors, inductors) and measurement devices (ammeters, ohmmeters) and to describe the relationship between electricity & magnetism and understand the Maxwell's equations	Cannot describe simple electrical components (resistors, capacitors, inductors) and measurement devices (ammeters, ohmmeters) and to describe the relationship between electricity & magnetism and understand the Maxwell's equations
课程 目标 3	Excellent at understanding the principles of geometrical optics.	Good at understanding the principles of geometrical optics.	Relatively good at understanding the principles of geometrical optics.	Can understand the principles of geometrical optics.	Cannot understand the principles of geometrical optics.