Syllabus of University Physics II

1 Course information

Course name: University Physics II
Course object: Undergraduates majoring in science and engineering
Course code: SCI4B3B002
Course category: Professional basic courses, compulsory
Prerequisite course: University Physics I, Advanced mathematics.
Total period: 51+17 (class :51, continue :17)
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Syllabus reviewer: Denghui Xu, Aicong Geng

Physics is the natural science about basic structure, basic motion form and interaction. Its basic theory permeates every field of natural science and is applied in many domains of production technology, which is the foundation of other natural science and engineering technology.

In the process of pursuit of truth and exploration of the unknown world, physics has presented a series of scientific world views and methodology, which profoundly affects human's basic understanding of the material world, thinking mode and social life. It is the cornerstone of human civilization development and plays an important role in the cultivation of scientific quality of talents.

University physics II consists of the basic concepts and rules of mechanical, thermal, mechanical vibration, mechanical wave and wave optics, and it's an important general professional basic course for students in major machinery, automation, electrical, computer, software, information, mathematics, chemistry, food, environment, biology, materials science and engineering in our school. The basic concepts, theories and methods taught in this course are important parts of students' scientific literacy, which are necessary for scientists and engineers.

University physics II plays an important role that can not be replaced by other courses in setting up the necessary physical foundation for students systematically, cultivating students' scientific world view, enhancing students' ability to analyze and solve problems, and cultivating students' exploration spirit and innovation consciousness.

Through this course, students should have a systematic and correct understanding of the basic concepts, theories and research methods of electricity, magnetism, special relativity and quantum physics in physics, so as to lay a solid foundation for further study. In the course of each section, not only knowledge should be taught, at the same time, but also pay attention to the cultivation of students' ability to analyze and solve problems, the cultivation of students' exploration spirit and innovative consciousness, and strive to achieve the coordinated development of students' knowledge, ability and quality.

2 Textbooks and teaching resources

2.1 Textbooks

General physics (6th edition), volume 1 and volume 2, edited by Shouzhu Cheng and Zhiyong Jiang, Higher Education Press, 2006.

2.2 Teaching resources

- General physics (6th edition), problem analysis and solution, Naijiang Sui, Panxin Hu, Higher Education Press, 2006.
- General physics (6th edition), analysis and development of thought problems, Panxin Hu, et al, Higher Education Press, 2006.
- Case base of university physics peer teaching(1st edition), Xiaobai Chen, Baohe Li, et al, China Machine Press, June 2014.

- University physics problem seminar guide(1st edition), Huijun Shen, Huzhu Wang, Tsinghua University Press, June 1991.

3 Course assessment

The grades are assessed by 30% and 70% respectively according to the normal time and the exam, including attendance, discussion, unit test, etc., and the final exam is a closed-book exam with 100 minutes.

4 Teaching content and teaching hours allocation

4.1 Total teaching hours

The total teaching hours of this course are 68, including 51 credit hours and 17 continuing hours.

4.2 Content and teaching hours allocation

Chapter 1 Electromagnetism (32 credit hours + 9 continuing hours)

1 Electrostatic field in a vacuum

Teaching content: Charge, the law of conservation of charge, Coulomb's law, electrostatic field, electric field intensity, power lines, electric field intensity superposition principle, the calculation of electric field intensity, electric dipole, electric flux, Gauss theorem in vacuum, work of static electric field force, electrostatic field loop theorem, electric potential energy, electric potential, electric potential superposition principle, electric potential difference, equipotential surface.

Teaching requirements:

- Mastering Coulomb's law, the concept of electric field intensity, the superposition principle of electric field intensity. Mastering the concept and superposition principle of electric potential. Using integration to calculate electric field intensity and electric potential according to superposition principle in some typical and simple problems.
- Understanding the properties of electrostatic field, Gauss theorem and loop theorem of electrostatic field, understand their status in electromagnetism, knowing the conditions and methods of calculating electric field intensity with Gauss theorem.
- Knowing the concept of electric dipole moment, the force and motion of electric dipole in uniform electric field can be analyzed.

2 Electrostatic fields in conductors and dielectrics

Teaching content: Conductor electrostatic balance, electrostatic shielding, dielectric polarization, electric displacement, the relationship between electric displacement vector D and electric field intensity E in isotropic dielectric, Gauss theorem in dielectric, capacitance, electric field energy and electric field energy density.

Teaching requirements:

- The charge distribution, electric field intensity distribution and electric potential distribution of a conductor or group of conductors of simple shape at electrostatic equilibrium can be analyzed and calculated, understanding electrostatic equilibrium conditions and charge distribution characteristics of conductors, knowing electrostatic shielding.
- Knowing the relationship and difference between electric displacement vector D and electric field intensity E in isotropic dielectric. Gauss theorem can be used to calculate the electric displacement and field intensity in isotropic media with simple symmetric distribution.

- Understanding the concept of capacitance and the characteristics of series and parallel capacitors.
- Knowing the material nature of the electric field. Knowing the electric field energy of the simple case.

3 Magnetic field with constant current

Teaching content: Magnetic induction intensity, magnetic field line, superposition principle of magnetic induction intensity, magnetic flux. Bisard's law, magnetic Gauss theorem, Ampere loop theorem. Lorentz force, the effect of a magnetic field on a current-carrying wire, and the effect of a magnetic field on a planar current-carrying coil. Magnetic moment.

Teaching requirements:

- Mastering the concept of magnetic induction intensity, understanding Bisard's law, the magnetic induction intensity of some typical and simple current distribution can be calculated with the principle of magnetic field superposition.
- Understanding Gauss theorem and Ampere loop theorem of magnetic field. Understanding the method and condition of calculating magnetic induction intensity by Ampere loop theorem.
- Understanding Ampere's law and Lorentz force, calculating the magnetic field force and moment of the current-carrying straight wire and simple planar current-carrying coil in the magnetic field, analyzing and calculating the force and motion of the moving point charge in the uniform magnetic field.

4 Magnetic field in a magnetic medium

Teaching content: Classification of magnetic media, magnetization of magnetic media, characteristics of magnetic media. Magnetic field intensity, relationship between magnetic field intensity H and magnetic induction intensity B in isotropic magnetic medium. Ampere loop theorem in medium.

Teaching requirements:

- Knowing the microscopic mechanism of magnetization of magnetic media and the characteristics of ferromagnetic materials.
- Knowing the definition of magnetic field intensity in homogeneous isotropic magnetic medium, knowing the Ampere loop theorem in magnetic medium, and using the Ampere loop theorem in magnetic medium to calculate simple problems.

5 Electromagnetic induction and electromagnetic field

Teaching content: Faraday's law of electromagnetic induction, Lenz's law, electromagnetic induction phenomena, dynamic electromotive force and induced electromotive force, eddy electric field, self-inductance and mutual inductance, magnetic field energy and energy density, displacement current, integral form of Maxwell's equations, generation and properties of electromagnetic waves.

Teaching requirements:

- Understanding the concept of electrodynamic potential.
- Mastering Faraday's law of electromagnetic induction and Lenz's law, knowing the relationship between electromagnetic induction and energy conservation, understanding the dynamic electromotive force, knowing the induced electromotive force, calculating the dynamic and induced electromotive force in simple situation.

- Knowing self-inductance, mutual inductance phenomenon and simple calculation. Knowing the energy of magnetic field.
- Knowing the concepts of eddy electric field and displacement current, knowing the integral form of Maxwell's equations and its physical significance, knowing the basic properties of electromagnetic waves and the physical properties of electromagnetic fields.

Chapter 2 Basis of modern physics (19 credit hours + 5 continuing hours)

6 Special relativity

Teaching content: The two basic principles of special relativity, Lorentz transformation, special relativity in space and time, relativity in time, shortening of length, expansion of time, relativistic relations of mass and velocity, and relations of mass and energy.

Teaching requirements:

- Knowing two basic postulates of Einstein's special theory of relativity and the Lorentz transformation. Understanding the space-time view of special relativity and its difference from classical mechanics.
- Understanding the relationship between mass and velocity, the relationship between mass and energy in special relativity.
- Analyzing and calculating the relatively simple questions about length shortening and time dilation. Using mass-velocity and mass-energy formulas to calculate simple problems.

7 Fundamentals of quantum physics

Teaching content: Thermal radiation, absolute blackbody, Schevan-Boltzmann's law, Wien's law of displacement, Planck hypothesis. Experimental law of photoelectric effect, photon hypothesis, Einstein equation of photoelectric effect, wave particle duality of light. Experimental laws of hydrogen spectra, Bohr's hydrogen theory and its significance and limitations. DE Broglie material wave hypothesis, wave-particle duality of microscopic particles, wave function and its statistical interpretation, uncertain relation. Schrodinger equation, one dimensional infinite potential well, quantum mechanics theory of hydrogen atoms, electron spin, Pauli exclusion principle, energy minimum principle, atomic shell structure.

Teaching requirements:

- Knowing the laws of thermal radiation.
- Understanding the experimental law of photoelectric effect, using Einstein equation to do simple calculation. Understanding the wave-particle duality of light.
- Understanding the status and significance of Planck hypothesis, Einstein photon hypothesis and Bohr quantization hypothesis in the development of modern physics
- Knowing DE Broglie's material wave hypothesis and electron diffraction experiments, knowing the wave-particle duality of real particles.
- Understanding the relationship between the physical quantities describing the volatility of particles and their properties.
- Knowing the uncertainty relationship between one-dimensional coordinates and momentum, using the uncertainty relationship for simple estimation calculation.
- Understanding the experimental laws of hydrogen spectrum, Bohr's hydrogen theory, and its significance and limitations.
- Knowing wave functions and their statistical interpretation. Knowing the one-dimensional stationary Schrodinger equation and its application to one-dimensional infinite potential well.

- Knowing angular momentum quantization and spatial quantization, understand Stern-Gerlach experiment and electron spin.
- Knowing the four quantum numbers that describe the motion of electrons in an atom, the Pauli exclusion principle, and the atomic shell structure.

8 Elective content
Reference topics:

- Laser formation, laser characteristics and its important applications.
- Band theory of solids, properties of semiconductors.
- Infrared radiation and its application in industry.
- Nuclear decay and isotopes and their applications in industry.

Teachers may determine the content of lectures according to the development of physics and the latest achievements.

5 Continuing teaching arrangement

Teaching hours :51 credit hours +17 continuing hours
Teaching hours allocation:

Content	Credit hours	Continuing hours
1 Electrostatic field in a vacuum	10	2
2 Electrostatic fields in conductors and dielectrics	3	2
3 Magnetic field with constant current	8	2
4 Magnetic field in a magnetic medium	2	0
5 Electromagnetic induction, electromagnetic field	9	3
6 Basis of special relativity	6	1
7 Fundamentals of quantum physics	13	2
8 Elective content		2
Review		3
Sum	51	17