Course syllabus

Basic Information:

Course title (中文): 近代物理

Course title (English): Modern Physics

Instructor: **大江昌人 (Oh-e, Masahito)** (oh-e@ee.nthu.edu.tw) @台達館#838

Language for teaching: English

Class time: T7T8R7 *Location:* DELTA 台達 209

Course Description:

This course offers introduction to "Modern Physics" established in the 20th century. Knowledge on "Modern Physics" is fundamental to understanding practically developed various optoelectronic contemporary devices such as transistors and lasers. The main purpose of this course is to learn fundamentals of relativity and quantum mechanics, which are representative fields beyond the concept of Newtonian mechanics. Relativity is the law for time and space and is usually concerned with high velocities comparable to the speed of light. Quantum mechanics is the law of the microscopic world for atoms, molecules and nuclei. Throughout this course, we mainly focus on learning how relativistic effects appear when dealing with high velocities, how ways of viewing materials have been developed and how materials are structured from microscopic viewpoints.

* The course is offered in English.

Textbook

- ☐ "Concepts of Modern Physics", sixth edition or others (McGraw-Hill) by Arthur Beiser and Kok Wai Cheah (2015).

Course materials:

Available on https://eeclass.nthu.edu.tw/

References:

- ☐ Physics for Scientists and Engineers with Modern Physics (Thomson Higher Education) by Raymond A. Serway and John W. Jewett, Jr. (2004).
- ☐ Modern Physics (Pearson Addison Wesley) by Randy Harris (2008).

Teaching Method:

Lecture style by combining power point viewgraphs and blackboard teaching.

Syllabus:

Session 0: Introduction – Course guide –

• What is "Modern Physics?"

Session 1–4 (5): Relativity

• Special relativity; • Michelson-Morley experiment; •Postulates of special relativity;
• Time dilation; • Length contraction; • Lorentz transformation; • Mass and energy;
• Spacetime; • Twin paradox; • Basic general relativity …etc.

Session 5–8: Problems with classical physics – Duality of photons and electrons –

• Blackbody radiation; • Photoelectric effect; • Compton scattering effect; • What is light; • Wave-function and density of probability; • de Broglie matter wave;
• Uncertainty principle; • Particle in a box; • Bohr theory and atomic spectra …etc.

Session 9: Atomic structure

• The nuclear atom; • Electron orbits; • Rutherfords's Nuclear Atom; • Bohr atom;
• Atomic spectra; • Atomic excitation …etc.

Session 10–11: Introduction to quantum mechanics

• One dimensional Schrödinger equation and wave-function; • Simple model of square well potential box; • Linearity and superposition; • Harmonic oscillator; • Operator; • Expectation value; • Tunneling phenomena …etc.

Session 12–13: Atomic and molecular physics

• Electron orbit; • Atomic spectra; • Three-dimensional Schrodinger equation; • Hydrogen atom; • Quantum number;

Session 14–15 Electron spin

• Spin; • Electron probability density; • Periodic law of the elements; • Exclusion principle; • Two atomic molecule; • Hydrogen molecule; • Bonding structures …etc.

Session 16: Final

** The contents and plans will be appropriately changed and adjusted during the course.

Grading:

1. Midterm I, Midterm II (can be turned into quizzes, a report, or others), and Final exams are main factors to determine the grades and will be equivalently treated.
2. Attendance, participation, homework, and quizzes will be used to adjust some points to finalize the grades.

*** This may be slightly altered and adjusted in the end of the semester.

Rules for students to use AI:

AI tools are prohibited for any assignment, and all work must be the student's original creation.