# Course Syllabus

**Course Name**: Modern Physics
**Course Code**: vp390

**Course Pre-requisites**
Physics II (vp240) or Honors Physics II (vp260)
Applied Calculus IV (vv256) or Honors Mathematics IV (vv286)

**Textbooks**
P.A. Tipler, R.A. Llewellyn, *Modern Physics* (6th edition)
additional reading: R.L. Liboff, *Introductory Quantum Mechanics* (4th edition, Addison Wesley, 2002)

**Instructor**
Mateusz KRZYZOSIAK (m.krzyzosiak@sjtu.edu.cn)
Office hours: Mon 20.10-21.15, Wed 20.10-21.15, and by appointment
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**Teaching Assistant**
ZHANG Boyu (email: ipromise@sjtu.edu.cn; recitation class: TBA; office hours: TBA; detailed schedule for the recitation session and office hours will be announced on Canvas).

**Grading Policy**

Coursework (25%)
Quiz (15%)
Midterm Exam (30%)
Final Exam (30%)

For this course, the expected median grade is around “B/B+”.

**Academic Integrity**

**Lectures**

Students are encouraged to read the relevant chapters in the textbook ahead of the lecture. Students are required to read and review the relevant chapters after the lecture. Lecture notes and other resources will be available on Canvas. Students are expected to attend lectures.

**Recitation Classes**

Weekly recitation sessions will be led by the teaching assistant. Recitation classes will focus mostly on problem solving and discussion. Students are expected to attend and actively participate in the recitation sessions.

**Homework**

Homework will be assigned in the form of problem sets to be solved by each student individually. Problem sets will have a due date assigned, by which date the homework has to be submitted electronically in Canvas. The assignment should be submitted electronically to Canvas in the form of PDF files. You should scan the homework you have done and save the file as a PDF. All work must be shown, and must be clearly legible in the final electronic document. Please plan your time well, as late homework will be accepted with the following late-submission penalties: 20% for submissions after the due time but no later than 24 hrs and 40% for submissions 24-48 hrs after the due time. No credit will be given for homework submitted more than 48 hrs after the due time.

**Quiz**

Quizzes will be based on weekly review lists that will be given to the students.

**Exams**

There will be two exams as listed in the class schedule. The form of the exams will be announced at least one week before the exam date. The use of a non-electronic English-Chinese dictionary will be allowed during the exams.

**Honor Code**

Oral discussion of homework problems with other students is allowed and encouraged on the level of general ideas, not specific solutions. It is not allowed to show any written work to other students. If any references to academic textbooks or research journals are made, they should be properly identified with the bibliographical data. No references to Wikipedia entries are allowed. For on-line teaching, additional regulations listed in the *Addendum to the Honor Code for Online courses* apply.

## Course description and teaching schedule

Modern Physics is a course in relativistic classical mechanics and elementary non-relativistic quantum mechanics. The formalism of quantum mechanics is introduced in the wave function approach and illustrated by discussing standard quantum mechanical problems. The concepts are further illustrated by applying the formalism to describe properties of molecules, solids, and nuclear matter.

| week | date | topic | textbook chapters |
|---|---|---|---|
| 1 | May 11–17 | special theory of relativity | 1 |
| 2 | May 18–24 | special theory of relativity;<br>basic concepts in the general theory of relativity | 1*, 2 |
| 3 | May 25–31 | experimental motivation for quantum mechanics; quantum mechanics in the wave-function formulation | 3-4,<br>5, * |
| 4 | Jun 1–7 | wave-function formalism; Schrödinger equation in one dimension – bound states | 5, 6, * |
| 5 | Jun 8–14 | Schrödinger equation in one dimension – bound states (contd) and unbound states (1D scattering and tunneling) | 5, 6 |
| 6 | Jun 15–21 | Schrödinger equation in one dimension – unbound states (contd)<br>measurement in quantum mechanics and uncertainty principles | 5, 6, * |
| 7 | Jun 22–28 | **midterm exam**<br>angular momentum, Schrödinger equation in three dimensions: the hydrogen atom | 7, * |
| 8 | Jun 29–Jul 5 | elements of the theory of the angular momentum and spin; applications in atomic physics | 7, 8 |
| 9 | Jul 6–12 | many-particle systems in quantum mechanics; elements of statistical physics – specific heat of gases | 9 |
| 10 | Jul 13–19 | molecular structure and bonding mechanisms; quantum-mechanical fundamentals of solid state physics | 10, * |
| 11 | Jul 20–26 | quantum-mechanical fundamentals of solid state physics; band structure of solids | 10, * |
| 12 | Jul 27– Aug 2 | basic ideas in quantum information processing (or fundamentals of nuclear physics) | */ 11 |
| 13 | Aug 3–7 | **final exam** | |

* additional teaching materials will be provided