

Sabancı University
Faculty of Engineering and Natural Sciences

Fall Semester 2022-2023

PHYS 211

MODERN PHYSICS

Instructor: Durmuş Ali Demir (Room: 1089, Ext. 7042, durmus.demir@sabanciuniv.edu)

Teaching Assistant: Ara Rahimpour (ara.rahimpour@sabanciuniv.edu)

Text : Arthur Beiser, “Concepts of Modern Physics”

Summary: An introduction to relativity and quantum physics based mainly on experiments.

Grading

Grades will be based on homeworks, 2 take-home midterm examinations, and 1 in-class final examination.

Midterm take-home exams ... 20 + 25 %

Final exam 40 %

Homeworks 15%

Class hours

Monday 13:40-14:30 (FENS L062)

Tuesday 15:40-17:30 (FENS L030)

Office hours:

Tuesday 14:40-15:30

PHYS 211 Course outline:

1. Understanding the Atom
 - a) Brownian Motion
 - b) Discovery of the Electron
 - c) Discovery of the Nucleus
 - d) Structure of the Atom

2. Understanding the Electron
 - a) Interference of Waves (Water and Light)
 - b) Interference of Corpuscles (Marbles)
 - c) Davisson-Germer Experiment
 - d) Interference of Electrons (Wave? Corpuscle?)

3. Understanding the Stability of the Atom
 - a) Propagating Waves
 - b) Standing Waves

4. Wave-Particle Duality

5. Quantization
 - a) Bounded and Unbounded Motions
 - b) Quantization Condition
 - c) Angular Momentum
 - d) Universal Angular Momentum Unit
 - e) Measuring the Universal Angular Momentum Unit

6. Uncertainty Principle

7. Basic Math
 - a) Complex Numbers
 - b) Complex Functions

8. Probability as a Physical Variable
 - a) Wavefunction
 - b) Interference
 - c) Classical vs Quantum Probabilities

9. Basic Math

- a) Matrices
- b) Operators
- c) Derivative Operator

10. Operators for Physical Quantities

- a) Position Operator
- b) Momentum Operator
- c) Fundamental Commutator

11. Dynamics of Wavefunction

- a) Energy Operator
- b) Schroedinger Equation
- c) Probability Waves

12. Particle in a Potential Well

- a) Wavefunction
- b) Energy spectrum

13. Particle in a Potential Wall

- a) Wavefunction
- b) Transmission/Reflection

14. Intrinsic Angular Momentum (Spin)

- a) $E = m c^2$
- b) $p = m c$
- c) $S = \hbar$