Sabancı University
Faculty of Engineering and Natural Sciences

Fall Semester 2023-2024

PHYS 211

MODERN PHYSICS

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


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 I (take-home exam) 20%
Midterm II (take-home exam) 25%
Final exam ............ 40%
Homeworks ............. 15%

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)