JAMESTOWN COMMUNITY COLLEGE
State University of New York

INSTITUTIONAL COURSE SYLLABUS

Course Title: Modern Physics

Course Abbreviation and Number: PHY 2720 **Credit Hours:** 4 **Course Type:** Lecture/Lab

Course Description: Students will study three major themes: the development of the theory of relativity; the old quantum theory of Planck, Einstein, Bohr, and Sommerfeld; and the new quantum physics of Schroedinger, Heisenberg, Dirac, and Pauli. Students' interest in relativity theory is motivated by the noncovariance problems discovered in the electromagnetic theory of Maxwell and Lorentz and by the null result of the Michelson-Morley experiment. The early quantum theory is developed from Planck's analysis of the problem of blackbody radiation and from Einstein's study of the photoelectric effect. This is followed by a careful study of the Schroedinger theory of quantum mechanics and solutions to the Schroedinger equation. In the laboratory students will repeat a number of historical experiments including the determination of the speed of light, the charge and charge to mass ratio of the electron, the Planck constant, and the Rydberg constant. Students may also perform the Franck-Hertz experiment. The last part of the semester in the modern lab is devoted to a special, student-designed project.

Prerequisite: PHY 2710; Corequisite: MAT 2680.

Student Learning Outcomes:

Students who demonstrate understanding can:

1. Read, write, and/or speak about current physics topics.
2. Write laboratory reports using proper grammar in which they:
    a. describe a purpose
    b. propose a hypothesis
    c. summarize and analyze observations
    d. draw a conclusion
3. Design and interpret graphs or tables of data.
4. Demonstrate an understanding of conceptual physics.
5. Choose effective problem solving techniques in the area of:
    a. Special relativity to include length contraction, time dilation.
    b. Lorentz transformations
    c. Wave/Particle duality
    d. Minkowski Spacetime diagram
    e. Schoredinger's Equation
    f. Photoelectric Effect
    g. Quantum Numbers
    h. Blackbody radiation
    i. Electron Probability Density
    j. Quantum mechanics
    k. Nuclear Decay
6. Employ a computer to either collect information or data. Students will also employ a computer for data analysis.
7. Demonstrate successful collaboration in the laboratory and/or classroom.
8. Demonstrate competency with standard laboratory equipment.

Topics Covered:

1. The Theory of Special Relativity: The Lorentz Transformation
2. The Theory of Special Relativity: Relativistic Dynamics
3. Roots of Quantum Theory
4. The Bohr-Rutherford Nuclear Atom
5. The Wave Nature of Particles
6. The Schrodinger Equation
7. The Schrodinger Equation in three dimensions: They Hydrogen Atom
8. Intrinsic Spin of the Electron
9. Nuclear Physics: Properties of Nuclei
10. Radioactivity and Nuclear Reactions

In the laboratory with this course, students repeat experiments that were the foundation for modern physics. These include the charge to mass ratio of the electron, the charge of the electron (Milikan Oil Drop), the measurement of Planck's constant, and the measurement of the Speed of Light. The last 5-6 weeks of lab are devoted to students' individual research and experimentation that results in a final project presentation.

Information for Students

- Expectations of Students
  - Civility Statement
  - Student Responsibility Statement
  - Academic Integrity Statement
- Accessibility Services
  Students who require accommodations to complete the requirements and expectations of this course because of a disability must make their accommodation requests to the Accessibility Services Coordinator.
- Get Help: JCC & Community Resources
- Emergency Closing Procedures
- Course grade is determined by the instructor based on a combination of factors, including but not limited to, homework, quizzes, exams, projects, and participation. Final course grade can be translated into a grade point value according to the following:

A=4.0	B+=3.5	B=3	C+=2.5	C=2	D+=1.5	D=1	F=0

- Veterans and active duty military personnel with special circumstances (e.g., upcoming deployments, drill requirements, VA appointments) are welcome and encouraged to communicate these to the instructor.

Effective Date: Fall 2021