PHYSICS

Program Goals

1.	**Overview**	Acquire a global view of the nature and scope of physics.
2.	**Principles**	Understand the fundamental principles of physics.
3.	**Applications**	Apply the fundamental principles to a variety of natural phenomena.
4.	**Theory**	Analyze and solve theoretical problems.
5.	**Experiment**	Conduct and design laboratory experiments.
6.	**Communication**	Collaborate on projects. Write and present scientific papers.

Learning Outcomes

1. Overview

A. Understand physics as a way of thinking, including its physical, conceptual, analytical, philosophical, and numerical modes of thought.
B. Understand how the different fields of physics are organized into a single whole. Understand the connection between the parts and the relation between theory and experiment.
C. Know and appreciate the historical evolution of physics and natural philosophy.
D. Understand the role of physics in science, society, and technology.

2. Principles

Understand the fundamental principles (laws, postulates, axioms) from which the entire subject of physics logically unfolds, including

A. Dynamical Laws: Classical mechanics (Newton) and quantum mechanics (Schrödinger).
B. Statistical Laws: Thermodynamics, energy, entropy, and probability (Boltzmann).
C. Fields and Quanta: Electromagnetic field (Maxwell) and photons (Einstein).
D. Conservation Laws: Mass-energy and momentum.
E. Spacetime Laws: Relativity (Einstein).

3. Applications

Demonstrate the ability to apply the fundamental principles learned in the core physics courses (classical mechanics, electricity and magnetism, statistical and thermal physics, quantum mechanics) to a variety of systems and processes within physics, and also at the interface of physics and the other sciences, including

A. Atomic, Molecular, and Optical Physics
B. Statistical and Condensed Matter Physics
C. Astronomy and Astrophysics
D. Mathematical and Computational Physics
E. Nuclear and Particle Physics
F. Biological, Chemical, and Environmental Physics
G. Physics Education

4. Theory

A. Understand and utilize the mathematical tools commonly used by physicists, including calculus, differential equations, linear algebra, Fourier analysis, and numerical methods.
B. Understand and appreciate the guiding principles used in formulating theories of the physical world, including linearity, symmetry, simplicity, and universality.
C. Develop the skills, or modes of thinking, that characterize the "art" of theoretical physics, including modeling, estimation, approximation, dimensional analysis, and limiting cases.

5. Experiment

A. Demonstrate the ability to perform standard experiments and reach valid conclusions.
B. Demonstrate the ability to design the experimental procedure and the method of analysis for a new experiment and to carry it to a successful conclusion.
C. Understand, utilize, design, and construct scientific instruments and data-collection systems for the experimental study of physics.
D. Know how to use a variety of techniques to organize, display, and analyze experimental data.

6. Communication

A. Work effectively in groups to solve problems, perform experiments, and conduct research.
B. Write acceptable laboratory reports, scientific essays, and journal articles.
C. Make effective poster and oral presentations on technical subjects.

Matrix of Physics Courses and Program Goals

	150	151	305	360	370	401	403	405	406	416	453	459	460	463
Overview	1	1	3	2	3	2	2	2	3	2	2	2	3	2
Principles	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Applications	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Theory	3	3	3	1	3	3	3	3	3	3	3	3	1	3
Experiment	2	2	1	3	1	1	1	1	1	1	1	1	3	1
Communication	2	2	3	3	3	3	3	3	3	3	3	3	3	3

Rankings: 3 = Extensive Coverage 2 = Substantial Coverage 1 = Basic Coverage