Program Learning Outcomes (Undergraduate Program):

1. Knowledge: The student will demonstrate knowledge and comprehension of the basic and applied fields of physics.
2. Problem Solving: The student will develop independent problem solving skills.
3. Laboratory Work: The student will develop good experimental technique, including proper setup and care of equipment, conducting experiments and analyzing results in order to observe physical phenomena, assess experimental uncertainty, and make meaningful comparisons between experiment and theory.
4. Written Communications: The student will develop effective written communication skills by clear and concise problem solving, well-structured laboratory reports, and accepted formatting of research papers.
5. Oral Communications: The student will develop effective oral communication skills in oral presentations of problem solution, seminars, and oral presentations at scientific meetings.
6. Professional Development: The student will discover the protocols of the professional physicist by attending meetings and giving papers.

Learning Objective -Assessment Method Matrix

Objective	Method	When	Who
1	A C	Questions embedded in test Senior Year	Course Instructor Instructor of PHY 470
2	A C	Questions embedded in test Senior Year	Course Instructor Instructor of PHY 470
3	B D	Laboratory rubric in the labs Independent Study Evaluation Rubric at conclusion of 475/476	Course Instructor Course Instructor
4	B	Laboratory rubric in the labs	Course Instructor
5	E G I	Seminar rubric At meeting Periodically in several courses	Faculty in attendance Faculty in attendance Course Instructor
6	F G H	At AAPT/APS events Once during curriculum Ethics Survey	SPS Adviser Adviser Instructor of PHY 470

Methods of Assessment:

A. Embedded Questions
B. Laboratory Rubric
C. Major Field Assessment Test (MFAT)
D. Independent Study Rubric
E. Seminar Rubric
F. Attendance at Professional Meetings
G. Presentation of Research Papers
H. Ethics Survey
I. Oral Presentation Rubric

Assessment Method-Learning Objective Matrix

Method	Objective	When	Who
A	1 2	Periodically through each course Senior Year	Course Instructor Instructor of PHY 470
B	3 4	Laboratory rubric in the labs Independent Study Evaluation Rubric at conclusion of 475/476	Course Instructor Course Instructor
C	1 2	Questions embedded in test Senior Year	Course Instructor Instructor of PHY470
D	3	Independent Study Evaluation Rubric at conclusion of 475/476	Course Instructor
E	5	Seminar rubric	Faculty in attendance
F	6	At AAPT/APS events	SPS Adviser
G	5 6	At Meeting Once during curriculum	Faculty in attendance Advisor
H	6	Ethics Survey	Instructor of PHY470
I	5	Periodically in several courses	Course Instructor

Core Courses Assessed through Exemplary Educational Objectives (EEOs). Those highlighted in red are not part of the identified program courses.

- **PHY 101, 102, 118, and 125**

AST 105 - Astronomy

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Recognize that the universe can be described by a few natural laws.	1
Describe the characteristics of objects within the solar system including the sun, planets, moons, asteroids, and comets.	1
Demonstrate a basic familiarity with stellar life cycles, galaxies, and extragalactic objects.	1

PHY 108 – Introduction to Engineering/Physics

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Demonstrate the ability to analyze and solve introductory physics and engineering problems.	1
Demonstrate the ability to communicate analysis of problems in a professional manner.	4
Exhibit the ability to work in teams effectively.	5

PHY 110 - Fundamentals of Electronics

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Demonstrate the ability to employ Ohm's Law and Kirchhoff's Laws to solve introductory DC and AC circuits.	1
Design, construct, and analyze DC and AC circuits.	1

PHY 131 – Mechanics and Heat

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Demonstrate the ability to apply Newton's Laws to the study of mechanical systems.	1
Describe the Laws of Thermodynamics.	1
Solve mechanics and thermodynamics problems using conservation principles	1, 4

PHY 132 – Electricity, Sound, and Light

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Solve problems using principles derived from Maxwell’s Equations.	1
Analyze DC and AC circuits.	1
Demonstrate an understanding of fundamental wave motion as applied to mechanical and electrical waves.	1
Solve problems involving geometrical and physical optics.	1

PHY 241 – Technical Physics I

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Demonstrate the ability to apply Newton's Laws to the study of mechanical systems.	1
Describe the Laws of Thermodynamics.	1
Solve mechanics and thermodynamics problems using conservation principles	1

PHY 242 – Technical Physics II

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Solve problems using principles derived from Maxwell’s Equations.	1
Construct and analyze and DC and AC circuits.	1, 3
Demonstration an understanding of fundamental wave motion as applied to mechanical and electrical waves.	1
Solve problems involving geometrical and physical optics.	1

PHY 250 – Engineering Statics

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Demonstrate an advanced level knowledge and understanding of Newton's First Law and its application to engineering.	1
Show quantitative and analytical skills necessary to solving physics/engineering problems.	1
Exhibit effective written communication skills in papers assigned.	4
Exhibit effective oral communication skills in presentations of physics/engineering problems to one's peers.	5

PHY 262 – Electrical Circuits and Devices

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Demonstrate a clear understanding of the theory and function of basic circuit components such as resistors, capacitors, inductors, diodes, transistors, transformers, and semiconductor devices.	1
Design and construct DC transient and AC filter circuits.	3
Build digital logic circuits using integrated circuit gates and interpret their operation.	3

PHY 321 – Engineering Dynamics

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Demonstrate an advanced level knowledge and understanding of the laws of classical mechanics to include representing these laws in mathematical expressions with appropriate units for physical quantities.	1
Show quantitative and analytical skills necessary to solving physics/engineering problems.	2
Exhibit effective written communication skills in presentations of physics/engineering homework problems.	4
Exhibit effective oral communication skills in presentations of physics/engineering problems to one's peers.	5

PHY 333 – Modern Physics

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Demonstrate on examination and through homework assignments, proficiency in solving problems in Special Relativity, the Quantum Theory of Light, the Particle nature of matter, the wave nature of matter, tunneling phenomena, three dimensional quantum theory solutions of hydrogen and hydrogen-like atoms, atomic structure and statistical physics	1, 4

PHY 333L – Modern Physics Lab

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Demonstrate effective writing skills through written laboratory reports.	4
Demonstrate good experimental technique in the laboratory by following directions and properly use the equipment in performing the experiments.	3

PHY 343 - Electronics

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Design and construct digital logic circuits using integrated circuit gates, decoders, counters, and flip-flops.	1, 3
Employ Karnaugh Maps and the Quine-McClusky method to solve complex logic problems.	2
Develop code for Programmable Integrated Circuits (PIC Chips) and install these programs on chips.	3, 4

PHY 347 – Mathematical Applications in Physics

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Demonstrate the ability to utilize algebra and the calculus of complex numbers in physics applications.	1, 2
Demonstrate skill in using advanced mathematical techniques to solve physics problems in classical mechanics, electricity and magnetism, optics, thermodynamics and quantum mechanics.	4

PHY 430 - Thermodynamics

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Understand fundamental concepts and definitions of thermodynamics such as temperature, equation of state, entropy, thermodynamic potentials, etc.	1
Know and apply the laws of thermodynamics to simple systems.	1
Derive the equation of state for an ideal gas using kinetic theory.	1

PHY 431 – Quantum Mechanics

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Demonstrate a working, quantitative understanding of the quantum phenomena and processes.	1
Apply the concepts of quantum mechanics to quantitatively predict behavior of physical systems.	1, 4

PHY 440 – Electricity and Magnetism

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Demonstrate on examination and through homework assignments, proficiency in solving problems in Electrostatics, Special Techniques of solving electrostatic problems, electric fields in matter, magnetostatics, magnetic fields in matter, electrodynamics, and Maxwell's Equations.	1, 4
Show problem solutions to the class from assigned homework problems.	4

PHY 441 - Optics

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Geometrical Optics: Apply the laws of reflection and refraction to plane and spherical surfaces, and discuss the principles of various optical instruments.	1
Wave Optics: Explain wave propagation of light, interference, diffraction, and polarization of light waves, and the electromagnetic nature of light.	1

PHY 441L – Optics Lab

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Develop good experimental technique and skill in error analysis.	3
Effectively communicate experimental results.	4
Reproduce some of the classic experiments in geometrical and wave optics.	1, 2

PHY 470 – Departmental Seminar

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Demonstrate a mastery of oral presentation of physics or astronomy research during two 20-30 minutes presentations.	5
Learn about the different physics and astronomy research areas available in the Department of Physics and Astronomy at SFA.	3
Distinguish ethical behavior in science	6

AST 305 – Observational Techniques

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Demonstrate an understanding of how to find and identify celestial objects.	1
Identify the different types of telescopes, cameras, and detectors used by astronomers.	1, 3
Independently repeat the process of making observations, including operation of an observatory, telescopes and related equipment.	3
Produce quality images and graphs using advanced techniques for reducing observations by converting raw observations into physical quantities which can be used to evaluate theoretical models	4

AST 335 - Astrophysics

By the end of the course, a successful student will be able to:

Student Learning Outcomes	Outcome
Analyze the classic two-body problem.	1
Describe the fundamental properties of light and stars.	1
Describe the principles of atomic structure.	1
Discuss the life cycle of stars.	1
Examine the equations governing the structure of stars.	1
Develop the physics that governs the energy production within stars.	1
Consider solar physics.	1