Physics and Environmental Sciences

School

School of Science, Engineering and Technology (http://www.stmarytx.edu/set)

School Dean

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Department

Physics and Environmental Sciences (https://www.stmarytx.edu/academics/set/undergraduate/physics-earth-sciences)

Department Chair

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Physics

Physics is the study of an enormous span of natural phenomena ranging from the large scale involvement of galaxies to the the submicroscopic motion of atoms and nuclei. A major in physics at St. Mary's University prepares students with a broad based view of science, as well as the analytical tools necessary to tackle problems in many different fields. Physics is an intensive course of study that emphasizes analytical and problem solving skills. Students have the opportunity to acquire a degree either in physics or applied physics.

The Bachelor of Arts in physics is usually chosen by students who wish to teach high school physics. The applied physics degree has an option in computer science or electrical engineering. Applied physics is a Bachelor of Science degree plan that provides an instructional base in physics, engineering, mathematics and computer applications. It prepares students to enter today's high technology marketplace upon graduation. Along with technical courses, students in the program benefit from liberal arts courses in English, social science, philosophy, theology, speech, foreign language and fine arts.

Environmental Science

The Environmental Science is a multidisciplinary field based on the nature of the complex environmental problems that need to be resolved. The St. Mary's Environmental Science degrees were designed to meet the demands of an ever increasing global population which brings about urbanization issues and the depletion of natural resources. This program aims to give students a foundation of scientific knowledge and professional skills that will enable them to assess a variety of environmental issues, and pose potential solutions. The degree plans allow the student to gain experience in one specialization, such as geosciences, chemistry, or ecology.

Majors in Physics and Earth Sciences

- B.A. in Physics with Math Minor (catalog.stmarytx.edu/undergraduate/majors-programs/science-engineering-technology/physics-environmental-sciences/physics-ba-math-minor)
- B.S. in Physics - Biophysics Option (catalog.stmarytx.edu/undergraduate/majors-programs/science-engineering-technology/physics-environmental-sciences/physics-bs-biophysics-option)
- B.S. in Physics with Math Minor (catalog.stmarytx.edu/undergraduate/majors-programs/science-engineering-technology/physics-environmental-sciences/physics-bs-math-minor)
- B.S. in Applied Physics - Computer Science Option (catalog.stmarytx.edu/undergraduate/majors-programs/science-engineering-technology/physics-environmental-sciences/applied-physics-bs-computer-science-option)
- B.S. in Applied Physics - Engineering Option (catalog.stmarytx.edu/undergraduate/majors-programs/science-engineering-technology/physics-environmental-sciences/applied-physics-bs-engineering-option)
- B.A. in Environmental Science (catalog.stmarytx.edu/undergraduate/majors-programs/science-engineering-technology/physics-environmental-sciences/environmental-science-ba)
- B.S. in Environmental Science (catalog.stmarytx.edu/undergraduate/majors-programs/science-engineering-technology/physics-environmental-sciences/environmental-science-bs)

Minors in Physics and Earth Sciences

- Physics (catalog.stmarytx.edu/undergraduate/majors-programs/science-engineering-technology/physics-environmental-sciences/physics-minor)
- Energy Science and Policy (catalog.stmarytx.edu/undergraduate/majors-programs/science-engineering-technology/physics-environmental-sciences/minor_in_energy_science_and_policy)

- Energy Science and Technology (catalog.stmarytx.edu/undergraduate/majors-programs/science-engineering-technology/physics-environmental-sciences/minor_in_energy_science-technology)
- Environmental Science (catalog.stmarytx.edu/undergraduate/majors-programs/science-engineering-technology/physics-environmental-sciences/environmental-science-minor)
- Geology (catalog.stmarytx.edu/undergraduate/majors-programs/science-engineering-technology/physics-environmental-sciences/minor_in_geology)

All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a "C" or better in order to advance to the next sequenced course.

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Earth/Environmental Science

ES 1100. General Geology Laboratory. 1 Semester Hour.
Laboratory study of earth materials (minerals and rocks), introduction to maps, historical geology (fossils), and plate tectonics. (3 hours per week) (Fall) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

ES 1173. Environmental Science Lab. 1 Semester Hour.
Laboratory study of ecological footprints and the effects humans have on the environment. May include some field studies. This lab will be required for all students working on a major or minor in Environmental Science and by all Engineering Science majors working to fulfill an environmental science concentration. (Spring).

ES 1300. General Geology. 3 Semester Hours.
A survey course covering the physical aspects of geology (minerals, rocks, Earth systems, plate tectonics) and the geological history of the Earth and development of life (fossils). Field trip required. (Fall and Spring) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

ES 1301. Physical Geology. 3 Semester Hours.
Minerals and rocks and work of agents of geology; water (rivers, ground water, oceans), wind, ice and vulcanism; dynamics of the Earth's crust as seen by use of maps and observation. (Lecture 2 hours, lab 2 hours, field trip.).

ES 1303. Geology of Earth Resources. 3 Semester Hours.
Explores the nature, origin, distribution, use, conservation and future availability of valuable earth materials such as minerals, rocks, soils and water. Earth materials and activities will be used in class where appropriate. (field trip required) (Fall; Even year) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

ES 1304. Geology of Energy Resources. 3 Semester Hours.
Explores the nature, origin, distribution, use, conservation and future availability of petroleum and natural gas, coal and nuclear fuels. The probable impact of alternative energy sources will also be considered. Energy materials and activities will be used in class where appropriate. (field trip) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

ES 1305. Physical Geography. 3 Semester Hours.
A survey course which considers the entire world in terms of location, mapping, time zones, weather and climate, soils and vegetation, land forms, surface processes, and oceanography. (Spring).

ES 1342. Oceanography. 3 Semester Hours.
A broad-based introductory course on every facet of ocean study: biologic, geologic, hydrologic, physical and chemical. (Saturday field trip) Prerequisite: ES 1300 or other natural science. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a "C" or better in order to advance to the next sequenced course.).

ES 1373. Intro. Environmental Science. 3 Semester Hours.
Investigation of man's relationship to the earth; earth resources and conservation, pollution problems, geological hazards (earthquakes, volcanoes, landslides). Designed to benefit students majoring in any field. Field trip required . (Fall, Spring, and Summer) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

ES 2300. Global Change. 3 Semester Hours.
The main objective of this course will be to provide students with a perspective of the geological history of the earth, and the natural changes the planet has endured. Learning about the history of environmental changes and events such as species extinctions and causes will give students a background to understand how recent environmental changes compare the past changes on the planet. (Fall only)Prerequisites: ES 1300 and ES 1373. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a "C" or better in order to advance to the next sequenced course.).

ES 2320. General Ecology. 3 Semester Hours.
The main objective of this course will be to will learn about the fundamentals of ecology by studying the hierarchy of life, adaptations, population ecology and community ecology. Prerequisites: ES 1373 and ES 1173. Concurrent enrollment in MT 2303 recommended. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a "C" or better in order to advance to the next sequenced course.) Field Trip required (Fall; Even Year).

ES 2325. Energy Resources and the Environment. 3 Semester Hours.
This course will help students understand and appreciate the importance of geology in controlling the nature, origins, and distribution of energy resources. Students will also examine economic and political factors that influence both the present and future development of these resources, as well as the associated potential environmental impacts. Alternative energy resources such as solar, wind, geothermal, biofuels, and hydropower will also be discussed. Key concepts are reinforced by giving students hands on experience through classroom demonstrations and projects using case studies and materials from the extensive collections of the Department of Physics and Environmental Sciences. Field Trip. (Spring) Prerequisites: ES1300 or with permission of the instructor. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

ES 2330. Introduction to Sustainability. 3 Semester Hours.
Humans rely on energy and natural resources from the Earth for every aspect of a modern, technological society. The idea of sustainability is to ensure that resources are identified and obtained in an environmentally sound manner that allows for fulfilling the social, economic and other requirements of present and future generations. This course will present students with an overview of the drivers for human resource needs, resource exploration and extraction, consumption, and waste disposal. Through a service learning component, the students will also be introduced to actions that enhance sustainability at the local, regional, and national level. (Required Field Trip, Fee). Prerequisites: ES 1300 and ES 1373 OR with permission of instructor. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.) (Fall; Odd Year) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

ES 2345. Experimental Design. 3 Semester Hours.
This class will be an applied statistics course that focuses on the design and analysis of experiments typical to research in environmental science. Students will learn the steps required to set up a sound experiment and then study the various methods used in single factor and multifactor analysis. Topics will include: ANOVAs, Confidence Intervals, the f-statistic, Pairwise Comparisons and Orthogonality. The course will require use of statistical software to analyze data sets. (Fall only) Prerequisite: MT 2303. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.) Lab Fee (Fall; Odd Year).

ES 2450. Environmental Geology. 4 Semester Hours.
Investigation of man's relationship to the earth; earth resources and conservation, pollution problems, geological hazards (earthquakes, volcanoes, land-slides), energy resources. Causes to environmental problems will be studied as well as possible preventative measures. (Spring) Pre-requisites ES 1100, ES1373, ES1173 or with permission of the instructor.

ES 3100. Environmental Science Seminar. 1 Semester Hour.
Presentation and discussion of current research in the environmental sciences will be covered in this course. Career development aspects will also be covered. Students will be expected to take 3 semesters of this course to meet the requirements of the major. (Fall; Spring).

ES 3103. Special Topics. 1 Semester Hour.
Subject matter varies. Topic must be stated precisely on transcript, e.g., energy resources, petroleum geology, geophysics. May include lab and field work. Prerequisites: ES 1300 or permission of instructor. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.) (Fall, Spring, Summer).

ES 3125. Earth Science Extravaganza. 1 Semester Hour.
This course will allow students to utilize their knowledge in understanding their environment to teach the next generation. Students will design and present demonstrations about the environment for elementary age students. Up to 3 semesters of this course may be taken for elective credit. No prerequisites required.

ES 3203. Special Topics. 2 Semester Hours.
Subject matter varies. Topic must be stated precisely on transcript, e.g., energy resources, petroleum geology, geophysics. May include lab and field work. Prerequisites: ES 1300 or permission of instructor. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.)(Fall, Spring and Summer).

ES 3300. Earth Science for Teachers. 3 Semester Hours.
Activity-oriented review of basic concepts of geology, astronomy, oceanography and meteorology. Emphasis on design of experimental units and development of resource files in each of these areas. Prerequisite: Science teaching experience or approval of the instructor. (Lecture-laboratory 3 hours, field trip).

ES 3301. Essential Elements of Life-Earth Sciences. 3 Semester Hours.
Includes essential elements in the following areas: classification, morphology and evolutions of life forms; characteristics, processes and evolution of the earth's lithosphere, oceans and atmosphere: and characteristics and evolution of the solar system and universe. Emphasis on learning through inquiry and discovery. No prerequisites. (Candidates for Teacher Certification only.).

ES 3303. Special Topics. 3 Semester Hours.
Subject matter varies. Topic must be stated precisely on transcript, e.g., energy resources, petroleum geology, geophysics. May include lab and field work. Prerequisites: ES 1300 or permission of instructor. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.) (Fall, Spring, Summer) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

ES 3310. Scientific and Technical Writing. 3 Semester Hours.
The purpose of this course is to teach the fundamentals of effective scientific writing. This class will focus primarily on the process of writing and publishing scientific manuscripts but writing lab reports will also be addressed. Students will: improve their ability to efficiently access the scientific literature and write literature reviews; improve their technical and scientific writing skills; learn principal forms of scientific writing; learn how to write clear, concise and correct scientific prose; learn the details of manuscript preparation for scientific publication; learn how to reference scientific sources and write a bibliography; and learn how to perform peer reviews of scientific manuscripts and respond to editor comments. (Fall; Odd Year).

ES 3320. Environmental Policy and Regulation. 3 Semester Hours.
This course is designed to acquaint the student with numerous issues and perspectives confronting society and environmental scientists, and their influence on the development of environmental policy and regulation. This course is intended as a practical overview of environmental regulation, focusing on using case studies and examples to illustrate selected statutes and regulations that commonly shape the career of an environmental professional. Pre-requisites: ES 1373 or permission of the instructor. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.) (Spring; Odd Year).

ES 3325. Geophysics. 3 Semester Hours.
This course covers Physics of the Earth's Interior, where students learn about examining Earth structure, plate tectonics, and earthquakes. Students will also study methods of exploring the makeup of the Earth's surface using seismic surveys, electrical methods, magnetics, gravity and well logging. Field demonstrations will be a required part of the course, which may require some Saturday meetings. (Fall; Even Year) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/. Pre-requisites: MT 1303.

ES 3330. Information Technology. 3 Semester Hours.
This course will teach the student the fundamentals of earth coordinate systems and collecting data with global positioning systems (GPS). Once the student is familiar with projection types and data collection systems they will begin using collected data to create maps with GIS technology, in order to better define and understand environmental problems. Map creation will also cover incorporating remotely sensed data, such as satellite imagery, showing how different layers of the mapping process can be used to display multiple maps in the GIS format, and examining ways the data can be interpreted using GIS software functions. (Spring; Odd Year) Pre-requisites: ES1300 and ES1373 or permission of the instructor (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

ES 3335. Advanced Spatial Analysis. 3 Semester Hours.
This elective course will cover advanced spatial analysis techniques, focusing on Geographic Information Systems (GIS) and remote sensing analysis. Unlike the introductory Information Technology course (ES 3330) which introduced students to GIS and remote sensing, this course will explore spatial analysis techniques such as cluster analysis, mapping distributions and density, and Model-building. The focus on remote sensing will explore land use/land cover change mapping and change mapping. Required Field Trip Fee. (Fall; Odd Year) Prerequites: ES 3330 (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

ES 3340. Physical Hydrogeology. 3 Semester Hours.
This class will give students a firm understanding of the way that geology influences the water resources that exist in the world. Physical studies of geologic environments will examine the science required to study the quantity and movement within surface and ground water systems. Hands on experience will be provided through classroom demonstrations and projects. (Fall; Odd Year) Pre-requisites: ES1300, MT 1303 or with permission of the instructor. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

ES 3360. Wildlife Research and Management Techniques. 3 Semester Hours.
The purpose of this course is to introduce students to the techniques wildlife professionals use to manage both wildlife populations and wildlife habitat. This is an active learning course in the sense that the class spends as much time as possible outside the classroom, in the field, working with wildlife professionals. Required Field Trip, Fee. (Fall; Even Year) Prerequites: ES 1373, ES 1173, and ES 2320 or permission from the instructor. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

ES 3365. Conservation Biology. 3 Semester Hours.
This course is designed to introduce students to conservation biology, a multidisciplinary field of study that focuses on the patterns of and the processes that contribute to biological diversity. Formed in response to the global loss in biodiversity, conservation biology is a value-laden, crisis discipline that not only studies biodiversity, but importantly identifies strategies to reduce or prevent further loss of it. In this course, we review the ethical foundations of conservation biology, discuss the scientific evidence that illustrates recent rapid loss of biological diversity at multiple spatial and temporal scales, identify and elaborate on the causative factors of biodiversity loss, and discuss various strategies for conserving biodiversity. Conservation biology is multidisciplinary in scope, and therefore we will discuss topics in fields of study that include wildlife management, restoration ecology, economics, ethics, geology, evolution, philosophy, phylogeny, taxonomy, genetics, behavioral ecology, population ecology, disease, sociology, sustainable living, and human dimensions. (Spring; Even Year) Prerequites: ES 1373, ES 1173, and ES 2320 or permission from the instructor. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.) Required Field Trip; Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

ES 3400. Environmental Geochemistry. 4 Semester Hours.
The principal objective for this course is to provide students with an understanding of the importance of chemistry in determining the quality of our environment. Students will learn about natural geochemical processes that occur in Earth's water, air, and soil systems, and explore how human activity can affect geochemical cycles in the environment. Fundamental concepts will be reinforced using examples at both a local and a global scale. Course content is largely based on applied geochemistry, with supporting content in theoretical geochemistry. (Spring; Even Year) Pre-requisites: ES1300, ES 1373, and CH 1401, or with permission of the instructor. ES 3400L must be taken concurrently. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.) Required Field Trip; Lab fee.

ES 4300. Environmental Science Internship. 3 Semester Hours.
This course will allow students to gain course credit for internship work performed with a supervisor outside the St. Mary’s University Environmental Science program. Students are expected to complete all work required by their supervisor in a timely manner and will provide a report and presentation on their experience to their academic advisor to gain credit. (Fall only) Permission of academic advisor is required. (Fall, Spring, Summer).

ES 4325. Pollution Analysis and Remediation. 3 Semester Hours.
In a practical sense, pollution can be considered to be the presence of something where it shouldn’t otherwise be. Pollution control efforts have historically focused on remediation – cleaning up pollution after the fact, but more recent efforts have focused on designing prevention and control measures to stop pollution before it happens. This course will present students with an overview of different types of pollution, with discussion of hazard/risk assessment, pollution regulation, and remediation technologies to minimize potential effects of pollution. (Required Field Trip, Fee). Prerequisites: Undergraduate level ES 1300 Minimum Grade of D AND Undergraduate level ES 1373 Minimum Grade of D AND Undergraduate level ES2300 Minimum Grade of D, OR with permission of instructor.

ES 4400. Field Based Environmental Chemistry. 4 Semester Hours.
Environmental Chemistry is a project-based course during which students apply environmental science and chemistry concepts to the analysis of a natural environment. The course is focused on the analysis of soil and water chemistry at a field site in San Antonio. Students will design and implement sampling plans based on best practices. Field measurements will be performed on site. Samples will be analyzed in the laboratory using major chemical instrumentation. An emphasis will be placed on quality control and assurance in the design of the laboratory analysis. Students will prepare the results of their analysis in written and oral forms. Prerequisites: Undergraduate level ES 1300 Minimum Grade of C, OR CH1402 OR ES3400 Minimum Grade of C, OR with permission of instructor. (Field Trip, Fee). Spring , Odd Years.

Physics

PY 1300. Physics Concepts & Application. 3 Semester Hours.
Designed to convey the considerable bearing physical laws have on common experience. Applications in trades, professions and industry are provided. Directed to ward non-science majors to help them evaluate the evidence of their own experience and see the pervasiveness of physics in virtually every aspect of technological society. Topics: Motion, Gravity, Relativity, Energy and Power, Energy Resources, Waves, Sound and Electricity.

PY 1310. Modern Astronomy. 3 Semester Hours.
A course that will be of interest to students not majoring in science, engineering or mathematics as well as those majoring in these fields. This course deals mainly with stellar and galactic astronomy but begins with a brief survey of our solar system including orbits and Kepler's laws. The emphasis is placed upon how compositions, ages and evolution are deduced. The course will be somewhat quantitative but the mathematical requirements are minimal.

PY 1401. General Physics I. 4 Semester Hours.
First semester: mechanics, sound and heat. Second semester: electricity, light, atomic and nuclear physics. Intended for non-physics and non-engineering students. (Fall; Spring; Summer) (Lecture 3 hours; Lab 4 hours.) (PHYS 1401) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

PY 1402. General Physics II. 4 Semester Hours.
First semester: mechanics, sound and heat. Second semester: electricity, light, atomic and nuclear physics. Intended for non-physics and non-engineering students. (Fall; Spring; Summer) (Lecture 3 hours; Lab 4 hours.) (PHYS 1402) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

PY 1404. University Physics I. 4 Semester Hours.
Calculus based physics course intended for physics and engineering students. This course covers the basics of Newtonian Mechanics including kinematics and dynamics of linear and rotating systems. The energy and momentum approach is also covered in this course as are applications of these concepts to rotational dynamics, simple harmonic oscillations, thermodynamics, acoustics and fluid mechanics. (Fall; Spring; Summer) (Lecture 3 hours; Lab 4 hours.) Co-requisite MT 2412 (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

PY 2404. University Physics II. 4 Semester Hours.
Calculus based physics course intended for physics and engineering students. This course covers the concepts of waves and optics, electricity, DC and AC circuits, and magnetism. (Spring; Summer) (Lecture 3 hours; Lab 4 hours.) Prerequisites PY1404, MT 2412 (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

PY 3101. Modern Physics Lab. 1 Semester Hour.
This course focuses on the exploration of modern scientific methods through the measurement of several classical and modern physical constants. Experiments include: e/m, Millikan Oil Drop, Photo-electric Effect, Speed of Light, Franck-Hertz, plus additional experiments available in the department. (Fall only) (Lab 4 hours per week; usually con current with PY 3301.) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

PY 3102. Nuclear Physics Lab. 1 Semester Hour.
This course focuses on the experiments relevant to the behavior of atomic nuclei including studies of nuclear decay, nucleon scattering, radiation scattering. (Lab 4 hours per week; usually concurrent with PY 3302.) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

PY 3110. Computational Physics Lab. 1 Semester Hour.
This course may be students' first exposure to computer programming, so the first three weeks are devoted to developing a competency in the programming language Python. After this, students will write code in Python using computational techniques, such as least-squares fitting, finite difference (numerical differentiation), quadrature (numerical integration), and the Runge-Kutta method (ordinary differential equation solver), to solve problems ranging from quantum mechanical theory to biological models (predator-prey interaction). An independent project will be assigned utilizing additional computational methods (matrix methods, partial differential equation solvers, and Monte Carlo methods). (Alternating Spring).

PY 3113. Electronics Lab I. 1 Semester Hour.
DC circuits; the diode as a nonlinear device; the oscilloscope; RC circuits; RC filters; LC resonant circuit; rectifier; signal diodes; diode clamp; emitter follower; current source; common emitter amplifier; transistor as a switch; op-amp open-loop gain; inverting and non-inverting op-amps; op-amp follower and current source; summing amplifier; op-amp as an integrator, a differentiator, an active rectifier, and an active clamp; FET transistor; FET current source and source follower; FET as a voltage-controlled resistance; amplitude modulation and AM radio; input and output characteristics of integrated gates: TTL and CMOS. Prerequisite: EG 2152; corequisite: EG 3356. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a "C" or better in order to advance to the next sequenced course.) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

PY 3114. Electronics Laboratory II. 1 Semester Hour.
Flip-flops; counters; shift registers; the cascading 16-bit counter with added display and keypad; programmable divide-by-n counters; period meters; capacitance meters; memory; RAM; divide-by-3; memory-based state machines; the dynamic diode curve tracer; the grounded emitter amplifier; current sources; the Ebers-Moll model; push-pull amplifiers; differential amplifiers; the bootstrap circuit; the Miller effect; the Darlingtonpair; the super beta; the analog switch and its applications: chopper circuits; sample-and-hold circuits; switched capacitor filters; voltage inverter circuits; A/D and D/A converters; the phase-locked loop circuit; the frequency multiplier. Prerequisite: EG 3156; Co-requisite: EG 3357. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a "C" or better in order to advance to the next sequenced course.) Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

PY 3120. Robotics Lab. 1 Semester Hour.
This is a beginning course in robotics. We will be utilizing Vex Robotics kits, Robolab software and various Lego Robotics materials. The objective of this course is to introduce the student to basic programming as well as problem solving strategies. This course will involve students in the development, building and programming of a robot, capable of performing a number of simple tasks. Students will work hands-on in teams to design, build, program and document their progress. Topics include motor control, gear ratios, torque, friction, sensors, timing, program loops, logic gates, decision-making, timing sequences, propulsion systems and binary number systems. (Alternating Fall).

PY 3125. Special Topics Laboratory. 1 Semester Hour.
Additional fee associated with this course. See fee schedule for details at https://www.stmarytx.edu/admission/financial-aid/tuition/.

PY 3301. Modern Physics. 3 Semester Hours.
This course is an introductory course in non-classical physics for students who have completed calculus-based physics. It is intended to introduce students to the frontiers of physics. Topics include: special relativity, basic ideas of quantum mechanics with experiments that revolutionized our understanding of nature, and lead to the development of new fields such as atomic and molecular physics, condensed matter physics, nuclear and elementary particle physics. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a "C" or better in order to advance to the next sequenced course.) (Fall only).

PY 3302. Nuclear Physics. 3 Semester Hours.
A course that focuses on the scientific study of the properties and behavior of atomic nuclei instruction in nuclear reaction theory, quantum mechanics, energy conservation, nuclear fission and fusion, strong and weak atomic forces, nuclear modeling, nuclear decay, nucleon scattering, pairing, photon and electron reactions, statistical methods, and research equipment operation and maintenance. (Lab 4 hours per week) Prerequisite: PY 3301. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a "C" or better in order to advance to the next sequenced course.).

PY 3303. Mathematical Methods in Physics. 3 Semester Hours.
This course introduces students to some of the more advanced mathematical methods and ideas most widely used to describe physical processes covered in upper-level courses. Major topics to be covered include vector calculus, orthogonal curvilinear coordinates, topics in linear algebra, topics in ordinary and partial differential equations, complex analysis, and asymptotics.

PY 3304. Thermodynamics. 3 Semester Hours.
This course focuses on the basic concepts of thermodynamics from the microscopic point of view. Methods of statistical physics are used to define entropy and temperature, heat and work, ideal gas behavior. Applications to chemical reactions, Fermi and Bose systems in condensed matter physics and phase transformations are discussed. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.).

PY 3305. Physical Optics. 3 Semester Hours.
Physical principles are used to develop a firm fundamental understanding of optics and imaging. Main topics include light as an electromagnetic wave, light at an interface, polarization, interference, and diffraction. Also includes a brief introduction to modern optics and a discussion of the fundamental limitations of an optical system and its effect on images. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.).

PY 3307. Mechanics. 3 Semester Hours.
This course presents kinematics and dynamics of particles using Newtonian, Lagrangian and Hamiltonian techniques. Topics include central force motion, oscillations and normal mode analysis, non-linear dynamics, rotating rigid bodies and motion in non-inertial reference frames. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.).

PY 3308. Quantum Mechanics. 3 Semester Hours.
The purpose of this course is to provide a comprehensive introduction to the principles of quantum mechanics and includes following topics: formal development of the postulates of quantum theory, representation of states, quantum mechanics in one and three dimensions, angular momentum, spin and perturbation theory. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.).

PY 3313. Electronics. 3 Semester Hours.
Theory of semiconductors; discrete devices and integrated circuits; linear and digital operation. (EG 2341, EG 2152, EG 2352, EG 2353 are prerequisites.) Note: PY 1404 and PY 2404 are prerequisites and MT 3311 is a co-requisite for 3000 level physics courses. (same as EG3356) (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.).

PY 3314. Electronics. 3 Semester Hours.
Theory of semiconductors; discrete devices and integrated circuits; linear and digital operation. (EG 2341, EG 2152, EG 2352, EG 2353 are prerequisites.) Note: PY 1404 and PY 2404 are prerequisites and MT 3311 is a co-requisite for 3000 level physics courses. (same as EG3357) (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.).

PY 3325. Special Topics. 3 Semester Hours.
This course is used to introduce special topics of interest. Topics in past have included the following: Particle Physics, Biophysics, Functional Neuro imaging, Fiesta of Physics Outreach, Advanced Electromagnetric theory and Advanced Quantum Mechanics. Note: PY 1404 and PY 2404 are prerequisites and MT 3311 is a co-requisite for 3000 level physics courses. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.).

PY 3330. Mathematical Methods in Physics. 3 Semester Hours.
The course introduces students to some of the more advanced mathematical methods and ideas most widely used to describe physical processes covered in upper-level courses. Major topics to be covered include vector calculus, orthogonal curvilinear coordinates, topics in linear algebra, topics in ordinary and partial differential equations, complex analysis, and asymptotics. (Fall).

PY 3350. Biophysics. 3 Semester Hours.
Biophysics is an interdisciplinary science that employs and develops theories and methods of the physical sciences for the investigation of biological systems. Currently, biophysics is one of the fastest growing physics research areas that is vital to many other fields, including medicine, bioengineering, and biology. There are two major ways that the biological processes are affected by physics: (i) through physical principles underlying molecular interactions and (ii) through development and application of physical methods to studies of biological systems: DNA, proteins, lipid membranes, and cells. (Spring even years).

PY 4308. Advanced Quantum Mechanics. 3 Semester Hours.
This course is the second semester continuation of Quantum Mechanics. We will revisit angular momentum then proceed to perturbation theory and scattering. The remainder of the semester will be devoted to understanding the application of quantum mechanics to a variety of disciplines and phenomena including relativistic quantum mechanics, and brief introductions to quantum electrodynamics and quantum chromodynamics. (Spring odd years).

PY 4309. Electromagnetic Theory. 3 Semester Hours.
This course is an intermediate level discussion of Maxwell's Equations and their applications: electrostatics and dynamics, magnetic fields and magnetic effects, and electro-magnetic waves, both in vacuum and in materials. (All courses serving as prerequisites in the School of Science, Engineering and Technology must be completed with a “C” or better in order to advance to the next sequenced course.) (Spring only).

PY 4310. Advanced Electromagnetic Theory. 3 Semester Hours.
The goal of this course is to expose students to advances topics in classical electromagnetism with a contemporary point of view. Broadly, four areas will be considered: Electromagnetic sources, propagation of electromagnetic radiation, the interaction of electromagnetic radiation with materials, and physical optics. Specific topics include antennas, Lienard-Wiechert potentials, synchrotrons, lasers, Gaussian beam propagation, electrodynamics of materials (electrons, phonons, plasmons, artificial materials, magneto-electrics), and nonlinear optics. Connections with current research will be made for each of these topics. An approximate lecture schedule is included below. The emphasis on this course is not mathematical physics, but rather stepping back and developing some physical insight into modern topics in E&M. (Spring even years).