Department of Physics, Astronomy, Geosciences, and Engineering Technology

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The Department of Physics, Astronomy, Geosciences, and Engineering Technology is a multidisciplinary department with programs that lead to a Bachelor of Science degree with a major in physics, a Bachelor of Science degree with a major in astronomy, a Bachelor of Science degree with a major in environmental geosciences, and an Associate of Science degree in Engineering Studies. The Regents' Engineering Pathway Program (REPP) enables a student to take core curriculum, mathematics, science, and engineering courses at Valdosta State University and then transfer to universities offering the B.S. degree in engineering in Georgia (Georgia Tech, the University of Georgia, Kennesaw State, Georgia Southern, or Mercer) or any engineering school outside of Georgia to complete the requirements for a degree in engineering. The department also offers minors in astronomy, environmental geosciences, geology, and physics.

This multidisciplinary department spans five related areas: physics, astronomy, geology, geography, and engineering. Physics is the foundation science which deals with space, time, matter, energy, gravitation, electromagnetism, light, atoms, nuclei, and the fundamental forces of the universe. Astronomy is the science that deals with the origin, evolution, position, motion, and nature of all the bodies in the observable universe, including the Sun, planets, moons, stars, nebulae, and galaxies. Geology is the science which deals with the Earth, our planet upon which we are totally dependent, its materials, environments, processes on its surface and in its interior, its origin, and its physical, chemical, and biological evolution. Environmental geoscience is an integrative discipline that examines the action, location, and distribution of natural phenomena and the influence of those natural phenomena on people and on the environment in which they live. Engineering is the application of mathematical and scientific principles, technological tools, and practical experience to the solution of real-world problems.

The program leading to the B. S. degree with a major in physics is designed to provide students with knowledge in the fundamental branches of physics (mechanics, electromagnetism, and quantum mechanics), as well as several elective areas within the field of physics, such as thermodynamics, electronics, optics, and computational physics, and to prepare students to enter graduate programs in physics or related disciplines, or to embark upon careers in research laboratories, government, industry, or education.

The program leading to the B. S. with a major in astronomy is designed to provide students with knowledge of the fundamental branches of astronomy, including solar system astronomy, astrophysics and observational astronomy, as well as supporting branches of physics; and with the skills to use the tools of astronomy, including telescopes and auxiliary equipment, appropriate to various astronomical observations; and to prepare students to enter graduate programs in astronomy, physics, or related disciplines or to embark upon careers in research laboratories and observatories, government, industry or education.

The program leading to the B. S. degree with a major in environmental geosciences is designed to provide students with the knowledge and the skills required to analyze environmental questions and to recommend solutions, using research tools in both geography and planning, as well as analytical and technical skills such as geographic information systems, spatial and temporal analysis, computer mapping, and statistical analysis to analyze environmental, hydrologic, and planning problems of the south Georgia region; and to prepare to enter graduate programs in geography, planning, and related fields or to embark upon careers in industry, government, or education.

The Engineering Transfer Program is designed to prepare students to transfer as third-year students into an engineering curriculum at a degree-granting institution. A major part of this program is the Regents' Engineering Pathway Program (REPP). The program covers course work through the first two years in major tracks such as aerospace engineering, civil engineering, chemical engineering, computer engineering, electrical engineering, industrial engineering, materials science and engineering, and mechanical engineering. After completing the required courses at VSU, the REPP students can receive an Associate of Science (A.S.) degree in engineering.

The minor in astronomy is designed to provide students with an understanding of fundamental astronomical principles and an appreciation of the disciplines of astronomy and astrophysics. The minor in environmental geosciences is designed to provide students with an understanding of the physical and cultural diversity of the Earth, with map techniques and spatial problem solving skills, and with an appreciation of the relationship between people and their environment. The minor in geology is designed to give students a greater understanding of the characteristics and processes of planet Earth and, depending upon the student's major, could better prepare the student for working in areas involving energy, material resources, or environmental problems. The minor in physics is designed to provide undergraduate students with an understanding of fundamental physical principles and an appreciation of the discipline of physics.

Students majoring in various disciplines may be able to gain work experience related to their major through the VSU Co-op Program. Such experience can prove valuable in terms of career exploration, acquisition of new skills, and career development. Students seeking more information should contact their academic advisors or the Office of Career Opportunities.

- Associate of Science in Engineering Studies (http://catalog.valdosta.edu/archive/2022-2023/undergraduate/academic-programs/sciences-mathematics/physics-astronomy-geosciences-engineering-technology/engineering-studies/as-engineering-studies/)

- Bachelor of Science with a Major in Astronomy (http://catalog.valdosta.edu/archive/2022-2023/undergraduate/academic-programs/sciences-mathematics/physics-astronomy-geosciences-engineering-technology/bs-astronomy/)
- Bachelor of Science with a Major in Engineering Technology (http://catalog.valdosta.edu/archive/2022-2023/undergraduate/academic-programs/sciences-mathematics/physics-astronomy-geosciences-engineering-technology/bs-engineering-technology/)
- Bachelor of Science with a Major in Environmental Geosciences (http://catalog.valdosta.edu/archive/2022-2023/undergraduate/academic-programs/sciences-mathematics/physics-astronomy-geosciences-engineering-technology/bs-environmental-geosciences/)
- Bachelor of Science with a Major in Physics (http://catalog.valdosta.edu/archive/2022-2023/undergraduate/academic-programs/sciences-mathematics/physics-astronomy-geosciences-engineering-technology/bs-physics/)

- Minor in Astronomy (http://catalog.valdosta.edu/archive/2022-2023/undergraduate/academic-programs/sciences-mathematics/physics-astronomy-geosciences-engineering-technology/minor-astronomy/)
- Minor in Geography (http://catalog.valdosta.edu/archive/2022-2023/undergraduate/academic-programs/sciences-mathematics/physics-astronomy-geosciences-engineering-technology/minor-geography/)
- Minor in Geology (http://catalog.valdosta.edu/archive/2022-2023/undergraduate/academic-programs/sciences-mathematics/physics-astronomy-geosciences-engineering-technology/minor-geology/)
- Minor in Physics (http://catalog.valdosta.edu/archive/2022-2023/undergraduate/academic-programs/sciences-mathematics/physics-astronomy-geosciences-engineering-technology/minor-physics/)

Astronomy

ASTR 1000. Introduction to the Universe. 3 Hours.
A survey of the universe, examining the historical origins of astronomy; the motions and physical properties of the Sun, Moon, and planets; the formation, evolution, and death of stars; and the structure of galaxies and the expansion of the Universe.

ASTR 1010K. Astronomy of the Solar System. 4 Hours.
Astronomy from early ideas of the cosmos to modern observational techniques. The solar system planets, satellites, and minor bodies. The origin and evolution of the solar system. Three lectures and one night laboratory session per week.

ASTR 1020K. Stellar and Galactic Astronomy. 4 Hours.
The study of the Sun and stars, their physical properties and evolution, interstellar matter, star clusters, our Galaxy and other galaxies, the origin and evolution of the Universe. Three lectures and one night laboratory session per week.

ASTR 2010. Tools of Astronomy. 1 Hour.
An introduction to observational techniques for the beginning astronomy major. Completion of this course will enable the student to use the campus observatory without direct supervision. The student will be given instruction in the use of the observatory and its associated equipment. Includes laboratory safety, research methods, exploration of resources (library and Internet), and an outline of the discipline.

ASTR 2020. The Planetarium. 1 Hour.
Prerequisites: ASTR 1000, ASTR 1010K, ASTR 1020K, or permission of instructor. Instruction in the operation of the campus planetarium and delivery of planetarium programs. Completion of this course will qualify the student to prepare and give planetarium programs to visiting groups.

ASTR 2950. Directed Study. 0-3 Hours.
Prerequisite: Consent of the instructor required. Supervised research on a specific astronomy project or topic as agreed upon by the instructor. A maximum of 6 credit hours may be taken, and they can only be applied toward the general elective requirements for the astronomy major.

ASTR 3220. Cosmology. 3 Hours.
Prerequisites: ASTR 1020K. A scientific and philosophical study of our perception of the universe, including the world views of Ptolemy, Copernicus, and Einstein.

ASTR 3400. Planetary Geology. 3 Hours.
Also offered as GEOL 3400. Prerequisites: ASTR 1010 or GEOL 1121 or GEOG 1113. Prerequisite or corequisite: PHSC 1100 or PHYS 1111 or PHYS 2211. A study of the geology of the terrestrial planets and solid-surface moons, asteroids, comets, and meteorites. The course will focus on comparative planetary geology, with emphasis on geologic processes on the surface, planetary interiors, and data collection methods such as remote sensing and image analysis.

ASTR 3800. Astrobiology. 3 Hours.
Prerequisites: Any one of the following: ASTR 1000, ASTR 1010K, ASTR 1020K, BIOL 1010, BIOL 1030, BIOL 2010, CHEM 1151K, CHEM 1211, PHYS 1111K, PHYS 2211K; and either MATH 1113 or MATH 2261. A multidisciplinary science course examining the possibility of extraterrestrial life in the solar system and the universe. Emphasis is on the definition of life from the perspectives of biology, chemistry, and physics, and the requirements for lifeforms. Extreme habitats where lifeforms might evolve will be explored in context with NASA's on-going exploration of the solar system and the search for intelligent life in the galaxy.

ASTR 4101. Observational Techniques I. 4 Hours.
Prerequisites: PHYS 2212K, ASTR 1010K, ASTR 1020K. Aspects of observational astronomy. Topics include spectroscopy, photometry, imaging, astrometry, and operation of the observatory.

ASTR 4102. Observational Techniques II. 3 Hours.
Prerequisite: ASTR 4101. Aspects of observational astronomy. Topics include radio astronomy, ultraviolet and x-ray astronomy, and data reduction techniques.

ASTR 4400. Physics of the Solar System. 3 Hours.
Celestial mechanics; physical features of the sun, planets, moons, and other material in the solar system.

ASTR 4410. Astrophysics. 3 Hours.
Prerequisite or corequisite: PHYS 4411. Radiative transfer in the stellar atmosphere, the interior structure of stars, stellar evolution, physical processes in gaseous nebulae and cosmology.

ASTR 4800. Internship in Astronomy. 3-6 Hours.
Active participation in research in astronomy, or in some field of science closely allied with astronomy, or work with a planetarium or museum which involves planetarium operations and programs. A daily log of activities, a report on the work done, and a research paper relating the work done to the field of astronomy are required.

ASTR 4900. Special Topics in Astronomy. 1-6 Hours.
Prerequisite: Consent of advisor and instructor. Topics to be assigned by instructor; may be taken more than once if topics are different; up to a total of 6 credit hours.

ASTR 4950. Directed Study in Astronomy. 1-6 Hours.
Prerequisites: Consent of advisor, instructor, and Department Head. Study in area or subject not normally found in established courses offered by the department; may also allow students to explore in more detail and/or depth an area or subject covered by the department in astronomy; up to a maximum of 6 credit hours.

Engineering Technology

ENGT 2010. Introduction to Engineering Technology. 3 Hours.
Introduction to engineering and engineering technology disciplines that form the basis for a variety of career opportunities; engineering design as creative problem solving; lessons from design failures; professionalism and ethics; and problem solving using industry standard software.

ENGT 2500. Engineering Graphics for Design. 3 Hours.
An introduction to engineering design and three-dimensional visualization, geometric construction, graphical projection and sketching, descriptive geometry, and computer graphics.

ENGT 2510. Statistics in Engineering Technology. 3 Hours.
Study and application of probability theory in the solution of industrial and manufacturing problems. Topics include descriptive statistics, hypothesis testing, probability and the normal curve, inferential statistics, confidence intervals and computer applications.

ENGT 2520. Engineering Economics. 3 Hours.
Prerequisites: MATH 1111, 1112, or 1113. Deals with aspects of investment analysis relating to equipment justification, retirement and replacement in industry; includes the evaluation of decision alternatives using different economic criteria.

ENGT 2530. Statics. 3 Hours.
Prerequisite: PHYS 1111K or 2211K. Selected topics of statics including equilibrium conditions, summation of forces and moment of a force in 2D and 3D; centroid, distributed loads, internal forces in trusses, frames and machines, and shear and moment diagrams in beams.

ENGT 3100. Six Sigma and Lean Manufacturing. 3 Hours.
A combination of lean manufacturing and Six Sigma to learn how to use collaborative team effort to improve performance by systematically removing waste and reducing variation.

ENGT 3120. Plant Layout and Material Handling. 3 Hours.
A study of using material flow in facility design and facility location for optimization of facility performance.

ENGT 3130. Industrial Cost Control. 3 Hours.
Examination of the factors associated with cost measurement and control in both manufacturing and non-manufacturing industries.

ENGT 3140. Simulation Modeling of Industrial Systems. 3 Hours.
Prerequisite: CS 1340 or CS 1301 or MATH 2261. Study of computer simulation and modeling analysis and its application to manufacturing, industrial, inventory, and distribution systems, including the use of statistical techniques.

ENGT 3150. Supply Chain and Logistics Concepts. 3 Hours.
Principles of decision making and problem solving to reduce challenges and optimize solutions around purchasing, inventory, and transportation.

ENGT 3500. Engineering Graphics for Design II. 3 Hours.
Prerequisite: ENGT 2500 and MATH 1111. Detail and assembly drawings of machines and machine elements including the design and fabrication of machine parts using geometric dimensioning and tolerancing; parametric design and solid modeling software is used.

ENGT 3510. Advanced Statistics in Engineering Technology. 3 Hours.
Prerequisite: ENGT 2510. Use statistical theory to solve industrial and manufacturing problems, including chi-squared contingency tables and goodness of fit tests, regression analysis, one-way and two-way ANOVA, multiple range tests, and experimental design,.

ENGT 3520. Industrial Safety Engineering. 3 Hours.
Introduction to the principles and practices of accident prevention and industrial hygiene and safety with emphasis on OSHA requirements.

ENGT 3530. Introduction to Manufacturing Systems. 3 Hours.
Study of methods to analyze manufacturing systems and components including material flow and storage, information flow, capacities and times and duration of events. Topics include optimization and linear and dynamic systems, factory planning and scheduling.

ENGT 4100. Motion and Time Study. 3 Hours.
Prerequisite: ENGT 2510. Covers work measurements and methods including the use of standards, value engineering methods design, time studies and ergonomics and the use of scientific methods and graphical tools toe examine efficiency of work methods and to improve prductivity and performance.

ENGT 4110. Industrial Automation. 3 Hours.
A study of the applications of industrial automation systems, including identification of system requirements, equipment integration, motors, controllers, and sensors. Include lab fee.

ENGT 4120. Project Management. 3 Hours.
Study of the concepts and methodologies used in industrial and production environment that lead to successful project completion. Topics covered include project cycles roles, time-cost tradeoff, resource allocation, and performance measurement.

ENGT 4500. Technical Project Proposal. 1 Hour.
Taken the fall of senior year, this capstone project proposal course provides students with the opportunity to work with a faculty member or local business participant in collaboration with faculty member input to design a project that reflects the knowledge and skills developed from the curriculum. Includes lab fee.

ENGT 4510. Basic Electricity and Electronics. 3 Hours.
Prerequisite: PHYS 1112k or 2212K and MATH 2261. Introduction to the principals of electricity and electrons including applications and problem solving surrounding AC and DC circuits, series and parallel circuits, electrical components, magnetism and power. Includes lab fee.

ENGT 4520. Applied Thermodynamics. 3 Hours.
Prerequisites: PHYS 1112K or 2212K and MATH 2261. Application of thermodynamics to engineering systems for both steady and transient processes.

ENGT 4550. Technical Project Lab. 2 Hours.
A continuation of ENGT 4500 where student will complete their proposed hands-on project; students are expected to spend significant amount of time outside of a typical classroom environment. Includes lab fee.

ENGT 4950. Directed Study in Engineering Technology. 1-3 Hours.
Prerequisite: Junior standing; permission of instructor and Department Head. Supervised investigation of a specific problem and preparation of a final report agreed upon by student and instructor. Three hours may be substitute for ENGT 4980 and 4990. Includes lab fee.

Geography

GEOG 1100. Introduction to Geography. 3 Hours.
A broad introduction to the field of geography, with its various traditions, subfields, and associated technologies. Topic areas covered include the multiple aspects of cultural and physical geography and tools used in the discipline, such as Geographic Information Systems (GIS) and Global Positioning Systems (GPS).

GEOG 1101. Introduction to Human Geography. 3 Hours.
A survey of global patterns of resources, population, culture and economic systems. Emphasis is placed upon the factors contributing to these patterns and the distinctions between the technologically advanced and less advanced regions of the world.

GEOG 1102. World Regional Geography. 3 Hours.
Examination of the interaction among the developed and developing regions of the world. Particular emphasis is placed on the interrelationships of historical, cultural, economic and political elements in critical areas of the world.

GEOG 1103. Geographic Perspectives on Multiculturalism in the U.S.. 3 Hours.
Geographic factors underlying multiculturalism and ethnic relationships in the U.S. Three interrelated themes are emphasized: the spatial development and organization of culture; population growth, migration, and urbanization; and the spatial dimensions of political, economic, and social processes.

GEOG 1105. Health Geography and Pandemics. 3 Hours.
An introduction to human-environment interactions and the influence these interactions have on public health and pandemics. The focus of this course will be on geographical patterns of health and pandemics from the viewpoint of populations rather than individuals.

GEOG 1110. Our Hazardous Environment. 3 Hours.
Also offered as GEOL 1110. A detailed examination of physical environmental hazards that influence human health and habitation. Lectures focus on the causes, processes, and results of naturally occurring and human-induced geologic, hydrologic, and atmospheric events, such as earthquakes, mudflows, floods, hurricanes, soil erosion, and nuclear and toxic waste. Some mathematics is used.

GEOG 1112K. Introduction to Weather and Climate. 4 Hours.
Pre- or corequisite: MATH 1101 or higher. Weather components, processes, and their measurements. Climatic elements and their control factors and geographic classification of climatic and vegetation types are also discussed.

GEOG 1113K. Introduction to Land Forms. 4 Hours.
Prerequisite or corequisite: MATH 1101 or higher. Introductory analysis and classification of major types of land surfaces, stressing geographic characteristics. Study and interpretation of relationships between landforms and other phenomena through maps, aerial photos, and field observations. World coverage with emphasis on North America.

GEOG 1120. Introductory Oceanography. 3 Hours.
An introductory examination of the physical, chemical, biological, and geological characteristics of the Earth's oceans. Effects of human activity on marine environments and resources as well as management of coastal resources will be discussed. Development of geographic skills and map interpretation through charts, graphs, and ocean models will be included.

GEOG 1125. Resources, Society, and Environment. 3 Hours.
Interactions between physical systems and human activities and their effects on environmental quality and stability. Topics include geography of population and resource consumption, food production, water and air quality, energy policy, land/biotic resource management. Contrasting social, ethical, and technological perspectives on environmental concerns are explored.

GEOG 2010. Tools of Environmental Geoscience. 3 Hours.
Also offered as GEOL 2010. An introduction to research techniques for the incoming environmental geoscience majors. This course includes an overview of the discipline and the tools used in geoscience research. Topics may include laboratory safety, research methods, exploration of resources (library and Internet), methods of data collection, data analysis, and scientific reporting of results.

GEOG 2011. Introduction to Geographic Information Science. 3 Hours.
Prerequisite: GEOG 2010 or permission of instructor. Introduction to principles and applications of Geographic Information Science (GIS). This course will examine spatial data acquisition, management, retrieval, analysis, and output. Instruction will involve computer examples and exercises that emphasize real-world problem solving.

GEOG 3020. Global Climate Change. 3 Hours.
Also offered as GEOL 3020. Prerequisites: GEOG 1112K and either GEOG 1113K or GEOL 1121K. An overview of global climate change based on changes to the Earth's atmosphere, lithosphere, and hydrosphere. This course provides an analysis of past climates in the geologic, biologic, and hydrologic record, the impact of fossil fuel utilization on climate over the last 250 years, and links to ice sheets and oceans. The course examines implications of global climate change on the human population, including diseases and severe weather, as well as biogeography, including the extinction of threatened species.

GEOG 3050. Computer Cartography and Image Analysis. 3 Hours.
Prerequisite or corequisite: GEOG 2010 or GEOL 2010. An introduction to digital production of general and thematic maps. Lectures and laboratory exercises cover principles of cartography and remote sensing as well as the manipulation and visualization of spatial data and imagery.

GEOG 3051. Introduction to Geographic Information Systems. 3 Hours.
Prerequisite: Junior standing or permission of the instructor. An examination of geographic information systems, including methods of capture, storage, analysis, and display of spatially-referenced data. Laboratory exercises provide experience with typical GIS operations and applications.

GEOG 3052. Advanced Geographic Information Systems. 3 Hours.
Prerequisite: GEOG 2011 or 3051. Advanced applications of GIS including: overlay analysis, writing short macros for repetitive operations, spatial modeling and technical support of complex land use and natural resource management decision making. Laboratory exercises designed to form a cartographic and software portfolio for students.

GEOG 3053. Application Issues in Geographic Information Systems. 3 Hours.
Prerequisite: GEOG 3051. Operational and planning issues in GIS. Students will learn which issues need to be considered when proposing and implementing software/hardware GIS and will have opportunities to evaluate how a GIS can be used to solve specific planning problems.

GEOG 3054. Introduction to GPS. 2 Hours.
Prerequisite: Junior standing or permission of the instructor. An introduction to global positioning systems (GPS) including reference systems, mapping, positioning methods, sources of error, data collection methodologies, and field procedures. Hands-on exercises will provide experience with typical GPS operation and application.

GEOG 3100. Regional Planning and Environmental Management. 3 Hours.
Prerequisite: Consent of instructor. Introduction to planning for economic development, service provision and resource management at scales larger than municipalities with an emphasis on the environmental impacts of planning policy and regulation.

GEOG 3120. Geosciences Field Trip. 3 Hours.
Also offered as GEOL 3120. Prerequisite: GEOG 1113K or GEOL 1121K. A study of the geology and geography of a selected region during the first week, followed by a two-week field trip to points of interest. The interactions among geology, surficial processes, and organisms and how those interactions impact humans will be emphasized. Field trip destination is different each summer. Student fee required. Offered only during Summer Session I.

GEOG 3150. Meteorology and Climatology. 3 Hours.
Prerequisites: GEOG 1112K. A detailed examination of atmospheric motions and climatic controls including, the Earth's radiation and energy balance, air mass dynamics, weather systems, and past and present climates of the Earth.

GEOG 3200. History of Life. 3 Hours.
Also listed as GEOL 3200. Prerequisites: Sophomore standing and consent of instructor. Principles of paleontology with emphasis on the history of life including vertebrates. Includes an account of the outstanding forms of life from the beginning of earthtime to the present, and those paleontologically significant groups that are uncommon, different, or extinct today.

GEOG 3210. Introduction to Hydrology. 4 Hours.
Also listed as GEOL 3210. Prerequisites: GEOL 1121K or GEOG 1112K, and GEOG 1113K. An introduction to surface and sub-surface hydrology, examining components of the hydrologic cycle. Topics include local and global water balance, precipitation, interception and infiltration, runoff, stream flow, water storage, and groundwater. This course makes use of some mathematical equations.

GEOG 3240. Hydrogeology. 4 Hours.
Also listed as GEOL 3240. Prerequisites: GEOL 1121K or GEOG 1112K, and GEOG 1113K. Introduction to the hydrology of groundwater. Study of the subsurface part of the hydrologic cycle and description of the occurrence, movement, and management of groundwater as a renewable resource. Special emphasis on surface water-groundwater interactions, sensitivity of karst aquifers to environmental stresses, water quality, groundwater contaminations, and field methods that are applied in groundwater studies. Weekend field trip(s) required.

GEOG 3300. Process Geomorphology. 4 Hours.
Also listed as GEOL 3300. Prerequisite: GEOL 1121K, or GEOG 1112K and GEOG 1113K. An introduction to process geomorphology examining landforms and their formative processes. Topics include weathering and slope, fluvial, coastal, aeolian, glacial, and periglacial processes, and the application of soils to geomorphology. This course makes use of some mathematical equations. Field trip required.

GEOG 3310. Physiography of North America. 3 Hours.
Prerequisites: GEOL 1121K, or GEOG 1112K and GEOG 1113K, or consent of the instructor. The physiographic description, including the landforms, soils, structural framework, climate, plant and animal geography, natural resources, and the unique environmental problems of each major physiographic province of the United States and Canada, including Alaska, Hawaii, and Puerto Rico.

GEOG 3320. Geomorphology of Fluvial and Coastal Environments. 3 Hours.
Also listed as GEOL 3320. Prerequisite: GEOG 3300. An examination of processes and landforms in fluvial (river) and coastal environments. Fluvial topics include channel geometry and pattern, characteristics of flow, sediment load, bedforms, and floodplains. Coastal topics include the study of waves and tides, coastal sediment transport, beaches, and the effects of changing sea level. This course makes use of some mathematical equations.

GEOG 3330. Geology, Hydrogeology, and Environmental Issues in Georgia. 3 Hours.
Also listed as GEOL 3330. Prerequisite: GEOL 1121K. An overview of the geologic framework of Georgia and surrounding states, with emphasis on topical hydrogeologic and environmental issues that impact Georgia's environment. Students receive the appropriate geologic background necessary for careers that address environmental issues in the southeastern United States. One or more field trips to locations in the area will be included.

GEOG 3410. Cultural Geography. 3 Hours.
Prerequisite: consent of the instructor. A study of the Earth as the home of humankind, emphasizing the spatial and functional complexes of human geography. Topics to be considered are population, settlement form, settling processes, resources, and economic, political, and societal organizations.

GEOG 3510. Urban Community Planning. 3 Hours.
Principles and applications of planning for neighborhoods, towns and cities with an emphasis on the United States. Topics covered include: public services, landuse decision making, economic development, growth management and the role of nongovernment organizations.

GEOG 3610. Economic Geography. 3 Hours.
Prerequisites: GEOG 1102K or GEOG 1112K, and GEOG 1113K, or consent of the instructor. A study of areal variations in human economic activities as related to production, exchange, and consumption of economic goods and services. Emphasis is placed on location of economic activities and related theories.

GEOG 3710. Environmental Soil Science. 4 Hours.
Also offered as GEOL 3710. Prerequisites: CHEM 1211 and CHEM 1211L; GEOG 1113K or GEOL 1121K. Soil properties, distribution and classification, factors of soil formation, and the relationships among soils, geomorphology, and the environment, stressing analysis and use of soils and soil databases for proper urban, agricultural, and environmental land use.

GEOG 3810. Introduction to Biogeography. 3 Hours.
Also offered as BIOL 3810. Prerequisites: Three of the following courses: GEOG 1112, GEOG 1113, BIOL 2010, BIOL 2230, or BIOL 2270. An overview of factors controlling the distribution of plants and animals on the Earth. Topics discussed include ecological and evolutionary processes, geophysical and climatic phenomena, and historical and anthropogenic events that have influenced current distributions.

GEOG 3910. European Geography. 3 Hours.
A survey of European geography, with a special emphasis on the European Union. Topic areas covered include physical, economic, political, and cultural geography of Europe.

GEOG 3920. Geography of the Middle East. 3 Hours.
A survey of the nations of the Middle East, with a special emphasis on the Arab-Israeli conflict. Topic areas covered include physical, economic, political, and cultural geography of the Middle East.

GEOG 4700. Field Methods in Environmental Geography. 4 Hours.
Prerequisites: Junior standing and consent of instructor. Study of field techniques and field problems in physical geography. Course includes classroom presentations, field projects, field trips, and writing technical reports.

GEOG 4710. Statistics for Geoscientists. 3 Hours.
Prerequisite: MATH 1401 or permission of instructor. A survey of statistical methods used by geoscientists to solve real-world problems. The course will examine the various quantitative methods available to collect, analyze, and interpret geographic data; enable students to read and understand statistical results presented by geoscientists; help students to apply the correct statistical methods for the collection, analysis, and interpretation of their own data.

GEOG 4800. Internship in Environmental Geosciences. 3-6 Hours.
Prerequisite: Consent of instructor and Department Head. Graded “Satisfactory” or “Unsatisfactory.” A supervised, practical experience using environmental geosciences skills in an appropriate organization. The course provides students with an opportunity to apply skills learned during pursuit of the environmental geosciences degree to real world situations.

GEOG 4860. Geosciences Senior Seminar. 1 Hour.
Also offered as GEOL 4860. Prerequisites: Junior or Senior standing and consent of the instructor. Graded "Satisfactory" or "Unsatisfactory". Exploration and selection of which option of experiential learning students will pursue as a senior. Each student will submit a proposal for approval by their supervising faculty member(s).

GEOG 4861. Senior Thesis. 3 Hours.
Also offered as GEOL 4861. Prerequisite: GEOG 4860 or GEOL 4860. Part of a two-course sequence in which a research project is designed by the student and supervising faculty member(s) in an approved area of interest. Students will collect sample data, conduct data analysis,and write a thesis.

GEOG 4862. Thesis Presentation. 2 Hours.
Also offered as GEOL 4862. Prerequisite: GEOG 4861 or GEOL 4861. The third course in a three-semester research project designed by the student and supervising faculty member(s) in an approved area of interest. Students will present their senior thesis project in both oral and poster form to the department or at an approved professional meeting.

GEOG 4900. Special Topics in Geography. 1-6 Hours.
Prerequisite: consent of instructor. Topic to be assigned by instructor; the course may be repeated more than once if the topics are different.

GEOG 4990. Directed Study in Geography. 1-6 Hours.
Prerequisites: at least Junior standing and permission of advisor, instructor, and Department Head. Study in area or subject not normally found in established courses offered by the department; may also allow students to explore in more detail and/or depth an area or subject covered by the department.

Geology

GEOL 1011K. Introductory Geosciences I. 4 Hours.
This course covers Earth materials and processes. For more information on this institution's eCore courses, please see http://www.valdosta.edu/ecore/.

GEOL 1110. Our Hazardous Environment. 3 Hours.
Also offered as GEOG 1110. A detailed examination of physical environmental hazards that influence human health and habitation. Lectures focus on the causes, processes, and results of naturally occurring and human-induced geologic, hydrologic, and atmospheric events, such as earthquakes, mudflows, floods, hurricanes, soil erosion, and nuclear and toxic waste. Some mathematics is used.

GEOL 1121K. Principles of Physical Geology. 4 Hours.
Prerequisite or corequisite: MATH 1101 or higher. An introduction to the physical processes responsible for the formation and ever-continuing modification of our Earth. Topics covered include the structure of the Earth and plate tectonics, volcanoes and earthquakes, formation of minerals and the rock cycle, origin and evolution of the landscape, and groundwater and energy resources.

GEOL 1122K. Principles of Historical Geology. 4 Hours.
Prerequisite or corequisite: MATH 1101 or higher. An introduction to the physical and biological development of the Earth from its cosmic beginning to the present, with emphasis on reconstructing sedimentary environments, tectonic processes, and life forms represented in selected regions of North America. Topics covered include families of rocks, principles and concepts of geologic time, origin and interpretation of sedimentary rocks, evolution, plate tectonics, origin of the solar system, and a survey of Earth history through time.

GEOL 2010. Tools of Environmental Geoscience. 3 Hours.
Also offered as GEOG 2010. An introduction to research techniques for the incoming environmental geoscience majors. This course includes an overview of the discipline and the tools used in geoscience research. Topics may include laboratory safety, research methods, exploration of resources (library and Internet), methods of data collection, data analysis, and scientific reporting of results.

GEOL 3010. Environmental Geology. 3 Hours.
Prerequisites: Two natural science lab courses. The application of basic geologic principles and techniques to problems in land-use planning, resource management, waste disposal, conservation, energy plant siting, under-and-above-ground construction, subsidence, construction in seismic areas, slope-stability, urban development and other problems resulting from human interaction with the geological habitat.

GEOL 3020. Global Climate Change. 3 Hours.
Also offered as GEOG 3020. Prerequisites: GEOG 1112K and either GEOG 1113K or GEOL 1121K. An overview of global climate change based on changes to the Earth’s atmosphere, lithosphere, and hydrosphere. This course provides an analysis of past climates in the geologic, biologic, and hydrologic record, the impact of fossil fuel utilization on climate over the last 250 years, and links to ice sheets and oceans. The course examines implications of global climate change on the human population, including diseases and severe weather, as well as biogeography, including the extinction of threatened species.

GEOL 3050. Oceanography. 3 Hours.
Prerequisites: Two natural science lab courses. The physical, chemical, geological, and biological characteristics of the ocean and the interactions between the hydrosphere, lithosphere, atmosphere, and biosphere.

GEOL 3100. Principles of Mineralogy/Petrology. 4 Hours.
Prerequisites: Sophomore standing, GEOL 1121K and GEOL 1122K, and consent of instructor. An introduction to mineral and rock identification, and the study of the genesis, occurrence, and uses of common minerals and rocks. Laboratory consists of identification of common rocks and minerals.

GEOL 3101. Mineralogy. 3 Hours.
Prerequisites: GEOL 1121K and CHEM 1211 and 1211L, or their equivalents, and/or consent of the instructor. The classification, identification, and crystallography of the principal rock-forming minerals, silicate and non-silicate; and the introduction to the use of the petrographic microscope in the study of the crystallography and identification of minerals.

GEOL 3102. Petrology. 3 Hours.
Prerequisite: GEOL 3101 and/or consent of instructor. Genesis, classification, and properties of igneous, metamorphic, and sedimentary rocks. Laboratory includes the use of analytical methods, hand specimens, thin-section study with the petrographic microscope, and the macroscopic and microscopic properties of important rock types.

GEOL 3103. Environmental Mineralogy and Clay Materials. 4 Hours.
Prerequisites: GEOL 1121K and CHEM 1211 and CHEM 1211L. An introduction to basic concepts of crystallography, mineralogy, and clay minerals, stressing environmental uses and applications. Includes mineral systems, analytical techniques, and basic clay surface chemistry. Laboratory exercises focus on practical applications of mineralogy useful to the modern environmental scientist. Weekend field trips required.

GEOL 3104. Optical Mineralogy and Petrography. 2 Hours.
Prerequisite or corequisite: GEOL 3100. A study of the petrographic microscope, principles of optical crystallography, identification of rock-forming minerals in thin section, and description of igneous, sedimentary, and metamorphic rocks in thin section. A field trip may be required.

GEOL 3120. Geosciences Field Trip. 3 Hours.
Also offered as GEOG 3120. Prerequisite: GEOG 1113K or GEOL 1121K. A study of the geology and geography of a selected region during the first week, followed by a two-week field trip to points of interest. The interactions among geology, surficial processes, and organisms and how those interactions impact humans will be emphasized. Field trip destination is different each summer. Student fee required. Offered only during Summer Session I.

GEOL 3200. History of Life. 3 Hours.
Prerequisites: Sophomore standing and consent of instructor. Principles of paleontology with emphasis on the history of life including vertebrates. Includes an account of the outstanding forms of life from the beginning of earthtime to the present, and those paleontologically significant groups that are uncommon, different, or extinct today.

GEOL 3210. Introduction to Hydrology. 4 Hours.
Also listed as GEOG 3210. Prerequisites: GEOL 1121K or GEOG 1112K, and GEOG 1113K. An introduction to surface and sub-surface hydrology, examining components of the hydrologic cycle. Topics include local and global water balance, precipitation, interception and infiltration, runoff, stream flow, water storage, and groundwater. This course makes use of some mathematical equations.

GEOL 3220. Invertebrate Paleontology. 3 Hours.
Prerequisite: GEOL 1122K or BIOL 2270 or permission of instructor. Identification, classification, and natural history of major groups of invertebrates preserved as fossils in the geologic record, with special attention to those forms commonly encountered in the southeastern United States. Emphasis in laboratory will include taxonomic affinities and functional morphology. Saturday (optional) field trips will be scheduled to local areas of interest.

GEOL 3230. Vertebrate Paleontology. 3 Hours.
Prerequisites: GEOL 1121K and GEOL 1122K, or BIOL 2010 and BIOL 2270. Geologic history and evolution of animals with backbones, with coverage of extinct groups such as the Dinosauria.

GEOL 3240. Hydrogeology. 4 Hours.
Also listed as GEOG 3240. Prerequisites: GEOL 1121K or GEOG 1112K, and GEOG 1113K. Introduction to the hydrology of groundwater. Study of the subsurface part of the hydrologic cycle and description of the occurrence, movement, and management of groundwater as a renewable resource. Special emphasis on surface water-groundwater interactions, sensitivity of karst aquifers to environmental stresses, water quality, groundwater contaminations, and field methods that are applied in groundwater studies. Weekend field trip(s) required.

GEOL 3250. Micropaleontology. 3 Hours.
Prerequisite: GEOL 1122K, GEOL 3210, or consent of instructor. The classification, stratigraphic relationships, and methods of study of microfossils with emphasis on the stratigraphically important groups.

GEOL 3300. Process Geomorphology. 4 Hours.
Also listed as GEOG 3300. Prerequisite: GEOL 1121K or GEOG 1112K, and GEOG 1113K. An introduction to process geomorphology examining landforms and their formative processes. Topics include weathering and slope, fluvial, coastal, aeolian, glacial, and periglacial processes, and the application of soils to geomorphology. This course makes use of some mathematical equations. Field trip required.

GEOL 3320. Geomorphology of Fluvial and Coastal Environments. 3 Hours.
Also listed as GEOG 3320. Prerequisite: GEOG 3300. An examination of processes and landforms in fluvial (river) and coastal environments. Fluvial topics include channel geometry and pattern, characteristics of flow, sediment load, bedforms, and floodplains. Coastal topics include the study of waves and tides, coastal sediment transport, beaches, and the effects of changing sea level. This course makes use of some mathematical equations.

GEOL 3330. Geology, Hydrogeology, and Environmental Issues in Georgia. 3 Hours.
Also listed as GEOG 3330. Prerequisite: GEOL 1121K. An overview of the geologic framework of Georgia and surrounding states, with emphasis on topical hydrogeologic and environmental issues that impact Georgia's environment. Students receive the appropriate geologic background necessary for careers that address environmental issues in the southeastern United States. One or more field trips to locations in the area will be included.

GEOL 3400. Planetary Geology. 3 Hours.
Also offered as ASTR 3400. Prerequisites: GEOL 1121K or GEOG 1112K, and GEOG 1113K. Prerequisite or corequisite: PHSC 1100 or PHYS 1111 or PHYS 2211. A study of the geology of the terrestrial planets and solid-surface moons, asteroids, comets, and meteorites. The course will focus on comparative planetary geology, with emphasis on geologic processes on the surface (e. g., volcanism, impact cratering, tectonism, erosion, mass wasting, mineralogy, and petrology), planetary interiors, and data collection methods such as remote sensing and image analysis.

GEOL 3410. Structural Geology. 4 Hours.
Prerequisites: GEOL 1121K and GEOL 1122K; MATH 1112 or equivalent. Structural features of rocks, such as folds, faults, joints, cleavage, and primary structures, including their origin, classification, analyses and economic relationships. A study of tectonic plate motion is included. Laboratory work includes depth and thickness problems, structure sections, and structure contour maps.

GEOL 3450. Field Methods in Geology. 4 Hours.
Prerequisites: Sophomore standing, GEOL 1121 and GEOL 1122K, and consent of instructor. An introduction to the basic tools and techniques used in preparation of topographic and geologic maps, and profiles and cross-sections. Includes uses of plane table, alidade, brunton compass, and aerial photographs.

GEOL 3500. Principles of Geochemistry. 3 Hours.
Prerequisites: GEOL 1121K, CHEM 1211 and CHEM 1211L, and MATH 2261. The application of chemical principles to study of geological and environmental processes. Course emphasis is on understanding processes that influence the chemistry of water, sediment, and soil. Topics include aqueous solutions, thermodynamics, mineral-water equilibria, oxidation-reduction reactions, and radiogenic and stable isotopes. Laboratory component of the course is field-based.

GEOL 3510. Environmental Issues in Economic Geology. 3 Hours.
Prerequisite: GEOL 1121K. An introduction to the concepts and practice of economic geology, with emphasis on the environmental impact of resource exploitation focusing on the resource industries that exist in Georgia and surrounding states. Topics include traditional metals-based economic geology, industrial minerals, and energy-based resources. One or more field trips to locations in the area will be included.

GEOL 3710. Environmental Soil Science. 4 Hours.
Also listed as GEOG 3710. Prerequisites: CHEM 1211 and CHEM 1211L; GEOG 1113K or GEOL 1121K. Soil properties, distribution and classification, factors of soil formation, and the relationships among soils, geomorphology, and the environment, stressing analysis and use of soils and soil databases for proper urban, agricultural, and environmental land use.

GEOL 4110. Principles of Sedimentation and Stratigraphy. 4 Hours.
Prerequisites: GEOL 1121K and GEOL 1122K. Corequisite: GEOL 3410. The interrelationships of sedimentation, stratigraphy, and paleogeography; methods in sediment studies, stratigraphic interpretation, and correlation. Field trips required.

GEOL 4800. Internship in Environmental Geosciences. 3-6 Hours.
Prerequisite: Consent of instructor and Department Head. Graded "Satisfactory" or "Unsatisfactory." A supervised, practical experience using environmental geosciences skills in an appropriate organization. The course provides students with an opportunity to apply skills learned during pursuit of the environmental geosciences degree to real world situations.

GEOL 4860. Geosciences Senior Seminar. 1 Hour.
Also offered as GEOG 4860. Prerequisites: Junior or Senior standing and consent of the instructor. Graded "Satisfactory" or "Unsatisfactory". Exploration and selection of which option of experiential learning students will pursue as a senior. Each student will submit a proposal for approval by their supervising faculty member(s).

GEOL 4861. Senior Thesis. 3 Hours.
Also offered as GEOG 4861. Prerequisite: GEOG 4860 or GEOL 4860. Part of a two-course sequence in which a research project is designed by the student and supervising faculty member(s) in an approved area of interest. Students will collect sample data, conduct data analysis,and write a thesis.

GEOL 4862. Thesis Presentation. 2 Hours.
Also offered as GEOG 4862. Prerequisite: GEOG 4861 or GEOL 4861. The third course in a three-semester research project designed by the student and supervising faculty member(s) in an approved area of interest. Students will present their senior thesis project in both oral and poster form to the department or at an approved professional meeting.

GEOL 4900. Special Topics in Geology. 1-6 Hours.
Prerequisites: GEOL 1121K and GEOL 1122K, or equivalent, and consent of instructor. Topics to be assigned by instructor; may be taken more than once if topics are different; up to a total of 6 credit hours.

GEOL 4950. Directed Studies in Geology. 1-6 Hours.
Prerequisites: GEOL 1121K and GEOL 1122K; Junior standing; and permission of advisor, instructor, and Department Head. Study of subjects not normally found in established courses offered by this department; may also allow students to explore in more detail and/or depth subjects covered by this department, up to a maximum of 6 credit hours.

Physics

PHYS 1111K. Introductory Physics I. 4 Hours.
Pre or co-requisite: MATH 1112 or MATH 1113. Part I of an introductory course in physics. Topics include mechanics, thermodynamics, and waves. Elementary algebra and trigonometry will be used. Three lecture hours, one two-hour laboratory per week, and one one-hour recitation session per week.

PHYS 1112K. Introductory Physics II. 4 Hours.
Prerequisite: PHYS 1111K with a grade of "C" or better. Part II of an introductory course in physics. Topics include electromagnestism, optics, and modern physics. Three lecture hours, one two-hour laboratory, and one one-hour recitation session per week.

PHYS 2010. Tools of Physics. 1 Hour.
An introduction to research techniques for the incoming Phy- sics major. Includes laboratory safety, research methods, exploration of resources (library and Internet), and an out- line of the discipline.

PHYS 2211K. Principles of Physics I. 4 Hours.
Co- or prerequisite: MATH 2261. Part I of an introductory course in calculus-based physics. Topics include mechanics, thermodynamics, and waves. Elementary differential and integral calculus will be used. Three lectures, one two-hour two-hour laboratory per week, and one one-hour recitation session per week.

PHYS 2212K. Principles of Physics II. 4 Hours.
Prerequisite: PHYS 2211K with a grade of C or better. Co- or prerequisite: MATH 2262. Part II of an introductory course in calculus-based physics. Topics include electromagnestism, optics, and waves. Elementary and integral calculus will be used. Three lecture hours, one two-hour laboratory per week, and one one-hour recitation session per week.

PHYS 2700. Modern Physics. 1 Hour.
Prerequisite: PHYS 2212K. A preparatory course for the upper-division physics curriculum, emphasizing topics not covered in PHYS 2211K and PHYS 2212K but essential for the success in upper level courses. Topics include fluids, elementary thermodynamics, and wave phenomena.

PHYS 2950. Directed Study. 0-3 Hours.
Supervised research on a specific physics or topic as agreed upon by the instructor. A maximum of 6 credit hours may be taken, and they can only be applied toward the general elective requirements for the physics major.

PHYS 3040. Electronics. 4 Hours.
Prerequisite: PHYS 2212K. A lecture-laboratory study of basic electrical circuits and techniques, including exten- sive use of the oscilloscope. Both continuous wave and pulse phenomena are treated.

PHYS 3100. Optics. 4 Hours.
Prerequisites: PHYS 2212K with a grade of "C" or better, Pre- or Co-requisite; MATH 2263. An intermediate level course with emphasis on physical optics. Lens matrices, interference, polarization, dispersion, absorption, resonance, and quantum effects will be covered. The electromagnetic nature of light is emphasized.

PHYS 3800. Differential Equations in Physical Systems. 3 Hours.
Prerequisite: PHYS 2212K with a grade of "C" or better, Pre- or Co-requisite: MATH 2263. Ordinary differential equations of first and second order, linear equations of higher order, and a brief introduction to partial differential equations. The course will emphasize equations and methods which are important to understanding advanced topics in physics, such as fluid flow, mechanics, wave equations, Schrodinger's time-independent equation, and boundary equations.

PHYS 3810. Mathematical Methods of Physics. 3 Hours.
Prerequisites: PHYS 2212K with a grade of "C" or better, Pre- or Co-requisite: MATH 2263. Special topics in mathematics as related to advanced study in physics. Topics include vector analysis, differential equations, orthogonal functions, eigenvalue problems, matrix methods, and complex variables.

PHYS 3820. Computational Physics I. 4 Hours.
Prerequisites: PHYS 2212K with a grade of "C" or better, Pre- or Co-requisite: MATH 2263. Formulation of equations describing physical systems and the use of computers to solve them, computer simulations of physical systems, the use of computers to acquire and analyze data, and graphical methods of displaying data.

PHYS 3821. Computational Physics II. 3 Hours.
Prerequisite: PHYS 3820 with a grade of "C" or better. Application of advanced numerical and computational techniques to real world problems, and utilizes multiples computer languages to solve them. Topics include matrix algebra, boundary value problems, nonlinear systems, and partial differential equations.

PHYS 4040. Experimental Physics. 4 Hours.
Prerequisite: PHYS 2212K. A lecture-laboratory course devot- ed to techniques of research in experimental physics. Topics include treatment of data, vacuum techniques, magnetic de- vices, preparation and manipulation of beams of particles, and radioactivity. A number of modern physics experiments are studied and performed.

PHYS 4111. Theoretical Mechanics I. 3 Hours.
Prerequisites: PHYS 2212K with a grade of "C" or better, Pre- or Co-requisite: MATH 2263. Topics include Newtonian mechanics, conservation laws, simple harmonic motion, and Lagrange"s equations.

PHYS 4112. Theoretical Mechanics II. 3 Hours.
Prerequisite: PHYS 4111 with a grade of "C" or better. Topics include Newtonian mechanics, rotational motion, waves relativity, and Hamiltonian formalism.

PHYS 4211. Electromagnetism I. 3 Hours.
Prerequisites: PHYS 2212K with a grade of "C" or better, Pre- or Co-requisite: MATH 2263. Topics include electrostatics, magnetostatics, charge distributions, and Maxwell's equations in differential form.

PHYS 4212. Electromagnetism II. 3 Hours.
Prerequisite: PHYS 4211 with a grade of "C" or better. Topics include electrodynamics, time-varying electric and magnetic fields, and propagation of electromagnetic waves.

PHYS 4300. Plasma Physics. 3 Hours.
Prerequisites: PHYS 4211with a grade of "C" or better. An introduction to the physics of ionized gases.

PHYS 4310. Thermodynamics. 3 Hours.
Also offered as ENGR 4310. Prerequisites: PHYS 2212K with a grade of "C" or better, Pre- or Co-requisite: MATH 2263. Basic principles of classical thermodynamics which includes open and closed systems for both steady and transient processes.

PHYS 4411. Quantum Mechanics I. 3 Hours.
Prerequisites: PHYS 2212K with a grade of "C" or better, Pre- or Co-requisite: MATH 2263 and PHYS 4111. Topics include the wave particle duality of light and matter, Schrodinger's equation, and time-independent solutions to Schrodinger's equation. Dirac notation and matrix formalism are introduced.

PHYS 4412. Quantum Mechanics II. 3 Hours.
Prerequisite: PHYS 4411. Topics include angular momentum and spin operators, time-independent perturbation theory, and the WKB approximation.

PHYS 4501. Capstone Seminar I. 1 Hour.
Prerequisite: Senior standing. A study of current development in the fields of physics. Oral presentations will be required of all students and will be based on recent research articles in physics and related journals.

PHYS 4800. Internship in Physics. 3-6 Hours.
Active participation in research in physics or in a field of science closely allied with physics, such as biophysics. A daily log of activities, a report on the work done, and a research paper relating the work done to the field of physics are required.

PHYS 4900. Special Topics in Physics. 1-6 Hours.
Prerequisite: Consent of advisor and instructor, and at least junior standing. Topics to be assigned by instructor; may be taken more than once if topics are different, up to a total of 6 credit hours.

PHYS 4950. Directed Study in Physics. 1-6 Hours.
Prerequisite: At least Junior standing; permission of advi- sor, instructor, and department head. Study in area or sub- ject not normally found in established courses offered by the department; may also allow student to explore in more detail and/or depth an area or subject covered by the de- partment in physics. Up to a maximum of 12 credit hours.