ENGINEERING and PHYSICS

Dr. Rick McDaniel, Chair; Dr. Shannon Clardy, Dr. Basil Miller, Mr. Peter Neidhart, Dr. Dever Norman, Dr. Zahra Zamanipour, Mrs. Paula Welch

The Department of Engineering and Physics offers programs of study leading to a Bachelor of Science degree in Engineering, Bachelor of Science degree in Computer Engineering, Bachelor of Arts degree in Physics, Bachelor of Science degree in Physics and a Bachelor of Science degree in Physics with Teacher Licensure.

Engineering Degrees

The engineering program is built upon a strong foundation in mathematics, science, and engineering fundamentals. Graduates of the program are qualified and prepared to meet the demands of a professional career in the present and future workplace and to assume a responsible place of leadership in a complex technological society.

Program Educational Objectives

The engineering program has a mechanism in place to periodically assess its effectiveness in meeting its educational objectives and outcomes (see below). This assessment process results in periodic modification to specific courses and the overall degree plan so as to better promote the achievement of the objectives and outcomes. Additionally, the objectives and outcomes are periodically formulated and revised, with the assistance of the Engineering Advisory Council, in relation to the evolving mission and resource base of the program. This occurs within the context of the evolving needs of the region and nation, and the current state-of-the profession.

The Department of Engineering and Physics strives to produce outstanding graduates who are successful in their careers. Within the three to five years following graduation a Henderson State University engineering alumni will:

- Have an engineering job or a position that utilizes the application of their engineering education in the workplace.
- Have completed professional development activities to enhance their credentials, including the pursuit of advanced degrees appropriate to their career fields.

The engineering program's outcomes define the knowledge, skills, attitudes, and behaviors that program graduates are expected to have by the time of graduation from the program. Graduates of the engineering program will have:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science and mathematics
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Major Requirement for the Bachelor of Science Degree in Engineering (General Track)

EGR 1413 Engineering Graphics 3
EGR 2033 Introduction to Materials 3
EGR 2253 Engineering Computation 3
EGR 2363 Statics 3
EGR 2584 Electric Circuits I 4
EGR 3043 Engineering Thermodynamics I 3

EGR 3434 Digital Electronics 4
EGR 3474 Electronics I 4
EGR 3493 Dynamics..... 3
EGR 4443 Embedded Microprocessors 3
EGR 4513 Fluid Mechanics 3
EGR 4523 Engineering Electromagnetics 3
EGR 4543 Engineering Measurements 3
EGR 4263 Engineering Design I 3
EGR 4553 Engineering Design II 3

Choose one of the following

EGR 3114 Strength of Materials 4
EGR 3464 Electric Circuits II 4
EGR 3484 Electronics II 4

Choose one of the following

EGR 3053 Engineering Thermodynamics II 3
EGR 3143 Signals and Systems 3
EGR 3503 Engineering Optics 3
EGR 4123 Heat Transfer 3
EGR 4133 Power Systems 3
EGR 4563 Control Systems 3

Major Requirement for the Bachelor of Science Degree in Engineering (Electrical Track)

EGR 1413 Engineering Graphics 3
EGR 2033 Introduction to Materials 3
EGR 2253 Engineering Computation 3
EGR 2363 Statics 3
EGR 2584 Electric Circuits I 4
EGR 3043 Engineering Thermodynamics I 3
EGR 3434 Digital Electronics 4
EGR 3474 Electronics I 4
EGR 3493 Dynamics 3
EGR 3543 Engineering Measurements 3
EGR 4513 Fluid Mechanics 3
EGR 4523 Electromagnetics 3
EGR 4263 Engineering Design I 3
EGR 4553 Engineering Design II 3
EGR 4563 Control Systems 3
EGR 4xx3 Professional Engineering Practices 3

Choose any 2-electives
EGR 3143 Signals and Systems 3
EGR 3464 Electric Circuits II 4
EGR 4443 Embedded Systems 3
EGR 4523 Electromagnetics 3

Major Requirement for the Bachelor of Science Degree in Engineering (Mechanical Track)

EGR 1413 Engineering Graphics 3
EGR 2033 Introduction to Materials 3

EGR 2253 Engineering Computation 3
EGR 2363 Statics 3
EGR 2584 Electric Circuits I 4
EGR 3043 Engineering Thermodynamics I 3
EGR 3114 Strength of Materials 4
EGR 3474 Electronics I 4
EGR 3493 Dynamics 3
EGR 3543 Engineering Measurements 3
EGR 4123 Heat Transfer 3
EGR 4513 Fluid Mechanics 3
EGR 4263 Engineering Design I 3
EGR 4553 Engineering Design II 3
EGR 4xx3 Professional Engineering Practices 3

Choose any 2-electives
EGR 3053 Engineering Thermodynamics II 3
EGR 4433 Embedded Systems 3
EGR 4563 Control Systems 3

Additional Requirements for the Engineering General, Electrical or Mechanical Track

CHM 1014 University Chemistry I 4
MTH 1294 Calculus I 4
MTH 2044 Calculus II 4
MTH 3104 Calculus III 4
MTH 4123 Differential Equations 4
PHY 2234 University Physics I 4
PHY 2244 University Physics II 4

The Bachelor of Science degree in Engineering requires a mathematics or physics minor.

Major Requirement for the Bachelor of Science Degree in Computer Engineering

Engineering Courses (36 Hours)

EGR 12033 Introduction to Engineering 3
EGR 2253 Engineering Computation 3
EGR 2584 Electric Circuits I 4
EGR 3434 Digital Electronics 4
EGR 3474 Electronics I 4
EGR 4063 Computer Engineering Design I 3
EGR 4073 Computer Engineering Design II 3
EGR 4443 Embedded Microprocessors 3
EGR 4543 Engineering Measurements 3
EGR 4563 Control Systems 3
EGR JR/SR Elective 3

Computer Science Courses (23 Hours)
CSC 1104 Foundations of Computer Science I 3
CSC 1114 Foundations of Computer Science II 3
CSC 2173 Assembler 3
CSC 2203 Data Structures 3
CSC 3193 Operating Systems 3
CSC 3223 Algorithm Analysis 3
CSC 3443 Computer Organization 3

Additional Requirements for the Computer Engineering Degree

MTH 1294 Calculus I 4
MTH 2044 Calculus II 4
MTH 2283 Discrete Mathematics 4
MTH 3124 Differential Equations 4
STA 2323 Stat Methods or STA 2053 Applied Biostat 3
PHY 2234 University Physics I 4
PHY 2244 University Physics II 4

Bachelor of Science degree in Computer Engineering will have earned enough hours to obtain a minor in mathematics and will not be required to complete an additional minor.

Engineering Minor Requirements

In addition to the Bachelor of Science degree, the Department also offers a minor in engineering. The curriculum provides the student with a foundation of engineering. Physics majors can minor in engineering, but no elective can apply to both the major and the minor. In addition to the courses listed below, the awarding of a minor in engineering will require that the student has made a grade of C or better in all courses comprising the 24 credit hours.

PHY 2234 University Physics I 4
PHY 2244 University Physics II 4
EGR 1413 Engineering Graphics 3
EGR 2033 Introduction to Materials 3
EGR 2363 Statics 3
EGR 3043 Engineering Thermodynamics I 3

Choose one of the following

EGR 2584 Electric Circuits I 4
EGR 3474 Electronics I 4
EGR 3434 Digital Electronics 4

Courses in Engineering

EGR 1011. Engineering Shop. This course introduces manufacturing processes and their relation to the design of machine elements. Basic and advanced machine tools operations, press tool operation, metal lathe and welding are studies.

EGR 1203. Introduction to Engineering. This course is designed to introduce the student to the engineering profession, problem solving, engineering design and presentation of technical information. Prerequisite: College Algebra (MTH 1243).

EGR 1413. Engineering Graphics. This course is designed to introduce the student to mechanical drawing employing the conventions of computer-aided drafting and modern engineering graphic principles. Prerequisite: College Algebra (MTH 1243).

EGR 1423. Engineering Modeling Applications. A continuation of EGR 1413 Engineering Graphics, covering 3D CAD features and solid modeling techniques including patterning, configurations, library features, sketch blocks, assemblies of parts, multi-body parts, and 3D printing. Prerequisite: EGR1413

EGR 2033. Introduction to Materials. A study of chemical, physical, and electrical properties of materials using fundamental atomistic approach. The materials of interest are metals, polymers, ceramics, and composites. The interactive relationship between structure, properties, and processing of materials will be emphasized. For various engineering applications. Prerequisite: PHY 2244

EGR 2101-2. Engineering Internship. This course is designed to give the student practical engineering experience working with a professional engineer in a staff approved industrial setting. This allows the beginning engineer to build a network of contacts and develop a broad range of important skills that cannot be learned in the classroom. Prerequisite: Department approval.

EGR 2253. Engineering Computation. This course is designed to introduce the student to the problems encountered in engineering with analysis and solution of these problems using computational techniques. Prerequisite: MTH 1294, PHY 2234.

EGR 2363. Statics. Principles of vector analysis, static equilibrium, analysis of structures, friction, internal forces, center of gravity, moment of inertia, and product of inertia. Prerequisite: PHY 2234, MTH 1294.

EGR 2584. Electric Circuits I. An introduction to circuit theory and electrical devices. Topics include resistive circuits, independent and dependent sources; analysis methods, network theorems; RC and RL first order circuits, and RLC second order circuits. Three (3) hours lecture, two (2) hours laboratory. Prerequisite: PHY 2244

EGR 3043. Engineering Thermodynamics I. An introduction to thermodynamics, including thermodynamic properties of pure substances, heat and work, the first and second laws of thermodynamics, and entropy with applications to power and refrigeration cycles. Prerequisite: PHY 2234, MTH 1294

EGR 3053. Engineering Thermodynamics II. A continuation of EGR 3043. The study of thermodynamics is extended to the investigation of relations for simple substances, non-reacting mixtures, reacting mixtures, chemical reactions and a study of availability analysis. Power and refrigeration cycles are studied in more depth. Prerequisite: EGR 3043

EGR 3114. Strength of Materials. Stress and deformation of members in tension, compression, torsion, and bending, and the design of these members. Columns, statically indeterminate beams, and simple connections. Prerequisite: EGR 2363

EGR 3143. Signals and Systems. Signal representation, including Fourier and Laplace transforms. System definitions and properties, such as linearity, causality, time invariance, and stability. Use of convolution, transfer functions and frequency response to determine system response. Prerequisite: EGR 2253, MTH 4123

EGR 3434. Digital Electronics. Introduction to the analysis and design of digital circuits including number systems, Boolean algebra, combinational and sequential logic. Upon completion, students should be able to construct, analyze, verify, and troubleshoot digital circuits using appropriate techniques and test equipment. Three (3) hours lecture, two (2) hours laboratory. Prerequisite: PHY 2044 or PHY 2244.

EGR 3464. Electric Circuits II. A study of the principles of DC and AC circuits. Passive linear components including resistor, capacitor, inductor. Basic circuit laws. Thevenin and Norton equivalent circuits. Transient and frequency domain analysis of linear circuits. Power and power transfer in circuits. Impedances and electrical units. Three (3) hours lecture, two (2) hours laboratory. Prerequisite: EGR 2464.

EGR 3474. Electronics I. Theory, analysis, and introductory design of diode, bipolar junction transistor, operational amplifier, and field effect transistor devices and circuits. Three (3) hours lecture, two (2) hours laboratory. Prerequisite: EGR 2584

EGR 3484. Electronics II. A continuation of EGR 3474 with emphasis on transistor amplifier design, frequency response, feedback principles, stability, analog integrated circuits, electronics circuit design, and applications. Three (3) hours lecture, two (2) hours laboratory. Prerequisites: EGR 3474

EGR 3493. Dynamics. A continuation of EGR 2363. Study of the problems of unbalanced force systems. Kinematics and kinetics of rigid bodies. Work and energy, impulse and momentum. Prerequisites: EGR 2363, MTH 2044

EGR 3503. Engineering Optics. This course gives an introduction to geometrical optics and physical optics, including interference, diffraction, dispersion, absorption, and polarization of light, as well as optics application and practical solutions. Prerequisites: PHY 2244, MTH 1294

EGR 3543. Engineering Measurements. This course is an introduction to the principles and applications of measurement methods and instrumentation techniques, as used in various engineering disciplines. Specific devices for measuring such parameters as displacement, force, strain, pressure, flow, temperature, motion, time and frequency are discussed. Prerequisite: EGR 2584

EGR 4063. Computer Engineering Design I. This course gives A study of engineering design and creative computer engineering problem-solving through design projects, presentations, and activities. Prerequisite: CSC-2173, EGR 2584, EGR3434

EGR 4073. (WI) Computer Engineering Design II. A continuation of EGR 4063 Engineering Design I, covering individual and/or team design projects that require creative application of computer engineering and basic science knowledge. Prerequisite: EGR 4263

EGR 4123. Heat Transfer. Basic thermal energy transport processes; conduction, convection, and radiation; and the mathematical analysis of systems involving these processes in both steady and time-dependent cases. Prerequisite: EGR 3043, EGR 4513

EGR 4133. Power Systems. Basic concepts of AC systems, single-phase and three-phase networks, electric power generation, transformers, transmission lines, electric machinery and the use of power. Prerequisite: EGR 3464

EGR 4153 Professional Engineering Practices. This course focuses on project management, the engineering code of ethics, engineering economy and the role of the engineer in modern society. Includes case studies. Prerequisite: Junior Standing or Consent of instructor

EGR 4263. Engineering Design I. A study of engineering design and creative engineering problem-solving through design projects, presentations, and activities. Prerequisite: EGR-2584, EGR 3043, EGR 3493

EGR 4443. Embedded Microprocessors. A study of the programming, architecture, and interfacing of microprocessors with emphasis on engineering applications. Prerequisite: EGR 2584 Electric Circuits I

EGR 4513. Fluid Mechanics. A study of the statics and dynamics of incompressible fluids. Major topics include the basic fluid flow concepts of continuity, energy and momentum, dimensional analysis, viscosity, laminar and turbulent flows, and flow in pipes. Prerequisites: EGR 3493, MTH3104

EGR 4523. Engineering Electromagnetics. A study of time invariant electric and magnetic fields in free space and in materials, electrical current flow as a function of electric field, magnetic flux, interaction of magnetic fields with electrical current and voltage, electrical and magnetic potentials, time changing electric and magnetic field, Maxwell's Equations and steady-state behavior of wave on transmission lines. Prerequisites: EGR 2584, MTH 3104.

EGR 4531, 4532, 4533, Independent Research. Independent work in engineering physics under direct supervision of a faculty member. Prerequisite: Departmental Approval.

EGR 4553. (WI) Engineering Design II. A continuation of EGR 4263 Engineering Design I, covering individual and/or team design projects that require creative application of engineering and basic science knowledge. Prerequisite: EGR 4263

EGR 4563. Control Systems. Mathematical modeling of dynamic systems, stability analysis, control system architectures and sensor technologies. Time-domain and frequency-domain design of feedback control systems: lead, lag, PID compensators. Special topics in microprocessor implementation. Prerequisite: EGR 2584 and MTH 3124

EGR 4571, 4572, 4573. Special Topics in Engineering. This senior level elective is designed for the department to offer courses relevant to an instructor's area of expertise, to offer courses of particular interest to current students, or to address contemporary topics in engineering not covered elsewhere. May be repeated for up to six hours total, provided topics are different. Course title to appear on transcript.

Bachelor of Science Degree in Physics

The physics program combines formal class work with hands-on laboratory work and independent research to create not just future scientists, but future leaders in the community. Following graduation, students find these skills in demand for careers such as science teaching, technical management, software or hardware engineering. Other physics graduates gain admission to graduate programs and continue their studies in specialized fields such as medical physics, meteorology, astrophysics, engineering, or geophysics. Many of our physics majors have gone on to receive a Ph.D. degree in physics. We are lucky to count teachers, engineers, business people, and others among our former students.

Program Educational Objectives

The Department of Engineering and Physics strives to produce outstanding graduates who are successful in their careers. Within the three to five years following graduation a Henderson State University engineering alumni will:

- Have a job or a career that utilizes the knowledge and skills gained through their physics education in the workplace.
- Have completed professional development activities or graduate study to enhance their credentials appropriate to their career fields.

As we prepare our graduating students to compete successfully for desired professional positions or to be accepted into highly selective graduate programs, students gain the following skills:

a. the ability to apply knowledge of mathematics, science, and engineering
b. the ability to communicate effectively with a range of audiences
c. the ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
d. the ability to develop and conduct appropriate experimentation, analyze and interpret data, and use judgment to draw conclusions.
e.

Major Requirement for the Bachelor of Science Degree (Traditional Physics)

PHY 2234 University Physics I 4
PHY 2244 University Physics II 4
PHY 3083 Mechanics 3
PHY 3103 Modern Physics 3
PHY 3473 Computational Physics 3
PHY 4183 Electrodynamics 3
PHY 4253 Advanced Physics Lab 3
PHY 4273 Quantum Mechanics 3
Junior-Senior Physics or Engineering Electives 12

Major Requirement for the Bachelor of Science Degree (Astronomy Track)

PHY 2234 University Physics I 4
PHY 2244 University Physics II 4
PHY 3053 General Astronomy 3
PHY 3083 Mechanics 3
PHY 3103 Modern Physics 3
PHY 3173 Optics 3
PHY 3473 Computational Physics 3
PHY 4093 Thermodynamics 3
PHY 4183 Electrodynamics 3
PHY 4253 Advanced Physics Lab 3
PHY 4273 Quantum Mechanics 3
PHY 4293 Nonwestern Cosmology 3
PHY 4343 Astrophysics and Cosmology 3

Additional Requirements for the Traditional or Astronomy Track

MTH 1294 Calculus I 4

MTH 2044 Calculus II 4

Major Requirement for the Bachelor of Science Degree (Teacher Licensure in Physics)

PHY 2234 University Physics I 4
PHY 2244 University Physics II 4
PHY 3083 Mechanics 3
PHY 3103 Modern Physics 3
PHS 3154 Physical Science for Teachers 4
PHY 3464 Electric Circuits 4
PHY 4253 Advanced Physics Lab 3
PHY 4293 Non-Western Cosmology 3
PHS 4953 Special Methods: Physical Science 3
Junior-Senior Physics or Engineering Electives 6

Bachelor of Arts Degree in Physics

The Bachelor of Arts degree in Physics is for students desiring a broader program in the arts, sciences, and social sciences while majoring in physics. This program is recommended for journalism, pre-business, pre-law and other students planning careers in fields for which a physics education would be beneficial.

Major Requirement for the Bachelor of Arts Degree

MTH 1294 Calculus I 4
PHY 2234 University Physics I 3
PHY 2244 University Physics II 3
PHY 3103 Modern Physics 3
PHY 4253 Advanced Physics Lab 3

Required Electives

PHY 3053 General Astronomy 3
PHY 3173 Optics 3
PHY 3323 Acoustics 3
PHY 3473 Computational Physics 3
PHY 4293 Nonwestern Cosmology 3

Additional Requirements for the Bachelor of Arts Degree in Physics

Six hours of elementary Foreign Language courses in French, German, or Spanish.
Six hours of intermediate Foreign Language courses in French, German, or Spanish.

Physics Minor Requirements

In addition to the Bachelor of Science degree, the Department also offers a minor in physics. The minor in physics requires 14 hours and is composed of the following courses:

- General Physics I (PHY 2034) or University Physics I (PHY 2234)
- General Physics II (PHY 2044) or University Physics II (PHY 2244)
- 6-hours of PHY courses at the junior or senior level

Courses in Physics

PHY 1024 (PHSC1204). Introduction to Astronomy. A general education course for non-science majors. The methods, history, and philosophy of science are studied in the context of modern astronomy. Ideas are emphasized through periodic planetarium presentations as the course traces human understanding from prehistory to the edges of the known cosmos. Laboratory activities include outdoor observation sessions. No prerequisites are required.

PHY 2034 (PHYS2014). General Physics I. An introductory course in the fundamental principles of mechanics, heat and sound with an emphasis on problem solving. Three (3) hours lecture, two (2) hours laboratory. Prerequisite: MTH 1243.

PHY 2044 (PHYS2024). General Physics II. A continuation of PHY 2034. Fundamentals of electricity, magnetism and light. Three (3) hours lecture, two (2) hours laboratory. Prerequisite: PHY 2034.

PHY 2234. (PHYS2034) University Physics I. An introductory course in mechanics, heat, and sound intended for students of science and engineering who are taking an introductory calculus course concurrently. Three (3) hours lecture, two (2) hours laboratory. Corequisite: MTH 1294.

PHY 2244 (PHYS2044). University Physics II. A continuation of PHY 2234. An introductory course in electricity, magnetism, and light. Three (3) hours lecture, two (2) hours laboratory. Prerequisites: PHY 2234 or PHY 2034 and MTH 1294.

PHY 2363. Statics. Principles of vector analysis, static equilibrium, analysis of structures, friction, internal forces, center of gravity, moment of inertia, and product of inertia. Prerequisite: PHY 2234, MTH 1294.

PHY 3053. (WI) General Astronomy. A study of the solar system, stars, clusters, nebulae, gravitation, instrumentation, and the search for life beyond earth. Includes observation sessions and development of planetarium activities. Prerequisite: PHY 2034 or PHY 2234 or the equivalent.

PHY 3083. Mechanics. Particle dynamics in inertial and accelerated reference frames. Newtons law of gravitation, orbit theory, and elementary rigid body dynamics. Prerequisites: PHY 2234 or PHY 2034, and MTH 2044.

PHY 3103. Modern Physics. An introduction to the topics of modern physics including relativity, atomic physics, quantum mechanics, condensed matter physics, nuclear physics and elementary particles. Prerequisites: PHY 2244 or PHY 2044 and MTH 1294.

PHY 3103L. Modern Physics Laboratory. Experiments in modern physics. Corequisite: Registration in or completion of PHY 3103.

PHY 3173. Optics. This course is an introduction to geometrical optics and physical optics, including interference, diffraction, dispersion, absorption, and polarization of light. Prerequisites: PHY 2044 or PHY 2244, and MTH 1294.

PHY 3201. (WI) Laboratory Physics Techniques. Experiments in the principles of physics designed for the junior physics student. Experiments in modern physics, mechanics, and optics. Corequisite: Registration in or completion of a 3000 or 4000 level physics course.

PHY 3493. History of Physics. A survey of important developments in the field of physics. The course will explore famous experiments and theories, as well as the physicists who performed and developed them. An emphasis will be placed on the role advances in physics played in events at the time and how history influenced the progress of physics. Prerequisite: PHY 2044 or PHY 2244.

PHY 3233. Geophysics. This course introduces the basic theory of geophysical instrumentation, data collection and reduction, and interpretation. The basic laws of physics are applied to study the internal characteristics of the earth such as geomagnetism, paleomagnetism, geogravity, earth tides, elastic waves, earthquake processes, and radioactivity. Prerequisite: PHY 3083.

PHY 3323. Applied Acoustics. The physical nature of vibration and its relation to music, speech, and hearing. Vibratory sources of sound used in music, mechanics of hearing, electronic recording, reproducing and synthesizing sound. No prerequisites are required.

PHY 3434. Digital Electronics. Introduction to the analysis and design of digital circuits including: number systems, Boolean algebra, combinational and sequential logic. Upon completion, students should be able to construct, analyze, verify, and troubleshoot digital circuits using appropriate techniques and test equipment. Three (3) hours lecture, two (2) hours laboratory. Prerequisite: PHY 2044 or PHY 2244.

PHY 3464. Electric Circuits. A study of the principles of DC and AC circuits. Passive linear components including resistor, capacitor, inductor. Basic circuit laws. Thevenin and Norton equivalent circuits. Three (3) hours lecture, two (2) hours laboratory. Prerequisite: PHY 2044 or PHY 2244.

PHY 3473. Computational Physics. This course gives an introduction to the basic methods to model physical and engineering systems using a programming package such as MATLAB. Basic computational tools and routines, including the ones for differential equations, spectral analysis, and matrix operations, are dealt with through relevant examples, and more advanced topics, such as Monte Carlo simulations and molecular dynamics. Prerequisite: PHY 2244.

PHY 3483. Atomic and Molecular Physics. A study of the structure and interaction of atoms and small molecules. Beginning with the study of the structure of the hydrogen atom and advancing to multi-electron atoms and molecules, the course will also cover the interaction of electrons, ions, and photons with atoms and molecules. Additional topics to be covered include atomic and molecular spectra, particle detection, accelerators, perturbation methods, and scattering theory. Prerequisites: PHY 3103 and PHY 3473.

PHY 4093. Thermal Physics. A unified development of the basic principles of thermodynamics, statistical mechanics and kinetic theory. Prerequisite: PHY 3083.

PHY 4183. Electrodynamics. A study of electrostatics, electric and magnetic properties of materials. Amperes and Faraday's laws, and Maxwell's equations. Prerequisite: PHY 3083.

PHY 4211-3. Independent Research. Independent work in physics under direct supervision of a faculty member. Prerequisite: Departmental approval.

PHY 4253. (WI) Advanced Physics Lab. Experiments in mechanics, electrodynamics, modern physics and optics using modern instrumentation and equipment. Corequisite: Registration in or completion of a 3000 or 4000 level physics course.

PHY 4273. Introduction to Quantum Mechanics. Solutions of the Schrodinger wave equation, including the infinite square well, finite square well, harmonic oscillator, the hydrogen atom, and perturbation theory, and associated topics. Prerequisite: PHY 3103.

PHY 4283. Advanced Mechanics. A continuation of PHY 3083. Rigid bodies; moving coordinate systems; continuous media; Lagrange's Equations. Prerequisites: PHY 3083

PHY 4293. Non-Western Cosmology. This course develops insight into how the cosmological worldview affects and reflects aesthetics, morality, religion, politics, sexuality and other aspects of human experience. People of every culture view the same sky and extrapolate these observations into a story that explains their place in the cosmos. Case studies include native American, ancient non-Western, medieval and Islamic cosmologies. Prerequisite: PHY 1024 or instructor permission.

PHY 4311-3. (WI) Independent Study. Independent work in physics under direct supervision of a faculty member. Prerequisite: Departmental approval.

PHY 4343. Astrophysics and Cosmology. A unified study of relationships between natural physical laws and the structure and evolution of the cosmos. The course surveys recent results from observational astronomy and related applications of quantum theory, nuclear physics, field theory, particle physics, and general relativity. Prerequisites: PHY 3083 and PHY 3103.

PHY 4443. Embedded Microprocessors. A study of the programming, architecture, and interfacing of microprocessors with emphasis on engineering applications. Prerequisite: PHY 3434.

PHY 4453. Signal Processing. Introduction to the fundamental concepts and mathematics in signal processing. Use of the fundamental transform techniques (Laplace transform, discrete Fourier transform, z---transform). Discrete time representation of signals, linear time invariant systems. Correlation, coherence, power spectral density, and time delays. Bode plots, poles and zeros, state space. Prerequisite: 3473.

PHY 4571, 4572, 4573. Special Topics in Physics. This senior level elective is designed for the department to offer courses relevant to an instructor's area of expertise, to offer courses of particular interest to current students, or to address contemporary topics in physics not covered elsewhere. May be repeated for up to six hours total, provided topics are different. Course title to appear on transcript.

PHYSICAL SCIENCE

Dr. Rick McDaniel, Chair; Dr. Shannon Clardy, Dr. Basil Miller, Mr. Peter Neidhart, and Dr. Dever Norman

Courses in Physical Science

PHS 1053. Earth Systems and the Environment. A study of the earth and earth history, emphasizing interrelationships between earth's dynamical systems and human activity. Course activities include periodic field experiences and planetarium presentations. No prerequisites are required.

PHS 1073. Meteorology. An introductory course that treats the composition and structure of the atmosphere, thermodynamic processes, forces and related small-and large-scale motions, air masses, fronts, tropical cyclones, solar and terrestrial radiation, general circulation and weather forecasting. Format may include field trips and guest lectures. No prerequisites are required.

PHS 1133. Introduction to Physical Geology. An examination of the basic concepts of physical geology, stratigraphy, mineralogy, and landforms.

PHS 3154/PHS 3154L. Physical Science for Teachers. A study of the principles and concepts of physical science designed for elementary teachers. Three (3) hours lecture, two (2) hours laboratory

PHS 4183, 5183. Higher Order Thinking in Science. This laboratory-based course stresses the learning of science as active, integrated, constructive processes involving experimentation, investigation, communication, reasoning and problem solving. The course builds foundations in content to show connections and relevant applications in the areas of life systems, earth systems, and physical systems. The goals of the course are to help teachers extend content learning, to help teachers create successful learning environments for every student by teaching them to use manipulatives, calculators, science equipment, and various learning strategies, and to provide access to appropriate materials, equipment and technology.

PHS 4953. Special Methods: Physical Science. Special methods in the teaching of physical science.