PHY 100
Intro to the Profession
Introduction to the physical sciences, scientific method, computing tools, and interrelations of physical sciences with chemistry, biology and other professions.
Lecture: 2 Lab: 0 Credits: 2
Satisfies: Communications (C)

PHY 120
Astronomy
A descriptive survey of observational astronomy, the solar system, stellar evolution, pulsars, black holes, galaxies, quasars, the origin and fate of the universe.
Lecture: 3 Lab: 0 Credits: 3

PHY 123
General Physics I: Mechanics
Prerequisite(s): MATH 151*, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 Lab: 3 Credits: 4
Satisfies: Natural Science (N)

PHY 200
Introduction to Energy, Waves, Materials, and Forces
This course will address the basic physical principles and concepts associated with energy, power, heat, light, sound, circuits, materials, fluids, and forces. Although quantitative at times, the course will stress conceptual understanding and practical applications.
Lecture: 4 Lab: 0 Credits: 4
Satisfies: Natural Science (N)

PHY 221
General Physics II: Electricity and Magnetism
Prerequisite(s): (MATH 149 or MATH 151) and MATH 152* and PHYS 123, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 Lab: 3 Credits: 4
Satisfies: Communications (C)

PHY 223
General Physics III
Prerequisite(s): PHYS 221
Lecture: 3 Lab: 3 Credits: 4
Satisfies: Communications (C)

PHY 224
General Physics III for Engineers
Prerequisite(s): PHYS 123 and MATH 152 and PHYS 221
Lecture: 3 Lab: 0 Credits: 3

PHY 225
General Physics III Lab only
General Physics III laboratory. The laboratory portion of PHYS 223.
Prerequisite(s): PHYS 224 and PHYS 221
Lecture: 0 Lab: 3 Credits: 1

PHY 240
Computational Science
This course provides an overview of introductory general physics in a computer laboratory setting. Euler-Newton method for solving differential equations, the trapezoidal rule for numerical quadrature and simple applications of random number generators. Computational projects include the study of periodic and chaotic motion, the motion of falling bodies and projectiles with air resistance, conservation of energy in mechanical and electrical systems, satellite motion, using random numbers to simulate radioactive decay, the Monte Carlo method, and classical physical models for the hydrogen molecule and the helium atom.
Prerequisite(s): PHYS 221 and (CS 104 or CS 105 or CS 115)
Lecture: 2 Lab: 3 Credits: 3
Satisfies: Communications (C)

PHY 297
Energy and Environmental Sustainability
With increases in world population and in per capita energy use, we must understand the fundamentals of energy production and the consequences of our energy use pattern. Avoiding serious problems both at the global level (acid rain, and global climate change) and at the local level (urban air and water pollution) requires an understanding of energy use pattern and its implication on human life. The overall objective of this course is to provide the student with an understanding of the costs and benefits of the various methods for meeting society’s energy needs. This course aims to deal with topics like energy demands and energy resources, production of non-renewable energy, nuclear energy, renewable energy sources (e.g., hydro, wind, solar, and bio-energy). After providing an in-depth understanding of the sources of energy and its efficient use, the course will teach how to reduce negative environmental impacts from energy production, conversion, and distribution. Since energy security is arguably the one of the biggest global challenges of the modern society, the course will conclude with a brief discussion on socioeconomic consequences and policy issues of energy use.
Lecture: 50 Lab: 0 Credits: 3
PHYS 300
Instrumentation Laboratory
Basic electronic skills for scientific research. Electrical measurements, basic circuit analysis, diode and transistor circuits. Transistor and integrated amplifiers, filters, and power circuits. Basics of digital circuits, including Boolean algebra and design of logic circuits.  
Prerequisite(s): PHYS 221  
Lecture: 2 Lab: 4 Credits: 4  
Satisfies: Communications (C)

PHYS 301
Mathematical Methods of Physics
Prerequisite(s): MATH 252 and MATH 251  
Lecture: 3 Lab: 0 Credits: 3

PHYS 304
Thermodynamics and Statistical Physics
Statistical basis of thermodynamics, including kinetic theory, fundamentals of statistical mechanics, fluctuations and noise, transport phenomena and the Boltzmann equation. Thermodynamic functions and their applications, first and second laws of thermodynamics.  
Prerequisite(s): PHYS 223 or PHYS 224  
Lecture: 3 Lab: 0 Credits: 3

PHYS 308
Classical Mechanics I
Prerequisite(s): MATH 252 and (PHYS 223 or PHYS 224)  
Lecture: 3 Lab: 0 Credits: 3

PHYS 309
Classical Mechanics II
Prerequisite(s): MATH 252 and (PHYS 223 or PHYS 224) and PHYS 308  
Lecture: 3 Lab: 0 Credits: 3

PHYS 348
Modern Physics for Scientists and Engineers
An introduction to modern physics with the emphasis on the basic concepts that can be treated with elementary mathematics. Subjects covered include Bohr atom, elementary wave mechanics and an introduction to quantum mechanics, atom and molecular spectra, nuclear, and particle physics.  
Prerequisite(s): PHYS 223  
Lecture: 3 Lab: 0 Credits: 3

PHYS 360
Introduction to Astrophysics
This course provides an overview of astrophysics and introduces the student to the many conventions, units, coordinate systems, and nomenclature used in astrophysics. The course will survey observational, stellar, and extragalactic astrophysics as well as cosmology. The course will also include planetary astronomy including extrasolar planets.  
Prerequisite(s): ((CHEM 122 and CHEM 123) or CHEM 124) and PHYS 221  
Lecture: 3 Lab: 0 Credits: 3  
Satisfies: Natural Science (N)

PHYS 361
Observational Astrophysics
This lecture/lab class covers the basics of multiwavelength observational astrophysics. Topics covered include statistical analysis techniques, multi-wavelength telescope design, instrument design (including CCDs, spectrographs and PMTs), and best practices applicable in different observational bands.  
Prerequisite(s): ((CHEM 123 and CHEM 122) or CHEM 124) and (PHYS 360 and PHYS 221)  
Lecture: 3 Lab: 1 Credits: 4  
Satisfies: Natural Science (N)

PHYS 403
Relativity
Introduction to the special and general theories of relativity. Lorentz covariance. Minkowski space. Maxwell's equations. Relativistic mechanics. General coordinate covariance, differential geometry, Riemann tensor, the gravitational field equations. Schwarzschild solution, astronomical and experimental tests, relativistic cosmological models.  
Prerequisite(s): (PHYS 308 and MATH 251) or Graduate standing  
Lecture: 3 Lab: 0 Credits: 3

PHYS 404
Subatomic Physics
Historical introduction; general survey of nuclear and elementary particle physics; symmetries and conservation laws; leptons, quarks, and vector bosons; unified electromagnetic and weak interactions; the parton model and quantum chromodynamics.  
Prerequisite(s): (PHYS 223 or Graduate standing) and PHYS 224  
Lecture: 3 Lab: 0 Credits: 3
PHYS 405
Fundamentals of Quantum Theory I
A review of modern physics including topics such as blackbody radiation, the photoelectric effect, the Compton effect, the Bohr model of the hydrogen atom, the correspondence principle, and the DeBroglie hypothesis. Topics in one-dimensional quantum mechanics such as the particle in an infinite potential well, reflection and transmission from potential wells, barriers, and steps, the finite potential well and the quantum harmonic oscillator. General topics such as raising and lowering operators, Hermitian operators, commutator brackets and the Heisenberg Uncertainty Principle are also covered. Many particle systems and the Pauli Exclusion Principle are discussed. Three-dimensional quantum mechanical systems, orbital angular momentum, the hydrogen atom.
Prerequisite(s): (MATH 252 or Graduate standing) and (PHYS 224 or PHYS 223)
Lecture: 3 Lab: 0 Credits: 3

PHYS 406
Fundamentals of Quantum Theory II
Zeeman and Stark Effects. Addition of spin and orbital angular momenta, the matrix representation of quantum mechanical operators, the physics of spin precession and nuclear magnetic resonance. Time independent and time dependent perturbation theory, Fermi’s Golden Rule and the physics of radiation emitted in the course of atomic transitions. Indistinguishable particles in quantum mechanics, the helium atom. Scattering theory, using partial wave analysis and the Born approximation.
Prerequisite(s): PHYS 405 or Graduate standing
Lecture: 3 Lab: 0 Credits: 3

PHYS 407
Introduction to Quantum Computing
An introductory course in quantum physics and quantum computing for non-physics majors suitable for upper division STEM majors and graduate students. Topics to be covered include quantum physics basics, types of physical qubit systems in current use, methods of qubit measurement, fault tolerance in quantum computing, and quantum algorithms including quantum teleportation, quantum cryptography, Deutch-Jozsa, Simon’s, Bernstein-Vazirani, Grover, Shor, and quantum Fourier transforms. Course will include hands-on exercises with online quantum computing resources. Previous experience with linear algebra and complex numbers preferred.
Lecture: 3 Lab: 0 Credits: 3

PHYS 410
Molecular Biophysics
The course covers thermodynamic properties of biological molecules, irreversible and open systems, information theory, biophysical measurements, the structure and properties of proteins, enzyme action, the structure and properties of nucleic acids, genetics at the molecular level, and molecular aspects of important biological systems.
Prerequisite(s): CHEM 343 or PHYS 224 or PHYS 223
Lecture: 3 Lab: 0 Credits: 3

PHYS 412
Modern Optics and Lasers
Prerequisite(s): (CS 105 or Graduate standing) and (PHYS 223 or PHYS 224)
Lecture: 3 Lab: 0 Credits: 3

PHYS 413
Electromagnetism I
Differentiation and integration of vector fields, and electrostatics and magnetostatics. Calculation of capacitance, resistance, and inductance in various geometries.
Prerequisite(s): (PHYS 221 and MATH 252) or Graduate standing
Lecture: 3 Lab: 0 Credits: 3

PHYS 414
Electromagnetism II
Prerequisite(s): PHYS 413
Lecture: 3 Lab: 0 Credits: 3

PHYS 415
Solid State Electronics
Energy bands and carrier transport in semi-conductors and metals. Physical principles of p-n junction devices, bipolar junction transistors, FETS, Gunn diodes, IMPATT devices, light-emitting diodes, semiconductor lasers.
Prerequisite(s): PHYS 223 or Graduate standing or PHYS 224
Lecture: 3 Lab: 0 Credits: 3

PHYS 418
Introduction to Lasers
Prerequisite(s): PHYS 224 or Graduate standing or PHYS 223
Lecture: 3 Lab: 0 Credits: 3

PHYS 420
Bio-Nanotechnology
In this multidisciplinary course, we will examine the basic science behind nanotechnology and how it has infused itself into areas of nanofabrication, biomaterials, and molecular medicine. This course will cover materials considered basic building blocks of nanodevices such as organic molecules, carbon nanotubes, and quantum dots. Top-down and bottom-up assembly processes such as thin film patterning through advanced lithography methods, self-assembly of molecular structures, and biological systems will be discussed. Students will also learn how bionanotechnology applies to modern medicine, including diagnostics and imaging and nanoscale, as well as targeted, nanotherapy and finally nanosurgery.
Prerequisite(s): PHYS 224 or Graduate standing or PHYS 223
Lecture: 3 Lab: 0 Credits: 3
PHYS 425
High Energy Astrophysics
High-energy astrophysics covers interactions in the most extreme physical conditions across the cosmos. Included in this course are the physics of black holes, neutron stars, large scale jets, accretion, shocks, and particle acceleration. Emission mechanisms resulting from relativistic particle acceleration are covered including synchrotron radiation and Bremsstrahlung and Compton processes. Recent observations of X-ray to TeV gamma-ray energies have contributed significantly to understanding these phenomena and will be highlighted.
Prerequisite(s): (MATH 252 and MATH 251) or Graduate standing and (PHYS 224 or PHYS 223)
Lecture: 3 Lab: 0 Credits: 3

PHYS 427
Advanced Physics Laboratory I
Experiments related to our present understanding of the physical world. Emphasis is on quantum phenomena in atomic, molecular, and condensed matter physics, along with the techniques of measurement and data analysis. The second semester stresses project-oriented experiments on modern topics including spectroscopy, condensed matter physics, and nuclear physics.
Prerequisite(s): PHYS 224 or Graduate standing or PHYS 223
Lecture: 3 Lab: 2 Credits: 3
Satisfies: Communications (C)

PHYS 428
Advanced Physics Laboratory II
Experiments related to our present understanding of the physical world. Emphasis is on quantum phenomena in atomic, molecular, and condensed matter physics, along with the techniques of measurement and data analysis. The second semester stresses project-oriented experiments on modern topics including spectroscopy, condensed matter physics and nuclear physics.
Prerequisite(s): PHYS 427 or Graduate standing
Lecture: 2 Lab: 3 Credits: 3

PHYS 437
Solid State Physics
Crystal structure and binding, lattice vibrations, phonons, free electron model, band theory of electrons. Electrical, thermal, optical, and magnetic properties of solids. Superconductivity.
Prerequisite(s): PHYS 405 or Graduate standing
Lecture: 3 Lab: 0 Credits: 3

PHYS 440
Computational Physics
Root finding using the Newton-Raphson method; interpolation using Cubic Splines and Least Square Fitting; solving ordinary differential equations using Runge-Kutta and partial differential equations using Finite Difference and Finite Element techniques; numerical quadrature using Simpson's Rule, Gaussian Quadrature and the Monte Carlo method; and spectral analysis using Fast Fourier Transforms. These techniques are applied to a wide range of physics problems such as finding the energy levels of a finite quantum well using a root finding technique, solving the Schrodinger equation using the Runge-Kutta-Fehlberg method, using random numbers to simulate stochastic processes such as a random walk, using the Fast Fourier Transform method to perform a spectral analysis on non-linear chaotic systems such as the Duffing oscillator, and using auto-correlation functions to simulate sonar or radar ranging problems.
Prerequisite(s): (PHYS 240 or Graduate standing) and (PHYS 223 or PHYS 224)
Lecture: 1 Lab: 4 Credits: 3

PHYS 460
Stellar Astrophysics
This course will cover the formation, structure, and evolution of stars. Stellar remnants (white dwarfs, neutron stars, and black holes) will also be covered. Aspects of the interstellar medium relevant to star formation will be covered as well.
Prerequisite(s): PHYS 360
Lecture: 3 Lab: 0 Credits: 3

PHYS 461
Extragalactic Astrophysics
This course will cover galaxy morphology, dynamics, and structure. This course will also cover cosmology including dark matter, dark energy, and fate of the universe.
Prerequisite(s): PHYS 360
Lecture: 3 Lab: 0 Credits: 3

PHYS 465
Electrical, Magnetic, and Optical Properties
Lecture: 3 Lab: 0 Credits: 3

PHYS 485
Physics Colloquium
Lectures by prominent scientists. This course exposes students to current and active research in physics both within and outside the IIT community. It helps prepare students for a career in research. It is complementary to our academic courses and provides examples of professional/scientific presentations. This course may not be used to satisfy the natural science general education requirement.
Prerequisite(s): PHYS 223 or PHYS 224 or Graduate standing
Lecture: 1 Lab: 0 Credits: 1
PHYS 491  
Undergraduate Research  
Recommendation of advisor and approval of the department chair. Student participation in undergraduate research, usually during the junior or senior year.  
Credit: Variable

PHYS 494  
Research Project  
Special research and development projects in X-ray optics, instrumentation, X-ray techniques for industrial applications, mechanical and opto-mechanical design and instrumentation, and thermal management techniques and systems.  
Credit: Variable

PHYS 497  
Special Topics in Physics  
Special topics in physics.  
Credit: Variable

PHYS 498  
Research Honors Thesis Preparation  
Background and research following a summer research honors project, preparing to write a research honors thesis in Physics 499. Student will organize a review committee to direct and review the research.  
Credit: Variable

PHYS 499  
Research Honors Thesis  
Background and laboratory research and thesis writing following a summer research project and thesis preparation. The student will meet regularly with his or her committee during thesis preparation and will write and defend thesis.  
Credit: Variable

PHYS 501  
Methods of Theoretical Physics I  
Lecture: 3 Lab: 0 Credits: 3

PHYS 502  
Methods of Theoretical Physics II  
Lecture: 3 Lab: 0 Credits: 3

PHYS 505  
Electromagnetic Theory  
Lecture: 3 Lab: 0 Credits: 3

PHYS 508  
Analytical Dynamics  
Lecture: 3 Lab: 0 Credits: 3

PHYS 509  
Quantum Theory I  
Lecture: 3 Lab: 0 Credits: 3
PHYS 510
Quantum Theory II
Prerequisite(s): (PHYS 405 with min. grade of C and PHYS 406 with min. grade of C) or PHYS 509 with min. grade of C
Lecture: 3 Lab: 0 Credits: 3

PHYS 515
Statistical Mechanics
Lecture: 3 Lab: 0 Credits: 3

PHYS 518
General Relativity
Lorentz transformations, Minkowski space, 4D vectors and tensors, kinematics and dynamics of special relativity. Riemann geometry, Christoffel symbols, covariant derivatives, geodesics, curvature tensor, Einstein equations. Classical experiments of general relativity, Schwarzschild solution, physics of black holes. Cosmology, Big Bang theory, gravitational waves. Instructor permission required.
Lecture: 3 Lab: 0 Credits: 3

PHYS 520
Bio-Nanotechnology
In this multidisciplinary course, we will examine the basic science behind nanotechnology and how it has infused itself into areas of nanofabrication, biomaterials, and molecular medicine. This course will cover materials considered basic building blocks of nanodevices such as organic molecules, carbon nanotubes, and quantum dots. Top-down and bottom-up assembly processes such as thin film patterning through advanced lithography methods, self-assembly of molecular structures, and biological systems will be discussed. Students will also learn how bionanotechnology applies to modern medicine, including diagnostics and imaging and nanoscale, as well as targeted, nanotherapy and finally nanosurgery.
Lecture: 3 Lab: 0 Credits: 3

PHYS 525
Applied Physics Methods for Scientists and Engineers
This is the first of a two-part course designed to provide science and engineering students with the opportunity to investigate the underlying physics and engineering principles governing challenging real-world problems or needs. Each student selects a topic based on her or his background and interest such as the development of novel or new scientific instruments, medical devices, consumer products, energy (conservation, transport, and storage) system, thermal management devices and systems, sustainability, etc.). Experimental, theoretical, numerical techniques or a combination thereof are used, as needed, in the development of new or improved designs, methodologies, systems, and solutions. No specific background is required other than curiosity, interest, and dedication.
Lecture: 3 Lab: 0 Credits: 3

PHYS 526
Applied Physics Case Studies for Scientists and Engineers
This is the second of a two-part course designed to provide science and engineering students with the opportunity to investigate the underlying physics and engineering principles governing challenging real-world problems or needs. Each student selects a topic based on her or his background and interest such as the development of novel or new scientific instruments, medical devices, consumer products, energy (conservation, transport, and storage) system, thermal management devices and systems, sustainability, etc.). Experimental, theoretical, numerical techniques or a combination thereof are used, as needed, in the development of new or improved designs, methodologies, systems, and solutions. No specific background is required other than curiosity, interest, and dedication.
Lecture: 3 Lab: 0 Credits: 3

PHYS 537
Solid State Physics I
Prerequisite(s): (PHYS 405 with min. grade of C and PHYS 406 with min. grade of C) or PHYS 509 with min. grade of C
Lecture: 3 Lab: 0 Credits: 3

PHYS 538
Solid State Physics II
Prerequisite(s): PHYS 510* with min. grade of C, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 Lab: 0 Credits: 3

PHYS 539
Physical Methods of Characterization
A survey of physical methods of characterization including x-ray diffraction and fluorescence surface techniques including SEM, TEM, AES and ESCA, thermal methods and synchrotron radiation methods. Same as CHEM 509.
Lecture: 3 Lab: 0 Credits: 3

PHYS 525
Applied Physics Methods for Scientists and Engineers
This is the first of a two-part course designed to provide science and engineering students with the opportunity to investigate the underlying physics and engineering principles governing challenging real-world problems or needs. Each student selects a topic based on her or his background and interest such as the development of novel or new scientific instruments, medical devices, consumer products, energy (conservation, transport, and storage) system, thermal management devices and systems, sustainability, etc.). Experimental, theoretical, numerical techniques or a combination thereof are used, as needed, in the development of new or improved designs, methodologies, systems, and solutions. No specific background is required other than curiosity, interest, and dedication.
Lecture: 3 Lab: 0 Credits: 3

PHYS 526
Applied Physics Case Studies for Scientists and Engineers
This is the second of a two-part course designed to provide science and engineering students with the opportunity to investigate the underlying physics and engineering principles governing challenging real-world problems or needs. Each student selects a topic based on her or his background and interest such as the development of novel or new scientific instruments, medical devices, consumer products, energy (conservation, transport, and storage) system, thermal management devices and systems, sustainability, etc.). Experimental, theoretical, numerical techniques or a combination thereof are used, as needed, in the development of new or improved designs, methodologies, systems, and solutions. No specific background is required other than curiosity, interest, and dedication.
Lecture: 3 Lab: 0 Credits: 3

PHYS 537
Solid State Physics I
Prerequisite(s): (PHYS 405 with min. grade of C and PHYS 406 with min. grade of C) or PHYS 509 with min. grade of C
Lecture: 3 Lab: 0 Credits: 3

PHYS 538
Solid State Physics II
Prerequisite(s): PHYS 510* with min. grade of C, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 Lab: 0 Credits: 3

PHYS 539
Physical Methods of Characterization
A survey of physical methods of characterization including x-ray diffraction and fluorescence surface techniques including SEM, TEM, AES and ESCA, thermal methods and synchrotron radiation methods. Same as CHEM 509.
Lecture: 3 Lab: 0 Credits: 3
PHYS 540
Computational Accelerator Physics
Single-particle dynamics and numerical integration; transverse and longitudinal motion; phase space distributions and ellipses; transfer map methods; periodic systems; advanced beam optics modules; magnetic fields and FEM; RF cavities; errors and resonances; symplectic integration; other topics (final presentations).
Prerequisite(s): PHYS 505
Lecture: 3 Lab: 0 Credits: 3

PHYS 545
Particle Physics I
The course is an introduction to and overview of the field of elementary particle physics. No previous exposure is assumed. The first third of the course is devoted to the symmetries of the strong interaction. The second third is a modern introduction to the gauge theories of the electromagnetic, strong, and weak interactions, and their leading evaluation via Feynman diagrams. The final third introduces topics of current and speculative research.
Prerequisite(s): PHYS 510 with min. grade of C and PHYS 509 with min. grade of C
Lecture: 3 Lab: 0 Credits: 3

PHYS 546
Particle Physics II
The course is a continuation of PHYS 545, but it is self-contained. The goal is to provide a functional understanding of particle physics phenomenology of QED, QCD, and electroweak physics. Topics include QED: Spin-dependent cross sections, crossing symmetries, C/P/CP; QCD: Gluons, parton model, jets; Electroweak interactions: W, Z, and Higgs. Weak decays and production of weak bosons; Loop calculations: Running couplings, renormalization.
Prerequisite(s): PHYS 510 with min. grade of C and PHYS 509 with min. grade of C
Lecture: 3 Lab: 0 Credits: 3

PHYS 550
Radiation Instrumentation Laboratory
Detecting and measuring radioactive material and radiation levels depends upon many types of detectors and instrumentation. Theory of detectors ranging from chambers operating in pulse and current producing modes to solid state detectors is applied to measuring and monitoring systems. Electronics ranging from simple rate meters and scalers to high speed multi-channel analyzers are used. Computer-linked instrumentation and computer-based applications are applied to practical problems.
Prerequisite(s): PHYS 571 with min. grade of C
Lecture: 1 Lab: 4 Credits: 3

PHYS 553
Quantum Field Theory
Quantum field theory is a language to understand large numbers of degrees of freedom in most areas of physics such as high energy, statistical, and condensed matter physics. Topics covered include: canonical quantization of fields; path integral quantizations of scalar, Dirac, and gauge theories; symmetries and conservation laws; perturbation theory and generating functionals; regularization and renormalization.
Prerequisite(s): PHYS 510 with min. grade of C
Lecture: 3 Lab: 0 Credits: 3

PHYS 561
Radiation Biophysics
Lecture: 3 Lab: 0 Credits: 3

PHYS 563
Project Management: Business Principles
The course will cover a wide range of business principles highlighting project management and the components of business that employees may encounter. The goal of the course is to help the student understand basic business principles and project management skills, help the student understand the application of organizational behavior in today's workplace and equip the student to function more effectively both independently and as a team in today's organizations.
Lecture: 2 Lab: 0 Credits: 2

PHYS 566
Environmental Health Physics
Impact of ionizing radiation and radionuclides on the environment. Identifying environmental effects of specific natural and artificial nuclides. Models for deposition and transport of nuclides, including air and water disbursement. Environmental dosimetry and remediation. Facility decommissioning and decontamination.
Lecture: 2 Lab: 0 Credits: 2

PHYS 567
Radiological Emergency Preparedness and Response
This course is designed to provide students an introduction of the nature of the nuclear and radiological emergencies arising from either accidents or malicious acts, and the management actions in the preparedness and response. The lecture content is to familiarize students with emergency management guidance documents. It will focus on several aspects of emergency preparedness and response. In the process it will also include the recovery from the incident.
Lecture: 3 Lab: 0 Credits: 3

PHYS 568
Radiation Source Security and Management
This course is designed to introduce radioactive sources that are currently used in all applications including defense, industry and medical areas. It will address the necessity to control and manage the licensed sources, particularly those designated by the International Atomic Energy Agency (IAEA) as Category I or II sources. The discussion will cover the potential consequences and impact of the lost sources either by lack of management or by theft. The course will cover the potential consequences and impact of the lost sources either by lack of management or by theft. The course will also address the potential use of radioactive sources for malicious intents, such as for the radiological dispersal device (RDD, or “dirty bomb”) or for the improvised nuclear device (IND).
Lecture: 3 Lab: 0 Credits: 3
PHYS 569  
Seminars on Radiological Emergency Field Experience  
This course will provide a series of discussions on the practical aspects in radiological emergency management by acquiring experiences from speakers representing various organizations in the emergency management community across the federal, state and local level. It is intended to provide students with valuable experiences in radiological emergency preparedness and response.  
Lecture: 3 Lab: 0 Credits: 3  

PHYS 570  
Introduction to Synchrotron Radiation  
Production and characterization of synchrotron radiation, dynamical and kinematical diffraction, absorption and scattering processes, x-ray optics for synchrotron radiation and x-ray detectors. Overview of experimental techniques including XAFS, XPS, SAXS, WAXS, diffraction, inelastic x-ray scattering, fluorescence spectroscopy, microprobe, tomography and optical spectroscopy.  
Lecture: 3 Lab: 0 Credits: 3  

PHYS 571  
Radiation Physics  
Fundamentals of Radiation Physics will be presented with an emphasis on problem-solving. Topics covered are review of atomic and nuclear physics; radioactivity and radioactive decay law; and interaction of radiation with matter, including interactions of heavy and light charged particles with matter, interactions of photons with matter, and interactions of neutrons with matter.  
Lecture: 3 Lab: 0 Credits: 3  

PHYS 572  
Introduction to Health Physics  
Health Physics profession; Units in radiation protection; Radiation sources; Interaction of ionizing radiation with matter; Detectors for radiation protection; Biological effects of ionizing radiation; Introduction to microdosimetry; Medical health physics; Fuel cycle health physics; Power reactor health physics; University health physics; Accelerator health physics; Environmental health physics; Radiation accidents.  
Lecture: 3 Lab: 0 Credits: 3  

PHYS 573  
Standards, Statutes and Regulations  
This course studies the requirements of agencies that regulate radiation hazards, their basis in law and the underlying US and international standards. An array of overlapping requirements will be examined. The effect regulatory agencies have upon the future of organizations and the consequences of noncompliance are explored.  
Lecture: 3 Lab: 0 Credits: 3  

PHYS 574  
Introduction to the Nuclear Fuel Cycle  
This course introduces the concept and components of the nuclear fuel cycle that originated from the mining of uranium through the production and utilization of nuclear fuel to the nuclear/radioactive waste generation and disposal. The mechanisms of normal operations through the fuel cycle process will be discussed, as well as the accidental situations, with expanded coverage on nuclear reactor issues. Emphasis will be placed on the radiological health and safety aspects of the operations. The study will also include key regulatory compliance issues.  
Lecture: 2 Lab: 0 Credits: 2  

PHYS 575  
Case Studies in Health Physics  
This is a non-instructional course designed to promote the understanding of radiation safety through lessons learned from the past incidents. The focus will be on the means for improving the future operations of the facilities/devices. The course is recommended to be among the last courses taken by students who have gained at least one year of academic exposure in health physics and with some level of capability to address the underlying technical aspects. This course should be taken in a student's final semester.  
Prerequisite(s): PHYS 571 with min. grade of C  
Lecture: 3 Lab: 0 Credits: 3  

PHYS 576  
Radiation Dosimetry  
This course is designed to study the science and technique of determining radiation dose and is fundamental to evaluating radiation hazards and risks to humans. This course covers both external dosimetry for radiation sources that are outside the human body and internal dosimetry for intake of radioactive materials into the human body. Topics will include: dosimetry recommendations of ICRP for occupational exposure; US NRC and DOE requirements for particular work environments; and MIRD methodology for medical use of radionuclides.  
Prerequisite(s): PHYS 572 with min. grade of C  
Lecture: 3 Lab: 0 Credits: 3  

PHYS 577  
Operational Health Physics  
Covers the basic principles for establishing and maintaining an effective institutional radiation safety program including the following: facility design criteria; organizational management issues; training; internal and external radiation control; radioactive waste disposal; environmental monitoring; radiation safety instrumentation; ALARA program; and emergency response planning. The course will also cover facility licensing/registration with state and federal agencies and legal issues such as institutional and individual liability, fines, violations, and worker rights and responsibilities.  
Lecture: 2 Lab: 0 Credits: 2
PHYS 578
Medical Health Physics
Medical Health Physics (MHP) profession; sources of radiation in the medical environment; radioisotopes in nuclear medicine; diagnostic use of X-rays (radiography, mammography, CT, fluoroscopy); therapeutic use of X-ray and gamma radiation (Co-60 and LINAC based radiation therapy); radiotherapy using sealed radioisotopes (brachytherapy); radiation protection in diagnostic and interventional radiology; radiation protection in nuclear medicine; radiation protection in external beam radiotherapy; radiation protection in brachytherapy; radiation accidents in medicine.
Lecture: 2 Lab: 0 Credits: 2

PHYS 580
Intro to Radiochemistry
This course is designed to introduce the fundamental principle of radiation science for students majoring in radiochemistry.
Lecture: 3 Lab: 0 Credits: 3

PHYS 581
Radiochemistry Laboratory
This laboratory-related course will offer opportunities for students to have hands-on experience in sample preparation, source preparation, and counting measurements.
Prerequisite(s): PHYS 550 with min. grade of C
Lecture: 1 Lab: 2 Credits: 3

PHYS 582
Applications of Radiochemistry
This course will provide discussion and overview of practical applications of radiochemistry. Various special topics in the following five general series of practical radiochemistry will be offered. Each series covers different topics related to that particular discipline. 1. Actinide Chemistry Series 2. Environmental Radiochemistry/Bioassay 3. Nuclear Fuel Cycle Series 4. Nuclear Forensics 5. Radioelement Compounds.
Lecture: 3 Lab: 0 Credits: 3

PHYS 585
Physics Colloquium
Lectures by invited scientists in areas of physics generally not covered in the department. May be taken twice by M. S. students and four times by Ph. D. students. Must be taken twice by M. S. students.
Lecture: 1 Lab: 0 Credits: 0

PHYS 591
Research and Thesis M.S.
(Credit: variable)Prerequisite: Instructor permission required.
Credit: Variable

PHYS 594
Research Project
Research project.
Credit: Variable

PHYS 597
Reading and Special Problems
Independent study to meet the special needs of graduate students in department-approved graduate degree programs. Requires the written consent of the instructor. May be taken more than once. Receives a letter grade. (Credit: variable) Prerequisite: Instructor permission required.
Credit: Variable

PHYS 600
Continuation of Residence
Continuation of Residence.
Lecture: 0 Lab: 0 Credits: 0

PHYS 685
Physics Colloquium
Lectures by invited scientists in areas of physics generally not covered in the department. Must be taken twice by M. S. students and four times by Ph. D. students. May be substituted by PHYS 585 for M. S. students.
Lecture: 1 Lab: 0 Credits: 0

PHYS 691
Research and Thesis Ph.D.
(Credit: Variable)
Credit: Variable