Physics (PHYS)

College of Natural Science and Mathematics
Physics Department (https://www.uaf.edu/physics/)
907-474-7339

PHYS F102X Energy and Society (n)
4 Credits
Offered Spring
Exploring the concept of energy. Investigation of the sources, conversion, distribution and ultimate dispersion of energy, as well as the consequences of its use in the development and maintenance of modern society. May be used to fulfill part of the natural science requirement. Designed for non-science majors.
Prerequisites: Placement in WRTG F111X; placement in MATH F105.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F115L PHYS F115X Laboratory
0 Credit
Co-requisites: PHYS F115X.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Non-Graded

PHYS F115X Physical Sciences (n)
4 Credits
Offered Spring
Basic concepts and general overview in physics. Presents interrelatedness and interdependence within this scientific field.
Prerequisites: Placement in WRTG F111X; placement in MATH F105.
Co-requisites: PHYS F115L.
Recommended: MATH F105.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F123L PHYS F123X Laboratory
0 Credit
Co-requisites: PHYS F123X.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Non-Graded

PHYS F123X College Physics I (n)
4 Credits
Offered Fall
Algebra-based introduction to classical physics, including: kinematics, Newton's laws, momentum, work, energy, gravity, rotational motion, fluids, heat, temperature, laws of thermodynamics. The laboratory part is integrated in the course.
Prerequisites: High school algebra, trigonometry and geometry; placement in WRTG F111X; placement in MATH F105.
Co-requisites: PHYS F123L.
Special Notes: Additional topics include oscillations and waves.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F124L PHYS F124X Laboratory
0 Credit
Co-requisites: PHYS F124X.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Non-Graded

PHYS F124X College Physics II (n)
4 Credits
Offered Spring
Algebra-based introduction to classical physics, including: Coulomb's law, electrical potential, electric circuits, capacitance, Kirchhoff's laws, magnetic fields, Faraday's law, electromagnetic waves, physical and geometric optics, waves and particles. The laboratory part is integrated in the course.
Prerequisites: PHYS F123X; placement in WRTG F111X; placement in MATH F105.
Co-requisites: PHYS F124L.
Special Notes: Additional topics include atomic and nuclear physics.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F165L PHYS F165X Laboratory
0 Credit
Co-requisites: PHYS F165X.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Non-Graded

PHYS F165X Introduction to Astronomy (n)
4 Credits
Offered Fall
Examination of the science of astronomy and its social consequences, with an emphasis on the interrelationships between astronomy and other sciences. Topics include astronomical concepts and tools, earth-based and satellite observation of light, the solar system, stellar astronomy and cosmology.
Prerequisites: Placement in WRTG F111X; placement MATH F105.
Co-requisites: PHYS F165L.
Special Notes: A laboratory part is integrated into the course.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F211L PHYS F211X Laboratory
0 Credit
Co-requisites: PHYS F211X.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Non-Graded

PHYS F211X General Physics I (n)
4 Credits
Offered Fall and Spring
Calculus-based introduction to classical mechanics, including: kinematics, Newton's laws, momentum, work, energy, gravity, rotational motion, oscillations and fluids. The laboratory part is integrated into the course.
Prerequisites: MATH F251X (concurrent enrollment in MATH F252X recommended) or ES F186 (concurrent enrollment in MATH F251X recommended); placement in WRTG F111X.
Co-requisites: PHYS F211L.
Recommended: One year of high school physics.
Special Notes: Additional topics include waves.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F212L PHYS F212X Laboratory
0 Credit
Co-requisites: PHYS F212X.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Non-Graded

PHYS F212X General Physics II (n)
4 Credits
Offered Fall and Spring
Calculus-based introduction to classical physics, including: Coulomb's law, electrical potential, electric circuits, capacitance, Kirchhoff's laws, Biot-Savart law, Faraday's law, and electromagnetic waves. Additional topics include thermodynamics. The laboratory part is integrated into the course.
Prerequisites: Concurrent enrollment in MATH F253X; PHYS F211X or ES F208 or concurrent enrollment in ES F210; placement in WRTG F111X.
Co-requisites: PHYS F212L.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F213L PHYS F213X Laboratory
0 Credit
Co-requisites: PHYS F213X.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Non-Graded

PHYS F213X Elementary Modern Physics (n)
4 Credits
Offered Fall
Geometrical and physical optics, elementary-level modern physics including special relativity, atomic physics, nuclear physics, solid-state physics, elementary particles, simple transport theory, kinetic theory and concepts of wave mechanics.
Prerequisites: Placement in WRTG F111X; MATH F252X; MATH F253X; PHYS F211X; PHYS F212X.
Co-requisites: PHYS F213L.
Attributes: UAF GER Natural Science Req
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F220 Introduction to Computational Physics (n)
4 Credits
Offered Spring
Introduction to computational techniques for solving physics problems. The computer is used as a tool to provide insight into physical systems and their behavior in all areas of physics.
Prerequisites: MATH F253X; PHYS F211X; PHYS F212X; PHYS F213X.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F301 Introduction to Mathematical Physics
4 Credits
Offered Spring
Introduction to theoretical foundations of classical and modern physics. Includes calculus of vector fields, linear algebra, elementary tensor theory, complex analysis, ordinary and partial differential equations, fourier analysis and probability. Physical applications include planetary motion, rotating bodies, damped and driven harmonic oscillator, wave equation, Schroedinger's equation and diffusive systems.
Prerequisites: PHYS F211X; PHYS F212X; PHYS F213X; MATH F253X.
Lecture + Lab + Other: 4 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F341 Classical Physics I: Particle Mechanics
4 Credits
Offered Fall
Newtonian mechanics, conserved mechanical quantities, motion of systems of particles, rigid body statics and dynamics, moving and accelerated coordinate systems, rigid body rotations and Lagrangian mechanics.
Prerequisites: PHYS F211X; PHYS F212X; PHYS F220; PHYS F301.
Lecture + Lab + Other: 4 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F342 Classical Physics II: Electricity and Magnetism
4 Credits
Offered Spring
Statics and dynamics of electric and magnetic fields in vacuum and in the presence of materials. Lorentz force law. Maxwell's equations.
Prerequisites: PHYS F341.
Lecture + Lab + Other: 4 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F343 Classical Physics III: Vibration and Waves
4 Credits
Offered Fall
Normal modes and small vibrations, continuum systems, wave mechanics, electromagnetic waves and radiation. Relativistic mechanics and electromagnetism.
Prerequisites: PHYS F342.
Lecture + Lab + Other: 4 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F351 Thermal Physics
2 Credits
Offered Spring
Classical macroscopic thermodynamics; systems and states, equations of state, the first and second laws of thermodynamics and their consequences, entropy, enthalpy, Helmholtz and Gibbs functions, equilibrium, Maxwell's relations.
Prerequisites: PHYS F212X, PHYS F220, PHYS F301, PHYS F341.
Lecture + Lab + Other: 2 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F381 Physics Laboratory Part I (n)
3 Credits
Offered Fall
Laboratory experiments in classical and modern physics. Part one of a two-part course series.
Prerequisites: COM F131X or COM F141X; PHYS F213X; WRTG F111X; WRTG F211X, WRTG F212X, WRTG F213X or WRTG F214X.
Lecture + Lab + Other: 1 + 6 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F382 Physics Laboratory Part II (n)
3 Credits
Offered As Demand Warrants
Laboratory experiments in classical and modern physics.
Prerequisites: WRTG F111X; WRTG F211X, WRTG F212X, WRTG F213X or WRTG F214X; PHYS F381.
Lecture + Lab + Other: 1 + 6 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F400 Capstone Project
0 Credit
Offered Fall and Spring
Course to be taken during semester of initiating a capstone project. Project must include communication of study intent, methods, results, interpretation and conclusions. It may consist of undergraduate research, independent study with a faculty member, or participation in the international University Physics Competition. Course duration may exceed one semester.
Prerequisites: PHYS F301.
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Pass/Fail Grades

PHYS F413 Atmospheric Radiation
3 Credits
Offered As Demand Warrants
Atmospheric radiation including the fundamentals of blackbody radiation theory and radiative properties of atmospheric constituents. Discussion of gaseous absorption including line absorption, broadening effects and radiative transfer. Includes scattering, radiative properties of clouds and radiation climatology.
Prerequisites: ATM F401 (may be taken concurrently).
Cross-listed with ATM F413.
Stacked with PHYS F613; ATM F613.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F421 Quantum Mechanics (n)
4 Credits
Offered Fall
Schrodinger's equation, Born interpretation, operator formalism, measurement and projection, stationary states, one-dimensional systems, hydrogen atom, states of definite angular momentum, perturbation theory.
Prerequisites: PHYS F213X; PHYS F220; PHYS F301; PHYS F341.
Lecture + Lab + Other: 4 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F451 Statistical Physics
2 Credits
Offered Spring
The canonical ensemble; maximizing entropy, the partition function and Helmholtz free energy, the harmonic oscillator, Einstein and Debye solids, classical systems and the ideal gas, diatomic molecules, equipartition theorem, the photon gas and the blackbody spectrum, the grand canonical ensemble, quantum statistics, Fermion and Boson systems.
Prerequisites: PHYS F342, F351, F421.
Lecture + Lab + Other: 2 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F462 Geometrical and Physical Optics (n)
4 Credits
Offered Spring
Geometrical optics, interference and diffraction theory, nonlinear optics, Fourier optics, and coherent wave theory.
Prerequisites: PHYS F213X; PHYS F301.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F471A Advanced Topics in Physics I: Condensed Matter Physics I (n)
1 Credit
Offered As Demand Warrants
Emphasis topics provide increased breadth in basic physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken unlimited times for up to unlimited credits

PHYS F471B Advanced Topics in Physics I: Condensed Matter Physics II (n)
1 Credit
Offered As Demand Warrants
Emphasis topics provide increased breadth in basic physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken unlimited times for up to unlimited credits

PHYS F471C Advanced Topics in Physics I: Space and Auroral Physics (n)
1 Credit
Offered As Demand Warrants
Emphasis topics provide increased breadth in basic physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken unlimited times for up to unlimited credits

PHYS F471D Advanced Topics in Physics I: Nonlinear Dynamics (n)
1 Credit
Offered As Demand Warrants
Emphasis topics provide increased breadth in basic physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken unlimited times for up to unlimited credits

PHYS F471E Advanced Topics in Physics I: Biophysics (n)
1 Credit
Offered As Demand Warrants
Emphasis topics provide increased breadth in basic physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken unlimited times for up to unlimited credits

PHYS F471F Advanced Topics in Physics I: Nuclear and Particle Physics (n)
1 Credit
Offered As Demand Warrants
Emphasis topics provide increased breadth in basic physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken unlimited times for up to unlimited credits

PHYS F471G Advanced Topics in Physics I: General Relativity (n)
1 Credit
Offered As Demand Warrants
Emphasis topics provide increased breadth in basic physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken unlimited times for up to unlimited credits

PHYS F471H Advanced Topics in Physics I: Astrophysics (n)
1 Credit
Offered As Demand Warrants
Emphasis topics provide increased breadth in basic physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken unlimited times for up to unlimited credits

PHYS F471I Advanced Topics in Physics I: Topics in Modern Mathematical Physics (n)
1 Credit
Offered As Demand Warrants
Emphasis topics provide increased breadth in basic physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken unlimited times for up to unlimited credits

PHYS F471J Advanced Topics in Physics I: Order of Magnitude Physics
1 Credit
Offered As Demand Warrants
By avoiding mathematical complexity, order-of-magnitude techniques increase our physical understanding and allow us to study difficult or intractable problems. Students will learn how to do so and apply these techniques to problems in fluid mechanics, biophysics, astrophysics, and/or other applications.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F471M Advanced Topics in Physics I: Machine Learning and Applications
1 Credit
Offered As Demand Warrants
Introduction to machine learning and applications. 14-lecture, one-credit courses. Python knowledge is required for taking this class.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F472A Advanced Topics in Physics II: Planetary Atmospheres (n)
1 Credit
Offered As Demand Warrants
Application topics provide expanded exposure to subjects in physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F472B Advanced Topics in Physics II: Fluid Dynamics (n)
1 Credit
Offered As Demand Warrants
Application topics provide expanded exposure to subjects in physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F472C Advanced Topics in Physics II: Plasma Physics (n)
1 Credit
Offered As Demand Warrants
Application topics provide expanded exposure to subjects in physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F472D Advanced Topics in Physics II: Hamiltonian Mechanics (n)
1 Credit
Offered As Demand Warrants
Application topics provide expanded exposure to subjects in physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F472E Advanced Topics in Physics II: Physics of Glaciers (n)
1 Credit
Offered As Demand Warrants
Application topics provide expanded exposure to subjects in physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F472F Advanced Topics in Physics II: Remote Sensing (n)
1 Credit
Offered As Demand Warrants
Application topics provide expanded exposure to subjects in physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F472G Advanced Topics in Physics II: Solar Physics (n)
1 Credit
Offered As Demand Warrants
Application topics provide expanded exposure to subjects in physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F472H Advanced Topics in Physics II: Advanced Laboratory (n)
1 Credit
Offered As Demand Warrants
Application topics provide expanded exposure to subjects in physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F472I Advanced Topics in Physics II: Spectroscopy (n)
1 Credit
Offered As Demand Warrants
Application topics provide expanded exposure to subjects in physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F472J Advanced Topics in Physics II: Cosmology (n)
1 Credit
Offered As Demand Warrants
Application topics provide expanded exposure to subjects in physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F472K Advanced Topics in Physics II: Quantum Computation (n)
1 Credit
Offered As Demand Warrants
Application topics provide expanded exposure to subjects in physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F472L Advanced Topics in Physics II: Covariant Kinematics/ Dynamics (n)
1 Credit
Offered As Demand Warrants
Application topics provide expanded exposure to subjects in physics. Three topics are offered within the fall and spring semesters of each academic year as compressed 14-lecture, one-credit courses.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F472Z Advanced Topics in Physics II: Current Topics in Physics
1 Credit
Offered As Demand Warrants
Advanced topics modules provide expanded exposure to modern subjects in physics. Three topics are offered each semester, providing breadth beyond the core subjects of the physics undergraduate curriculum. This course will present most current material from one particular topic in physics, to be determined at the time of the offering.
Prerequisites: PHYS F220; PHYS F301.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken 2 times for up to 2 credits

PHYS F488 Undergraduate Research
1-3 Credits
Offered Fall, Spring and Summer
Advanced research topics from outside the usual undergraduate requirements.
Prerequisites: Permission of instructor.
Recommended: A substantial level of technical/scientific background.
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken 98 times for up to 294 credits

PHYS F605 Physics Teaching Seminar/Practicum
1 Credit
Offered Fall and Spring
This course will give science graduate students both lectures and hands-on training in dealing with all aspects of teaching, focused on but not exclusive to the Teaching Assistant level. Course topics include teaching pedagogy, preparation strategies, student management, time management and learning assessment.
Prerequisites: Graduate standing in a science discipline.
Lecture + Lab + Other: 1 + 0 + 1
Grading System: Pass/Fail Grades
Repeatable for Credit: May be taken 2 times for up to 2 credits

PHYS F611 Mathematical Physics I
3 Credits
Offered Fall
Mathematical tools and theory for classical and modern physics. Core topics: Linear algebra including eigenvalues, eigenvectors and inner products in finite dimensional spaces. Infinite series. Hilbert spaces and generalized functions. Complex analysis, including Laurent series and contour methods. Applications to problems arising in physics. Selected additional topics, which may include operator and spectral theory, groups, tensor fields, hypercomplex numbers.
Prerequisites: graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F612 Mathematical Physics II
3 Credits
Offered Spring
Continuation of Mathematical Physics I; mathematical tools and theory for classical and modern physics. Core topics: classical solutions to partial differential equations of electromagnetism, classical and quantum mechanics. Boundary value problems and Sturm-Liouville theory. Green's functions and eigenfunction expansions. Integral transforms. Orthogonal polynomials and special functions.
Prerequisites: PHYS F611.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F613 Atmospheric Radiation
3 Credits
Offered As Demand Warrants
Atmospheric radiation including the fundamentals of blackbody radiation theory and radiative properties of atmospheric constituents. Discussion of gaseous absorption including line absorption, broadening effects and radiative transfer. Includes scattering, radiative properties of clouds and radiation climatology.
Prerequisites: ATM F601 (may be taken concurrently); graduate standing.
Cross-listed with ATM F613.
Stacked with PHYS F413; ATM F413.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F614 Ice Physics
3 Credits
Offered Spring Even-numbered Years
A survey of the physics of ice. Topics will include the crystal structure and properties of ice, high pressure phases, hydrogen bonding, mechanical, thermal, electrical and acoustic properties, nucleation and growth, and optical and surface properties (adhesion, friction).
Prerequisites: Graduate standing.
Cross-listed with GEOS F614.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F621 Classical Mechanics
3 Credits
Offered Fall Odd-numbered Years
Lagrange's equations, two-body problem, rigid body motion, special relativity, canonical equations, transformation theory, and Hamilton-Jacobi method.
Prerequisites: Graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F622 Statistical Mechanics
3 Credits
Offered Spring Even-numbered Years
Classical and quantum statistics of independent particles, ensemble theory and applications.
Prerequisites: PHYS F621; graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F625 Inverse Problems and Parameter Estimation
3 Credits
Offered As Demand Warrants
An inverse problem uses observations to infer properties of an unknown physical model. This course covers methods for solving inverse problems, including numerous examples arising in the natural sciences. Topics include linear regression, method of least squares, estimation of uncertainties, iterative optimization, and probabilistic (Bayesian) and sampling approaches.
Prerequisites: MATH F253X; MATH F314.
Cross-listed with GEOS F627.
Stacked with GEOS F427.
Lecture + Lab + Other: 2 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F626 Fundamentals of Plasma Physics
3 Credits
Offered Fall
Single charge particle motion in the electromagnetic fields, plasma kinetic theory, Vlasov equations for collisionless plasmas, magnetohydrodynamic equations, linear plasma waves and instabilities, nonlinear plasma waves and instabilities.
Prerequisites: Graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F627 Advanced Plasma Physics
3 Credits
Vlasov description of small amplitude waves in magnetized plasmas, advanced particle orbit theory, fluctuation and incoherent scattering theory, plasma discontinuities and collisionless shocks, weak turbulent theory, statistical theory of turbulence.
Prerequisites: PHYS F626; graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F628 Digital Time Series Analysis
3 Credits
Offered As Demand Warrants
Applied time series analysis, including correlation, convolution, filtering and spectral estimation of multivariate data. The statistical properties of estimators; signal detection; and array processing.
Prerequisites: experience in programming; graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F629 Methods of Numerical Simulation in Fluids and Plasma
3 Credits
Offered Spring Odd-numbered Years
The fundamentals of computer simulation for fluids and multi-particle systems. Topics include methods for the discretization of numerical solutions, and boundary and initial conditions. Methods will be applied to convection, diffusion, and steady states in fluids and plasmas.
Prerequisites: Experience in programming; graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F631 Electromagnetic Theory Part I
3 Credits
Offered Fall Even-numbered Years
Electrostatics, magnetostatics, Maxwell's equations, and potentials. Lorentz equations, field energy, gauge conditions, retarded potentials, waves, radiation and tensor formulations. Part one of a two-part course series.
Prerequisites: Graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F632 Electromagnetic Theory Part II
3 Credits
Offered Spring Odd-numbered Years
Electrostatics, magnetostatics, Maxwell's equations and potentials. Lorentz equations, field energy, gauge conditions, retarded potentials, waves, radiation and tensor formulations.
Prerequisites: PHYS F631; graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F639 Geodetic Imaging
3 Credits
Offered Spring Even-numbered Years
We cover concepts and applications of Geodetic Imaging, a technology field that encompasses techniques for extracting geodetic information from images. Focusing on Synthetic Aperture Radar (SAR) and optical instruments, we cover techniques to measure the shape (InSAR; stereo-photogrammetry; structure-from-motion) and displacement (InSAR time-series analysis; feature tracking) of the earth surface.
Prerequisites: Basic remote sensing course.
Cross-listed with GEOS F639.
Lecture + Lab + Other: 2 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F640 Auroral Physics
3 Credits
Offered Spring Odd-numbered Years
Survey of aurora phenomena, the associated physical processes, and techniques used to investigate the aurora. Includes electron and proton impact spectra; physical processes that accelerate and precipitate electrons and protons; auroral currents; ionospheric effects of auroral activity; and principles for ground-based satellite spectroscopy and imaging and the measurements of magnetic and electric fields.
Prerequisites: Graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F647 Fundamentals of Geophysical Fluid Dynamics
3 Credits
Offered Fall Odd-numbered Years
Introduction to the mechanics of fluid systems, the fundamental processes, Navier-Stokes' equations in rotating and stratified fluids, kinematics, conservation laws, vortex motion, irrotational flow, laminar flow, boundary layer phenomena, waves, instabilities, turbulent flows and mixing.
Prerequisites: Graduate standing.
Cross-listed with ATM F647.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F648 Nonlinear Dynamics
3 Credits
Offered Spring Even-numbered Years
Introduction into the dynamics of nonlinear systems. Continuous and discrete dynamical systems, stability analysis, bifurcations, limit cycle, chaos and strange attractors, fractals and dimension algorithms, controlling chaos, synchronization processes, and stochastic dynamical systems.
Prerequisites: Graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F650 Aeronomy
3 Credits
Offered As Demand Warrants
The physical and chemical processes that govern the response of planetary atmospheres to solar radiation and energetic particles. Formation of and characteristic processes in the layers within the ionosphere and basic magneto-ionic theory. Includes principles of remote sensing by lidar and radar techniques.
Prerequisites: Graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F651 Quantum Mechanics Part I
3 Credits
Offered Fall Even-numbered Years
Schrodinger's equations, operator formalism, correspondence principle, central force problems, perturbation theory, quantum statistical mechanics, and applications of quantum mechanics to collision problems, radiation and spectroscopy. Part one of a two-part course series.
Prerequisites: Graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F652 Quantum Mechanics Part II
3 Credits
Offered Spring Odd-numbered Years
Schrodinger's equations, operator formalism, correspondence principle, central force problems, perturbation theory, quantum statistical mechanics, and applications of quantum mechanics to collision problems, radiation and spectroscopy. Part two of a two-part course series.
Prerequisites: PHYS F651; graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F672 Magnetospheric Physics
3 Credits
Offered Spring Even-numbered Years
The physics and dynamics of Earth's magnetosphere. Discusses the magnetosphere as a test bed for microscopic plasma processes equilibrium configurations, plasma instabilities, highly nonlinear eruptive plasma processes, and global dynamics which involve the interaction of various regions of the magnetosphere. Introduction to various aspects of magnetospheric physics with a systematic discussion of the various elements of the magnetosphere, their structure and dynamics, and a discussion of the relevant plasma physics.
Prerequisites: PHYS F626; graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F673 Space Physics
3 Credits
Offered Fall Odd-numbered Years
Plasma physics of the heliosphere from the solar core to the interstellar medium. Includes coronal structure, interplanetary magnetic field and solar wind, shocks, interactions with planets, planetary magnetospheres, cosmic rays, solar-terrestrial relations and instrumentation.
Prerequisites: Graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

PHYS F692P Seminar
1 Credit
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Pass/Fail Grades
Repeatable for Credit: May be taken unlimited times for up to 99 credits

PHYS F698 Non-thesis Research/Project
1-9 Credits
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Pass/Fail Grades
Repeatable for Credit: May be taken unlimited times for up to 99 credits

PHYS F699 Thesis
1-12 Credits
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Pass/Fail Grades
Repeatable for Credit: May be taken unlimited times for up to 99 credits