

Fall 2020 Course Descriptions as of 04/05/2020 08:13 PM

Information in Browse Course Catalog is subject to change. Information is term specific. Please refer to the appropriate term when searching for course content. Key to Course Descriptions may be found at: http://rcs.registrar.arizona.edu/course_descriptions_key.

Physics (PHYS)

PHYS 102: Introductory Physics I (3 units)

Description: Introductory Physics, without calculus, for liberal arts students and biological science majors. Students needing a laboratory should register for Physics 181. Topics include motion of particles in one and two dimensions, forces, Newton's laws, energy, momentum, angular momentum, and conservation laws, gravitation, fluids: Archimedes and Bernoulli, mechanical waves, sound, temperature, heat, heat engines, laws of thermodynamics.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Discussion	May Be Offered
	Lecture	Required

Course typically offered:

Main Campus: Fall, Spring, Summer

Online Campus: Fall

Enrollment requirement: PPL 50+ or SAT I MSS 590+ or ACT MATH 24+ or one course from MATH 108, 112, 113, 116, 119A, 120R, 122B, 125, 129, or 223. Test scores expire after 2 years.

Special Exam: Special Exam Credit Only

Shared Unique Number: SUN# PHY 1111

PHYS 103: Introductory Physics II (3 units)

Description: Introductory Physics, without calculus, for liberal arts students and biological science majors. Students needing a laboratory should register for Physics 182. Topics include electrostatics, potential, resistance, circuits, electromagnetism, Faraday's law, light, lenses, optical instruments, interference, quantum physics, atoms, and nuclei.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Discussion	May Be Offered
	Lecture	Required

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: PHYS 102 OR PHYS 140 OR PHYS 141.

Special Exam: Special Exam Credit Only

Shared Unique Number: SUN# PHY 1112

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 105A: Introduction to Scientific Computing (1 unit)

Description: The course provides an introduction to the use of computing in a scientific environment. The course objective is to introduce students to the C programming language as a tool for solving numerical problems. This course is prerequisite to PHYS 305.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Workshop Required

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Prerequisite or concurrent enrollment in MATH 122B.

PHYS 139: Calculus-based Introductory Mechanics (1 unit)

Description: Physics 139 is an introductory calculus-based physics laboratory course designed to teach students fundamental concepts of physics by performing actual experiments. The students will get hand-on experience using various equipment to collect the data that they need for their experiments. They will analyze the data and submit a report or a worksheet. It is intended solely for students who transferred here but who only have credit for our calculus-based mechanics lecture. This class, in combination with PHYS 140, is the equivalent of PHYS 141.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Laboratory Required

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: MATH 122B and PHYS 140.

PHYS 140: Introductory Mechanics (3 units)

Description: An introductory course in calculus-based Newtonian mechanics; introduces freshman-level students to the statics and dynamics of point particles, rigid bodies, and fluids. Topics include vector algebra, projectile and circular motion, Newton's Laws, conservation of energy, collisions and conservation of momentum, rotational dynamics and conservation of angular momentum, statics, harmonic oscillators and pendulums, gravitation and Kepler's Laws, fluid statics and dynamics.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Discussion May Be Offered
Lecture Required

Course typically offered:

Main Campus: Fall, Spring, Summer

Recommendations and additional information: PHYS 140 is equivalent to lecture portion of PHYS 141 or 161H. If you need both lecture and lab please take PHYS 141.

Enrollment requirement: MATH 122B, 124, or 125, or appropriate Math Placement Level.

Special Exam: Special Exam Credit Only

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 141: Introductory Mechanics (4 units)

Description: A first course in Newtonian mechanics; introduces freshman-level students to the statics and dynamics of point particles, rigid bodies, and fluids. Topics include vector algebra, projectile and circular motion, Newton's Laws, conservation of energy, collisions and conservation of momentum, rotational dynamics and conservation of angular momentum, statics, harmonic oscillators and pendulums, gravitation and Kepler's Laws, fluid statics and dynamics.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$50

Course Components:	Discussion	May Be Offered
	Laboratory	Required
	Lecture	Required

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: MATH 122B, 124, or 125, or appropriate Math Placement Level.

PHYS 142: Introductory Optics and Thermodynamics (3 units)

Description: A freshman-level course in the fundamental properties of light and heat and related applications such as optical instruments and heat engines; introduces students to the propagation of light and heat. Topics include temperature scales and heat, laws of thermodynamics, basic kinetic theory of gases, heat engines, elementary wave theory and sound, light as an electromagnetic wave, geometrical optics, lenses and mirrors, physical optics, diffraction and interference, optical instruments.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$50

Course Components:	Laboratory	Required
	Lecture	Required

Equivalent to: PHYS 143, PHYS 162H

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: (PHYS 141 or PHYS 140 or PHYS 161H, including transfer and AP credit) and (MATH 129 or MATH 250A or appropriate Math Placement Level, including transfer and AP credit).

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 143: Introductory Optics and Thermodynamics (2 units)

Description: Temperature scales, heat, thermodynamics, heat engines and kinetic theory; geometrical optics, lenses, mirrors and optical instruments; physical optics, diffraction, interference and wave theory.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: PHYS 142, PHYS 162H

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: (PHYS 141 or PHYS 140 or PHYS 161H, including transfer and AP credit) and (MATH 129 or MATH 250A or appropriate Math Placement Level, including transfer and AP credit).

Special Exam: Special Exam Credit Only

PHYS 161H: Honors Introductory Mechanics (4 units)

Description: A freshman-level course in Newtonian mechanics, taught at an accelerated level: introduces freshman-level students to the statics and dynamics of point particles, rigid bodies, and fluids. Topics include vector algebra, projectile and circular motion, Newton's Laws, conservation of energy, collisions and conservation of momentum, rotational dynamics and conservation of angular momentum, statics, harmonic oscillators and pendulums, gravitation and Kepler's Laws, fluid statics and dynamics.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$50

Course Components:	Laboratory	Required
	Lecture	Required

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: MATH 122B, 124, or 125, or appropriate Math Placement Level. Honors active.

Honors Course: Honors Course

Honors Course: Honors Course

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 162H: Honors Introductory Optics and Thermodynamics (4 units)

Description: A freshman-level course in the fundamental properties of light and heat, taught at an accelerated level; introduces students to the propagation of light and heat and related applications such as optical instruments and heat engines. Topics include temperature scales and heat, laws of thermodynamics, kinetic theory of gases and elementary statistical mechanics, heat engines, elementary wave theory and sound, light as an electromagnetic wave, geometrical optics, lenses and mirrors, physical optics, diffraction and interference, optical instruments.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$50

Course Components:	Laboratory	Required
	Lecture	Required

Equivalent to: PHYS 142, PHYS 143

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: (PHYS 141 or PHYS 140 or PHYS 161H, including transfer and AP credit) and (MATH 129 or MATH 250A or appropriate Math Placement Level, including transfer and AP credit). Honors active.

Honors Course: Honors Course

Honors Course: Honors Course

PHYS 170A1: The World Around Us (3 units)

Description: This is a course inquiring into basic concepts used by every physical science in its exploration of the world. The concepts originate in physics, which offers the framework on which other disciplines are built. Applications of the concepts are made in the course, not just to traditional physics problems, but to problems in many other scientific disciplines. In the course we will explore the development of the concepts from their intuitive beginnings to their present forms. In the process, we will see how science searches for a logically consistent explanation of the world, and how the creation of these concepts has influenced our perception of that world.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Discussion	May Be Offered
	Lecture	Required

Enrollment requirement: Enrollment not allowed if you have previously taken NATS 101 "The World Around Us" (Topic 11).

General Education: NATS 101

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 181: Introductory Laboratory I (1 unit)

Description: Quantitative experiments in physics, both illustrative and exploratory. Designed to accompany 102 or 131; sections are established corresponding to each course.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$50

Course Components: Laboratory Required

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: PPL 50+ or SAT I MSS 590+ or ACT MATH 24+ or one course from MATH 108, 112, 113, 116, 119A, 120R, 122B, 125, 129, or 223. Test scores expire after 2 years.

Shared Unique Number: SUN# PHY 1111

PHYS 182: Introductory Laboratory II (1 unit)

Description: Quantitative experiments in physics, both illustrative and exploratory. Designed to accompany 103 or 132; sections are established corresponding to each course.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$50

Course Components: Laboratory Required

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: (PHYS 102 and PHYS 181) or PHYS 141. Prerequisite or concurrently enrolled in PHYS 103.

Shared Unique Number: SUN# PHY 1112

PHYS 199: Independent Study (1 - 4 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

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-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 199H: Honors Independent Study (1 - 4 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: Student must be active in the Honors College.

Honors Course: Honors Course

Honors Course: Honors Course

PHYS 200: The Science of Good Cooking (3 units)

Description: This course shows students how to cook well using scientific observation, experiment and hypothesis testing. Lectures introduce the conceptual science behind kitchen technology and the cooking process, including heat transfer, phase changes, and material properties of foods. Students perform kitchen experiments at home using guidelines provided in class and turn in brief two-page reports of their observations. Semester grades are based on these reports and on two midterms in short-answer or essay style.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring

Recommendations and additional information: Two Tier 1 Natural Science courses.

General Education: Tier 2 Natural Sciences

PHYS 204: Mathematical Techniques in Physics (3 units)

Description: Mathematical techniques used in upper division physics courses. Complex numbers, Taylor series, coordinate systems, elementary probability, Fourier series, Linear algebra, vector operators, partial differential equations.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: MATH 223 and (PHYS 162H or 261H or 142 or 241 or 240 or 143).
Prerequisite or concurrent registration in MATH 254 or MATH 355.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 239: Calculus-based Introductory Electromagnetism Lab (1 unit)

Description: Physics 239 is an introductory calculus-based physics laboratory course designed to teach students fundamental concepts of physics by performing actual experiments. The students will get hand-on experience using various equipment to collect the data that they need for their experiments. They will analyze the data and submit a report or a worksheet. It is intended solely for students who transferred here but who only have credit for our calculus-based electromagnetism lecture. This class, in combination with PHYS 240, is the equivalent of PHYS 241.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Laboratory Required

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: Math 129 and Physics 240.

PHYS 240: Introductory Electricity and Magnetism (3 units)

Description: An introductory calculus-based course in electromagnetic fields and their applications. Topics include: Coulomb's and Gauss' Law, electric fields and potentials, electrical and magnetic properties of matter, Ampere's and Faraday's laws, elementary DC and AC circuits, Maxwell's equations and electromagnetic waves.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Discussion May Be Offered
 Lecture Required

Equivalent to: PHYS 241, PHYS 241H, PHYS 251, PHYS 261H

Course typically offered:

Main Campus: Fall, Spring, Summer

Recommendations and additional information: MATH 223 is a useful corequisite but it is NOT required.

Enrollment requirement: (PHYS 141 or PHYS 140 or PHYS 161H, including transfer and AP credit) and (MATH 129 or MATH 250A or appropriate Math Placement Level, including transfer and AP credit).

Special Exam: Special Exam Credit Only

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 241: Introductory Electricity and Magnetism (4 units)

Description: A first course in electromagnetic fields and their applications. Coulomb's and Gauss' Law, electric fields and potentials, electrical and magnetic properties of matter, Ampere's and Faraday's laws, elementary DC and AC circuits, Maxwell's equations.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$50

Course Components:	Discussion	May Be Offered
	Laboratory	Required
	Lecture	Required

Equivalent to: PHYS 240, PHYS 241H, PHYS 251, PHYS 261H

Course typically offered:

Main Campus: Fall, Spring, Summer

Recommendations and additional information: MATH 223 is recommended but not required. Some elementary vector calculus will be taught in class.

Enrollment requirement: (PHYS 141 or PHYS 140 or PHYS 161H, including transfer and AP credit) and (MATH 129 or MATH 250A or appropriate Math Placement Level, including transfer and AP credit).

Shared Unique Number: SUN# PHY 1131

PHYS 242: Introductory Relativity and Quantum Physics (3 units)

Description: A first course in relativistic and quantum concepts developed in the 20th century. Lorentz transformation, relativistic kinematics, basic relativistic dynamics, quantization of energy and angular momentum, atomic and molecular structure, nuclear and elementary particle physics, quantum statistics.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Equivalent to: PHYS 252

Recommendations and additional information: PHYS 141, PHYS 142, PHYS 241, MATH 223. Credit will be allowed for only one of the following sequences of courses; PHYS 102-103-181-182, 131-132-181-182, 141-142-241-242, 151-152-251-252.

Special Exam: Special Exam Credit Only

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: A first course in electromagnetic fields and their applications. Coulomb's and Gauss' Law, electric fields and potentials, electrical and magnetic properties of matter, Ampere's and Faraday's laws, elementary DC and AC circuits, Maxwell's equations. Methods of vector calculus are used extensively.

Career: Undergraduate

Course Components:	Laboratory	Required
	Lecture	Required

Course typically offered:

Enrollment requirement: (PHYS 141 or PHYS 140 or PHYS 161H, including transfer and AP credit) and (MATH 129 or MATH 250A or appropriate Math Placement Level, including transfer and AP credit). Honors active.

Honors Course: Honors Course

Description: A first course in relativistic and quantum concepts developed in the 20th century concepts. Lorentz transformation, relativistic kinematics, basic relativistic dynamics, quantization of energy and angular momentum, atomic and molecular structure, nuclear and elementary particle physics, quantum statistics.

Career: Undergraduate

Course typically offered:

Enrollment requirement: (PHYS 162H or 142 or 143) and prerequisite or concurrent enrollment in (PHYS 261H or 241 or 240) and MATH 254 or MATH 355. Student must be active in the Honors College.

Honors Course: Honors Course

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 299: Independent Study (1 - 4 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

PHYS 299H: Honors Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: Student must be active in the Honors College.

Honors Course: Honors Course

Honors Course: Honors Course

PHYS 305: Computational Physics (3 units)

Description: Introduction to numerical techniques for solving physics problems. Introduction to a high-level programming language, numerical integration, finding roots, ordinary differential equations, least squares fitting. This course is a prerequisite for the following courses:

PHYS332, PHYS426, PHYS472.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Laboratory May Be Offered
 Lecture Required

Equivalent to: ASTR 305

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: (PHYS 105A or ECE 175) and (PHYS 142 or 143 or 162H) and (PHYS 240 or 241 or 261H). Prerequisite or concurrent registration in MATH 254 or MATH 355.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 320: Optics (3 units)

Description: A study of electromagnetic waves in their generation, propagation and superposition that lead to the understanding of ray optics, polarization, interference, diffraction, and coherence, geometrical optics, and to the applications in optical instruments, including lasers, fiber optics, imaging techniques, dispersion and holography. Fourier transforms are used.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall (odd years only)

Enrollment requirement: (PHYS 142 or 143 or 162H) and (PHYS 241 or 240 or 261H) and MATH 223. Prerequisite or concurrent registration in MATH 254 or MATH 355.

PHYS 321: Theoretical Mechanics (3 units)

Description: A mid-level course in classical mechanics using Newtonian, Lagrangian and Hamiltonian formulations. Motions studied include: simple, damped and forced harmonic oscillators, conservation laws and collisions, central forces, gravitation and planetary orbits, rotation of rigid bodies. Non-inertial reference frames are examined. Vector calculus in curvilinear coordinates and in phase space are used.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: (PHYS 142 or 143 or 162H) and (PHYS 240 or 241 or 261H) and MATH 223. Prerequisite or concurrent registration in PHYS 204 and (MATH 254 or MATH 355).

Special Exam: Special Exam Credit Only

PHYS 331: Electricity and Magnetism I (3 units)

Description: The study of static electric and magnetic fields separately in vacuum and in matter leads to Maxwell's equations, which relate electric and magnetic fields when time-dependence sets in. Vector calculus in curvilinear coordinates is an indispensable tool throughout the course.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: (PHYS 240 or 241 or 261H) and MATH 223 and PHYS 204.
Prerequisite or concurrent registration in PHYS 321.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 332: Electricity and Magnetism II (3 units)

Description: The second half of a course in electricity and magnetism. Topics cover electrodynamics, conservation laws, electromagnetic waves, potentials and fields, and continuous media. Maxwell's equations in differential form are applied to dynamic systems, especially, radiation. Einstein's theory of special relativity and electrodynamics are treated in 4-vector and tensor form.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: PHYS 331 and PHYS 305.

PHYS 371: Quantum Theory (3 units)

Description: A mid-level course starts with Schrödinger's equation and waves applied to one particle in one-dimensional potential wells and ends with the hydrogen atom in three dimensions. Topics cover limits of classical physics, wave equations, phase and group velocities, Schrodinger's equation, one dimensional problems - square well, step potentials, operators and matrices, observables and measurements, the uncertainly principle, the harmonic oscillator, raising and lowering operators, two particle problems, Schrodinger's equation in three dimensions, angular momentum and the hydrogen atom. Partial differential equation and linear algebra are basic tools.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: PHYS 321, PHYS 263H, and PHYS 204.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 381: Methods in Experimental Physics I (2 units)

Description: Designed to develop experimental skills and to demonstrate important concepts in classical and modern physics by measuring fundamental physical constants, as well as the importance of error estimation and propagation. This is a Writing Emphasis Course to develop professional writing skills including notebook documentation and manuscript preparation.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$150

Course Components:	Laboratory	Required
	Lecture	Required

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Prerequisite or concurrent enrollment: PHYS 321 and (PHYS 305 or 320 or 331 or 371).

Writing Emphasis: Writing Emphasis Course

PHYS 382: Methods of Experimental Physics II (2 units)

Description: Continuation of PHYS 381 with a special project to be determined by the student and the instructor. This is a Writing Emphasis Course like PHYS 381.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$150

Course Components:	Laboratory	Required
	Lecture	Required

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: PHYS 381.

Writing Emphasis: Writing Emphasis Course

PHYS 391: Preceptorship (1 - 6 units)

Description: Specialized work on an individual basis, consisting of instruction and practice in actual service in a department, program, or discipline. Teaching formats may include seminars, in-depth studies, laboratory work and patient study.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 4 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 392: Directed Research (1 - 6 units)

Description: Individual or small group research under the guidance of faculty.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Course typically offered:

Main Campus: Fall, Spring, Summer

PHYS 399: Independent Study (1 - 6 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

PHYS 399H: Honors Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: Student must be active in the Honors College.

Honors Course: Honors Course

Honors Course: Honors Course

PHYS 403: Physics of the Solar System (3 units)

Description: Survey of planetary physics, planetary motions, planetary interiors, geophysics, planetary atmospheres, asteroids, comets, origin of the solar system.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: ASTR 403, GEOS 403

Also offered as: ASTR 403, GEOS 403, PTYS 403

Course typically offered:

Main Campus: Spring (odd years only)

Home department: Planetary Sciences

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 405: Digital Electronics Techniques (3 units)

Description: Electronics techniques used in experimental physics. Emphasizes computer aided schematic capture and simulation. Topics include diodes and transistors, op-amps, D/A and A/D conversion, combinatorial logic, sequential logic, programmable logic.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$100

Course Components:	Laboratory	Required
	Lecture	Required

Co-convened with: PHYS 505

Course typically offered:

Main Campus: Fall (odd years only)

Recommendations and additional information: PHYS 241 or PHYS 251.

Enrollment requirement: (PHYS 105 or ECE 175) and (PHYS 241 or 261H).

PHYS 422: Continuum Mechanics (3 units)

Description: A second semester of Newtonian mechanics. It begins with the description, statics and dynamics of deformable solids, and proceeds to the mechanics of fluids. Topics include statics; equilibrium conditions, simple deformations, inertia and stress tensors and deformations in general, review of Lagrange and Hamilton techniques, coupled harmonic oscillators and normal modes, theory of small oscillations, mechanics of the vibrating string, mechanics of fluids; ideal fluid approximations, sound, viscosity and the dynamics of viscous fluids.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Co-convened with: PHYS 522

Course typically offered:

Main Campus: Spring (even years only)

Recommendations and additional information: MATH 254.

Enrollment requirement: PHYS 321 and (PHYS 331 or PHYS 371).

PHYS 426: Thermal Physics (3 units)

Description: A study of the energetics and the relations among bulk properties of macroscopic systems in terms of the energies available to the individual microscopic constituents. Classical and quantum statistics are applied to systems in thermal equilibrium to derive their bulk properties. Kinetic theory, transport phenomena, fluctuations and irreversible processes are examined.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: PHYS 331, PHYS 371, and PHYS 305.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 427: Philosophy of the Physical Sciences (3 units)

Description: Theories and models. Measurement, experimentation, testing hypothesis. Philosophical problems concerning explanation, causation, and law of nature. Philosophical problems raised by quantum mechanics and/or other physical theories.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: PHYS 427

Also offered as: PHIL 427

Course typically offered:

Main Campus: Fall (even years only)

Home department: Philosophy

PHYS 431: Molecular Biophysics (3 units)

Description: A survey of basic biological processes and the advanced physical techniques to study these processes, primarily at the single-molecule scale. Topics may include thermal and statistical physics, free energy transduction, entropic forces, biopolymers, molecular motors, and biological machines, but also biochemical networks, nerve impulses, and neural computing.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: PHYS 531

Course typically offered:

Main Campus: Spring (odd years only)

Recommendations and additional information: CHEM 103A; CHEM 103B or equivalent.

Enrollment requirement: PHYS 103 or 240 or 241 or 261H.

PHYS 439: Physics Teaching Methods (3 units)

Description: This is a culminating course in the preparation of physics teachers. It is required for students in the College of Science Teacher Preparation Program who plan to teach physics. The course focuses on the understanding of central ideas in physics traditionally included in the secondary school curriculum. Additionally, the course helps students identify and assess physics concepts that secondary level students are likely to have difficulty understanding. Students will create curriculum plans, compile resources for physics teaching, and examine physics lab safety regulations.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Repeatable: Course can be repeated a maximum of 3 times.

Equivalent to: CHEM 439

Recommendations and additional information: Concurrent registration, STCH 410, or have completed STCH 410 or STCH 420 or STCH 420A. STCH 250, STCH 310, 18 units of physics or chemistry major courses.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 440: Medical Physics (3 units)

Description: Applications of physics in medicine. Physics of the human body, mechanics, thermodynamics, light and radiation and their roles in biological systems, biomedical applications.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: PHYS 540

Course typically offered:

Main Campus: Fall

Enrollment requirement: PHYS 263H.

Honors Course: Honors Contract

Honors Course: Honors Contract

PHYS 450: Nuclear and Particle Physics (3 units)

Description: An introduction to the study of the nucleus and elementary particles. Topics include nuclear masses and binding energies, nuclear angular momentum, spin and parity, internucleon forces, shell model, collective model, radioactive decays, nuclear reactions, fission and fusion, particle interactions and families, symmetries and conservation laws, quark model, standard model.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: NEE 450

Course typically offered:

Main Campus: Fall

Enrollment requirement: PHYS 371.

PHYS 460: Solid-State Physics (3 units)

Description: Modern theory of crystalline solids. Topics include crystal structure, reciprocal lattice and X-ray diffraction, crystal binding, lattice vibrations and phonons, phonon heat capacity, free electron model of metals, band theory and fermi surfaces, tight binding model, semiconductors, magnetic properties - diamagnetism, paramagnetism, ferromagnetism, superconductivity.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring

Recommendations and additional information: PHYS 371.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: Causality, simultaneity, time dilation and Lorentz contraction; space-time symmetries and transformations and invariants; covariance, relativistic kinematics, potentials and forces, covariant dynamics and variational principle, conservation laws; relativistic electromagnetic forces and fields; relativistic quantum mechanics, Dirac atom, spin-orbit force, antimatter, discrete CPT symmetries.

Career: Undergraduate

Co-convened with: PHYS 568

Course typically offered:

Main Campus: Fall (even years only)

Recommendations and additional information: Concurrent registration with PHYS 472.

Enrollment requirement: PHYS 371 and PHYS 331. Co-requisite PHYS 472.

Honors Course: Honors Contract

Honors Course: Honors Contract

Description: An introduction to Einstein's theory of General Relativity for seniors or beginning graduate students. Topics include: Review of Special Relativity; Gravity as Geometry; Curved Spacetimes/Geodesics; Introduction to Tensors/Curvature; Solar system Tests of Gravity; Gravitational Lensing; Black Holes; Gravitational Waves; Gravity and Cosmology; Dark Matter/Dark Energy.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: ASTR 469

Co-convener with: PHYS 569

Course typically offered:

Main Campus: Spring (odd years only)

Enrollment requirement: PHYS 263H, PHYS 321, PHYS 331, and PHYS 332.

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 472: Quantum Theory II (3 units)

Description: Continuation of PHYS371. Topics include matrix formulation of quantum mechanics, theory of angular momentum, spin, addition of angular momenta, variational methods, the periodic table, molecules, stationary state perturbation theory, fine structure, of hydrogen, time dependent perturbation theory, transition rates, Fermi's golden rule. Optional topics include nuclear, elementary particle or condensed matter physics.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: PHYS 572

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: PHYS 371 and PHYS 305.

PHYS 473: Atomic and Molecular Spectroscopy for Experimentalists I (3 units)

Description: Experimental techniques to generate, analyze and detect photons from X-ray to infrared; interpretation of spectra from gases, liquids, solids and biological macromolecules; light scattering, polarization.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: OPTI 473

Co-convened with: PHYS 573

Enrollment requirement: PHYS 242 and PHYS 263H

PHYS 476: Methods of Mathematical Physics II (3 units)

Description: Mathematical techniques and their physical applications. Topics include partial differential equations, complex variables, Fourier analysis, calculus of variations, tensors and tensor calculus, special functions. Additional topics may include numerical analysis, group theory and probability or stochastic systems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: PHYS 576

Course typically offered:

Main Campus: Fall (even years only)

Enrollment requirement: PHYS 204 and PHYS 321.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 483: Methods of Experimental Physics IV (3 units)

Description: This is the culmination of the series of Experimental Methods courses. It consists of a research project designed and executed by the student, under the tutelage of a research professor in or outside of the department.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$150

Course Components: Laboratory Required

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: PHYS 382.

PHYS 484: Nuclear Magnetic Resonance Spectroscopy (3 units)

Description: Basic theory and interpretation of nuclear magnetic resonance (NMR) methods from a multidisciplinary perspective. The course covers experimental NMR methods; nuclear spin interactions; relaxation and dynamics; solid state NMR; liquid state NMR; and magnetic resonance imaging (MRI). Emphasis is placed on a unified description of magnetic resonance phenomena at a level appropriate for chemists, physicists, biochemists, and engineers.

Grading basis: Student Option ABCDE/PF

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall

Recommendations and additional information: PHYS 371 or CHEM 480B or CHEM 481 or equivalent experience or consent of instructor.

PHYS 492: Directed Research (1 - 6 units)

Description: Individual or small group research under the guidance of faculty.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated for a maximum of 6 units.

Course typically offered:

Main Campus: Fall, Spring, Summer

Student Engagement Activity: Discovery

Student Engagement Competency: Innovation and Creativity

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 494: Practicum (3 units)

Description: The practical application, on an individual basis, of previously studied theory and the collection of data for future theoretical interpretation.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

PHYS 496A: Communicating Physics (1 - 3 units)

Description: A course for intermediate-advanced undergraduates and graduate students interested in demonstrating physics concepts and experimental methods for the public and for students in grades K-12. Students will use experimental stations to teach physics and run hands-on demonstrations for visiting K-12 students. Demonstrations will be chosen from mechanics, thermodynamics, optics, and electricity and magnetism. Students will be trained in instruction techniques in a day-long workshop (TBA) at the beginning of the semester, after which they will engage in weekly outreach at the Flandrau planetarium under the guidance of the instructor. The time commitment and the number of credits a student registers for will, in part, depend upon the student's availability during the K-12 sessions. An organizational meeting will be held to determine the time commitment and the number of credits for each student.

Grading basis: Student Option ABCDE/PF

Career: Undergraduate

Course Components: Seminar Required

Repeatable: Course can be repeated for a maximum of 6 units.

Co-convened with: PHYS 596A

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: PHYS 321.

PHYS 498: Senior Capstone (1 - 3 units)

Description: A culminating experience for majors involving a substantive project that demonstrates a synthesis of learning accumulated in the major, including broadly comprehensive knowledge of the discipline and its methodologies. Senior standing required.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated for a maximum of 6 units.

Course typically offered:

Main Campus: Fall, Spring, Summer

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 498H: Honors Thesis (3 units)

Description: An honors thesis is required of all the students graduating with honors. Students ordinarily sign up for this course as a two-semester sequence. The first semester the student performs research under the supervision of a faculty member; the second semester the student writes an honors thesis.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 2 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: Student must be active in the Honors College.

Honors Course: Honors Course

Honors Course: Honors Course

Writing Emphasis: Writing Emphasis Course

PHYS 499: Independent Study (1 - 5 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

PHYS 499H: Honors Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: Student must be active in the Honors College.

Honors Course: Honors Course

Honors Course: Honors Course

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 502: Health Physics (3 units)

Description: Health physics is the study of radiation and radiation protection. This involves understanding how to use the benefits of radiation, such as in medicine, while minimizing the potential hazards from radiation. During this course students will learn basics in radiation physics, radiation protection practices, federal regulations and radiation shielding. Particular emphasis will be given to the medical applications of health physics.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: PHYS 502

Also offered as: RONC 502

Course typically offered:

Main Campus: Fall

Home department: Radiation Oncology

PHYS 503: Physics of the Solar System (3 units)

Description: Survey of planetary physics, planetary motions, planetary interiors, geophysics, planetary atmospheres, asteroids, comets, origin of the solar system. Graduate-level requirements include an in-depth research paper on a selected topic and an oral class presentation.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Equivalent to: ASTR 503, GEOS 503

Also offered as: ASTR 503, GEOS 503, PTYS 503

Course typically offered:

Main Campus: Spring (odd years only)

Home department: Planetary Sciences

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-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 505: Digital Electronics Techniques (3 units)

Description: Electronics techniques used in experimental physics. Emphasizes computer aided schematic capture and simulation. Topics include diodes and transistors, op-amps, D/A and A/D conversion, combinatorial logic, sequential logic, programmable logic. Graduate-level requirements include completion of a final project including programmable logic and at least one of the following components in its design: state machine, tri-state logic, memory or FIFOs, arithmetic units.

Grading basis: Regular Grades

Career: Graduate

Flat Fee: \$100

Course Components:	Laboratory	Required
	Lecture	Required

Co-convened with: PHYS 405

Course typically offered:

Main Campus: Fall (odd years only)

PHYS 511: Analytical Mechanics (3 units)

Description: Laws of motion as developed by Newton, d'Alembert, Lagrange and Hamilton; dynamics of particles and rigid bodies.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Fall

PHYS 515A: Electromagnetic Theory (3 units)

Description: Theory of classical electromagnetic phenomena, including time-dependent and static solutions of Maxwell's equations, radiation theory and relativistic electrodynamics.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Spring

Recommendations and additional information: PHYS 332, PHYS 476.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 515B: Electromagnetic Theory (3 units)

Description: Theory of classical electromagnetic phenomena, including time-dependent and static solutions of Maxwell's equations, radiation theory and relativistic electrodynamics.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall

Recommendations and additional information: PHYS 332, PHYS 476.

PHYS 522: Continuum Mechanics (3 units)

Description: A second semester of Newtonian mechanics. It begins with the description, statics and dynamics of deformable solids, and proceeds to the mechanics of fluids. Topics include statics; equilibrium conditions, simple deformations, inertia and stress tensors and deformations in general, review of Lagrange and Hamilton techniques, coupled harmonic oscillators and normal modes, theory of small oscillations, mechanics of the vibrating string, mechanics of fluids; ideal fluid approximations, sound, viscosity and the dynamics of viscous fluids. Graduate-level requirements include a semester long project either experimental or computational plus class presentation.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Co-convener with: PHYS 422

Course typically offered:

Main Campus: Spring (even years only)

Recommendations and additional information: PHYS 511 or pre-requisite can also be satisfied by an equivalent of PHYS 321 taken at the student's undergraduate institution.

PHYS 528: Statistical Mechanics (3 units)

Description: Physical statistics; the connection between the thermodynamic properties of a macroscopic system and the statistics of the fundamental components; Maxwell-Boltzmann, Fermi-Dirac, Einstein-Bose statistics.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall

Recommendations and additional information: PHYS 476.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 531: Molecular Biophysics (3 units)

Description: A survey of basic biological processes and the advanced physical techniques to study these processes, primarily at the single-molecule scale. Topics may include thermal and statistical physics, free energy transduction, entropic forces, biopolymers, molecular motors, and biological machines, but also biochemical networks, nerve impulses, and neural computing. Graduate-level requirements include an extra term paper.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: MBIM 531, MICR 531

Co-convened with: PHYS 431

Course typically offered:

Main Campus: Spring (odd years only)

PHYS 534: Atomic, Molecular, and Optical Physics (3 units)

Description: Development of theoretical and conceptual framework required to understand and interpret light-matter interactions in atoms and molecules, especially in the interesting modern limits, such as, intense-fields, low-temperatures and fast timescales. Topics include: review of one-electron atomic systems, two and many-electron atomic systems, electronic structure and binding in molecules, static and time-dependent external fields, strong fields interactions, interactions on ultrafast timescales, laser cooling and trapping.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Fall (odd years only)

Recommendations and additional information: Experience with Quantum Mechanics equivalent to PHYS 472 or consent of instructor.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 537: The Physics of the Sun (3 units)

Description: The purpose of this course is to present an introduction to the physics of the Sun. The course begins with a discussion of the standard solar model, the solar-neutrino problem, and observational techniques. Long-term variability in the total irradiance, sunspot number, and diameter, and its effect on Earth's climate will be addressed in some detail. Other topics include the physics of the solar interior, solar oscillations, and solar composition. This course will also introduce the equations of magnetohydrodynamics and apply them to important solar-physics problems, such as: the solar magnetic dynamo, stability of prominences, physics of sunspots and flares, and heating of the solar atmosphere. The emphasis throughout will be on basic physical processes and the various approximations used in their application to concrete problems.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: ASTR 537, ATMO 537, PHYS 537

Also offered as: ASTR 537, ATMO 537, PTYS 537

Home department: Planetary Sciences

PHYS 540: Medical Physics (3 units)

Description: Applications of physics in medicine. Physics of the human body, mechanics, thermodynamics, light and radiation and their roles in biological systems, biomedical applications. Graduate-level requirements include students to complete supplemental assignments at the graduate level.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Also offered as: OPTI 540

Co-convener with: PHYS 440

Course typically offered:

Main Campus: Fall

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: Mathematical formulation and problems of statistical physics, quantum physics and field theory, relations between macroscopic and microscopic and between classical and quantum descriptions of physical systems, analytical, probabilistic and geometric methods. Contents vary.

Career: Graduate

Repeatable: Course can be repeated a maximum of 3 times.

Equivalent to: PHYS 541

Also offered as: MATH 541

Course typically offered:

Main Campus: Fall

Recommendations and additional information: MATH 523A, MATH 523B or MATH 527A, MATH 527B or consent of instructor.

Home department: Mathematics

Description: Students perform laboratory experiments on the following six topics: spectroscopy, acoustics, optics of small particles, geometrical and physical optics, optical interferometry, and vacuum techniques and thermodynamics of gases. The student can do one or all of these in a given semester. Experiments on each topic last one-third of the semester. Graduate-level requirement includes one extra ORIGINAL measurement and writing a separate report on this measurement.

Grading basis: Regular Grades

Career: Graduate

Course Components: Laboratory Required

Repeatable: Course can be repeated for a maximum of 6 units.

Equivalent to: FCM 544, FCR 544, FCSC 544, NURS 544

Co-convener with: PHYS 444

Recommendations and additional information: While students can take this course for up to six credits, they may not repeat any of the subtopics (e.g. Spectroscopy, acoustics, etc.)

Description: Theory of nuclear systems, including stability, decay, nuclear forces, scattering, reactions, structure and interaction with electromagnetic radiation.

Grading basis: Student Option ABCDE/PF

Career: Graduate

Course Components: Lecture Required

Equivalent to: ASTR 551, PTYS 551

Course typically offered:

Main Campus: Fall (even years only)

Recommendations and additional information: Concurrent registration, PHYS 570A, PHYS 570B

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 558: Plasma Physics with Astrophysical and Solar System Applications (3 units)

Description: The goal of this course is to present an introduction to fundamental plasma physics and magnetohydrodynamics, beginning with kinetic theory. The various important limits including the vlasov equation and magnetohydrodynamics will be derived. Applications will be mostly from astrophysics and the solar system. These will include the main dynamical processes in the solar atmosphere, interplanetary medium, magnetospheres, interstellar medium, blast waves, accretion disks, etc. The emphasis throughout will be on basic physical processes and the various approximations used in their application to concrete problems.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: ASTR 558, PHYS 558

Also offered as: ASTR 558, PTYS 558

Course typically offered:

Main Campus: Spring

Home department: Planetary Sciences

PHYS 560A: Condensed Matter Physics (3 units)

Description: Quantum theory of solids: second-quantization; electrons and phonons; band theory and semiconductors; transport theory; magnetic field effects; semiconductor devices; phenomenological treatments of magnetism and superconductivity.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall

PHYS 560B: Condensed Matter Physics (3 units)

Description: Continuation of PHYS 560A, including a comprehensive selection of the following topics: microscopic theories of magnetism and superconductivity; metal-insulator transitions; broken symmetries and order parameters; surfaces and interfaces; nanostructures and quantum transport; membranes; polymers; liquid crystals; hydrodynamics; complex fluids; novel materials.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring (even years only)

Recommendations and additional information: PHYS 560A.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 561: Physics of Semiconductors (3 units)

Description: Elementary excitations in solids, phonons, electrons and holes, dielectric formalism of optical response, many-body effects in a Coulomb system.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: OPTI 561

Also offered as: OPTI 561

Course typically offered:

Main Campus: Spring (odd years only)

Recommendations and additional information: PHYS 460; OPTI 507 recommended but not formally required.

PHYS 562: Theory of Condensed Matter (3 units)

Description: Quantum theory of solids. Elementary excitations. Electron-phonon and electron-electron interactions. Spins and magnetism. Metal-insulator transitions. Basic concepts in superconductivity.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Repeatable: Course can be repeated a maximum of 2 times.

Recommendations and additional information: PHYS 460 or PHYS 560; PHYS 475, PHYS 476.

PHYS 566: Green's Function Methods in Many-Body Theory (3 units)

Description: Course reviews the second-quantization method, Green's Function techniques in zero-temperature quantum field theory, basic properties of zero-temperature Feynman-Stuckelberg-Dyson diagrams and Green's Function methods at finite temperatures. Course will also consider applications of these methods in condensed-matter physics, optics and nuclear physics.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Recommendations and additional information: PHYS 570A, PHYS570B and consent of instructor.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 568: Classical and Quantum Relativity (3 units)

Description: Causality, simultaneity, time dilation and Lorentz contraction; space-time symmetries and transformations and invariants; covariance, relativistic kinematics, potentials and forces, covariant dynamics and variational principle, conservation laws; relativistic electromagnetic forces and fields; relativistic quantum mechanics, Dirac atom, spin-orbit force, antimatter, discrete CPT symmetries. Graduate-level requirements include a written project report and a 20 minute presentation on a special topic. The presentations will occur at the very end of the semester and all graduate students will be required to attend the presentations. Attendance will be optional for undergraduates.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: PHYS 468

Course typically offered:

Main Campus: Fall (even years only)

PHYS 569: Introduction to General Relativity (3 units)

Description: An introduction to Einstein's theory of General Relativity for seniors or beginning graduate students. Topics include: Review of Special Relativity; Gravity as Geometry; Curved Spacetimes/Geodesics; Introduction to Tensors/Curvature; Solar system Tests of Gravity; Gravitational Lensing; Black Holes; Gravitational Waves; Gravity and Cosmology; Dark Matter/Dark Energy. Graduate-level requirements include a term project that will be presented towards the end of the semester. Moreover, graduate students will be required to solve more (and more advanced) homework problems.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: ASTR 569

Co-convened with: PHYS 469

Course typically offered:

Main Campus: Spring (odd years only)

Interdisciplinary Interest Area: ASTR - Astronomy

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 570A: Quantum Mechanics (3 units)

Description: Introduction to quantum mechanics. Covers theoretical foundations of quantum mechanics (state kets, operators, complex vector spaces, measurement theory, wavefunctions); position, momentum, and linear translations; time evolution and quantum dynamics; decoherence of wave packets; harmonic oscillators; quantum mechanics and classical electromagnetism; path-integral formulation of quantum mechanics; theory of rotations and angular momentum; Wigner-Eckart theorem.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Fall

Recommendations and additional information: PHYS 475; PHYS 476 recommended but not required.

PHYS 570B: Quantum Mechanics (3 units)

Description: Continuation of PHYS 570A. Covers discrete symmetries (parity inversion, lattice translations, time reversal, exchange symmetries and correlations); approximation methods (time-dependent and time-independent perturbation theory, variational techniques, WKB approximation); transition rates and Fermi's Golden Rule; relativistic quantum mechanics (Klein-Gordon and Dirac equations). Also covers scattering theory and interaction of radiation with matter as time permits.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Spring

Recommendations and additional information: PHYS 570A, PHYS 566, PHYS 551.

PHYS 572: Quantum Theory II (3 units)

Description: Topics include matrix formulation of quantum mechanics, theory of angular momentum, spin, addition of angular momenta, variational methods, the periodic table, molecules, stationary state perturbation theory, fine structure, of hydrogen, time dependent perturbation theory, transition rates, Fermi's golden rule. Optional topics include nuclear, elementary particle or condensed matter physics. Graduate-level requirements include additional homework problems.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Co-convened with: PHYS 472

Course typically offered:

Main Campus: Fall, Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 579A: Advanced Relativistic Quantum Mechanics I (3 units)

Description: Pair production in e+e- annihilation; Klein-Gordon field; Dirac field; Feynman diagrams; basic quantum electrodynamics and radiative corrections; functional methods; renormalization and the renormalization group; critical exponents.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall (even years only)

Recommendations and additional information: PHYS 515B, PHYS 570B.

PHYS 579B: Advanced Relativistic Quantum Mechanics II (3 units)

Description: Non-abelian gauge invariance, quantization of non-abelian gauge theories, quantum chromodynamics, gauge theories with spontaneous symmetry breaking, quantization of spontaneously broken gauge theories. Standard Model of particle physics.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring (odd years only)

Recommendations and additional information: PHYS 579A.

PHYS 579C: Advanced Relativistic Quantum Mechanics (3 units)

Description: Application of quantum field theory to particle physics. The Standard Model of elementary particles and interactions will be introduced and various topics will be covered, including symmetries, quantum gauge theories, quantum chromodynamics, electroweak theory and phenomenology, flavourdynamics, chiral Lagrangian, effective field theory, grand unification and alternatives to the Standard Model.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Recommendations and additional information: PHYS 579A, PHYS 579B or consent of instructor.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 581: Elementary Particle Physics (3 units)

Description: Production, interaction, and decay of mesons, baryons and leptons; high energy scattering of elementary particles; particle classification and symmetries; theoretical interpretation.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall (odd years only)

Recommendations and additional information: PHYS 472.

PHYS 586: Techniques in Particle Physics (3 units)

Description: Classification of elementary particles and their interactions with matter, relativistic kinematics, detectors, data acquisition techniques, statistical techniques, analysis of experiments, cosmic radiation and accelerators.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Laboratory	Required
	Lecture	Required

Course typically offered:

Main Campus: Spring

PHYS 589: Topics of Theoretical Astrophysics (3 units)

Description: Current topics in theoretical astrophysics in depth, with emphasis on the methodology and techniques of the theorist and the cross-disciplinary nature of astrophysics theory. Example subjects are nuclear astrophysics, hydrodynamics, transient phenomena, planetary interiors and atmospheres, neutron stars, jets and the evolution of star clusters.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Repeatable: Course can be repeated a maximum of 2 times.

Equivalent to: ASTR 589, PTYS 589

Also offered as: PTYS 589

Course typically offered:

Main Campus: Spring (odd years only)

Interdisciplinary Interest Area: ASTR - Astronomy

-SA represents a Student Abroad & Student Exchange offering

-**CC** represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 591: Preceptorship (1 - 3 units)

Description: Specialized work on an individual basis, consisting of instruction and practice in actual service in a department, program, or discipline. Teaching formats may include seminars, in-depth studies, laboratory work and patient study.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring

PHYS 593: Internship (1 - 6 units)

Description: Specialized work on an individual basis, consisting of training and practice in actual service in a technical, business, or governmental establishment.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 2 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

PHYS 596A: Communicating Physics (1 - 3 units)

Description: A course for intermediate-advanced undergraduates and graduate students interested in demonstrating physics concepts and experimental methods for the public and for students in grades K-12. Students will use experimental stations to teach physics and run hands-on demonstrations for visiting K-12 students. Demonstrations will be chosen from mechanics, thermodynamics, optics, and electricity and magnetism. Students will be trained in instruction techniques in a day-long workshop (TBA) at the beginning of the semester, after which they will engage in weekly outreach at the Flandrau planetarium under the guidance of the instructor. The time commitment and the number of credits a student registers for will, in part, depend upon the student's availability during the K-12 sessions. An organizational meeting will be held to determine the time commitment and the number of credits for each student. Graduate-level requirements include designing a NEW experiment to be used with the standard outreach events and lead at least one session of weekend/evening public outreach in addition to the K-12 weekday sessions.

Grading basis: Regular Grades

Career: Graduate

Course Components: Seminar Required

Repeatable: Course can be repeated for a maximum of 6 units.

Co-convened with: PHYS 496A

Course typically offered:

Main Campus: Fall, Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 596C: Medical Physics Seminar (1 unit)

Description: During the Medical Physics Seminar several areas of medical physics will be explored, including faculty research, professional issues and guest speakers. Students who attend the course will be up to date on current research, credentialing and professional issues.

Grading basis: Regular Grades

Career: Graduate

Course Components: Seminar Required

Equivalent to: PHYS 596C

Also offered as: RONC 596C

Course typically offered:

Main Campus: Fall

Home department: Radiation Oncology

PHYS 596H: Philosophy of Physical Science (3 units)

Description: The development and exchange of scholarly information, usually in a small group setting. The scope of work shall consist of research by course registrants, with the exchange of the results of such research through discussion, reports, and/or papers. Courses for which students receive the grade of P (Pass) do not satisfy requirements for the M.A. or Ph.D. or minor in philosophy.

Grading basis: Student Option ABCDE/PF

Career: Graduate

Course Components: Seminar Required

Repeatable: Course can be repeated a maximum of 3 times.

Equivalent to: PHYS 596H

Also offered as: PHIL 596H

Course typically offered:

Main Campus: Fall, Spring

Home department: Philosophy

PHYS 599: Independent Study (1 - 6 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work. Graduate students doing independent work which cannot be classified as actual research will register for credit under course number 599, 699, or 799.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 601A: Radiation Dosimetry (3 units)

Description: Radiation dosimetry is the science of how ionizing radiation interacts with matter and specifically the energy absorbed. This course will deal with quantitative methods used to determine energy deposition. Topics will include radiation interactions, radiation measurements and dosimetry fundamentals.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: PHYS 601A

Also offered as: RONC 601A

Course typically offered:

Main Campus: Fall

Home department: Radiation Oncology

PHYS 601B: Therapeutic Radiological Physics (3 units)

Description: Therapeutic radiological physics is the study of using radiation to treat different medical pathologies. This course will cover areas of basic radiation physics, external beam therapy, brachytherapy and linear accelerators.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: PHYS 601B

Also offered as: RONC 601B

Course typically offered:

Main Campus: Spring

Home department: Radiation Oncology

PHYS 695A: Current Problems in Physics (1 unit)

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Colloquium Required

Repeatable: Course can be repeated a maximum of 2 times.

Course typically offered:

Main Campus: Fall, Spring

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-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 697B: Applied Mathematics Laboratory (3 units)

Description: The practical application of theoretical learning within a group setting and involving an exchange of ideas and practical methods, skills, and principles.

Grading basis: Regular Grades

Career: Graduate

Course Components: Workshop Required

Equivalent to: MSE 697B, PHYS 697B

Also offered as: MATH 697B, MSE 697B

Course typically offered:

Main Campus: Spring

Recommendations and additional information: Applied math core or equivalent.

Home department: Mathematics

PHYS 699: Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work. Graduate students doing independent work which cannot be classified as actual research will register for credit under course number 599, 699, or 799.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Course typically offered:

Main Campus: Fall, Spring, Summer

PHYS 900: Research (1 - 6 units)

Description: Individual research, not related to thesis or dissertation preparation, by graduate students.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

PHYS 909: Master's Report (1 - 9 units)

Description: Individual study or special project or formal report thereof submitted in lieu of thesis for certain master's degrees.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

PHYS 910: Thesis (1 - 6 units)

Description: Research for the master's thesis (whether library research, laboratory or field observation or research, artistic creation, or thesis writing). Maximum total credit permitted varies with the major department.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

PHYS 920: Dissertation (1 - 9 units)

Description: Research for the doctoral dissertation (whether library research, laboratory or field observation or research, artistic creation, or dissertation writing).

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

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-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.