

PHYSICS AND ASTRONOMY (PHYS)

Subject-area course lists indicate courses currently active for offering at the University of Louisville. Not all courses are scheduled in any given academic term. For class offerings in a specific semester, refer to the Schedule of Classes (<http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm>).

500-level courses generally are included in both the undergraduate- and graduate-level course listings; however, specific course/section offerings may vary between semesters. Students are responsible for ensuring that they enroll in courses that are applicable to their particular academic programs.

Course Fees

Some courses may carry fees beyond the standard tuition costs to cover additional support or materials. Program-, subject- and course-specific fee information can be found on the Office of the Bursar website (<http://louisville.edu/bursar/tuitionfee/>).

PHYS 501. Independent Study 1-3 Units

Description: Independent research conducted with the approval and supervision of a faculty member.

For class offerings for a specific term, refer to the Schedule of Classes (<http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm>)

PHYS 502. Independent Study 1-3 Units

Description: Independent research conducted with the approval and supervision of a faculty member.

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PHYS 507. Solar System Astronomy 3 Units

Prerequisite(s): PHYS 300; MATH 206 or ENGR 102.

Description: This is an advanced course in solar system astrophysics, and will cover orbital mechanics, the nature of light, astronomical instrumentation, solar physics, planetary atmospheres/geophysics, comets/asteroids, interplanetary dust and exo-planets.

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PHYS 517. Physics of Climate 3 Units

Term Typically Offered: Spring Odd Years

Prerequisite(s): MATH 206 or ENGR 102 (or equivalent) or permission of instructor.

Description: Introduction to the physics of Earth's climate system, including the energy budget of the atmosphere, oceans, and cryosphere, shortwave and longwave radiation, the effects of clouds and aerosols, and models of the greenhouse effect, climate sensitivity, atmosphere-ocean feedbacks, and climate change.

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PHYS 518. Space Weather 3 Units

Term Typically Offered: Spring Even Years

Prerequisite(s): MATH 206 or ENGR 102 (or equivalent), or permission of instructor.

Description: This course provides a comprehensive overview of the physics and effects of space weather. Space weather refers to conditions on the Sun and in the solar wind, magnetosphere, ionosphere, and thermosphere that can influence the performance and reliability of space-borne and ground-based technological systems, and affect human life or health.

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PHYS 520. Vibrations and Sound 3 Units

Term Typically Offered: Occasionally Offered

Prerequisite(s): PHYS 298, PHYS 299 and MATH 206.

Description: Vibrating bodies, propagation of sound waves, physical acoustics, and ultrasonics.

For class offerings for a specific term, refer to the Schedule of Classes (<http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm>)

PHYS 530. Thermal Physics 3 Units

Prerequisite(s): PHYS 299; MATH 301 or ENGR 201.

Description: The laws of thermodynamics, thermodynamic reasoning, and elements of statistical mechanics.

For class offerings for a specific term, refer to the Schedule of Classes (<http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm>)

PHYS 531. Introductory Statistical Physics 3 Units

Prerequisite(s): PHYS 530.

Description: Elementary probability theory applied to the understanding of properties of macroscopic matter in terms of their microscopic constituents. Kinetic theory of gases, transport phenomena. Equations of state derived from ensemble theory.

For class offerings for a specific term, refer to the Schedule of Classes (<http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm>)

PHYS 541. Electromagnetic Fields 3 Units

Term Typically Offered: Occasionally Offered

Prerequisite(s): PHYS 300; PHYS 350 or MATH 405 or ENGR 205; MATH 301 or ENGR 201.

Description: Electrostatic and magnetostatic fields in free space and in material media, solutions of Poisson's equation, time dependent fields, Maxwell's equations.

For class offerings for a specific term, refer to the Schedule of Classes (<http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm>)

PHYS 542. Electromagnetic Radiation 3 Units

Term Typically Offered: Spring Only

Prerequisite(s): PHYS 541.

Description: Poisson's equation and LaPlace's Equation, propagation of electromagnetic fields with applications to optics and microwave physics.

For class offerings for a specific term, refer to the Schedule of Classes (<http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm>)

PHYS 545. Advanced Optics	3 Units	PHYS 562. Mathematical Physics II	3 Units
Prerequisite(s): PHYS 355 and PHYS 542; or consent of instructor.		Prerequisite(s): PHYS 350 or MATH 405 or ENGR 205.	
Description: Topics in optical physics including optical system design, lasers, and quantum optics.		Description: Selected mathematical techniques and their applications to various fields of physics.	
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PHYS 546. Advanced Optics Lab	1 Unit	PHYS 563. Fluid Dynamics	3 Units
Prerequisite(s): PHYS 355 or equivalent.		Term Typically Offered: Spring Odd Years	
Fee: An additional \$25.00 is charged for this course.		Prerequisite(s): MATH 301 or ENGR 201 (or equivalent), or permission of instructor.	
Description: Laboratory experiments illustrating fundamental optical phenomena, the interaction of light and matter, lasers, and quantum optics.		Description: An introduction to nonlinear fluid dynamics, covering kinematics (strain, rotation, transport), nonlinear conservation laws (mass, momentum, energy; dimensions forms), vorticity dynamics, viscous flows, boundary layers, shear instability, and turbulence. Concepts are illustrated with applications drawn from aerodynamics (lift and drag on airfoils, propulsion of fish and birds), biofluids (flow in blood vessels), compressible flow (shock waves), geophysical fluid dynamics (waves, shear instability), and turbulence (energy cascades, modeling strategies).	
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PHYS 547. Fundamentals of Lasers	3 Units	PHYS 565. Advanced Computational and Numerical Methods in Physics	3 Units
Term Typically Offered: Occasionally Offered		Term Typically Offered: Spring Only	
Prerequisite(s): PHYS 355; and PHYS 542 or ECE 473; or consent of instructor.		Prerequisite(s): PHYS 350 or PHYS 561.	
Description: Topics to be discussed include interaction of light with matter, optical amplifiers, laser resonators, Gaussian and higher order optical beams, non-linear optics, and ultra-fast laser pulses.		Fee: An additional \$25.00 is charged for this course.	
Note: Cross-listed with ECE 540.		Description: Modern computational and numerical methods in physics with application to problems in different branches of physics.	
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PHYS 555. Elementary Quantum Mechanics	3 Units	PHYS 570. Atomic and Molecular Physics	3 Units
Term Typically Offered: Fall Only		Term Typically Offered: Occasionally Offered	
Prerequisite(s): PHYS 300; PHYS 350 or MATH 405 or ENGR 205; PHYS 460.		Prerequisite(s): PHYS 541 and PHYS 555; or consent of instructor.	
Description: General concepts of quantum mechanics. Schrodinger equation and solutions in one, two and three-dimensions, hydrogen atom, and orbital angular momentum.		Description: The structure of atoms and diatomic molecules, the production of coherent radiation and its interaction with matter.	
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PHYS 556. Quantum Theory of Matter	3 Units	PHYS 575. Solid State Physics	3 Units
Term Typically Offered: Spring Only		Term Typically Offered: Fall Only	
Prerequisite(s): PHYS 555.		Prerequisite(s): PHYS 541 and PHYS 555, or consent of instructor.	
Description: Spin and general angular momentum, perturbation theory, variational principle, applications, identical particles, and scattering.		Description: Crystal structure, elastic waves, lattice dynamics, phonons, band theory of solids and conductivity phenomena.	
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PHYS 561. Mathematical Physics I	3 Units	PHYS 580. Nuclear Physics	3 Units
Prerequisite(s): PHYS 350 or MATH 405 or ENGR 205.		Term Typically Offered: Occasionally Offered	
Description: Selected mathematical techniques and their applications to various fields of physics.		Prerequisite(s): PHYS 541 and PHYS 555; or consent of instructor.	
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)		Description: Phenomenological study of nuclear properties. Nuclear structure and reactions, radioactive decay, interaction of charged particles with matter.	
		For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	

PHYS 585. Elementary Particle Physics	3 Units	PHYS 612. Electromagnetic Theory II	3 Units
Term Typically Offered: Spring Even Years		Prerequisite(s): PHYS 542 and PHYS 561, and consent of instructor.	
Prerequisite(s): PHYS 541 and PHYS 555, or consent of instructor.		Description: Microscopic and macroscopic Maxwell's equations; the energy-momentum tensor; multipole radiation; radiation from accelerated charges; scattering and dispersion; and covariant formulation.	
Description: Properties of elementary particles. Detectors and accelerators. Weak and electromagnetic interactions. Quark model of hadrons, strong interactions.		For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)		PHYS 621. Quantum Mechanics I	3 Units
PHYS 589. General Relativity	3 Units	Prerequisite(s): PHYS 556 and PHYS 605, and consent of instructor.	
Term Typically Offered: Spring Even Years		Description: Nonrelativistic quantum mechanics. Hilbert space formalism, Schrodinger and Heisenberg representations, angular momentum theory, perturbation theory, scattering theory. Systems of identical particles and symmetries. Applications.	
Prerequisite(s): PHYS 460; MATH 301 or ENGR 201.		For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	
Description: Review of classical gravitation and special relativity, Riemannian geometry, Einstein field equations, exact solutions, tests of the theory, gravitational collapse and black holes, gravitational waves, cosmology.		PHYS 622. Quantum Mechanics II	3 Units
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)		Prerequisite(s): PHYS 556 and PHYS 605, and consent of instructor.	
PHYS 590. Astrophysics	3 Units	Description: Nonrelativistic quantum mechanics. Hilbert space formalism, Schrodinger and Heisenberg representations, angular momentum theory, perturbation theory, scattering theory. Systems of identical particles and symmetries. Applications.	
Term Typically Offered: Spring Only		For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	
Prerequisite(s): PHYS 307; PHYS 350 or MATH 405 or ENGR 205 (or equivalent).		PHYS 625. Statistical Mechanics	3 Units
Description: Physics applied to the interstellar medium; the atmospheres, structure, and evolution of stars; galaxies.		Prerequisite(s): PHYS 530 and PHYS 555, and consent of instructor.	
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)		Description: Application of ensemble or information theory to derivation of the laws of thermodynamics for classical or quantum systems.	
PHYS 595. Special Topics	1-3 Units	Properties of perfect and imperfect gases, magnetic phenomena, fluctuation phenomena, and the Onsager equations.	
Description: Introduction to an advanced topic or elaboration of an intermediate topic not treated comprehensively in a regular course.		For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)		PHYS 640. Solid State Physics I	3 Units
PHYS 601. Quantum Mechanics Laboratory	3 Units	Prerequisite(s): PHYS 575, and concurrent registration in Quantum Mechanics, and consent of instructor.	
Prerequisite(s): PHYS 621 or PHYS 555 (may be taken concurrently).		Description: Quantum mechanical foundation of the theory of solids, the many-body problem, the band approximation, and other approximate methods. Electron-photon interaction, theory of superconductivity, electronic transport processes.	
Fee: An additional \$25.00 is charged for this course.		For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	
Description: Laboratory exercises demonstrating the principles of Quantum Mechanics.		PHYS 641. Solid State Physics II	3 Units
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)		Prerequisite(s): PHYS 575, and concurrent registration in Quantum Mechanics, and consent of instructor.	
PHYS 605. Theoretical Mechanics	3 Units	Description: Quantum mechanical foundation of the theory of solids, the many-body problem, the band approximation, and other approximate methods. Electron-photon interaction, theory of superconductivity, electronic transport processes.	
Prerequisite(s): PHYS 460, PHYS 561 and PHYS 562, and consent of instructor.		For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	
Description: Analytical dynamics of systems of particles and rigid bodies. Hamiltonian and Lagrangian formulations, special relativity, canonical transformations, Hamilton-Jacobi theory and action-angle variables.		PHYS 611. Electromagnetic Theory I	3 Units
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)		Prerequisite(s): PHYS 542 and PHYS 561, and consent of instructor.	
PHYS 611. Electromagnetic Theory I	3 Units	Description: Microscopic and macroscopic Maxwell's equations; the energy-momentum tensor; multipole radiation; radiation from accelerated charges; scattering and dispersion; and covariant formulation.	
Prerequisite(s): PHYS 542 and PHYS 561, and consent of instructor.		For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	
Description: Microscopic and macroscopic Maxwell's equations; the energy-momentum tensor; multipole radiation; radiation from accelerated charges; scattering and dispersion; and covariant formulation.			
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PHYS 650. Research Methods in Physics & Astronomy **3 Units**

Grading Basis: Pass/Fail

Fee: An additional \$25.00 is charged for this course.

Description: A survey of research methodologies. Topics may include modeling and simulation, experimental, theoretical, and computational techniques used in any branch of Physics and Astronomy, particle detector technologies, advanced handling of data statistics, data mining, laboratory safety, and research ethics.

For class offerings for a specific term, refer to the Schedule of Classes (<http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm>)

PHYS 670. Special Topics **1-12 Units**

Prerequisite(s): Concurrent or previous registration in PHYS 605, PHYS 611, or PHYS 621; and consent of instructor.

Description: One or more advanced topics not treated comprehensively in the regular courses.

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PHYS 690. Independent Study **1-12 Units**

Prerequisite(s): Consent of instructor.

Description: Advanced study conducted under the direction of a faculty member.

For class offerings for a specific term, refer to the Schedule of Classes (<http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm>)

PHYS 695. Research Seminar **1-12 Units**

Prerequisite(s): Consent of instructor.

Description: Regular but informal meetings of faculty members and graduate students active in an area of research to discuss problems of mutual interest, and to review the current literature.

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PHYS 699. Research **1-12 Units**

Prerequisite(s): Consent of instructor.

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