

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 (https://csprd.louisville.edu/psp/ps_class/EMPLOYEE/PSFT_CS/c/COMMUNITY_ACCESS.CLASS_SEARCH./x/?state=62dab551a0d600a5e8237359c50704e59007&duo_code=sjUx20STJ21bWVEuQ3ZiYRlHmfxpgov).

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 (<https://louisville.edu/bursar/tuitionfee/university-fees/>).

PHYS 107. Elementary Astronomy - S 3 Units

Term Typically Offered: Fall, Spring, Summer

Description: Introduction to the basic laws of nature as seen in the large-scale structure of the universe: galaxies, stars and our solar system. For class offerings for a specific term, refer to the Schedule of Classes (<http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm>)

PHYS 108. Elementary Astronomy Laboratory - SL 1 Unit

Term Typically Offered: Fall, Spring

Prerequisite(s): Concurrent or prior registration in PHYS 107.

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

Description: Experiments in astronomy illustrating basic physical concepts.

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

PHYS 111. Elements of Physics - B 4 Units

Term Typically Offered: Fall, Spring

Prerequisite(s): Appropriate math placement.

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

Description: An introduction to the physics of mechanics, forces, energy and momentum. Electricity and magnetism: electrical conduction, and magnets. Optics: color, mirrors, and lenses. Basic ideas and concepts of quantum physics.

Note: Not acceptable toward a Physics major.

Note: May not be taken by student who has completed 5 or more hours in Physics at the 200-level.

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

PHYS 195. Introductory Special Topics 1-3 Units

Term Typically Offered: Occasionally Offered

Description: Basic introduction to a topic in physics and astronomy of general interest that is not covered by existing courses.

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

PHYS 220. Introduction to Weather and Climate - S 3 Units

Term Typically Offered: Fall Only

Description: The topics to be covered in this course include season, temperature, pressure, wind and moisture of the atmosphere, storm system such as mid-latitude cyclones, thunderstorms, tornadoes and hurricanes, the weather forecast process, and climate change.

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

PHYS 221. Fundamentals of Physics I - S 3 Units

Term Typically Offered: Fall, Spring, Summer

Prerequisite(s): Appropriate Math placement.

Description: Basic concepts and methods of physics as applied in the study of mechanics, heat and sound.

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

PHYS 222. Fundamentals of Physics II - S 3 Units

Term Typically Offered: Fall, Spring

Prerequisite(s): PHYS 221 or PHYS 298 or equivalent.

Description: Basic concepts and methods of physics as applied in the study of electricity, magnetism, optics and modern physics.

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

PHYS 223. Fundamentals of Physics Lab I - SL 1 Unit

Term Typically Offered: Fall, Spring, Summer

Prerequisite(s): PHYS 221 (or concurrently).

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

Description: Experiments in mechanics, heat and sound.

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

PHYS 224. Fundamentals of Physics Laboratory II - SL 1 Unit

Term Typically Offered: Fall, Spring, Summer

Prerequisite(s): PHYS 222 (or concurrently).

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

Description: Experiments in electricity, magnetism, and light.

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

PHYS 275. Introduction to Scientific Computing and Data Analysis 3 Units

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

Description: An introduction to data analysis, statistical distributions, fitting models and functions to data, estimating uncertainties, and visualizing data. Students learn a modern scientific programming language (e.g. Python, Matlab), with examples based on real problems in the physical and life sciences.

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

PHYS 295. Introductory Laboratories I - SL**Term Typically Offered:** Fall, Spring, Summer**Prerequisite(s):** PHYS 298 (or concurrently).**Fee:** An additional \$25.00 is charged for this course.**Description:** Experiments in mechanics and heat.

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

PHYS 296. Introductory Laboratories II - SL**Term Typically Offered:** Fall, Spring, Summer**Prerequisite(s):** PHYS 299 (or concurrently).**Fee:** An additional \$25.00 is charged for this course.**Description:** Experiments in electricity, magnetism, and light.

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

PHYS 298. Introductory Mechanics, Heat and Sound - S**Term Typically Offered:** Fall, Spring, Summer**Prerequisite(s):** MATH 205 or ENGR 101 (or concurrently in either).**Description:** Basic methods of physics with calculus applied to topics in mechanics, heat and wave motion.

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

PHYS 299. Introductory Electricity, Magnetism and Light**Term Typically Offered:** Fall, Spring, Summer**Prerequisite(s):** PHYS 298 and (MATH 206 or ENGR 102 (or concurrently in either).**Description:** Basic methods of physics with calculus applied to topics in electricity, magnetism and light.

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

PHYS 300. Introductory Modern Physics**Term Typically Offered:** Fall, Spring**Prerequisite(s):** PHYS 299; physics majors should take PHYS 301 concurrently.**Description:** Introduction to special relativity and quantum theory, with applications to atomic, nuclear, and solid state physics.

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

PHYS 301. Introductory Modern Physics Laboratory**Term Typically Offered:** Fall Only**Prerequisite(s):** PHYS 300 (or concurrently).**Fee:** An additional \$25.00 is charged for this course.**Description:** Experiments in modern physics.

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

1 Unit**PHYS 307. Introductory Stellar Astrophysics****Term Typically Offered:** Fall Only**Prerequisite(s):** PHYS 299; MATH 206 or ENGR 102; PHYS 300 recommended.**Description:** A calculus-based introduction to the physics of the solar system, and stars, covering celestial mechanics, tides, the nature of light, star and planet formation and evolution.

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

1 Unit**PHYS 308. Observational Astronomy****Term Typically Offered:** Fall Only**Prerequisite(s):** PHYS 221 and PHYS 222, or PHYS 298 and PHYS 299, or equivalent.**Description:** Optical astronomy including observing at Moore Observatory, solar observing, instrumentation control with computers, and astronomical data acquisition and interpretation.

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

4 Units**PHYS 350. Differential Equations for the Physical Sciences****Term Typically Offered:** Fall Only**Prerequisite(s):** MATH 206 or ENGR 102 or permission of instructor.**Fee:** An additional \$50.00 is charged for this course.**Description:** Topics include methods of solution of differential equations, and simple modeling of phenomena using differential equations.

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

4 Units**PHYS 351. Atomic and Nuclear Physics Laboratory****Term Typically Offered:** Spring Only**Prerequisite(s):** PHYS 300.**Fee:** An additional \$25.00 is charged for this course.**Description:** Experimental procedures in atomic and nuclear physics.

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

3 Units**PHYS 355. Optics****Term Typically Offered:** Fall Only**Prerequisite(s):** PHYS 299.**Description:** Introduction to wave theory of light and relation between light waves and rays; theory of thick lenses and lens aberrations; interference and diffraction of coherent light.

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

1 Unit**PHYS 356. Optics Laboratory****Term Typically Offered:** Fall Only**Prerequisite(s):** PHYS 299.**Fee:** An additional \$25.00 is charged for this course.**Description:** Laboratory experiments illustrating the reflection, refraction, interference, diffraction, and polarization of light.

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

2 Units**3 Units****1 Unit****4 Units****2 Units****3 Units**

PHYS 360. Introduction to Weather Analysis**3 Units****Term Typically Offered:** Fall Only**Prerequisite(s):** MATH 205 or ENGR 101.**Fee:** An additional \$50.00 is charged for this course.

Description: A study of day-to-day weather patterns with an emphasis on understanding the basics of meteorological processes, forecast preparation, and mastery of manual data analysis. Topics covered will include manual construction of weather maps, interpreting observations, an introduction to physics of meteorological processes and the structure of circulation patterns.

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

PHYS 361. Atmospheric Thermodynamics**3 Units****Term Typically Offered:** Spring Only

Prerequisite(s): MATH 206 or ENGR 102 with a C or better, or an ACT Math score of 24, or a SAT Math score of 550; and MATH 301 or ENGR 201 (or either concurrently).

Description: An introduction to the principles of thermodynamics and their applications to atmospheric structure and dynamics. Includes the study of relationships among pressure, temperature, density, internal energy, entropy, atmospheric interaction with gravity, and the central role of water in atmospheric dynamics.

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

PHYS 362. Physical Meteorology**3 Units****Term Typically Offered:** Fall Only**Prerequisite(s):** PHYS 361.

Description: An introduction to the application of physics to atmospheric structure and dynamics. Includes cloud formation, and the effects of planetary rotation on large-scale atmospheric motion.

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

PHYS 363. Atmospheric Physics**3 Units****Term Typically Offered:** Fall Only

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

Description: This course will cover atmospheric thermodynamics, radiative transfer, cloud microphysics, planetary boundary layer, elementary atmospheric chemistry, and physics of the atmosphere.

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

PHYS 365. Mesoscale Meteorology**3 Units****Term Typically Offered:** Spring Only**Prerequisite(s):** PHYS 360.**Fee:** An additional \$50.00 is charged for this course.

Description: Introduction to mesoscale processes, with an emphasis on convective storms and severe weather, and the techniques used for the study and prediction of such events.

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

PHYS 371. Special Topics**3 Units****Prerequisite(s):** Faculty consent.

Description: Exploration of intermediate level of some well-defined topic not treated comprehensively in a regular course.

Note: Topic announced in Schedule of Courses.

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

PHYS 375. Intermediate Scientific Computing and Data Analysis**3 Units****Term Typically Offered:** Spring Only**Prerequisite(s):** PHYS 275 or CSE 120 or permission of instructor.**Fee:** An additional \$25.00 is charged for this course.

Description: Prerequisites or corequisites: PHYS 221 or PHYS 298; MATH 206 or ENGR 102; or permission of instructor. Advances skills in programming with high-level languages (e.g. Python, Matlab, Mathematica) for physics-based modeling and analysis of real data. Students learn how to prepare input data for discovery of correlations and systematic behavior, how to effectively employ linear and multi-parameter regressions, error propagation and mitigation, and how to objectively evaluate model fits. Students should be familiar with Python at the level of PHYS 275, CSE 120, or a similar course.

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

PHYS 390. Introductory Computational Physics**3 Units****Term Typically Offered:** Occasionally Offered**Prerequisite(s):** PHYS 300 and MATH 301.**Fee:** An additional \$25.00 is charged for this course.

Description: Introduction to the Unix/Linux operating system and the use of contemporary programming languages with applications to physics, including basic numerical methods, simulations, and data manipulation. Introduction to scientific software packages including data visualization.

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

PHYS 430. Practicum in Physics Education - CUE**1 Unit****Term Typically Offered:** Fall, Spring

Prerequisite(s): Completion of PHYS 300 and PHYS 460; PHYS majors only; permission to enroll required; minimum 3.0 GPA in major to be eligible.

Description: A guided learning experience in inquiry-based instructional techniques and best practices in STEM education that includes field experience as an undergraduate teaching assistant.

Note: May be repeated for a maximum of 6 credit hours.

Course Attribute(s): CUE - This course fulfills the Culminating Undergraduate Experience (CUE) requirement for certain degree programs. CUE courses are advanced-level courses intended for majors with at least 90 earned credits/senior-level status.

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

PHYS 450. Introductory Mathematical Physics Term Typically Offered: Occasionally Offered Prerequisite(s): PHYS 350 or ENGR 205 or MATH 405; MATH 301 or ENGR 201. Description: Introduction to mathematical methods and concepts used in physics. Topics include: vector calculus, matrices and linear vector spaces, special functions and partial differential equations. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units	PHYS 475. Machine Learning in the Physical Sciences Term Typically Offered: Fall Only Prerequisite(s): PHYS 375. Fee: An additional \$25.00 is charged for this course. Description: Covers the fundamentals of machine learning (ML), including the classification and regression of data using different ML tools, e.g. supervised and unsupervised learning, Monte Carlo Markov Chains (MCMC), and Bayesian methods. Students will learn the metrics of ML success applied to real data from the physical sciences, tuning hyperparameters, and the critical evaluation of ML outcomes. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units
PHYS 460. Mechanics Term Typically Offered: Fall, Spring Prerequisite(s): PHYS 298 and PHYS 350 or MATH 405 or ENGR 205 Kinematics, particle dynamics, oscillatory motion, central forces, rigid body motion, variation methods. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units	PHYS 495. Communicating in Physics Prerequisite(s): Senior standing. Description: Preparation and oral presentation of scientific results in a seminar format. Organization and written presentation of scientific results in a journal format. Communication of research results through a website. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	1 Unit
PHYS 464. Atmospheric Dynamics Term Typically Offered: Spring Only Prerequisite(s): MATH 206 or ENGR 102 (or equivalent), or permission of instructor. Description: Introduction to atmospheric dynamics, including conservation of mass, momentum, and energy, scale analysis, the Coriolis force and geostrophic balance, the thermal-wind equation and its connection to remote-sensing, and Rossby waves. The critical roles of conservation of potential vorticity and baroclinic instability in setting the synoptic scale (the separation between highs and lows) and in maintaining persistent unsteadiness in atmospheres and oceans are established. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units	PHYS 496. Senior Seminar in Physics - CUE, WR Prerequisite(s): PHYS 460 and senior standing. Description: Students will review current professional journals in the discipline and discuss effective scientific writing, including the draft and revision process. Students will write a reflect on the connections between their physics education and critical thinking models. Students will also perform a research project and present the results in journal format. Note: Approved for the Arts and Sciences upper-level requirement in written communication (WR). Course Attribute(s): CUE - This course fulfills the Culminating Undergraduate Experience (CUE) requirement for certain degree programs. CUE courses are advanced-level courses intended for majors with at least 90 earned credits/senior-level status. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units
PHYS 465. Dynamic Meteorology I Term Typically Offered: Fall Only Prerequisite(s): PHYS 361. Fee: An additional \$50.00 is charged for this course. Description: An introduction to the theory of atmospheric dynamics with application of Newtonian physics and classical thermodynamics to geophysical fluid dynamics. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units	PHYS 497. Senior Thesis in Physics - CUE, WR Term Typically Offered: Occasionally Offered Prerequisite(s): PHYS 460 and senior standing. Description: Students will perform original research and write up their methods and results in a multi-chapter thesis. Research projects may be a continuation of previously initiated research. Note: Approved for the Arts and Sciences upper-level requirement in written communication (WR). Course Attribute(s): CUE - This course fulfills the Culminating Undergraduate Experience (CUE) requirement for certain degree programs. CUE courses are advanced-level courses intended for majors with at least 90 earned credits/senior-level status. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units
PHYS 466. Dynamic Meteorology II Term Typically Offered: Spring Only Prerequisite(s): PHYS 465. Fee: An additional \$50.00 is charged for this course. Description: This is the second semester in the theory of atmospheric dynamics and dynamic meteorology. Topics may include shear instability, atmospheric waves, moist convection, and weather fluctuation. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units		

PHYS 498. Undergraduate Research - CUE Term Typically Offered: Fall, Spring Prerequisite(s): PHYS 301, PHYS 350, PHYS 351 and approval of instructor. Description: Experimental or theoretical research under the guidance of a physics faculty member. The student will participate in one of the ongoing research projects in the department. The student will acquire hands-on-experience in an actual research project. The student will produce a written report on the results of the research project and give an oral presentation of the work completed. Note: May be repeated for a maximum of 6 credit hours; 3 credits are required for use as a CUE course. Course Attribute(s): CUE - This course fulfills the Culminating Undergraduate Experience (CUE) requirement for certain degree programs. CUE courses are advanced-level courses intended for majors with at least 90 earned credits/senior-level status.	3 Units	PHYS 517. Physics of Climate 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. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units
PHYS 499. Cooperative Internship in Physics - CUE Term Typically Offered: Fall, Spring, Summer Prerequisite(s): PHYS 295, PHYS 296, PHYS 298, PHYS 301 and 6 additional hours in Physics; Junior standing or above; approval of department. Description: Note: May be repeated to a maximum of 6 hours. Note: Three hours may apply toward BA or BS major programs as upper division major electives or may be used to satisfy requirement for Culminating Undergraduate Experience. Course Attribute(s): CUE - This course fulfills the Culminating Undergraduate Experience (CUE) requirement for certain degree programs. CUE courses are advanced-level courses intended for majors with at least 90 earned credits/senior-level status.	1-3 Units	PHYS 518. Space Weather 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. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units
PHYS 501. Independent Study 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)	1-3 Units	PHYS 520. Vibrations and Sound 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)	3 Units
PHYS 502. Independent Study 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)	1-3 Units	PHYS 530. Thermal Physics 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)	3 Units
PHYS 507. Solar System Astronomy 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. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units	PHYS 531. Introductory Statistical Physics 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)	3 Units
		PHYS 541. Electromagnetic Fields 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)	3 Units

PHYS 542. Electromagnetic Radiation 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)	3 Units	PHYS 561. Mathematical Physics I Prerequisite(s): PHYS 350 or MATH 405 or ENGR 205. Description: Selected mathematical techniques and their applications to various fields of physics. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units
PHYS 545. Advanced Optics Prerequisite(s): PHYS 355 and PHYS 542; or consent of instructor. Description: Topics in optical physics including optical system design, lasers, and quantum optics. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units	PHYS 562. Mathematical Physics II Prerequisite(s): PHYS 350 or MATH 405 or ENGR 205. Description: Selected mathematical techniques and their applications to various fields of physics. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units
PHYS 546. Advanced Optics Lab Prerequisite(s): PHYS 355 or equivalent. Fee: An additional \$25.00 is charged for this course. Description: Laboratory experiments illustrating fundamental optical phenomena, the interaction of light and matter, lasers, and quantum optics. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	1 Unit	PHYS 563. Fluid Dynamics Term Typically Offered: Spring Odd Years Prerequisite(s): MATH 301 or ENGR 201 (or equivalent), or permission of instructor. 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). For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units
PHYS 547. Fundamentals of Lasers Term Typically Offered: Occasionally Offered Prerequisite(s): PHYS 355; and PHYS 542 or ECE 473; or consent of instructor. 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. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units	PHYS 565. Advanced Computational and Numerical Methods in Physics Term Typically Offered: Spring Only Prerequisite(s): PHYS 350 or PHYS 561. Fee: An additional \$25.00 is charged for this course. Description: Modern computational and numerical methods in physics with application to problems in different branches of physics. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units
PHYS 555. Elementary Quantum Mechanics Term Typically Offered: Fall Only Prerequisite(s): PHYS 300; PHYS 350 or MATH 405 or ENGR 205; PHYS 460. Description: General concepts of quantum mechanics. Schrodinger equation and solutions in one, two and three-dimensions, hydrogen atom, and orbital angular momentum. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units	PHYS 570. Atomic and Molecular Physics Term Typically Offered: Occasionally Offered Prerequisite(s): PHYS 541 and PHYS 555; or consent of instructor. Description: The structure of atoms and diatomic molecules, the production of coherent radiation and its interaction with matter. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units
PHYS 556. Quantum Theory of Matter Term Typically Offered: Spring Only Prerequisite(s): PHYS 555. Description: Spin and general angular momentum, perturbation theory, variational principle, applications, identical particles, and scattering. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units	PHYS 575. Solid State Physics Term Typically Offered: Fall Only Prerequisite(s): PHYS 541 and PHYS 555, or consent of instructor. Description: Crystal structure, elastic waves, lattice dynamics, phonons, band theory of solids and conductivity phenomena. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)	3 Units

PHYS 580. Nuclear Physics **3 Units**

Term Typically Offered: Occasionally Offered

Prerequisite(s): PHYS 541 and PHYS 555; or consent of instructor.

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**

Term Typically Offered: Spring Even Years

Prerequisite(s): PHYS 541 and PHYS 555, or consent of instructor.

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>)

PHYS 589. General Relativity **3 Units**

Term Typically Offered: Spring Even Years

Prerequisite(s): PHYS 460; MATH 301 or ENGR 201.

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.

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

PHYS 590. Astrophysics **3 Units**

Term Typically Offered: Spring Only

Prerequisite(s): PHYS 307; PHYS 350 or MATH 405 or ENGR 205 (or equivalent).

Description: Physics applied to the interstellar medium; the atmospheres, structure, and evolution of stars; galaxies.

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

PHYS 595. Special Topics **1-3 Units**

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>)