Class List

Mechanics Courses

Physics 1250H: Honors Mechanics and Conservation Laws; Special Relativity **AU 2022**

Instructor(s): Roland Kawakami and Richard Leonard *5 cr.*

- Topics: *Study of classical mechanics including Newton's laws, conservation laws, and introduction to special relativity.*
- Textbook: `Six Ideas that Shaped Physics: Unit C, Unit N, Unit R` by Thomas A. Moore.

Physics 2300: Intermediate Mechanics I **AU 2023**

Instructor(s): Michael Lisa and Andrew Dougherty *4 cr.*

- Topics: *Vectors and kinematics; foundations of Newtonian mechanics; momentum, work, and energy; conservative and non-conservative forces; potentials; angular momentum; rotation about a fixed axis; rigid body motion. Introduction to Mathematica.*
- Textbook: `Introduction to Classical Mechanics` by David Morin, `Basic Training in Mathematics: A Fitness Program for Science Students` by Ramamurti Shankar.

Physics 2301: Intermediate Mechanics II **SP 2024**

Instructor(s): Antonio Boveia *4 cr.*

- Topics: *Generalized angular momentum; inertia tensors; precession; fictitious forces. The special theory of relativity; relativistic kinematics; relativistic momentum and energy. Introduction to general relativity. More rigorous use of Mathematica.*
- Textbook: `Introduction to Classical Mechanics` by David Morin, `Basic Training in Mathematics: A Fitness Program for Science Students` by Ramamurti Shankar.

Physics 5300: Theoretical Mechanics **AU 2025**

Instructor(s): Daniel Brandenburg *4 cr.*

- Topics: *Development of Lagrangian mechanics, inertia and stress tensors, rigid body rotations and introduction to the mechanics of continuous media. Numerical methods, visualizations, approximations, and simulations.*
- Textbook: `Classical Mechanics` by John Taylor.

Electricity and Magnetism Courses

Physics 1251H: Honors E&M; Thermal Physics, Waves, and Quantum Physics **SP 2023**

Instructor(s): Samir Mathur and Richard Leonard *5 cr.*

- Topics: *Electricity and magnetism including Maxwell's equations, thermodynamics, quantum mechanics.*
- Textbook: `Six Ideas that Shaped Physics: Unit E, Unit Q, Unit T` by Thomas A. Moore.

Physics 5400H: Honors Intermediate Electricity and Magnetism I **AU 2024**

Instructor(s): Alexandra Landsman *4 cr.*

- Topics: *Electrostatic fields; dielectrics; boundary-value problems; magnetic fields of steady currents; induction; Maxwell's equations; plane waves.*
- Textbook: `Introduction to Electrodynamics` by David Griffiths.

Physics 5401H: Honors Advanced Electricity and Magnetism II **SP 2025**

Instructor(s): Alexandra Landsman *4 cr.*

- Topics: *Plane waves, plane waves in matter; physical optics; coherence, interference, diffraction, and dispersion; Special relativity and relativity in E&M.*
- Textbook: `Introduction to Electrodynamics` by David Griffiths.

Quantum Courses

Physics 5500H: Honors Quantum Mechanics I **AU 2024**

Instructor(s): Samir Mathur *4 cr.*

- Topics: *Quantum mechanics and its history; the Schrödinger equation; solutions of one-dimensional scattering; Bound state problems; Dirac notation.*
- Textbook: `Introduction to Quantum Mechanics` by David Griffiths and Darrell Schroeter.

Physics 5501H: Honors Quantum Mechanics II **SP 2025**

Instructor(s): Samir Mathur *4 cr.*

- Topics: *The Schrödinger equation in three dimensions, angular momentum, the hydrogen atom; time-independent perturbation theory, time-dependent perturbation theory, scattering theory and the Born approximation, multi-electron atoms. Short introductions to quantum information, quantum computing, experiments, path integrals, the Aharonov-Bohm effect, and Hamilton-Jacobi equations.*
- Textbook: `Introduction to Quantum Mechanics` by David Griffiths and Darrell Schroeter.

Lab Courses

Physics 3700: Experimental Physics Instrumentation and Data Analysis **SP 2024**

Instructor(s): K. K. Gan and Richard Leonard *3 cr.*

- Topics: *Construction, simulation and statistical analysis of data from advanced experiments in nuclear processes. Introduction to advanced instrumentation and computer controlled data acquisition.*
- Lab Topics: *Uncertainties and propagation of errors; Radioactive liquids and solids with NaI Calorimeter; Spectroscopy; Probability Distributions; Statistical analysis of collected data; Experiment through computer simulation.*
- Textbook: `An Introduction to Error Analysis` by John Taylor. Various lecture notes: `https://www.asc.ohio-state.edu/gan.1/teaching/spring24/3700.html`.

Physics 5680: Big Data Analytics in Physics **AU 2024**

Instructor(s): Richard Hughes *3 cr.*

- Topics: *Introduction to machine learning and advanced algorithms. Emphasis on practical physics-based applications, using publicly available data sets.*
- Lab Topics: *Python and Jupyter notebooks; OSC high-performance computing; Elementary machine learning: data processing and resultation, linear regression, classification, random forests/decision trees; Neural networks: CNNs, object detection, graph analytics, text analysis, autoencoders, siamese networks; Culminates in a final machine learning project of choice.*
- Textbook: `Hands-on Machine Learning With Scikit-learn, Keras, and Tensorflow` by Aurélien Géron.

Astronomy 3350: Methods of Astronomical Observation and Data Analysis **AU 2025**

Instructor(s): Donald Terndrup *4 cr.*

- Topics: *Overview of observational methods and quantitative analysis in astronomy with applications to the large datasets produced by modern astronomy surveys. Applications of commonly used methods to reproduce major astronomical results in a collaborative setting.*
- Lab Topics: *Data analysis in Python with Pandas and Numpy. Statistics including Gaussian distributions, Central Limit Theorem, errors, and conditional probability. Visualizations and plotting. Undergraduate research experience on IC4665 cluster (Traceback Project).*
- Textbook: Various lecture notes.

Astrophysics Courses

Astronomy 2291: Basic Astrophysics and Planetary Astronomy **AU 2024**

Instructor(s): Krzysztof Stanek *3 cr.*

- Topics: *Motions and physical nature of objects in the solar system; electromagnetic radiation, telescopes, and astronomical detectors.*
- Textbook: `Foundations of Astrophysics` by Barbara Ryden and Bradley M. Peterson.

Astronomy 2292: Stellar, Galactic, and Extragalactic Astronomy and Astrophysics **SP 2025**

Instructor(s): Krzysztof Stanek *3 cr.*

- Topics: *Observational and physical properties of the sun and stars; stellar structure and evolution; interstellar medium; galaxies and cosmology.*
- Textbook: `Foundations of Astrophysics` by Barbara Ryden and Bradley M. Peterson.

Astronomy 5682: Introduction to Cosmology **AU 2025**

Instructor(s): Paul Martini *3 cr.*

- Topics: *Detailed overview of structure and evolution of the Universe. Modern formalisms and formulations of cosmology. Conceptual overview of general relativity.*
- Textbook: `Introduction to Cosmology` by Barbara Ryden.

Astronomy 3810: Order of Magnitude Astronomy **AU 2025**

Instructor(s): Evan Jennerjahn, Becca McClain, and Todd Thompson *1 cr.*

- Topics: *Develop skills needed to approach problems at an order-of-magnitude level. Introduce mathematical techniques and critical thinking skills used to create approximate solutions to problems that may at first seem impossible to solve.*
- Textbook: None.