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 nonconservative 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 momentunm; 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.

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.

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.